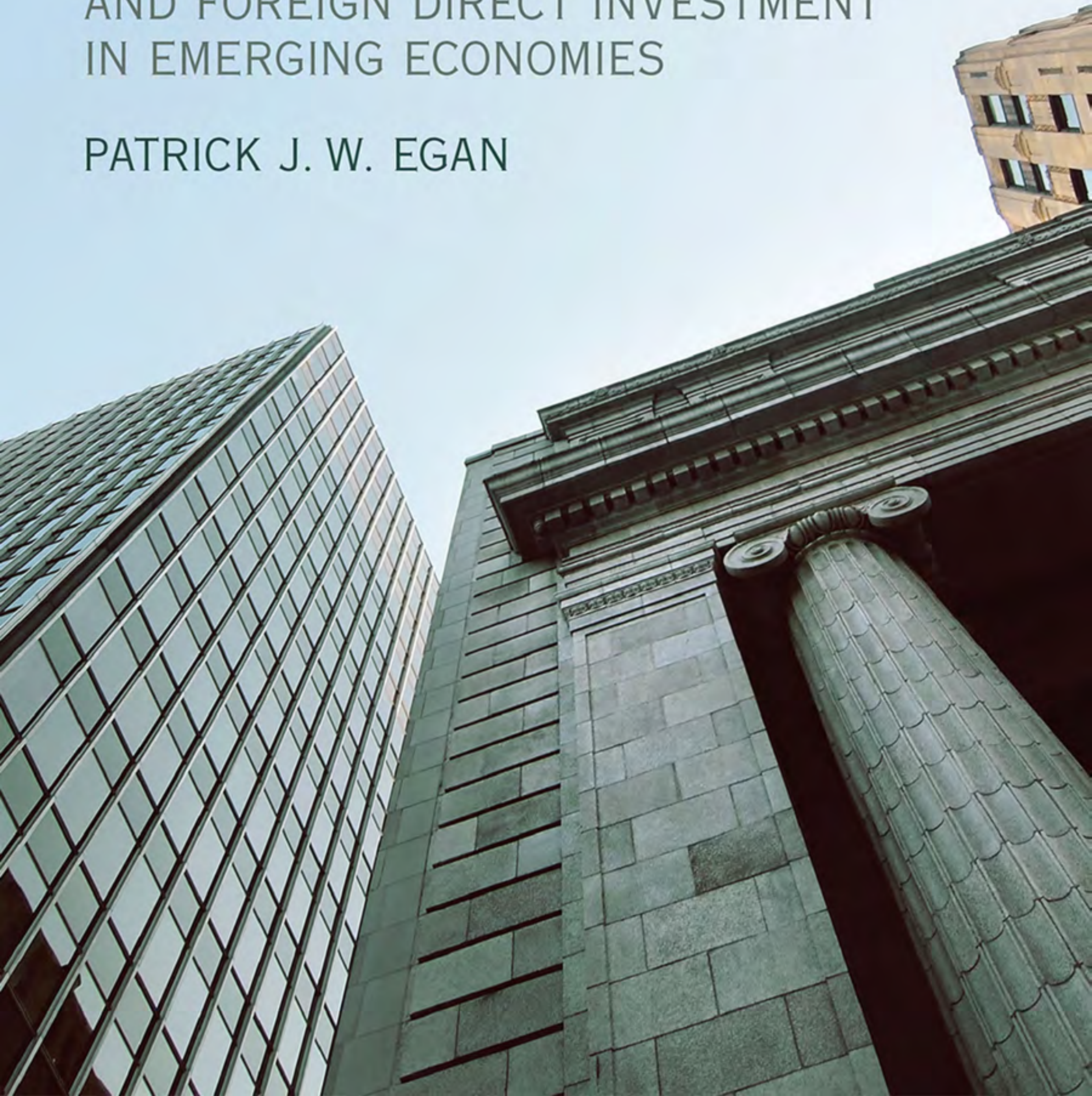
GLOBALIZING INNOVATION

STATE INSTITUTIONS AND FOREIGN DIRECT INVESTMENT IN EMERGING ECONOMIES

PATRICK J. W. EGAN



Globalizing Innovation

Globalizing Innovation

State Institutions and Foreign Direct Investment in
Emerging Economies

Patrick J. W. Egan

The MIT Press
Cambridge, Massachusetts
London, England

This book was set in Palatino LT Std by Toppan Best-set Premedia Limited. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data

Names: Egan, Patrick, 1978- author.
Title: Globalizing innovation : state institutions and foreign direct investment in emerging economies / Patrick J. W. Egan.
Description: Cambridge, MA : MIT Press, [2017] | Includes bibliographical references and index.
Identifiers: LCCN 2017019415 | ISBN 9780262037358 (hardcover : alk. paper)
Subjects: LCSH: International business enterprises--Developing countries. | Public institutions.
Classification: LCC HD62.4 .E374 2017 | DDC 338.8/881724--dc23 LC record available at https://lccn.loc.gov/2017019415

10 9 8 7 6 5 4 3 2 1

For Diane and Chip

Contents

List of Figures

List of Tables

Preface

The ideas and questions in this book have been percolating in my mind a long time. In retrospect, I probably became interested in international and comparative political economy as an exchange student in Brazil over two decades ago, though I didn't know those scholarly fields existed at the time. When I arrived in August 1994, Brazil had just introduced a new currency and stabilized inflation rates. I heard stories of people rushing to spend their paychecks on the day they arrived, so that they would not lose value. I also remember the inequality: rows and rows of shanties stacked up in the hills behind newly constructed shopping malls. In the mid-1990s in Brazil, measures of inequality were among the highest in the world. As a student from a small town in South Carolina, I experienced these things as a set of shocks to the system. I met so many wonderful people in Brazil, and returned again and again, always as a student and always fascinated by the country's development path. As time passed, I began to focus more and more on the economic connections between my own country and Brazil. I understood that the trade and investment flows between the economic and political behemoths of North and South America were substantial and growing. However, I did not yet understand their causes and effects.

I received much-needed guidance and direction at the University of North Carolina, Chapel Hill. As a graduate student in the department of political science, I was drawn to classes in international political economy (IPE) and comparative politics. IPE, in particular, offered elegant explanatory frameworks for cross-national phenomena, and foreign direct investment (FDI) was an issue area experiencing increased scholarly attention. My own interests and work seemed to straddle the subfields of international and comparative politics. On the one hand, I was interested in a country (Brazil) and region (Latin America) with an incredibly rich theoretic tradition in political economy. On the other hand, the transnational phenomenon that had grabbed my attention (FDI) seemed to belong under the purview of international relations. I have since come to regard the separation between international and comparative political economy as somewhat arbitrary, and have felt no reservations in forcing the two together. After all, common IPE theories that prioritize domestic societal interests or institutions as explanatory factors are forced to open the black box of within-state politics.

I wrote a dissertation on FDI in Brazil, and in particular how Brazilian institutions had shaped incoming investment and promoted development through integration with the world economy. On completing this dissertation, I was immediately confronted with two unpleasant thoughts. First, that despite my best efforts, I would never know as much about Brazilian politics as a native-born Brazilian academic. Second, I would not be satisfied with turning the dissertation into a book based on one country's (or even one region's) experience with foreign investment. The book project had to be broader. So I set about extracting what I could from the dissertation, expanding its questions and lessons to a larger set of countries. The result of that effort is this book.

I have long felt that the IPE literature on FDI could be greatly expanded with a focus on the types of activities pursued by multinational enterprises. This has often been the domain of international business studies, but there are numerous avenues for political economy arguments concerning the evolving relationships between foreign firms and host country governments. In my view, institutionalist perspectives are especially appealing for interpreting these relationships. Governments are the gatekeepers for FDI. They may perform this job poorly, but for good or ill they help condition what kinds of firms enter and what kinds of activities those firms pursue. This book summarizes my ideas on how states and firms pursue their sometimes overlapping interests, and most importantly how the form and function of state institutions matter for firm activities. The argument of the book requires the recognition that firms do not operate in a vacuum; they are engaged in a continual dialogue with host country governments. Societal explanations do not play as large a role in this account, as multinational firms often operate at a greater level of remove from societies in host countries, particularly when compared with domestic firms. In a broader sense, this book reaffirms (at least to my mind) a comparative institutionalist approach, as applied in a large-sample empirical setting to the study of FDI.

I have benefited tremendously from the guidance and assistance of many individuals and institutions while working on this project. Tulane University provided me with pretenure leave in fall 2014. I also received seed grant funding from the Murphy Institute for Political Economy at Tulane to conduct research in Ireland in summer 2012. This led to a partnership with the Central Statistics Office in Dublin and Cork, which kindly appointed me as an officer of statistics and allowed me access to data on multinational activities in Ireland. I returned in summer 2013 with the assistance of another research grant, and much of what appears in chapter 6 is a result of these periods of fieldwork. I am grateful to the staff at Dublin City University for providing me with office space during these visits. I am also grateful to Tulane for substantial research startup funds when I was hired as an assistant professor. Many of these funds were used to procure the datasets that are used in this book. I also want to acknowledge the support of the School of Liberal Arts at Tulane and the department of political science. It is rare to find institutions as dedicated to helping their employees succeed, and it is appreciated.

I have also benefited from the comments of various audiences, including attendees at a number of annual meetings such as the American Political Science Association, International Studies Association, and the Southern Political Science Association. There were also a number of smaller workshops in which individual chapters were featured, including those of the young(ish) faculty workshop at Tulane. A number of individuals have taken the time to provide extensive and always appreciated comments on earlier drafts. I am indebted to Frank Barry, Joel Blit, Juan Bogliaccini, Sam Brazys, Lawrence Broz, Geoffrey Burn, Martin Dimitrov, Michael Fitzgibbon, Niamh Hardiman, Mirya Holman, Diana Kapiszewski, Virginia Oliveros, Darius Ornston, Ben Ross Schneider, Aaron Schneider, Eduardo Silva, Dan Tirone, Michael Tyburski, and Mark Vail, among others. Geoff Dancy saved me a great deal of time by helping me with count modeling. Michael Breen provided me with excellent comments, and both he and Iain McMenamin were most accommodating at DCU. I am grateful to Adam Beauchamp and Eric Wedig at the Tulane library. Kevin Phelan at the Central Statistics Office in Cork was very helpful, as was Carol Anne Hennessy in Dublin. I have also received able research assistance from a

number of graduate students, including Lucia Kovacikova, Zhen Lin, and Kayemba Mvula.

No matter how much time elapses since the end of graduate school, I will forever be grateful to my graduate advisors. Jonathan Hartlyn, John French (Duke), Gary Gereffi (Duke), Layna Mosley, and Evelyne Huber were all on my committee, and my scholarship is better for it. Layna in particular spurred much of my interest in FDI, and has always been willing to help. Gary turned my attention to the value chain literature, and for that I am grateful. Evelyne Huber, as my chair, has earned my enduring admiration and respect (along with hundreds of other graduate students and colleagues) for her work ethic, intellect, and dedication to her students. Without Evelyne and John Stephens, I would not be in this business. Even though we now work in different subfields, I am so grateful to both of them for being tough, supportive, and intellectually stimulating examples for future academics to follow.

Emily Taber of MIT Press was enthusiastic about this project as soon as I sent it to her, and I appreciate her confidence and patience as I completed this book. She has been very easy to work with for this first-time book author, and has promptly answered all my questions about the process. Portions of chapter 5 appeared in modified form as an article in *Business and Politics* in 2013, and I thank the editorial office there and Cambridge University Press for permission to use this material. Portions of the appendix on Generalized Methods of Moments models also appeared in appendix form in a 2010 article I wrote for *Latin American Politics and Society*. My thanks to Al Montero and Wiley. I also appreciate the detailed reviews provided by four anonymous reviewers for MIT Press, as they have greatly improved the quality of the manuscript. I am grateful to Peter Evans, Alexander Gerschenkron, John Dunning, and Ted Moran (among many others) for their ideas. Although I have likely forgotten to mention other individuals who have helped me, I hope they know that I am grateful.

Of course I cannot forget to mention here my family and friends, as they are the ones who have sacrificed the most to see me through. My three boys, Jack, Liam, and Craig, are all excellent creative disruptors and destructors, and they have made sure I do not take myself too seriously. They are huge sources of joy in my life, joy I would not have imagined possible before they arrived. My wife Gillian read through every bit of this manuscript and corrected mistakes. More importantly, she never doubted I would finish, supported our family unit in all the ways possible, and makes my life easier (and classier) every day. My friends here in New Orleans and all over the country have provided much-needed distractions and enrich my life. The city of New Orleans itself has been an outstanding place for research, teaching, and living life. I thought when we first moved here that I had stumbled into another dimension, a place with such weirdness and wonder that it didn’t seem real. I still feel that way, and I am so glad we are here. Last, I wish to thank my parents for their never-ending love and support. I am dedicating this book to them, Diane and Chip. Mom first because she is the one who made me sit down and do my homework.

New Orleans, Louisiana
February 2017 (Lundi Gras)

List of Abbreviations

BEA	Bureau of Economic Analysis
BERD	Business Enterprise Expenditure on R&D
BERI	Business Environment Risk Intelligence
BIT	bilateral investment treaty
CIS	Community Innovation Survey
CPI	Corruption Perception Index
EPZ	export processing zone
FDI	foreign direct investment
GDP	gross domestic product
GERD	gross domestic expenditure on research and development
GMM	generalized method of moments
GVC	global value chain
ICRG	International Country Risk Guide
ICSID	International Centre for Settlement of Investment Disputes
IMF	International Monetary Fund
IPA	investment promotion agency
IPE	international political economy
IPR	intellectual property rights
ISI	import substitution industrialization
IT	information technology
LPI	Logistics Performance Index
M&A	mergers and acquisitions

NBER	National Bureau of Economic Research
OECD	Organisation for Economic Cooperation and Development
OLI	ownership, location, and internalization
OLS	ordinary least squares
PRS	Political Risk Services
PTA	preferential trade agreement
R&D	research and development
TRIMs	Trade-Related Investment Measures
TRIPs	Trade-Related Aspects of Intellectual Property Rights
TTU	technology transfer unit
UNCTAD	United Nations Conference on Trade and Development
USPTO	US Patent and Trademark Office
WDI	World Development Indicators
WGI	World Governance Indicators
WIPO	World Intellectual Property Organization
WPM	world product mandate
WTO	World Trade Organization

1 Introduction

Rush-hour traffic in Nairobi can reach epic proportions. Kenya's capital is poorly served by its highway system, and robust economic growth along with a burgeoning population have put pressure on infrastructure. Commutes from the suburbs can take up to two hours, depending on traffic. Interspersed among the cars and trucks inching their way through town are thousands of *matatus*, or public minibuses seating approximately 20 people. Up to a third of Nairobi's residents use these buses for transportation every day (Kalan 2013). And where long commutes generate boredom, they also generate opportunity. In 2012, a Kenyan startup named Flashcast designed a location-aware advertising system to be installed in these buses. 3G modems were connected to GPS units, and from there to the red LED lights inside the buses. These lights would then display ads, but also encourage the passengers to participate in games, quizzes, and other diversions on their phones. Beyond game-playing and advertising, however, the GPS units also allow customers to track the progress of buses and make transportation plans accordingly. As free wifi has increased among the *matatu* fleet, Flashcast has increased in popularity. Yet soon after its inception, Flashcast had a problem. Its directors realized that they had accumulated a great deal of data on commuters, including their behaviors and patterns. Given the company's limited resources, Flashcast had no way to analyze these data to create further commercially viable ventures. For assistance, they turned to one of the largest, most established information technology (IT) multinationals: IBM.

In November 2013 IBM announced, to much fanfare (including features in the *Wall Street Journal* and *The Economist*), that it was inaugurating its twelfth research lab in Nairobi.[1] IBM Research Africa was

1. Vogt 2013; Grand Challenges 2013.

the first lab on the African continent, located on the grounds of the Catholic University of Eastern Africa in Karen, a wealthy suburb. Other labs around the world include IBM's Watson lab, right next to MIT and Harvard, Almaden lab in California, and another lab near ETH Zurich. Kenya's President Uhuru Kenyatta attended the inauguration festivities, and the Kenyan government agreed to contribute at least $10 million over the first five years of its operation. IBM chose Kenya because of its emerging reputation as a tech center, particularly in the use of mobile phone payment systems and rapid installation of high-speed internet. The government has also nurtured a reputation for efficient regulation of its information and communication technologies sector, and has grand designs to build an IT center south of Nairobi, the so-called silicon savannah, by 2030. The IBM research lab in Kenya therefore represents a bet on the future of the African market, but also a shot across the bow of other companies such as Google and Microsoft, which are also developing their African presence. IBM has since expanded its African research capabilities, opening another facility at the University of Witwatersrand in Johannesburg in April 2015.

IBM's research lab investment was symbolic for a country and continent that had struggled to attract significant amounts of foreign direct investment (FDI) for decades, let alone investment with a significant research and development (R&D) component. Certainly, the lab has been active, employing scientists from the African diaspora and partnering with numerous indigenous companies similar to Flashcast. By lagging behind in the construction of communications infrastructure, Africa has somewhat paradoxically created opportunity for a mobile-based economy, with cashless payment systems and the exponential growth of smart phone utilization as prime indicators. There are certainly many reasons for optimism, and IBM's decision gives another boost to Kenya's status as an investment destination for multinational IT companies. However, there are also reasons to remain cautious. Kenya, and Africa at large, presents many barriers to foreign investors, and these barriers often diminish the efficient operation of multinationals and their potential contributions to growth. The security situation in Kenya is uncertain, and corruption is still common. Moreover, there are some limitations on the innovative work being done by IBM and similar companies. Many of the projects being done in Africa are research endeavors designed to find solutions for local problems such as health and sanitation. This kind of applied work being done at IBM Research Africa is often quite different from the work done at the Almaden lab, where pure, or "blue sky," research is more common.[2] That there is great need for these kinds of initiatives is in no doubt. However, these activities can occasionally give the appearance of another form of foreign aid and/or corporate public relations (PR), rather than commercially viable innovations for domestic and foreign markets. Do IBM's actions in Africa represent the beginning of a trend? Will we see significant amounts of high-tech investment in Africa's future? Or is IBM the exception to the dominant patterns of investment? What can Kenya's government do to entrench this kind of investment and provoke future investments like it?

Flashcast found a partner in IBM, and IBM has committed to Kenya. This example illustrates a process of multinational-linked innovation growing more common in emerging economies, and is the subject matter of this book. I consider here the innovative activities of multinational enterprises in developing countries. Two decades ago, it would have been a much shorter book. While developing countries welcomed significant inward FDI flows in the 1980s and 1990s, not much of that investment was innovation-intensive. This continued postwar trends, in which foreign investors looked to developing countries as sources of raw materials, markets, and/or production efficiencies, but rarely as locations for R&D facilities or other kinds of innovative activity. Yet as foreign investment increased in poorer countries, innovative activities of multinational firms have spread to these locations as well. This contradicts longstanding notions of where multinational firms locate innovation within their production chains. Some of the best-known works in international business literature characterize innovation as a highly centralized phenomenon (Vernon 1966; 1971; Hymer 1970; 1972). According to these and other works, multinationals have strong incentives to keep their innovative activities close to home, in their countries of origin. Firms enjoy tangible and intangible assets from new technologies and production processes, and

2. As an example of this, much has been made of IBM bringing the Watson project's African equivalent, nicknamed "Lucy" in reference to the fossil human ancestor, to the research lab in Nairobi. However, the focus of this cognitive computing initiative in Africa is on education and developing solutions to African problems (Bright 2016), not necessarily on commercially viable applications for exterior markets. In an interview with *Fortune* magazine, IBM Global Business Services chief Bridget van Kralingen explained that Lucy was a "first instance" of Watson, and that its focus would be on helping find solutions to energy, water, transportation, agriculture, and health care issues in Africa (Lashinsky 2014).

worry about losing their competitive advantages if innovations are spread to affiliates abroad. Developing countries, with their often relatively immature intellectual property protections, lack of other regulatory infrastructure, and poor state capacity, were seen to be especially risky locations for innovative activities. Yet the recent spread of innovation within multinational production chains is unmistakable. According to a 2005 report by the United Nations Conference on Trade and Development (UNCTAD), approximately two-thirds of global R&D spending is accounted for by business enterprises. The lion's share of this spending is done in developed countries. However, the developing world is increasing its share of global business R&D spending. Developing countries accounted for $20 billion in business R&D spending in 1996, or 5.4 percent of global business R&D spending (UNCTAD 2005, 106). By 2002 that figure had reached $32 billion, or 7.1 percent. By 2010, companies in the *Fortune 500* list had 98 R&D facilities in China and 63 in India ("The World Turned Upside Down" 2010). Blue-chip companies such as Ford, IBM, Pfizer, Microsoft, Intel, Cisco, and Boeing have constructed R&D labs in not only China and India, but also Brazil and South Africa (Hall 2010). This diffusion of innovation within and among multinationals has occurred at the same time as firms invest in more diverse sectors in emerging economies. Gone are the days when natural resource-seeking multinationals dominated investment in poorer countries. In certain countries, one is now just as likely to find an international accounting firm offering business process outsourcing as a mining conglomerate.

As multinational investment in developing countries becomes more diverse, and as multinationals adopt a variety of governance structures that may include polycentric innovation strategies, students of foreign investment are presented with a puzzle. If firms are supposed to conduct innovation close to home, what explains these new patterns? This book proposes a variety of answers to this puzzle, but its most fundamental message is one rooted in the tradition of political economy. Rather than concentrating on macroeconomic or firm-level explanations for innovation outcomes, I argue that host country institutions and policies are vital to explaining the diffusion of innovation in developing economies. Firms are attracted to the well-educated labor forces that many developing countries have to offer. They are also often eager to innovate close to new markets. But in addition to this, the strength of host country institutions and the qualities of the country's investment policies have a strong impact on firm decisions, both during initial investments and over time. Strong institutions make firms more comfortable with the risks inherent in decentralized innovation. This is important for explaining not only how investment patterns change through time, but also how they vary across countries. Some states have simply done better at transitioning to investment models where higher value-added activities are well represented, and to investment profiles where firms engage in local innovation rather than rote reproduction. These states are more likely to display coherent and coordinated institutions. In addition, I argue that institutions and policies are vital explanatory factors for understanding how multinational firms fit into local economies. Certain institutional and policy configurations are more likely to result in firms that are more enmeshed into local production networks, rather than functioning as "islands" with little connection to local economies. This kind of connection makes technology transfer much more likely. Throughout this book, I recognize international economic and firm strategic goals as important in determining the innovation content of investments. However, I continually emphasize the interaction between firms and host states, and how both parties pursue and achieve their sometimes overlapping interests.

The main concern of this book is the investigation of innovation within multinational enterprises. However, there are a number of additional questions, both broad and narrow, addressed here. Do multinationals in emerging economies partner with domestic firms and other organizations, or do they produce in isolation from the domestic economy? Does innovation associate in a reliable way with this kind of "embeddedness"? Over time, how do overall investment patterns and the investment profiles of individual firms change when a country is developing? On the policy front, how do country governments support or incentivize technology transfer? Why do some countries fail to diversify their investment profiles, and why are some countries dominated by investment with little or no innovative characteristics? What effects do international agreements have on the investment models of firms, and do these treaties leave room for host countries to extract developmental benefits from inward investment? How do institutional characteristics of host countries combine with the internal attributes of firms to influence innovation outcomes? While the central argument of the book is the importance of domestic institutions and policies in creating the conditions for local innovation, other issues are repeatedly raised. I seek to create a narrative that is simultaneously cognizant of the real-world implications of my arguments and aware of the limitations and scope of these claims.

In addressing these and other questions, I emphasize the interdisciplinary nature of my investigations. There are three main academic literatures directly related to this project. Development theorists have long been concerned with the contributions foreign firms do or do not make to economic growth in host countries. Among those disposed to emphasize gains from investment, innovation “spillovers” or “linkages” in the domestic economy are claimed to heighten productivity and competitiveness among domestic firms, leading also to enduring partnerships with local actors such as universities and research centers and provoking a virtuous cycle of industrial upgrading. Among those disposed to distrust multinational enterprise and discount its contributions, innovation is seen as limited, ephemeral, and capable of crowding out domestic firms. Too often scholars on one side or the other simply assume that if a firm is in country, it must be helping or hurting. Yet as I will explain, this approach is simplistic and misleading. In the field of international business studies, scholars have long considered how multinational firms innovate and have proposed a variety of firm-level motivations for both the locations of these activities and how innovation is managed. However, international business scholars until recently have tended to (perhaps unsurprisingly) prioritize firm-level explanations over ones that integrate host country characteristics. In the field of political science, a substantial political economy literature considers the political determinants of inward investment flows in rich and poor countries. However, these explanations rarely look at the specific activities pursued by multinationals in host countries. In this book, I seek to integrate these three literatures, and other works not directly contained within their purview. I synthesize their respective contributions and argue that they all offer important pathways to understanding how investment in emerging economies is changing.

In the remainder of this chapter, I briefly provide the context for my central argument, which is that host country institutions matter for the innovative characteristics of inward FDI in emerging economies. When firms perceive institutions as well-functioning and when policies exploit opportunities for innovative linkages, innovation becomes more likely. I first summarize a new approach to the analysis of FDI in emerging economies, and then briefly discuss the main findings of the empirical analysis in the book and its implications. After a short examination of the data used in the book and the dominant methodologies, I describe each chapter's contents in the plan of the book.

An Alternative Approach to Foreign Direct Investment in Emerging Economies

Cross-national research on FDI often treats these important international capital flows as uniform. Political economists have made numerous arguments regarding the relationship between political institutions (democracy, federalism, etc.) and incoming aggregate investment (Oneal 1994; Henisz 2000; Jensen 2003; Li and Resnick 2003; Kenyon and Naoi 2010). These studies have increased our understanding of investment patterns worldwide and have demonstrated what kinds of political configurations are most attractive to multinational corporations. While specific conclusions differ, this literature shows us that multinational firms consider the policy and institutional environment in host countries when making decisions about where and when to invest. Yet these approaches are incomplete because they do not often separate investments by sector or ask what exactly multinational firms are doing in countries. Political economists often make sweeping generalizations about FDI based on broad correlations, but these statements lack depth. Studies in the development tradition often make the same mistake, lumping incoming FDI together with measures of trade, capital account flexibility, and other macroeconomic indicators. But the specific kind of FDI a country attracts is immensely important, as policymakers have long understood. We should not assume the same kind of developmental benefits from a textile factory and a software development facility, although both may contribute to development. We naturally expect governments will differ in the resources and strategies employed to attract these two very different investments. It is impossible to say that FDI is "good" or "bad" for development. We have to know more about the investments in question.

There are a number of reasons for academic aggregation and simplification of FDI characteristics in developing countries. Scholars in the field of international political economy tend to use levels or yearly flows of FDI as independent or dependent variables, but concentrate on political configurations. Academics in the field of international business studies are more likely to investigate the specific activities of multinational firms in developing countries. Business scholars might ask why firms do more R&D in one location than another. However, these works often rely on theories of the firm. That is, the causes of FDI heterogeneity are largely internal to the firm and result from different business strategies. Development scholars, on the other hand, while extremely interested in how states promote technological change and industrial upgrading, have not always recognized the potential for multinational-led development. Scholars in the development tradition have increasingly come to grips with the spread of global production chains and the effects these networks have on development trajectories and the nature of state agency. Foreign investment promotion is now an essential part of state development strategy across the world. Governments can no longer rely solely on promoting national champion firms; they must consider how their countries fit in global divisions of labor. Thus, the relationships between multinational firms and governments are ever more important, and global competition to attract the top firms is intense.

Academics have also been prevented from disaggregating FDI due to a lack of data. Data that separate FDI by sector have been rare, especially in emerging economies. Even data on overall levels of FDI flows and stock date only from the early 1980s. However, this is changing. Developing countries have kept better track of the kinds of investments made by multinational enterprises, especially since the 1990s. Moreover, national-level statistics are increasingly supplemented by large-scale surveys of firms, some of which take place across countries. In the last decade, a number of new data sources have become available, both at the micro (firm) level and in larger contexts. These new datasets allow for more fine-grained analysis of FDI. These new sources of data are often continually refined and revised, in order to represent more accurately the amount of inward investment and the sectoral distribution of that investment. Firm surveys allow the expansion of the traditional international business case study analytic model, to include variation across firms and occasionally through time. In other words, we now know more about investment profiles of firms and we also know more about how FDI in emerging economies is distributed by sector. These data advances are occurring at the same time as advances in time-series and multilevel econometric methods. The felicitous congruence of data and method allows a deeper understanding of FDI in developing countries than was possible as recently as 10 years ago.

All of these developments require a different and more comprehensive perspective on the relationship between FDI and developing countries than is offered by any one of the academic fields contemplated in this book. Foreign investment in emerging economies is becoming more diverse. To be sure, there are still countries that rely primarily on mining investments or textile investments. But most developing countries are beginning to see shifts in the composition of incoming FDI. Services are increasing as a proportion of overall foreign investment, and it appears this trend will continue. Monolithic treatments of FDI, especially when considering its potential developmental contributions, are ill-advised. We have new and better tools for examining investments in poorer countries. These developments combine to mandate a more nuanced approach to questions of inward investment in developing countries, one that marries firm-level analysis with awareness of larger socioeconomic trends and influences, both within states and at the international level.

The Argument in Brief

Multinational firms are pulled in different directions when considering how to invest in emerging economies. On the one hand, innovation is an inherently risky endeavor. It often involves significant expense without the guarantee of returns. Innovation is subject to unsanctioned appropriation, especially when it comes in the form of intellectual property rather than physical production. This creates strong pressure to maintain close control of innovation, and multinationals have consistently guarded their newest innovations in their countries of origin. However, multinational firms also confront strong motivations to move innovation to locations abroad. Other countries may offer well-educated labor forces with ample supplies of skilled labor (Reddy 2000). Markets abroad may demand innovation and adaptation for successful commercialization of products. Sources of expertise may surface in varied locations. As Bartlett and Ghoshal (1989) have argued, consumer trends, new technologies, and competitive advantages can come from anywhere, and multinationals can no longer assume they have access to the cutting edge only in their countries of origin. When faced with these countervailing pressures, I argue that state institutions and policies in host countries play a crucial role in mitigating risk and convincing firms to locate innovation-intensive investment abroad. Strong institutions may convince firms that local innovative efforts will remain sources of profit and not sources of competitive disadvantages. If institutions affect noninnovative forms of FDI, they should be *doubly* important for innovation-intensive forms of investment. I argue that these types of institutions are more likely to exist in democracies and that there is an overall association between democratic regimes and increased multinational innovation. However, nondemocracies may also display institutional characteristics that mitigate innovation risk for multinational firms.

Throughout this book, but particularly in chapters 5 and 6, I refer to institutions broadly as rules and regulations, channeled through formal governmental bodies and agencies, which affect the decisions and operations of multinational firms. I follow here in the tradition of North (1987; 1990), who in his pioneering work on institutional analysis in the social sciences, explained institutions as formal rules (constitutions, laws and regulations) and informal constraints (norms, culture, conventions, and codes of conduct). While acknowledging their importance, I do not dwell on informal institutions in this book. Rather, I focus on existing, formal governmental bodies and agencies designed to exercise authority. This is similar to the approach adopted by Williamson (2000), who also emphasized formal and organizational characteristics of government bodies. Therefore, state investment promotion agencies, property rights protection, and degree of corruption receive more attention in this book than cultural attributes such as citizen attitudes toward bartering, for example. I also find it useful to sometimes make a distinction between institutions and policy, and consider both in this book. Dunning (2005, 57) acknowledges that this distinction is often difficult, but characterizes policy as referring "only to government action," whereas institutions are the bodies and organizations of the state through which policies must pass. One can have inappropriate policies within a sound institutional framework, but strong policies can also be made ineffective by poorly designed or functioning institutions. This distinction is useful particularly in the context of chapters 5 and 6, as chapter 5 mainly deals with institutions and chapter 6 adds policy consideration in a specific country setting.

Beyond the focus on state institutions, I develop a number of complementary arguments about the determinants of multinational innovation in emerging economies. These arguments are outlined more fully in chapter 2. Historical data show that as countries become richer, their inward investment profiles (a) become more diverse, and (b) shift away from primary and manufacturing investments and toward services. This increases the chances of innovation-intensive investment, as the heterogeneous service sector contains opportunities for higher value-added and decentralized activities. However, innovation is also quite possible and even likely in manufacturing. I also argue that when certain sectors with higher value-added characteristics, such as pharmaceuticals, increase in importance, this tends to drive up innovation indicators not only in that sector but in other sectors, such as IT. Some countries do not manage to make the transition to diverse investment profiles and continue to exhibit low value-added investment profiles. However, most developing countries experienced this investment diversification in the 1990s, and it continues today.

I argue that certain firm characteristics are associated with the likelihood and intensity of local innovation. In general, I find that market-seeking strategies are associated with more innovation and that efficiency-seeking investments tend to be characterized by more hierarchical ownership structures and therefore less local innovation. The degree of foreign ownership is also influential. Wholly owned subsidiaries are less likely to conduct innovation in developing countries than firms with lower levels of foreign ownership. I argue that strong institutions in developing countries make firms more comfortable with less hierarchical models of investment, thereby increasing the chances of innovation diffusion.[3] However, it is not the case that subsidiaries with lower levels of foreign ownership are necessarily engaging in less valuable kinds of research. Indeed, the last decade has witnessed a proliferation of investment models whereby subsidiaries and affiliates are granted substantial autonomy and produce cutting-edge innovations.[4] I argue that rigid hierarchies, associated often with "vertical" models of investment where different stages in production chains are carried out in different locations, are less likely to lead to innovations in emerging economies. Rather, firms with these kinds of organizational structures are more likely to centralize innovation in their home

3. This stands in contrast to the argument that low institutional quality in host countries pushes firms toward joint venture models of investment, as firms in these environments become worried about a variety of policy instabilities and prefer to partner with local firms (Slangen and Van Tulder 2009).

4. See, for example, Pearce and Papanastassiou's (2009) discussion of "world product mandate" (WPM) organizational forms, where autonomy is greater and subsidiaries commit significant resources to innovation.

countries. I consider other linkages between firm governance structures and innovation outcomes, much of it prompted by the recent and influential global value chain interpretive framework (Gereffi and Kaplinsky 2001; Gereffi et al. 2005).

I also consider the role of host country policy and its effect on firm innovation. There are two kinds of policies that may affect firm investment models: indirect and direct. This refers to those measures that are specifically designed to influence the behavior of firms in country or attract new entrants (direct) and those policies that are designed for other purposes but may have concomitant impact on multinational investment (indirect). With regard to indirect policy influences, I examine the effect of (often liberalizing) reforms on firm investment models. For example, I argue that trade liberalization is not necessarily associated with local innovation. This is because trade liberalization encourages firms to substitute foreign-produced inputs for local innovations. I also consider policies with more direct impact on firm investment models. I ask whether bilateral investment treaties (BITs) are associated with higher levels of innovation. However, as my argument is primarily focused on domestic policies and institutions, I do not dwell on international agreements or the impact of international organizations such as the World Trade Organization.

I devote significant attention to host country policies designed to impact FDI, most often known as investment promotion policies. Host country governments have long recognized the heterogeneity of FDI, and many actively target those investments deemed most likely to contribute to development. But what increases the likelihood a country will receive the investments it desires, and what increases the likelihood that the investment actually results in spillovers? I argue that innovation-intensive FDI leading to significant spillover is more likely in situations where governments pursue active, sectorally discriminating investment promotion strategies matched to host capabilities *and* policies that incentivize multinationals to enmesh themselves in domestic production and education networks. States that adopt passive investment-promotion strategies, by contrast, are more likely to end up with multinationals functioning as enclaves. Innovation-intensive FDI with significant linkages to the local economy does not simply materialize. Governments have to go out and get it, and incentivize its embeddedness. I argue that if governments hope to wring maximum developmental benefits out of foreign investment, state institutions should be positioned in such a way that they can increase the absorptive capacities of domestic actors such as domestic supplier firms or local universities.

Data and Methods

In order to evaluate my arguments about the determinants of multinational innovation in emerging economies, I have made a deliberate effort to approach existing data from a variety of methodological angles. I am interested in not only how host country institutions condition the composition and behavior of incoming investment, but also how multinationals already in country evolve their investment models through time, while interacting with various state representatives. Similarly, I am interested in how state institutions and policies change through time, and the effects these changes have on the investment profiles of firms. This book is cross-national in orientation. There is a case study of investment patterns in a specific country, Ireland, in the penultimate chapter. However, the large majority of the book involves either firm survey data, accumulated across countries, or country-level data, often accumulated through time. While I believe that much is offered by more in-depth consideration of one or a few countries, I am more interested in the ways in which accumulated data can reveal relationships with as much generalizability as possible. Similarly, I believe that in-depth firm case studies can add much understanding to the various claims advanced in this book. This kind of methodological approach, common in international business literature, provides greater knowledge of the micro mechanisms implicit in my arguments. However, again I sacrifice depth for breadth in my approach. In chapters 3 through 5, I rely on a number of large datasets, supplemented with country-level variables obtained from additional datasets. I rely extensively on sectoral FDI data provided by UNCTAD's Division on Investment Technology and Enterprise Development, firm survey data from the World Bank's Investment Climate Surveys, and US Bureau of Economic Analysis data on the investment models of American firms, patent data from international and US sources, and some Organization for Economic Cooperation and Development (OECD) data. In chapter 6, I utilize data from the European Business Enterprise Expenditure on R&D (BERD) and Community Innovation Survey (CIS) firm-level surveys. The data largely come from the period after 2000, though the late 1990s are represented in some datasets. Many of the poorest developing countries are not well represented in the datasets, so it is important to limit many of the conclusions presented here to what might be more accurately be described as low- to middle-income countries.[5] With all of these large datasets, I have attempted to include as many different firms from as many different sectors as possible, so as to avoid selection bias. However, I do discuss sectoral differences where possible.

In all chapters, the kinds of data available determine the methodologies used. For example, the US Bureau of Economic Analysis retains information on the amount of money American firms have spent on R&D (by sector) in individual countries over time. Therefore, I am able to utilize time-series econometric tools and make linkages between country attributes and investment model changes. The World Bank's Investment Climate Surveys contain firm responses, but do not track these responses in multiple years. Because I add various country-level variables, here I employ multilevel models where one level (firms) is nested in another (countries). Because I believe no single method is sufficient for evaluating the interplay between firms and host countries, I employ different types of data. In the chapter on Ireland, I combine qualitative case study examination of investment promotion and integration policies with quantitative assessment of firm-level data and historical narratives about investment policy. I believe that this multiple-angle approach best ensures a comprehensive treatment of the subject, while avoiding picking sides in ongoing methodological debates. In all chapters, I devote significant energies to explaining the nature of the data being tested and the sources, and I attempt to acknowledge any limitations.

Implications and Scope

This book has two sets of implications for students of political economy, international development, and international business. The first is a set of important interpretive points, and the second is a more normative set of proposals. On the first, this book reaffirms the importance of domestic institutions for interpreting the political economy of international investment. Domestic institutions, far from being only an aggregation of individual preferences, have a kind of independent agency. Or, as

5. Some of the least developed countries are sporadically represented, for example, in the firm surveys. However, the data skew toward relatively more advanced developing countries.

March and Olsen (1984, 738) explained it years ago, “[institutions] are also collections of standard operating procedures and structures that define and defend interests. They are political actors in their own right.” Institutions not only influence what foreign firms will contemplate doing in emerging economies, they influence what is possible from FDI in general. Institutions shape preferences as well as accumulate them. Multinational firms do not operate in vacuums—they consider the institutional environment in host countries both before initial investment and continually once the investment has happened. The location of innovative activities within multinational production networks is not only a function of firm strategy and prevailing economic conditions, it is also determined by the institutional infrastructure offered by host countries, and the unceasing interplay between the state and the firm.

On the second, more normative implication of the argument, I claim that countries with significant multinational innovative activity tend to be those that not only actively target investment in sectors with these characteristics, but also implement policies that incentivize forward and backward linkages in the domestic economy. In the same vein, passive investment promotion, whether sectorally discriminating or not, does not seem to reliably associate with innovation-intensive forms of investment and certainly not with linkage creation. This means that countries seeking to attract innovation-intensive FDI not only need strong institutions, but also need appropriate policies designed to incentivize innovation and enmesh it in the domestic economy. More countries have been adopting these strategies in recent years, but the dominant approach still appears to be what Narula and Dunning (2010) called the “passive FDI-dependent” strategy. That is, most emerging economies are content to reduce barriers to investment, perhaps selectively, in the hope that this will contribute to developmental outcomes. However, this book points to the many difficulties inherent in the international transfer of knowledge, and the importance of state institutions in actively facilitating that transfer.

Before proceeding, it is also important to set the boundaries of this book and explain what it is not. My argument does not consider multinationals originating from developing countries, although these firms have been multiplying in number and importance in recent years, and a number of important academic treatments of this phenomenon have emerged.[6] Many of the theoretic arguments and empirical treatments advanced here could also apply to emerging-market multinationals in their interactions with host countries. However, while developing countries' proportion of overall FDI flows is growing quickly, these flows are still overshadowed by investment from wealthy countries. Investments from emerging markets are thus far dominated by a relatively small number of large players, and do not exhibit the same amount of sectoral heterogeneity as multinationals from wealthy countries. Moreover, I am concerned with the contributions inward FDI can make to processes of development in emerging economies, and the longstanding debates about the most likely mechanisms for FDI-assisted development. Innovation from multinationals originating in developed countries is still the gold standard objective for many investment promotion agencies in emerging economies, and often represents the technological frontier. Emerging-market multinationals can also demonstrate an especially high innovation profile, but their still relative infrequency in transnational investment flows results in data that are heavily weighted toward firms from wealthy countries.

This book does not advocate for FDI-assisted development or insist that development is possible only through FDI. Indeed, the historical record bears several examples of countries that have progressed rapidly in a short amount of time while placing significant limitations on inward investment.[7] Moreover, I recognize that noninnovative FDI is absolutely essential for many developing countries, particularly for employment reasons. Many of the poorest developing countries do not have the luxury of discriminating in favor of innovation-intensive investment and are instead locked in a battle to attract any kind of foreign investment at all. For these countries an export processing zone with little embeddedness may be quite sufficient. While I do argue that innovation-intensive FDI can be a boon to development under the right circumstances, my primary focus is in identifying the socioeconomic determinants of this kind of investment, and the policies and institutions most likely to integrate multinational innovation into development trajectories. I also do not consider the experience of developed countries with inward investment, beyond the case study of Ireland (due to its potential lessons for developing countries). The variation in institutional quality is lower among developed countries,

6. See Ramamurti and Singh (2009), Wells (1983), and Williamson et al. (2013) for a sample of this growing literature.

7. See the examples of South Korea (Amsden 1989) and Japan (Johnson 1982).

and these countries are subject to different political and international dynamics. While the volume of innovation-intensive FDI flows is much higher among developed countries (see chapter 3), relationships between firms and states are not subject to the same intriguing theoretic mechanisms as they are in developing countries.

The Plan of the Book

The following chapter sets the theoretical context for the empirical exercises that follow. I briefly summarize theoretical approaches to the study of FDI and development, and then develop ideas about how strong institutions lessen perceptions of risk for firms and particularly the innovation-intensive activities of firms. I consider the bargaining literature on host country–multinational interaction, as well as international business ideas about the spread of innovation and the increasingly influential global value chain perspective on firm organization and governance. I develop a theoretical interpretation for investment promotion policy, advancing notions about active and passive investment promotion strategies. I also propose general versions of several hypotheses, which subsequent chapters then develop further and test.

Chapter 3 considers the uneven spread of multinational innovation in emerging economies, as well as the sectoral evolution of FDI through time. I emphasize in this chapter sectoral divisions within primary (resources-based), secondary (manufacturing), and tertiary (services-based) FDI. I develop a hierarchy of FDI based on its value-added characteristics and show how the type of FDI attracted by developing countries changes in composition over time. I argue that many developing countries have made the transition to more innovation-intensive FDI profiles. This chapter also introduces the innovation concepts that are important for the econometric analyses in subsequent chapters. I discuss patterns in R&D spending among multinationals, noting how these activities have unevenly spread to peripheral economies. I also discuss the innovation content of FDI-linked exports from developing countries, and outline how firms do or do not make "upstream" and "downstream" linkages in the domestic economy, often with indigenous supplier firms. This chapter outlines the many ways in which innovation takes place within multinational firms and shows how these patterns have changed through time.

Chapter 4 examines the determinants of multinational innovation in developing countries, adding econometric analysis to the descriptive statistics in chapter 3. This chapter relies primarily on US Bureau of Economic Analysis survey data and the World Bank's cross-national Productivity and Investment Climate surveys from 2002 to 2005, along with patent data from various sources. I employ a variety of innovation indicators as dependent variables, including local R&D spending levels, linkages with local firms and universities, international patents, and production process changes. I argue in this chapter that increased levels of foreign ownership are associated with firm hierarchies and lower levels of local innovation; bilateral investment treaties are associated with more innovation (but not necessarily those treaties with the firms' countries of origin); and democracies are associated with more innovation-intensive forms of investment. This chapter also considers why some multinationals operate as enclaves in developing countries, while others are enmeshed with indigenous firms in a process of technological upgrading.

Chapter 5 continues the firm-level approach of chapter 4, but adds variation in state institutions as a key independent variable. I link institutional configurations in host countries with patterns of R&D spending among multinationals, relying mostly on firm surveys. I relay insights from the growing international business literature on the importance of state institutions for firm entry modes. I argue in this chapter that firm perceptions about institutional environments in host countries, as well as institutional perceptions of third parties, affect the likelihood that the firms will conduct R&D locally, taking into consideration such variables as firm size, sector, and other controls. I also argue that firm perceptions of competent state institutions influence the intensity of R&D expenditure, not only its presence.

While the first five chapters are cross-national, chapter 6 focuses on the individual case of Ireland, which has often been held up as an example of a country using innovation-intensive FDI as a catalyst for development. Ireland is not a developing country, but as recently as the 1980s it was a much poorer country on Europe's periphery.[8] I use Ireland as a case study in order to consider the role of specific FDI promotion policies and institutions through time, and because Ireland's

8. It is also important to note that the dividing line between developed and developing is not really a line at all. The continuum of development is uninterrupted, and there have been recent movements to de-emphasize these kinds of artificial dichotomies (Olopade 2014).

experience with high-tech foreign investment is often held up as an example for developing countries to follow. Here I rely on datasets accessed during two periods of field research at the Central Statistics Office in Cork, datasets that contain proprietary information on firm innovative activities in Ireland. I connect these firm-level data with public policies and institutions in Ireland designed to incentivize innovation. I argue that the Irish case is more complex than commonly portrayed. The country's progress has been remarkable, and investments from (mostly American) multinationals have certainly played a part in its success. However, while successive Irish administrations were able to attract numerous multinationals to the country, Ireland has only recently begun to realize successful initiatives to integrate its inward investment more fully into its domestic economy. This is reflected in popular notions of Ireland as a "dual" economy, where multinationals operate in some degree of isolation from the domestic economy. I also consider the types of innovative activities pursued by firms in Ireland and argue that the state has squandered some opportunities to exploit its locational advantages, which include access to mature markets and a well-educated labor force.

In chapter 7, I conclude by reviewing the contributions of the book and explain how theoretical and empirical insights might be applied practically in investment promotion policy and strategy. I again underline the need for sectorally specific research on FDI and consideration of firm-level data on the activities of multinational corporations in developing countries. I suggest potential avenues for future research. The conclusion also offers a robust defense of FDI as a potential vehicle for industrial upgrading, but cautions that FDI is historically neither necessary nor sufficient for development. I ask in this chapter what the implications of my arguments are for developing country governments and firms, and suggest that many of the issues brought forward in this book will continue to inform debates about international investment and the role of the state in the future.

2 Multinational Enterprise, Innovation, and Development: Theoretical Perspectives

Emerging economies have hosted multinational enterprises for decades. While it is true that the volume of investment has increased markedly since the 1990s, foreign firms have long had a presence in the developing world. And just as foreign firms have a long history, so too does the debate about whether and how these investments contribute to development. It is a controversial topic, and this controversy never really disappears. It lingers around the periphery of nearly every academic discussion of inward FDI in poorer countries. This is primarily due to perceived or actual power imbalances between firms and host countries, as well as quite actual divergence in the priorities of both firms and governments. One side of the debate looks to FDI as a source of new products or practices, whether transferred to domestic partner firms or to other local actors. Multinational firms may further integration with the international marketplace and strengthen competitiveness, and may reverse "brain drain" pressures in developing countries. Foreign firms may induce or strengthen domestic savings and may catalyze a process of industrial upgrading and increased productivity. On the other side, there are claims that multinationals repatriate profits, limit spillovers into the local economy, engage in competitive and counterproductive tax and environmental arbitrage, use transfer pricing to undercut competition, and crowd out productive domestic firms. There are numerous other arguments on both sides. This debate is unlikely to ever be resolved, in part because FDI in developing countries is so heterogeneous. In a review of the topic, Wells (1998, 102) noted that "some FDI is good, almost certainly some is harmful." But it has been quite difficult to determine which is which, and even more difficult to trace the vital mechanisms through which FDI might under certain circumstances contribute to development.

This book is an examination of one of the most likely (though not only) channels for developmental processes via multinational investment: the dissemination of innovation. Multinationals remain important conduits for innovation and in many instances represent a ready source of innovation in both developed and developing countries. Host country governments often justify their pursuit of multinational investment by pointing to the possibility of technology transfer, and firms often trumpet their partnerships with universities and researchers in host countries. However, there are also many long-established reasons why innovation should *not* spread outward from multinational investors, who often have strong incentives to keep tangible and intangible assets under tight control. Multinational-linked innovation in developing countries is therefore an important potential developmental channel, but there has been some degree of uncertainty about how common it is and about its determinants across firms and countries. As the next chapter documents, multinationals are increasingly engaging in innovation in emerging economies. As the rest of the book demonstrates, this is due to a wide variety of political-economic phenomena, including institutional variation among host countries and the active pursuit of these types of activities by host country governments. I argue that the terms of the debate about FDI should shift from whether or not to let foreign investments in to how to embed certain kinds of investment activities in domestic economies.

This chapter serves as a theoretic backdrop to the more empirically informed chapters that follow. I integrate a number of relevant literatures from international business studies, international political economy, and development studies in this chapter to make the case that the determinants of multinational innovation are not limited to internal firm attributes but also include a variety of international and host country characteristics. Importantly, I argue that host country governments are able to influence the investment models of foreign firms and that host country institutions have an impact on not only the presence of local innovation but also the likelihood that backward innovative linkages and spillovers develop in the local economy. I generate some general hypotheses in this chapter, which are then made more specific and tested in subsequent chapters. The aim of this chapter is therefore to explain how this research builds on and integrates with existing studies of the determinants of FDI in emerging economies.

I begin with a discussion of approaches to foreign investment from a development perspective, paying special attention to the historical antagonism between foreign investors and developing country governments. I consider how foreign investors fit into existing explanations of national systems of innovation, and argue that modern theoretic approaches to innovation must transcend tired developmental debates surrounding import substitution industrialization (ISI) and its alternatives. I then consider the large body of scholarship from international business studies that considers how innovation is distributed through multinational production structures. Here I argue that the relatively recent spread of innovation to emerging economies has challenged longstanding ideas about where companies innovate. I then consider the tradition of institutional analysis within political science, and how it has been applied to studies of FDI. This section incorporates the important bargaining literature on host country–multinational interaction. Finally, I conclude with a section on innovation-incentivizing industrial policies in host countries and how these policies might be used to promote the integration of innovation-intensive investments into the domestic economy. I argue here that host countries have more success when policy is active instead of passive, and when it is used to promote the development of multinational roots in the local economy. In each of the sections that follow, I highlight how firms have increasing incentives to exploit locational advantages in emerging economies, while host countries retain a large number of policy and institutional tools to best incorporate multinational-linked innovation.

Revisiting the Role of FDI in Development

The development literature has not come to grips with the profound impact multinational production has had on the nature of state development strategies in the periphery. Too often, this literature remains locked in well-traveled debates about the merits of infant industry protection or privatization. The broadest normative debate concerns the contribution that international capital should make to domestic development. This debate has a long intellectual lineage, particularly in Latin America. Modernization theories suggested that countries could develop quickly by embracing international capital and could, under certain conditions, move through stages of development in quick succession or even skip some stages altogether. Dependency theorists, in contrast, argued that an international division of labor had developed over a long period of time whereby international economic actors conspired quite naturally to keep Latin America in a perpetual state of underdevelopment (Dos Santos 1970; Cardoso and Faletto 1978).[1] While earlier *dependistas* argued that international capital played the primary role, later more sophisticated analyses acknowledged the role of domestic capital and admitted some conditional and contextual benefits to foreign capital penetration.[2] However, the dependency school in its broadest sense discounted the benefits from international economic integration and formed part of the theoretic justification for the continuation of many of the ISI policies so common in Latin America and elsewhere from the 1930s until the 1980s. As recently as two decades ago, debates about the role of state in jump-starting innovation centered on what sorts of things the state could do to encourage the emergence or advancement of national firms. The enduring legacy of ISI in some countries had conditioned a generation of policymakers to believe that infant industry protection could generate substantial rewards in the long run by encouraging the emergence of entrenched domestic industrial groups. International capital, when it was considered by economic planners, was looked on primarily as a source of financing. For dependency theorists, the most important questions therefore continued to revolve around how to allow resources to reach productive domestic firms.

For much of the postwar period, developing country governments did not consider multinational firms to be reliable sources of innovation spillovers. In the 1960s and 1970s, FDI in developing countries went predominantly to natural resource sectors, with some manufacturing. This period witnessed several nationalizations of foreign mining and petroleum investments, and negotiations between firms and host country representatives were often antagonistic (Moran 1975). Attitudes toward multinationals as agents of exploitation were neatly encapsulated by the book *Global Reach: The Power of the Multinational Corporation* (Barnet and Müller 1974). The book was essentially an indictment of multinationals, characterizing them as rapacious and their relationships with developing countries as inherently conflictual. While this book was nominally an academic publication, it was translated into many languages and became a best-seller many times

1. See Valenzuela and Valenzuela (1978) for a good summary of the evolution of the debate between modernization and dependency theorists.

2. See Evans (1979) and Cardoso and Faletto (1978). Both concentrated on the role of domestic elites in perpetuating situations of dependency. Evans in particular examined the benefits derived by local capital from international linkages.

over (Robock 2005, 385). The idea that multinationals could in certain circumstances complement development strategies did enjoy support during this period, but it was far from the consensus view.

Multinationals encountered attitudes of indifference, at best, and more often antagonism in developing countries. These attitudes were not limited to Latin America. Multinationals did not figure prominently in the development strategies of many of the economic success stories of East Asia and were rarely direct sources of technological change. Countries such as South Korea and Japan were able to engineer durable growth trajectories with only minimal multinational participation, relying instead on strategies of imitation, export subsidies, and extensive state-directed protection (Johnson 1982; Amsden 1989; Gereffi and Wyman 1990). Even Taiwan, which had more of a multinational presence earlier on, significantly limited incoming investment and became increasingly discriminating about what kind of foreign investment was allowed in during the 1960s and 1970s (Wade 1990).[3] There have been significant debates about the extent to which liberal reforms were undertaken in East Asia and the effect these reforms may or may not have had on developmental success, but it is uncontroversial to note that multinational firms were not key players in many of these cases, and certainly did not engage in innovative activity in these countries at anywhere close to current levels. Narula and Dunning (2010) use these cases to emphasize the point that FDI is by no means a prerequisite for development, but that in other cases, such as Singapore and Ireland, a direct connection is easier to make.

Historical antagonism and ambivalence aside, what does determine whether or not FDI can contribute to development? The answer to this question is a substantial concern for this book, though not its primary objective.[4] Developing countries became gradually more receptive to different forms of investment in the 1980s, and the period of policy reform in the 1990s cemented FDI liberalization as one of the key elements of the Washington Consensus (Williamson 1990). But in many cases countries that opened to international investment did not grow as quickly as hoped. Many investments did not

3. While it is true that Taiwan's limited domestic market naturally resulted in export-oriented FDI, almost all investments were met with strict export requirements and incentives. The 1960 "Statute for the Encouragement of Investment" provided, along with other incentives, income tax exemption on 2 percent of export profits and business/commodity tax exemptions on exports (Riedel 1975).

4. For a more direct and contemporary assault on this important question, see the collection of essays in Görg (2016).

generate hoped-for spillovers in domestic economies, and some became enclaves of lower-wage employment, particularly in export processing zones (EPZs).

The varying experiences of developing countries with multinational investment suggest that there can be no blanket statements regarding its usefulness for development. Instead, it is necessary to examine the conditions under which foreign investment *may* contribute to development. I contend that this requires not only investigation of firm incentives but also the incorporation of host country institutional analysis. Multinational firms may generate positive development outcomes when interests *and capabilities* of firms and host countries align. This emphasis on host country institutions does have precedent in scholarship. Advocates of neoliberal reform often failed to recognize the serious obstacles facing the international transfer of technical knowledge (Nelson 2005). Technological assets enjoyed by firms are subject to high uncertainty and involve intangible characteristics, and their diffusion through liberalization is not as automatic as other firm assets. "Evolutionary" approaches, drawing on neo-Schumpeterian ideas, have proposed that countries cannot rely on the market mechanism alone but must be able to absorb and perpetuate new technologies (Nelson and Winter 1985). According to this line of logic, the contribution of an open economy to technological change depends not only on a country's comparative advantages but also on such diverse factors as the organizational quality of its bureaucracy and the intellectual property regime in place. From a neo-Schumpeterian perspective, then, technology transfer is very much a function of policy and institutional settings in developing countries, just as it is a result of internal firm characteristics. There are a range of preconditions, from educational systems to intellectual property regimes, that determine the absorptive capacity of host countries. Policies that impact innovation, and the institutions that create and promote them, form the basis for what has been called a national system of innovation (Lundvall 1992; Nelson 1993; Edquist 1997). I argue that multinational firms can figure prominently in a national system of innovation, particularly if institutions exist that simultaneously draw attention to the country's potential for innovation-intensive investment and increase the likelihood of spillovers from that investment.

The sectoral composition of FDI in an economy is an important signal of its developmental potential. Partly due to data constraints, FDI has not often been separated into different categories in cross-national analysis. This has changed somewhat in recent years. A number of economists have outlined various determinants of "high quality" FDI from a development perspective (Reuber 1973; Kumar 2002; Mutti 2003).[5] Other social scientists have looked at host country efforts to upgrade to nontraditional forms of investment, and the varying outcomes of these efforts (Nelson 2009; Guimon and Filippov 2012). It is certainly true that whether a country seeks to attract, and can attract, textile plants or IT firms will have an impact on the types of contributions FDI can make toward development. However, the developmental prospects of countries are augmented not only by landing investments from firms, but also by the integration of those firms into the domestic economy. Cross-national studies of aggregate FDI flows and development are often incomplete because they do not separate investments by sector or ask what exactly multinational firms are doing in developing countries. In a similar fashion, sectoral distinctions are useful only if they convey information about the activities multinationals are pursuing in developing economies. It is quite possible for a pharmaceutical plant to locate production in an emerging economy and conduct no local R&D, although pharmaceutical plants are more likely to engage in local innovation than other kinds of investment. It is also possible for a textile plant to conduct substantial R&D, although textiles are less likely to do so than firms in other sectors. In this book, I pursue a micro-level approach wherever possible in order to determine how institutional configurations affect the innovative activities of firms and their embeddedness in local production networks.

For students of international development, the process of sectoral industrial transformation is an important indicator. As countries get richer, sectoral patterns of employment and production change. In general, agriculture and reliance on natural resources tend to decline in importance as countries move up the development ladder. Industrial diversification and development are correlated, although of course there are many different kinds of manufacturing and service activities with varying levels of developmental potential. This kind of industrial transformation is mirrored in patterns of FDI in developing countries. In chapter 4, I show that as certain sectors become more prominent in developing countries' economies, the rate of multinational innovation tends to rise. This is true for export diversification as well. The kind of foreign investment a country attracts therefore reflects its production

5. For a good overview of the economic literature on the determinants of FDI in the developing world, see Caves (1996), particularly chapter 9.

and export profile and impacts the likelihood that foreign investors will engage in innovative activities in the local economy.

Hypothesis: Sectoral production patterns, in particular the prominence of natural resource production and export, in emerging economies associate with the incidence of multinational innovation.

That foreign firms should display more local R&D in countries with larger chemical manufacturing sectors as opposed to countries with larger textile manufacturing sectors (for example) is not particularly surprising. However, analysts seeking to establish these relationships have long been limited by the relative lack of both sectoral FDI data and data on the innovation activities of multinational firms. This book takes steps to solve both problems, while emphasizing the endogenous relationship between FDI upgrading and broader industrial upgrading processes. Importantly, I argue that sectoral patterns of FDI tend to associate with one another as well as with industrial transformations in emerging economies. In other words, if a country's pharmaceutical sector grows, this not only makes multinational R&D in pharmaceuticals more likely, it also makes innovation in other sectors more likely. Beyond these specific associations, I argue that it is important for development theory to incorporate multinational investment and the potential for FDI-linked spillovers into theories about sectoral industrial transformation and change.

There have been some efforts in this regard. Most of the debates concerning the successes of the East Asian countries relative to other developing regions have focused on the earlier introduction of export-incentivizing public policy alongside import substitution industrialization models (Gereffi and Wyman 1990; Haggard 1990; Bruton 1998). These debates focus on where and when countries incorporate inward-looking, import-substituting policies or outward-oriented policies that prioritize export competitiveness. However, there are two important problems with these debates as they apply to foreign investment. First, this debate (which largely happened in the 1990s) was primarily oriented toward trade. When multinational firms were considered, it was largely in the context of neoliberal reform programs promoted by the International Monetary Fund (IMF) and other organizations. Openness toward foreign investment was indeed an important ingredient in structural adjustment programs, but when countries considered export-oriented policies, they did so mostly in the context of boosting national firm competitiveness. Likewise, ISI often invoked an implicit hostility toward multinationals, despite the fact that tariff-hopping FDI had been an integral part of ISI policy for decades in Latin America and elsewhere. Simply put, the export-oriented/import-substituting dichotomy was not focused on FDI's role in development. Countries were placed on a continuum of openness toward foreign investment, but explicit incorporation of FDI into development strategies and industrial policy was rarely considered. Trade openness mattered more.

The second problem is related to the first. The developmental experiences of different regions in the 1980s and onward led to a conflation of import substitution and industrial policy, when in fact the two are not necessarily linked and are certainly not codetermined. East Asian "tiger" countries retained active industrial policies with significant limitations on foreign participation *and* export incentives throughout the economic boom (Amsden 1994). Schrank and Kurtz (2005) identify a form of industrial policy emerging in select Latin American countries, distinct from the kinds of industrial policy pursued during the ISI period, that combines support for select industries with outward orientation. This "open economy industrial policy" challenges the traditional dichotomy between inward-orientation/statism and outward-orientation/laissez-faire, arguing that industrial policies increasingly in vogue in Latin America combine support for select industries with an emphasis on external competitiveness.[6] The authors argue that this kind of industrial policy has the potential to move countries toward self-perpetuating cycles of innovation and development, while avoiding the rent-seeking tendencies of earlier ISI models. While they do not focus on inward foreign investment, this line of argument suggests that removal of barriers to foreign investment may not be the only choice facing host country governments. They must also make industrial policy decisions about whether and how to influence the kinds of investments coming into the country and the integration of these investments into the domestic economy. I will have more to say about the divisions in attitudes toward industrial policy related to FDI later in this chapter. For now it is sufficient to note that the import-substituting/export-oriented dichotomy is both too trade-centric and too simplistic when dealing with foreign investment in emerging economies. The next section moves on from these development

6. Lall (2004) makes a similar open economy argument that industrial policy can build competitiveness in instances where market failures exist and that this kind of policy can be especially beneficial if applied selectively.

theory traditions to consider international business literature on firm innovation models and where political economy approaches can and should inform theory about the spread of multinational innovation in the developing world.

Multinational Innovation and Theories of the Firm

This book does not originate in the tradition of international business studies. I seek to convey the extent of multinational innovation in emerging economies and investigate the determinants of this phenomenon. Firm activity is the object of inquiry, therefore international business literature on the spread of FDI and innovation is quite important. However, my argument focuses on the politics of investment and innovation in host countries: the interplay between firms and governments. This places priority on political economy and development traditions, which overlap quite regularly. However, there are three interrelated reasons why it is also important to consider theories of the firm originating in the international business tradition. The first reason is because the firm matters. Beginning in the 1960s and 1970s, international business scholars began to de-emphasize host country institutions in theories about the spread of multinational investment. A distinct dividing line developed between economic investigations of firm behavior and development works considering the (assumed mostly harmful) effects of foreign investment. This trend continued into the 1980s, with business scholars concentrating on internal attributes of the firm. Buckley and Casson's (1976) influential work *The Future of the Multinational Enterprise* quickly became a staple in business literature. Authors devoted significant energies to explaining firm organization, with some of the best-known works constructing elegant typologies of multinational investment and firm strategy (Bartlett and Ghoshal 1989; Pearce 1989). These works and others reviewed in this section explained how various firm qualities impacted not only whether internationalization took place but also the form of investment. The second reason is reciprocity. Eminent international business scholars such as Rajneesh Narula and John Dunning (2000; 2010) implored analysts to take host countries seriously, and emphasize the degree to which institutions are left out of many conventional accounts. These factors have been integrated more fully into international business scholarship, and it is now more common to find institutionalist accounts in prominent international business journals. It would be the height of irresponsibility to not reciprocate and ignore firm influences in the present institutionalist account. The third reason is quite simply that firm attributes are interesting. Beyond whatever effect a host country's institutional setting has on the likelihood of innovation, the degree of foreign ownership within the firm (for example) should also matter and can tell us interesting things about what the parent firm may prioritize. In other words, innovation is a function of both internal firm characteristics and host country characteristics, and we ignore either category at our peril.

Early postwar work on multinational investment in developing countries focused on explanations for its very existence. Innovation was rarely a topic of inquiry, not least because so few firms conducted innovation abroad in rich countries, let alone poor ones. Kindleberger (1969), drawing from Hymer (1960), argued that multinational investment was possible only because of market imperfections. He argued explicitly against consideration of political issues of power, and instead focused on economic explanations for FDI. Vernon (1971), writing very much in the spirit of the times, did consider government power but only in order to challenge the prevailing idea that multinationals had to satisfy national interests in host countries. Instead, Vernon argued that firms had numerous options and priorities that differed inevitably and sometimes drastically from their hosts. Competing interests of firms and host governments produced conflict, with multinationals often gaining the upper hand.

According to this early literature, multinationals did not innovate abroad, either empirically or in the abstract. The authors were certainly correct on the empirics, and had good theoretic reasons to doubt multinational innovation was likely. Vernon (1966) advanced the idea of the product life cycle, whereby host countries developed levels of income and markets that provided sufficient demand for firms' goods. However, innovation remained centralized in the home country of the multinational according to this model. New methods and goods would eventually percolate through to foreign markets, but they were to be strictly controlled. Multinationals would develop new technologies at home, and then transfer them to subsidiaries when the technologies had reached a phase of sufficient "maturity." However, this would not take place until well after the initial innovation happened, and had become routinized enough to be located in developing countries.[7] According to the product life cycle, firms faced numerous incentives for the centralization of R&D, including economies of scale and problems of coordination. Countries with abundant skilled labor (developed countries) should have an advantage in the production of goods with high innovation content. Subsidiaries in emerging economies did little more than produce for foreign markets, at least in the early stages of investment. It is important also to remember that efficiency-seeking FDI was not in great evidence during this period, as vertical production networks were not common beyond the import of raw materials.

In his work on the organization of multinationals, Caves (1971) argued that firms internationalize to exploit oligopolistic advantages, which could include innovation. Horizontal production networks duplicated like products in different markets, while vertical production networks separate different stages in a process in different locations. In both cases, firms move abroad to reduce uncertainty about transaction-costs. Competition is also a factor, and international investments can be motivated by the desire to keep other firms from gaining access to new markets. Innovation was an additional source of oligopolistic advantage in this competitive environment, and therefore needed to be protected within firm hierarchies. Hymer (1970; 1972) adopted a similar largely centralized perspective on the innovation process. However, Hymer argued that firms often had significant motivations to spread innovations widely in a "trickle down" process. According to this argument, multinationals enjoy significant competitive advantages through innovation, and therefore have incentives to spread these innovations widely. Innovations also allow the headquarters of the multinational to exercise control. Indeed, for Hymer the spread of innovative products and processes within multinationals was a top-down process. That is, even though incentives existed for the spread of innovation, it was to remain a tightly controlled process and one that radiated outward from the center.

Subsequent international business literature expanded on these motivations for innovation, and developed further explanations for

---

7. Reddy (2000) points out that Vernon (1979) in later works acknowledges the limitations of the product cycle model, particularly given the degree of internationalization of new products and the increases in the speed of the cycle. Pearce (1989) argued that the cycle had been shortened to such a degree that firms could simultaneously release like products through subsidiaries in other countries, increasing the chances of innovation in those subsidiaries.

why firms might locate R&D outside the firm's home country. One of the earliest of these works was by Terpstra (1977), who recognized the centralization of R&D at the time but nevertheless cataloged a number of reasons for R&D internationalization (mostly among developed countries). These included access to foreign skilled labor, reduced cost, incorporation of local ideas and products, and taking advantage of local tax laws, among others. Ronstadt (1977) conducted a survey of seven large US multinationals and constructed a typology of different kinds of R&D units within these corporate structures. Most of these units were dedicated to adapting products to local conditions, and were concentrated in wealthy industrial countries. One of the more intriguing arguments came from Lall (1979), who found that US firms in different industries displayed different propensities to locate R&D abroad. In engineering industries, firms must devote significant energies toward development work. This drives up R&D propensities in firm subsidiaries, but also makes it unlikely that these activities will be conducted abroad. In other words, R&D is not easily "uncoupled" in engineering, but is more easily distributed in what Lall calls "process" industries. In these sectors, firms with high research intensity are more likely to internationalize innovation. This study is one of the few to construct sectorally distinct arguments about the likelihood of innovation, and informs the tests developed in chapter 4 of this book.

Business scholars began to observe the international spread of innovative activities (detailed empirically in the next chapter) in the 1980s and 1990s, and thus began to propose various theories regarding this phenomenon. This literature exploded in the 1990s, with many treatments of the relationship between multinational investment and the spread of innovation (Granstrand, Håkanson, and Sjölander 1992; Pearce and Singh 1992; Casson and Singh 1993; Niosi 1999). Cantwell (1992) argued that multinationals integrated innovation activities among far-flung locations because (a) it allowed firms to take advantage of differences and distinctions among national systems of innovation, which then might lead to innovations within the firm, and (b) it allowed firms to gain access to new forms of innovation already existing in other countries. Williamson (1981), operating from the transaction cost perspective, argued that the spread of innovation was in fact inextricably wrapped up with the spread of multinational corporations, as multinationals simply collected innovations under a corporate umbrella as a way to minimize these costs. Most of the innovation being done abroad was at first recognized as adapting products to local conditions.[8] This implied market-seeking strategies on the part of firms, and conformed to what most analysts suspected were the dominant motivations for production abroad especially in developing countries (tariff-hopping investment, horizontal production, etc.).

At the same time, there were also new forms of investment emerging, which brought alternative motivations for local innovation and confounded existing theoretic paradigms. In particular, the increase in efficiency-seeking and the emergence of knowledge-seeking investments seemed new. According to the once-dominant theories of international production, multinationals could find all the needed skilled labor and knowledge in their home countries. Innovation generated at home would then trickle down to locations abroad. However, multinationals increasingly realized that well-trained workforces and other bases of knowledge existed abroad, and these firms might avail themselves of more (perhaps cost-effective) options beyond their home countries. Bartlett and Ghoshal (1989) argued that consumer trends, new technologies, and competitive advantages could come from anywhere and that multinationals could no longer assume they had access to the cutting edge only in their countries of origin. Cantwell (1992) argued that knowledge-oriented motivations had become more important to firms over time. Reddy (2000) argued that firms increasingly looked to developing countries as sources of efficiency not only for rote production processes but also from pools of well-trained, skilled labor that offer cost savings to multinationals.[9] This supposes that innovation abroad might represent a source of efficiency itself. However, another perspective holds that rigid hierarchies, associated often with efficiency-seeking "vertical" models of investment, are less likely to lead to innovations in emerging economies. Firms with these kinds of organizational structures may be more likely to centralize innovation

8. Narula and Dunning (2000) refer to this kind of innovation as "adaptive." Behrman and Fischer (1980), based on a survey of US and European firms, found that R&D done beyond the home country was mostly limited to adaptations for the local market. According to the results of these 1970s surveys, foreign countries were not often considered locations for discovering technological advantages.

9. Pearce (1999, 157) saw the emergence of overseas R&D as reflecting four basic trends: (1) increasing involvement of subsidiaries in product development rather than adaptation, (2) interdependent rather than dependent firm patterns of organization, (3) increased relevance of supply side influences, such as host country technology competence, and (4) the decline in centripetal forces on R&D.

in their home countries. Subsequent chapters, particularly chapter 4, test these propositions.

Hypothesis: Market-seeking motivations increase the incidence of multinational innovation.

Hypothesis: Efficiency-seeking motivations decrease the incidence of multinational innovation.

Hypothesis: Knowledge-seeking motivations increase the incidence of multinational innovation.

There have been numerous changes in multinational production, prompted and reinforced by the information revolution, which make it difficult to think of innovation in limited terms. Whereas in decades past innovation might have consisted of a new assembly-line process or a revolutionary manufactured product, multinationals are now extremely active in service sectors where new technologies often *are* the products. Multinationals no longer simply sell physical goods to populations abroad, they also generate revenue through intellectual property rights. Innovation is therefore less often a means to an end than the end itself. As explained in the next chapter, innovation has become broader and more separated from physical production processes. Scholars have developed numerous ways of cataloging these changes, most of which help explain the diffusion of innovation within multinational production networks. Narula (2003) documents the increase in "strategic partnerships" between multinationals and firms in developing countries, which combine collaboration on innovation with looser ownership structures. Pearce and Papanastassiou (2009) describe the wide array of organizational models available to firms as they contemplate how to invest and spread innovation throughout subsidiary networks. Narula and Dunning (2010) and Dunning and Lundan (2008) argue that firms have begun to shift away from an emphasis on hierarchy toward a wider choice of organizational forms, including nontraditional alliances between firms and between firms and foreign research institutes. All of these works recognize the increasing diversity of multinational investment models and most acknowledge the simultaneous diffusion and growth of innovation as an important element of investment. Even authors who had previously emphasized centripetal innovation practices within multinational firms have recognized its recent spread and have developed unique accounts for this phenomenon (Rugman and Verbeke 2001).

Unsurprisingly, international business scholars have unleashed a slew of firm-level studies seeking the motivations of international R&D.[10] These are examined in more detail in subsequent chapters, which contain econometric models that adopt some of the key independent variables identified in this literature. Many of the more recent works in international business studies cope with the growing complexity of international production networks by integrating a relatively new theoretical approach to the study of firm organization and motivation. Known as the global value chain (GVC) framework, this approach attempts to develop typologies for the ways in which economic agents participate in the global economy. GVC analysis has reinvigorated old debates with new approaches to analyzing global production.[11] At its core, the GVC approach refers to the sequence of activities undertaken by firms as they produce goods or deliver services. With regard to innovation, GVC analyses identify how firms participate in innovative processes, and how much additional value firm units may add to the final product. The decentralization of innovation within larger multinational firms provides opportunities for GVC analysis, which forces scholars to ask *how* a firm is participating in a sector with high technological dynamism. In other words, the participation of a developing country firm (or subsidiary of a multinational) in an innovative sector is not a guarantee that the firm will realize spillovers. This instead depends on the location of innovative activities within the larger multinational.

In a value chain perspective, industrial upgrading should be seen as both distinct from innovation and a possible outcome of innovation. Here I use the simple definition of upgrading outlined in Kaplinsky and Morris (2001, 37–38). Upgrading refers to the development of "dynamic capabilities" within a firm, arising from its internal processes that facilitate learning, its access to regional or national systems of innovation, and/or its path or trajectory. Upgrading possibilities depend crucially on the ability of firms to move away from activities where value added is low.[12] If and when firms are able to engage in a sustainable pattern of upgrading through innovation, and if these firms enjoy

10. As a representative sample, see Håkanson and Nobel (1993), Kuemmerle (1999), Von Zedtwitz and Gassmann (2002), and Ambos (2005).

11. For literature on GVC analysis, including broad overviews of the field, see Gereffi and Kaplinsky (2001), Sturgeon (2001), and Gereffi et al. (2005).

12. Giuliani et al. (2005) point out that little possibility for upgrading exists in industries where competition is based on cost and barriers to entry are low.

substantial linkages to the host country's economy, the likelihood of developmental spillovers improves greatly.

There are many factors that determine whether firms display innovative characteristics in developing countries. According to the GVC framework, industries display variety along three different dimensions: "1) the geography or character of linkages between tasks, or stages, in the chain …, 2) how power is distributed and exerted among firms and other actors in the chain, and 3) the role that institutions play in structuring business relationships and industrial location" (Sturgeon et al. 2008, 2). While the focus of this book is on the role of institutions in conditioning the investment behavior of firms (the third GVC dimension), the concept of "value chain governance," which relates to the second point, is also important. Multinational firms make decisions about locations of various chain activities based not only on the institutional environment, but also on power relations among different parts of the chain. To illustrate this point, it is useful to consider how multinational firms may coordinate production. In a simple dichotomy, value chain researchers have proposed that most multinational production networks are either "buyer driven" or "producer driven." Buyer-driven value chains, prominent in such industries as garment manufacturing, food, and retail, allow large global buyers, which may have not manufacturing facilities themselves, to coordinate global production and distribution. Producer-driven chains, in contrast, are coordinated by large multinational corporations that retain more direct control over the production system. Producer-driven chains are more common in technology and capital-intensive industries such as the automotive and IT industries. Recent GVC research has expanded and complicated this dichotomy to account for more complex firm governance structures.[13]

Taking into account the different possibilities for value chain governance, it seems likely that how a company organizes and governs its global value chain will have an impact on the potential for innovation and upgrading in developing countries. Kosacoff, López, and Pedrazzoli (2008) have suggested that it is difficult for firms in developing countries to develop more complex activities within the value chain when these firms are located in hierarchical structures. This is because

13. Gereffi et al. (2005) propose five typologies of value chain governance, ranging from market transactions characterized by arm's-length relationships between assemblers and suppliers to hierarchies, where different stages in the production chain are absorbed within and controlled by a single corporate structure.

firms in these structures often issue specific requests to their suppliers, without exchanging intangible and other assets that might facilitate a learning process. In less rigid value chain structures, suppliers are often given more freedom to participate in product development, and the parent company may develop a cooperative relationship with suppliers based on the exchange of new information about innovations. Much of the literature on firm entry modes in developing countries, detailed in chapter 5, reinforces this idea. Tight control over subsidiaries may lessen the likelihood of local innovation taking place.

Hypothesis: More foreign control lessens the likelihood of local innovation in subsidiaries.

This hypothesis is based on the premise that more foreign control of the subsidiary leads to more rigid hierarchies, and centralization of whatever innovation exists. In vertical forms of investment, where stages in a production chain are dispersed among geographic units, I argue that there are strong incentives toward centralization. There are a few examples of foreign research units in emerging economies, used by firms as sources of efficiency in vertical producer-driven chains. However, it is more likely that such arrangements will result in centralization of innovation.[14] This argument is not dissimilar to that put forward by Pearce and Papanastassiou (2009), who argue that the kinds of multinational subsidiaries most likely to engage in local innovation, labeled world product mandate (WPM) firms, are characterized by a high degree of independence and do not often display much verticality. Their markets, in other words, are not only their parent firms. There is also a similar argument in Cantwell and Mudambi (2005), who develop a distinction between competence-creating subsidiaries, which usually develop more strategic independence from parent companies over time, and competence-exploiting subsidiaries, which do not necessarily enjoy this independence.[15]

14. There are also a number of debates about the true prevalence of vertical production chains among multinationals. According to Ramondo et al. (2013), for example, intrafirm trade is concentrated among a very small number of large multinational firms. While this may create the impression that the amount of intrafirm trade is large, it is actually quite concentrated. This would mean that market-seeking strategies are much more common.

15. This study does not make explicit the linkages between degree of foreign control (beyond strategic independence) and innovation outcomes, as R&D may rise in both cases depending on circumstances. However, Cantwell and Mudambi (2005) do argue that firm and locational factors combine to increase or decrease the likelihood of developing a competence-creating mandate. The authors argue that competence-exploiting mandates tend to be demand-driven, while competence-creating mandates are often more supply-driven.

The global value chain perspective is valuable precisely because it frees business scholars from thinking about firm organization in traditional and outdated ways, even while it adds levels of complication to parsimonious theories of multinational production. The form of value chain governance is likely to affect the likelihood of innovation in emerging economies. While the focus of this book is on the institutional environment in host countries, and the resulting political economy of multinational investment, I cannot discount the influence these changing patterns of firm organization have on innovation outcomes. This underscores the point that institutions in developing countries are not deterministic. That is, encouraging innovation among multinational firms is not simply a matter of getting the institutions right or putting in place the right policies. Much will also depend on how a global value chain is organized and governed. Firms translate competitive advantages into profit possibilities through their internal decision-making. Host countries can have an important impact on this process, but the dominant models of firm organization in different sectors will impose limits on what institutional and policy fixes can accomplish. Even with that caveat, however, the role institutions play in structuring innovative possibilities is an important one. It is to this role that I now turn.

Host Country Institutions and Multinational Innovation

Scholars of international business mostly de-emphasized host country institutions throughout the 1980s and into the 1990s. There were theoretic reasons for this, but also empirical and normative reasons carried through and reflected by the policy prescriptions dominant at the time. The economic orthodoxy promoted by international financial institutions and common in developing countries in the 1980s and 1990s held that technological change would develop endogenously as countries liberalized their economies and allowed foreign investment to penetrate sectors that had previously been off-limits. However, missing from this approach was the recognition of the serious obstacles facing the international transfer of knowledge. Innovative assets enjoyed by firms are often subject to high uncertainty and intangible characteristics, and their diffusion through liberalization is not as automatic as other firm assets. Challenges to the economic orthodoxy of the time often focused on this lack of attention to the mechanisms of technological change. Evolutionist approaches, drawing on neo-Schumpeterian ideas, held that countries could not rely on the market mechanism alone but must be able to absorb and perpetuate new technologies. According to this interpretation, the contribution of an open economy to technological change depends not only on a country's comparative advantages, but also on the institutions in place and how these institutions operate. This is the crux of the institutionalist argument, as it relates to the potential for innovation spillovers from multinational investment.

I do not want to suggest that international business scholars were wholly dismissive of host country influences on multinational firm behavior. Indeed, there have been a number of influential theoretic paradigms to consider the role of host countries, none more so than Dunning's (1988) ownership, location, and internalization (OLI) framework, which remains an enduring taxonomy of investment motivations and has informed much subsequent research on why firms invest abroad. According to this approach, firms derived advantages from each of the three sources. Ownership and internalization were firm-centric and explained why firms chose to produce abroad rather than produce at home and trade. The location category brought in the attributes of the host country and eventually encompassed a great deal. In the 1980s, locational incentives in developing countries were mainly thought to consist of access to raw materials, cheap labor, and perhaps tax advantages. However, scholars operating within the OLI framework soon began to add other characteristics to the locational advantages offered by host countries, including educational systems, intellectual property protections, and investment promotion frameworks. These differed from previous locational advantages in that they had the potential to highlight positive aspects of a country's national system of innovation and its absorptive capacity for multinational investment. Dunning was an enthusiastic proponent of such efforts. While he by no means regarded FDI as a prerequisite for development, he consistently argued that a country's institutions were crucial to supporting domestic capacity building and the potential integration of FDI into development strategies (Dunning and Lundan 2008; Narula and Dunning 2010). The reinvigoration and expansion of the "L" in the OLI framework is important for this book because it serves as a vital link between the international business literature and works in the development and political science traditions. Emphasis on locational incentives for investment implicitly calls for an end to the divorce between firm-centric explanations for the spread of innovation and those explanations that emphasize more political-socioeconomic factors (Florida

1997; Doh et al. 2005). I therefore refer to this approach often in constructing institutionalist explanations for innovation patterns within multinational enterprises.

Institutionalist arguments are not limited to explanations of modern foreign direct investment. They are widely applied in the social sciences. In development literature, there is an ongoing debate about the primacy of institutions in explaining divergent rates of growth in poor and rich countries.[16] Acemoglu et al. (2002) asked development theorists to contemplate the divergent developmental paths of "extractive" and "settler" colonies in the age of exploration, arguing that institutional path-dependencies determined initial and long-term economic success and failure. In the more modern context, they have considered the diverging fortunes of South and North Korea and economic conditions on both sides of the US–Mexico border (Acemoglu and Robinson 2013). Their argument, that institutions determine prosperity even in like geographic conditions, is expansive in its ambition. Yet institutional analysis in development studies is not without its critics. Rodrik (2006) argues that institutionalist analysis can sometimes be a dead-end for promoting development, because institutions come in many different forms and there are often different institutional pathways to success. He contrasts the experience of China and Russia in the 1990s, where Russia failed at generating consistent growth under quasi-Western-style institutional reform, while China succeeded under a system of public ownership. It is often impossible to pinpoint what the "right" institutions are. Moreover, when reforms fail there is an almost endless list of institutional "wrongs" to blame. This is an important criticism, but perhaps less so in the more limited context of foreign investment. It is relatively easy to determine, for instance, whether there is a correspondence between government support for research institute partnerships with foreign firms and resulting innovation outcomes for those firms. It is more difficult to determine whether a country's overall institutional constellation did or did not lead to high growth rates. There are many more potential intervening and antecedent variables in the latter case. Certainly, the process is still endogenous, but more limited outcomes lead to more facile connections between institutional characteristics and firm behavior.

16. See Rodrik et al. (2004) for a good summary of the debate. The authors argue that in many circumstances institutions can be a more powerful force for development than either geography or trade. Also see Easterly and Levine (2003) for another well-known example of institutional analysis.

Debates about institutions are intertwined with debates about the role of the state in developing economies. In the 1980s, neoclassical approaches to political economy had become more strident in attacks on some development economists' faith in government agency. In the neoclassical interpretation, the captive nature of the state to distributional coalitions meant not only that states could not impact development trajectories but that any attempt would have deleterious consequences for the society as a whole. Yet almost as soon as this movement reached its peak, it generated a set of ideas that affirmed the importance of analyzing the state as an actor capable of overriding societal demands. The state-centric school challenged neoclassical theorists' efforts to explain away the state and sought to bring the analysis of the state back to the forefront of discourse. These theorists claimed that effective institution building was the key variable that set successful developing countries apart from slow growing countries.[17] They recognized the ability of poor institutions to wreck an economy, but also insisted that state agency did exist and that effective bureaucracy could also exist. While not denying the existence of rent-seeking behavior, state-centric theorists observed that this behavior might be overcome with effective institutions. Poorly functioning institutions might crash an economy, but if designed well they could also move it forward. Thus the principle explanation for development failure turned from rent-seeking behavior of individuals to poorly designed institutions and policy. Or, as Evans (1995, 40) explained it:

> A comparative institutional approach turns the neo-utilitarian image of the state on its head. It is the scarcity of bureaucracy that undermines development, not its prevalence.

The proponents of this state-centric interpretation of economic growth are a diverse group, and vary in their policy prescriptions for developing countries. They do, however, share a belief that market forces alone cannot entirely explain developmental outcomes. In this respect, they follow in the tradition of Gerschenkron, who emphasized the capacity of the state as a key explanatory variable for economic success in late developing countries.[18] There are no guarantees that

17. See Evans et al. (1985) for a collection of essays along these themes.

18. In his influential examination of European economies, Gerschenkron (1962) claimed that when domestic capital does not have the ability to contribute a market framework on its own (from either a lack of domestic sources or the unwillingness of international capital), the state must act as a risk-taking entrepreneur itself. However, the state is not necessarily capable of filling this role either. Even if it can act as the primary mover of

states will be able to provide the kind of framework that will encourage growth. Because of this, a comparative analysis of the strength and efficacy of institutions becomes necessary.

The often conflictual relationships that existed between multinational firms and developing country governments in the 1970s gave rise to a literature that I have not addressed yet, but one that is integral to both international business and political economy literature on foreign direct investment. The bargaining approach to multinational–host country relationships began with the obsolescing bargain, which held that the firm's bargaining power would decline relative to the host country's power once the initial investment was made, as the government figured out ways to extract more and more concessions from the firm (Vernon 1971; Kobrin 1987). The theory behind bargaining literature has since expanded and remains an important part of the study of international business and government relations (Grosse 2005). The insight of the bargaining perspective is simple. Suppose we were to imagine a best-case scenario for an innovation-intensive investment in a developing country. From the point of view of the host country, what would such an investment look like? Let us also assume the country's leadership and bureaucracies are interested in economic development and not personal enrichment. The wish list for such states is straightforward. Domestic firms that partner with the multinational would have access to the latest innovations, as the multinational embeds its technological activities in the host country. This would create backward and forward linkages with the domestic economy, generating a virtuous cycle that leads inexorably to technological upgrading and overall development. Innovation-intensive FDI might strengthen the competitiveness of multiple domestic firms in this developing country, through the formation of innovative clusters. This may in turn keep highly educated workers from emigrating. Job program partnerships with local universities might develop. Exports would increase, as would their technological content. Profits would multiply, and the multinational might choose to forgo repatriation and reinvest those profits in the domestic economy and develop new products.

What would the ideal point for the firm look like? The best set of circumstances might include a generous set of incentives for the firm, perhaps including tax exemptions and reliable infrastructure. A location with a highly skilled and quiescent workforce might be

development, an increasingly powerful state in a late-developing country may also move a country toward authoritarianism (as was the case in Russia).

desired. The firm would look for proximity to hungry markets. If engaging in exports to third countries, the firm would hope for a liberal trade regime. Every attribute of that ideal point would be designed to increase profit and ease operations. Even if we assume clear intentions from both state and firm, it is not difficult to see that these ideal points may be distant from one another. Firms are designed to increase profits – we should not expect them to do otherwise. Potential development of the host country, while perhaps a happy benefit of investment, is not a motivating factor for multinational enterprise. Large multinational firms operating truly global value chains may prioritize globally rational models that take advantage of comparative advantages and factor endowments in different locations. Yet the productive activities the multinational desires for a country are not guaranteed to be those activities most conducive to development. States, especially democratic states, are beholden to a different and more diverse set of interests. In contrast to the multinational, states are concerned with the contribution firms can make to local development. An equilibrium for a developmental state would extract from the multinational just enough concessions for the firm to go through with the investment, while providing maximum benefits to development objectives. The contrast between the globally rational strategies of firms and locally rational strategies of states can produce divergence and conflict, but need not result in stalemate. Neither the state nor the firm is able to get everything it desires, so what determines whether the firm invests or not, and what form that investment takes?

Of course, for each firm–state interaction the outcome will be different, and it is difficult to make uniform statements. However, there have been a number of developments in the literature on the obsolescing bargain that deserve to be emphasized here, as they may impact the likelihood of innovation outcomes. First, scholars have pointed out that the obsolescing bargain was developed during a period when multinational–host country interactions were more often conflictual than they are today, especially in emerging economies. Grosse and Behrman (1992) argue that conflict need not be the case and that firms and states may actually have a large set of overlapping interests. Each party to negotiation has resources that are of interest to the other party; each will have relative stakes in the bargaining outcome; and each will potentially recognize a similarity of interests. Thus mutual hostility is only one possible outcome, and perhaps unlikely. Eden et al. (2005) argue that firm and state goals may be different, they may be in agreement, or they may conflict. Yet in the first two situations, and perhaps under certain circumstances even in the third, there should be some range of complementarity where both parties could achieve net benefits through cooperation. Outright nationalization, one of the outcomes more common in the 1970s and often attributed to obsolescing bargain dynamics, is but one possible (and less likely) result of firm–state interaction.

The second point to emphasize about the obsolescing bargain is that its severity depends on sector. It seems to be most common in natural resource investments, which as chapter 3 details, represent a declining proportion of inward investment in emerging economies. Kobrin (1987) argued that the obsolescing bargain was less likely to apply in more footloose manufacturing sectors. Even in the oil industry, Jenkins (1986) found evidence that certain multinationals were able to enhance their bargaining power in Canada by contemplating alternative investments. In IT and many high-tech service sectors, bargaining power should shift even more in favor of the multinational, especially as host countries must compete to attract flagship firms.

Third, it is important to recognize that bargaining between firms and hosts is not a one-off event, but an iterative process. While this is implicit in the obsolescing bargain logic, many previous analyses of investments in developing countries tended to focus on the initial terms of investment and not on changes in these investments through time. As Grosse (2005) notes, both firms and governments repeatedly interact with other stakeholders in their environments, and investment outcomes will depend not only on learning but also on such diverse factors as host country macroeconomic performance, competitor firms, and volatility in the international economy. While it is difficult to include all of these potential influencing factors at once in an updated bargaining model, it is enough to emphasize here that the initial investment is only the beginning of the bargaining process. When data allow in subsequent chapters, I emphasize temporal evolutions in firm innovative behavior, and link those changes to host country institutions and policies through time. This is especially the case in chapter 6, where I am able to focus on a single case study, Ireland, and its evolving efforts to embed innovative multinational firms in the domestic economy.

The institutional framework in a particular host country can be interpreted as another source of bargaining leverage. That is, well-functioning institutions can help the state get what it wants from multinational firms. I argue that institutions can make firms feel more comfortable locating innovative activities away from their country of origin. At the same time, institutions can be viewed as a source of leverage for the multinational as well, by expanding the scope of profit-making opportunities and activities in emerging economies. If, for example, intellectual property rights protections are strong and consistent enough in a particular host country, this may increase the areas of interest overlap for both firm and host. Mutually acceptable investment outcomes may multiply in number, representing net benefits for both firm and state. Institutional attributes that incentivize innovation may therefore be positive sum tools for both firm and state.

Outside the bargaining perspective, there are additional reasons to believe institutional characteristics matter for firms. Rugman and Doh (2008, 103) argue that stable and well-functioning institutions can encourage actors to engage in transactions at lower costs, particularly those institutions that guarantee an impartial legal system, a judiciary designed to enforce property rights, and predictability through time. According to Hausmann and Rodrik (2003), modern industries often involve unknown production costs tied to entrepreneurial activity and product diversification. Firms often cannot know how they will grow until the investments are made and interaction with a market begins. This can often involve high sunk costs. If host countries do not display the institutional characteristics to guarantee property rights, firms will be unable to retain competitive advantages. This brings us to the importance of institutional development with respect to innovation. I note in the next chapter the strong forces that have kept innovation centralized in the home countries of multinationals for much of the postwar period. There are important reasons for this. Innovation is inherently risky. It often involves significant expenses without the guarantee of returns. When innovation does generate marketable products and processes, it is often immediately subject to appropriation by other firms. This is especially true if the innovation is based on intangible firm assets. This creates strong pressure to maintain close control of innovation, pressure that is not easily overcome. Host country institutions are one area where this risk can be reduced. Strong institutions may convince firms that their local innovative efforts will remain sources of profit and not risk. If institutions affect noninnovative forms of FDI, they should be *doubly* important for innovation-intensive forms. Incentives exist for the spread of multinational innovation in emerging economies, but I argue the institutional environment serves a de facto gatekeeper role for this kind of investment.

Just as strong institutions can reduce risk for multinationals contemplating the form of investment, the absence of institutions such as the rule of law, high quality bureaucracy, and so on can result in significantly greater risk. Firms must internally construct these institutions if they are not provided by host countries, and this drives up transaction-costs. It is easy to recognize institutional failures in slow-growing economies. However, it is also important to recognize that even in countries with records of institutional stability and catalysis, there are still many barriers to the spread of innovation. Lall (2003), in a more pessimistic account, argued that even in the aftermath of the East Asian tiger phenomenon, very few countries could supply the institutional environment for "deep integration" of innovative FDI.[19] There are many ways in which institutions can fail in the integration of innovation-intensive FDI. For example, if the educational system cannot supply an adequate number of skilled workers for a multinational, certain activities may not materialize, or the investment may disappear altogether. If an investment promotion agency does not match skill sets of specific municipalities with potential investors, and highlight these complementarities, the investment may dissipate. If tax regimes do not apply credits for innovative expenditures, or if these credits are applied randomly or perhaps due to political favoritism, firms will be more unlikely to locate these activities in country. Inefficient institutions are quite capable of slowing knowledge transfer, even when conditions are otherwise ripe for industrial upgrading.

This brings us to the role of institutional change. If host countries see the need to modify their institutions, are these changes worth the cost? There are two countervailing forces at work here, presenting a conundrum to host countries. On the one hand, firms value stability and predictability. Institutions are often strongly ingrained in societies, a phenomenon Narula (2003) refers to as institutional inertia. Firms may become habituated to the use of certain inputs and modes of production, while governments in emerging economies remain content with steady returns from FDI. However, institutional inertia does not necessarily produce optimal or even efficient outcomes. It certainly can limit possibilities for industrial upgrading, even while providing firms with a relatively stable investment environment. Fundamental shifts to institutions can generate shocks, which can be disruptive to historically stable investment models. However, it is unlikely that developing

19. The one exception was Singapore.

countries will continue to attract nontraditional forms of FDI without some level of institutional change. It is unlikely, for example, that emerging economies will realize significant levels of local pharmaceutical R&D without a robust intellectual property legal regime in place. Reliance on one particular kind of FDI can generate a self-perpetuating process where only that kind of FDI enters, and institutions evolve to support this specific investment. In other words, firms are not the only parties that engage in creative disruption. Governments occasionally find ways to disrupt institutional equilibria as well, and hopefully develop the preconditions for new forms of investment. The liberalization process of the 1980s and 1990s, while resulting in some positive institutional changes, also at times hollowed out the state's ability to provide public goods necessary not only for the integration of investment but for development in general.

Host country institutions, as the primary points of contact for firms, are critical to reducing firm uncertainty associated with innovation-intensive investment. The functioning of these institutions, and how firms interact with them, serves as a signal to the multinationals of the risk associated with investment, and also the form that investment may take. As important as the institutional environment in host countries is for FDI, it should be even more so for innovation-intensive FDI. In the entry mode literature, detailed more extensively in chapter 5, scholars have disagreed about how institutions impact the form investment takes. Slangen and Van Tulder (2009) argue that low institutional quality in host countries pushes firms toward joint venture models of investment, as firms in these environments become worried about a variety of policy instabilities and prefer to partner with local firms. My argument is more closely linked to that of Oxley (1999), who argues that technology-intensive firms adopt hierarchical models when intellectual property protection is weak in host countries. I argue elsewhere that hierarchical models, with corresponding high degrees of foreign control, often correspond with centralized innovation patterns. Therefore, low institutional quality may employ a direct effect on innovation incidence and an indirect effect, through ownership patterns.

Hypothesis: High institutional quality (as perceived by firms and third parties) is associated with higher levels of multinational innovation.

Strong institutions should make multinational firms more comfortable with polycentric patterns of innovation. Institutional quality reduces risk for firms. With regard to the specific kinds of institutions in place in host countries, here I am also able to test additional claims common in the cross-national literature on FDI. There is a longstanding debate about whether democracies or authoritarian regimes attract more FDI (Oneal 1994; Jensen 2003; Li and Resnick 2003; Kenyon and Naoi 2010), and these and other works ask which form of government lowers uncertainty for firms. Henisz (2000) has argued that democracies, with their multiple veto points, enhance stability and predictability for firms and protect against expropriation. Busse and Hefeker (2007) argue that governmental stability and the absence of internal political conflict (associated with democracies) are associated with more investment from abroad. These arguments all directly apply to risk calculation for innovation-intensive FDI as well, and I expect similar dynamics will appear.

Hypothesis: Established democratic regimes are associated with higher levels of multinational innovation.

These hypotheses are made more specific and subject to empirical testing in later chapters. I find that institutional characteristics do influence patterns of innovation among multinational firms in emerging economies, in sometimes surprising and complex ways. This is true even when accounting for the firm-level attributes that have been found influential in the broader international business literature. I argue throughout the book that host country institutions may constitute a strong locational advantage and should be considered alongside other international and firm influences on innovation and development.

The Policy Context for Multinational Innovation

Changing institutions can be difficult. Countries do not develop a hierarchical and independent court system overnight. Shifts in educational standards often take decades to bear fruit. Institutional inertia is real, and it is difficult to overcome. For governments of emerging economies, there are often easier levers to pull. I make in this book a distinction between policy changes and institutional changes, where policies are government actions and institutions are the infrastructure of governance through which those actions must pass. The effects of policy changes on FDI can be diluted or augmented by the institutional framework. Even the best policies may fail when institutions fail. Nevertheless, policies are an attractive option for states because they are often short term and easier to accomplish. It is much easier to reduce a tariff rate than to revamp an educational system. In this section I consider evolving practices of host country policy toward FDI, and how these policies have or have not incentivized innovation among multinationals. The consideration of policy evolution is continued in chapter 6, with a particular focus on Ireland's experience with foreign investment and innovation.

The economic orthodoxy common in the 1980s and 1990s held that technological change would develop as countries liberalized their economies and allowed foreign investment in diverse sectors. The lifting of barriers to FDI generated immediate results, with multinationals pouring into developing countries in the latter half of the 1980s and through the 1990s. This dramatic increase in FDI contributed much to domestic economies, but in many cases the contribution of these flows to processes of technological change was less than expected (Mortimore 2000). The failure of the orthodox model to consistently deliver a sustainable process of upgrading through FDI has reinvigorated the debate over industrial policy. In the 1990s, industrial policy was associated with notions of picking winners among national firms, inefficient and counterproductive state initiatives designed to boost the economy, and general state interventionism. As such, the term was frowned on by international financial institutions. The dominant economic policy paradigm discouraged the targeting of specific sectors, viewing such intervention as inimical to stabilization and growth. However, governments very quickly realized upon liberalization that not all FDI is created equal. Foreign investments vary a great deal in their ability to contribute to developmental processes, and liberalization on its own did not guarantee that the "right" kinds of FDI would enter. Early on in the liberalization process, developing country governments began to distinguish among different types of FDI and offer incentives to the forms of investment believed more likely to add value to the domestic economy. Tax credits, subsidies, and procurement of land were all applied to varying degrees. This passive sectoral targeting could be considered industrial policy "light," in the sense that it reduced barriers for entry overall, but also singled out certain sectors for even more generous incentives. Developing countries have since engaged in intense competition to attract large investments from multinational firms in high-tech fields such as IT and pharmaceuticals.[20] Social

20. As a well-known example of this kind of competition, see details of the negotiating process between Intel and various Latin American countries in Spar (1998), Rodriguez-Clare (2001), and Nelson (2009). Intel eventually invested in Costa Rica in 1996.

scientists from diverse fields encouraged this focus on the heterogeneity of FDI (Narula and Dunning 2000; Kumar 2002; Mutti 2003). In chapter 3, I highlight how the sectoral composition of FDI has changed in many developing countries since liberalization.

Liberalization comes in many forms, and it is often difficult to separate the effects of one kind of policy change from another. Does capital account liberalization have an impact on firm activities by allowing additional sources of finance? How specifically does trade liberalization impact the investment models of multinationals? The fact that many of these policy reforms were pursued concurrently adds another layer of difficulty. However, there are reasons to believe that these policy choices have impacts on the innovative practices of multinational firms in emerging economies. The policy reforms implemented in developing countries in the 1990s alongside FDI liberalization may also impact the form of these investments. In chapter 4, I argue that trade liberalization does not necessarily lead to more innovation among multinationals, as there are countervailing pressures on firms. On the one hand, there have been a number of efforts to identify the relationship between trade and FDI (Gastanaga et al. 1998; Noorbakhsh et al. 2001), with most concluding that open trade is associated with increased levels of investment. However, trade may allow firms to substitute imported inputs for local innovation in developing countries, especially those firms with vertical production networks. If intrafirm trade makes it less likely that firms will innovate locally, there may be a negative association between trade liberalization and innovation outcomes.

Hypothesis: Liberalizing policy reforms are not necessarily associated with higher levels of multinational innovation.

Policy choices such as trade liberalization are not designed solely to impact foreign investment. They may impact the investment models of firms, but their goals go beyond FDI to encompass a variety of foreign policy objectives, such as regional trade integration. There are, however, a set of policies designed to directly impact the investments of multinational enterprises and in particular their potential for spillovers and linkages. Industrial policy remains an essential government tool in an environment of multinational production, but liberalization has changed its context. Knowledge flows through multinationals, and host country governments may enact policies that incentivize the adaptation and assimilation of these flows in the domestic economy. Narula and Dunning (2010, 272) note that many developing countries have not developed these policy tools, which are focused on embedding multinational enterprises rather than attracting them. They refer to the "passive FDI-dependent" strategy, still dominant in many emerging economies, which "underestimates the costs and the difficulties of internalizing technological spillovers." Many developing countries have remained content to dismantle barriers to foreign investment, perhaps with some sectoral targeting, in the hopes that this will generate substantial flows of investment with high value-added characteristics. Yet these investments often do not materialize. Other times, the investments arrive but develop few roots in the local economy and function as enclaves.

Focusing on attracting FDI, even specific kinds of FDI, without paying attention to the potential for linkages and spillovers is insufficient and does not fully exploit the developmental potential of foreign firms. Tavares and Teixeira (2006) argue that it is much more difficult to embed companies than to attract them in the first place, but that there is nonetheless a need to move beyond attracting investment and toward stimulating embeddedness. This is not to discount the potential contribution of FDI with little embeddedness, from jobs to tax revenue. Yet a firm that develops real roots in the domestic economy can bring additional benefits. Too few policies are designed and implemented to promote this kind of embeddedness. Governments may offer everything from tax incentives for partnership with local universities to support for internships. Yet many policies are designed to entice firms for initial entry and lose focus afterward. This calls for an active FDI-embedding industrial policy. These types of industrial policies discard the suspicion of foreign capital characteristic of older industrial policies and eschew imposing obligations on firms. Instead, these policies incentivize cooperation and nurture the conditions for the transfer of knowledge. While there are still significant barriers to these transfers, host country policy can play a pivotal role in increasing their odds.

The conditions under which innovation-intensive FDI may be influenced by host country policy are represented in figure 2.1, which displays the potential paths policy may follow. If policy is passive, firms are more likely to assume a more or less natural state of enclave operations. This occurs whether or not host governments target specific sectors for investment by reducing barriers selectively. Active strategies for FDI promotion may also result in enclave investments,

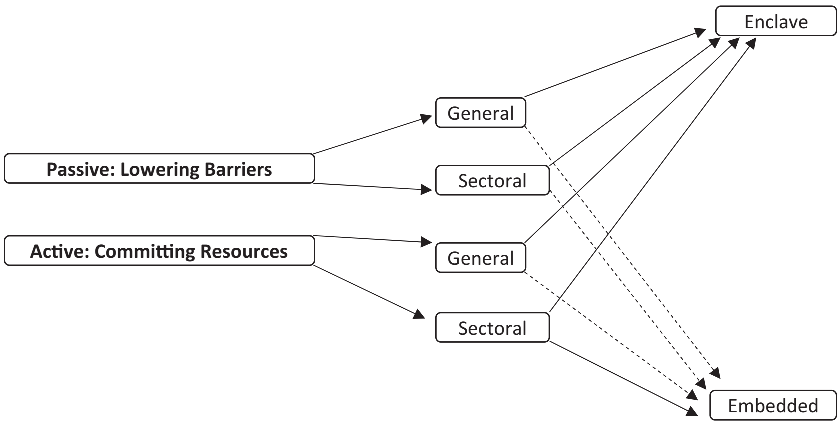


Figure 2.1
State FDI strategies and possible outcomes.
Note: Dashed arrows represent less likely outcomes

even if they are sectorally discriminating. The only pathway where embedded innovation-intensive investments are more likely occurs with active, sectorally discriminating investment promotion. In other words, states are most likely to achieve spillovers and linkages when actively pursuing those results in specific sectors. Note that this figure does not discount the possibility that passive policies may result in embedded investments. That is certainly possible. It is, however, less likely than if governments promote embeddedness through policy initiatives.

Figure 2.1 also underscores just how difficult the international transfer of knowledge can be. It is not the natural state of affairs. Host countries cannot assume that even the "right" kinds of investments will result in industrial upgrading through osmosis. These dynamics are possible, but are more likely when host countries and institutions align. In chapter 6, I detail Ireland's experience with innovation-intensive FDI. Despite the country's reputation as a magnet for high-tech investments, I show that it was only after Ireland adopted policies incentivizing spillovers that multinationals operated less like islands and more like full participants in an improving economy.

Multinational firms are moving toward a richer variety of organizational structures, many of which include the possibility of decentralized innovation. Host country policy can be formulated to take advantage of these possibilities. Yet policy has often suffered from three interlocking shortcomings. First, governments have been most focused on attracting the right kinds of investments, rather than monitoring existing investments through time. Yet firms continually upgrade and shift their production models, and some of the largest and most important multinational firms have been present in developing countries for decades. Second, industrial policy has generally neglected spillovers and linkages, instead focusing on initial entry and reducing barriers for investment. While this is a worthwhile endeavor, FDI on its own merits is no panacea. Foreign investment is a common element of contemporary development strategy, and in many industries the technological frontier is so distant that multinationals represent the only likely source of upgrading. However, the areas where multinational interest and developmental state objectives overlap can be fully exploited when policy is designed to enmesh multinationals with domestic economies. The third shortcoming of FDI industrial policy concerns the matching of firm needs and host country capabilities. When countries do target innovation-intensive FDI, there is often a disconnect between the institutional context of the host country and the production profile of the firm. Investment promotion agencies around the world tend to go after the same set of the largest and most visible investments, from global flagship IT firms to famous biomedical device manufacturers. However, in many cases specific countries do not display the institutional attributes necessary to absorb these large investments, and the firms go elsewhere. Governments must be more modest in their approach to integrating innovation-intensive FDI, and this process is often sequential and long term. A country that has been dependent on textile investments for four decades is unlikely to efficiently integrate a large-scale pharmaceutical lab without proper preparation. Policies must be designed to be cognizant of the host country's attributes and strengths, and must build on those strengths to continually and sometimes incrementally move to higher and higher levels of embedded innovation. This does not preclude the possibility of creative institutional and investment disruption or the attraction of nontraditional FDI. It does, however, require that countries not waste real opportunities for developmental spillovers by concentrating on high-risk, high-reward investment promotion. Every developing country would welcome an Apple software development center, but there are probably only a handful of countries that are currently appropriate for such an investment. These three interrelated policy issues are examined in chapter 6 and revisited again in the conclusion.

Thus far in this section I have concentrated on domestic policies and the effects they may have on the composition and investment models of inward investment. However, these are not the only kinds of policies enacted by host countries that may impact investment outcomes. My argument in this book largely looks inward in host countries. That is, I prioritize internal institutions and policies within emerging economies as important determinants of multinational investment. However, the very nature of multinational investment subjects it to international policy influences. There are a variety of international agreements that govern FDI, some bilateral and others multilateral. Host countries and home countries make choices to sign these international agreements, and these policy choices most certainly can impact the entry and investment strategies of foreign firms. While I do not give investment treaties as thorough a treatment as domestic institutions in host countries (this is, after all, an institutionalist argument), it would be a mistake not to acknowledge their potential influence as policy choices.

Most developing countries are party to a variety of multilateral agreements that may affect the incidence of multinational innovation. The reduction in Trade-Related Investment Measures (TRIMs) agreed to in the Uruguay Round of the World Trade Organization (WTO) and afterward has had an impact on what host countries can and cannot require of international firms. Trade-Related Investment Measures are trade-affecting conditions on foreign investors imposed by host governments, most often to encourage investment that furthers national priorities. Some of these measures were deemed inconsistent with articles III (national treatment) and XI (prohibition of quantitative restrictions) of the WTO. In practice, this means that host country governments cannot force firms to take certain actions, for example, to meet domestic content requirements. Does this mean that countries are forbidden by their WTO commitments from influencing the production models of multinational firms? In practice, no. The agreements are limited in scope. States are not prohibited from requesting that a foreign investor must use certain technologies or conduct a specific level or type of R&D locally (Low and Subramanian 1995). Most developing country governments were already phasing out its domestic content requirements when the Uruguay Round was completed, and some of the more controversial aspects of TRIM removal are still being debated.

This is also true for the related Trade-Related Aspects of Intellectual Property Rights (TRIPs).[21] In short, developing country governments still have ample opportunities to condition the investment models of firms within the context of WTO regulations.

More directly impactful on the innovative activities of multinational firms are the agreements known as bilateral investment treaties (BITs). These treaties were originally designed to protect large multinationals from expropriation, and they have exploded in number since the 1990s. They usually include protections against violations of intellectual property and international patent recognition, among other safeguards. One of the reasons BITs have become so popular is the changing nature of multinational production. As Cassiolato et al. (2014) note, private property rights have been expanded to a range of intellectual activities, and these activities have become more important to multinational firms as revenue streams in and of themselves, not as part of larger production processes. Firms increasingly make money based on intellectual and property rights in a variety of sectors. BITs can safeguard tangible and intangible assets, even as innovation becomes more decentralized.

As treaties have multiplied in number, scholarly interest in their determinants and effects has increased as well (Elkins et al. 2006; Tobin and Rose-Ackerman 2011; Simmons 2014). Chapter 4 explores this literature in more detail. BITs are clearly intended to be commitment devices for both firms and states. By signing BITs, countries signal that they want to reduce risk for incoming firms. BITs often contain language on protection for proprietary technology, and governments usually accede to this language in order to enhance perceptions of property rights protection.[22] There are various arguments as to the effect of BITs on the innovative activities of multinational enterprises, and these arguments cut both ways. On the one hand, a BIT may signal reduced risk for a firm, and the firm may then be more willing to locate innovation in peripheral locations. If BITs are indeed credible commitment mechanisms, the proliferation of BITs should be associated with a spread in innovative activities. Firms should be more

21. Ramamurti (2005) shows how American multinationals in the pharmaceutical industry, particularly Pfizer, were among the most important and influential proponents of global agreements governing intellectual property.

22. See Yackee (2008) on the importance of language within these agreements and how they may not lead to significant inflows of FDI. It is important to also acknowledge that many countries have embraced BITs, but others (for example South Africa) have retreated from them and pursue other investment conflict resolution mechanisms.

willing to locate potentially sensitive activities in countries with legal commitments to settling disputes. On the other hand, BITs may allow more freedom of movement to firms, in particular, minority partnerships in developing countries, and therefore allow them to centralize innovation in the home country of the multinational. BITs may enable firms to better resist pressures for technology spillovers and linkages promoted by the host country government, and put pressure instead on the government to tamp down incentives for technology transfer for fear of legal response. These countervailing pressures are contemplated in chapter 4.

Hypothesis: Bilateral investment treaties increase the likelihood of local innovation by multinational enterprises.

International treaty obligations, as a subset of host country policy, are potentially quite influential for FDI flows and the composition of such investment. Their role has been thoroughly contemplated in political economy literature. While these agreements are important, they are not deterministic. The international legal regime surrounding the innovative activities of multinational firms is certainly a work in progress and has in some cases generated a backlash from host country governments. International agreements do set parameters on what is possible for both firms and states, but they do not supplant the host–multinational relationship. States and firms are still the most important parties in determining innovation outcomes and potential developmental effects of multinational investment.

Conclusion

This chapter serves two purposes. It brings together a diverse set of literatures from international business studies, development studies, and international political economy and integrates them into a narrative about FDI. The second objective is to briefly trace the theoretical mechanisms for some of the hypotheses tested later in the book. The subsequent chapters use these general hypotheses as departure points for more in-depth investigations of the macro and micro determinants of innovation in multinational enterprises. I have acknowledged these different literatures because I believe they each have something important to say about why firms do the things they do in emerging economies, and about the effects of their actions. While the primary argument of the book is that state institutions have an impact on the innovative content of inward investment, I also acknowledge the various firm-level and international factors that impact investment models.

The next chapter examines available data sources to make claims about the spread of innovation within multinational enterprises. This is the necessary first step for what follows in chapters 4 and 5, which add econometric analysis and a variety of independent and dependent variables. Throughout these chapters, I highlight the ways in which the institutional environment in host countries interacts with investment patterns and firm decisions. I emphasize the temporal and evolutionary aspects of multinational investment, as firms and governments continually interact and evaluate what each wants and/or can get from the other. I also repeatedly call for a recognition of the central role FDI now plays in the development strategies of emerging economies. Autarkic development is more unlikely in the current era of multinational production. This has broad implications for development policy and a number of social science fields. Nevertheless, governments retain significant autonomy in formulating their strategies to assimilate and exploit FDI. Their policy and institutional choices are consequently fully capable of both success and failure.

I also emphasize the conditions under which embeddedness may develop. This goes further than many existing studies of FDI in developing countries, which tend to emphasize overall flows of FDI and often fail to acknowledge its sectoral heterogeneity. As the next chapter describes, there are significant historical and practical reasons for firms to resist polycentric innovation models. If FDI is to be a reliable asset for development, academics and policymakers alike will need to place closer attention to the connections multinationals develop with local partners.

3 Patterns of Innovation among Multinational Firms

Traditionally, multinational enterprises have been some of the most important sources of innovation worldwide. Their size allows and often compels them to adopt global competitive strategies, and innovation can be an ingredient of these strategies. Whereas national and small firms sometimes face logistical and financial constraints, multinational firms can construct whole divisions dedicated to new products and processes. Equally a part of tradition, however, is the idea that this innovation takes place at the head office of the multinational enterprise. Innovation, particularly when revolutionary and not incremental, is a source of tremendous competitive advantage. There are strong incentives to protect innovation, and firms must remain vigilant against rivals. These two traditions—the innovative characteristics of multinationals and the incentives for centralization—make the recent spread of innovation to peripheral countries all the more intriguing. For most of the past half-century, multinationals produced in developing countries to get around tariff barriers, access local markets or natural resources, take advantage of potential production efficiencies, or some combination thereof. Production facilities in developing countries tended to reproduce goods developed elsewhere or perhaps facilitate the transfer of resources out of country. The emergence of multinational R&D activities in developing countries is a relatively recent development, and it is important to understand its contours and limitations. This chapter does that.

I ask a few simple questions in this chapter: are multinational corporations engaging in innovation in developing countries? If so, what kind and how much? Are they developing the often-pursued spillovers or linkages by partnering with domestic actors in host countries? Or are they functioning like islands, with minimal connection to the host countries' systems of innovation? This chapter consolidates a great deal of cross-national data on innovation, drawing principally from the UN Conference on Trade and Development (UNCTAD), the US Bureau of Economic Analysis (BEA), and the World Bank's Investment Climate Surveys. I situate these data in the contexts of evolving definitions of innovation and historical patterns identified by other researchers. The first section of the chapter considers various conceptualizations of innovation, from pure R&D spending levels to more abstract ideas about innovation diffusion. I then consider how and when multinationals began to situate innovative units in developing countries, internationalizing what was once the most centralized of firm activities. I then relay empirical evidence on three broad themes: the sectoral evolution of FDI in developing countries, patterns of R&D spending and other innovation indicators, and linkage patterns (principally, domestic sourcing and exporting). The accumulated data show that while multinational innovation is still centralized in core countries, the periphery has dramatically increased its innovation competencies in the last two decades. The spread of multinational innovation is not uniform but concentrated in certain developing regions. This chapter therefore provides a comprehensive picture of the diffusion of multinational enterprise innovation to developing regions. While this chapter is largely descriptive in nature, it provides the context for the econometric exercises and evaluations of theory that follow in subsequent chapters.

Conceptualizing Innovation

Innovation is a difficult concept to pin down. It is by nature transitory. Nothing is more useless than yesterday's cutting-edge technology, and yet innovation is the core of economic development for advanced and developing economies alike. The continual "creative destruction" recognized by Schumpeter has exploded in scale in the past quarter-century, beginning with the IT revolution of the 1990s. This revolution has transformed the way we comprehend industrial development and has challenged old ways of thinking about and measuring innovation. It is no longer enough to simply quantify how much a firm devotes to engineering salaries or to the capital invested in a new piece of machinery. Instead, a broader perspective is necessary. In the early postwar period, developing countries might seek to import production process technologies from rich countries or to reproduce whole industries domestically. In the current environment, new technologies often *are* the products. Multinationals generate revenue through intellectual property rights, in addition to the sale of tangible goods. Innovation is now less often a means to an end than the end itself. Innovation has become wider and more separated from physical production processes.

Despite the complexity of the term and its sometimes ephemeral connotations, scholars have made numerous attempts to understand what is meant by innovation. Fagerberg (2005) and Hall (2002) divide innovation into three subcomponents: invention (the idea for a new product or production process), innovation (the first attempt to carry out this idea), and diffusion (transferring the idea or process to a different context). This definition is useful because it moves the concept of overall innovation beyond a strict focus on a technological advancement to include new ways of producing goods or perhaps even new managerial techniques.[1] The geographic spread of new models of production can be considered innovative in the sense that it means introducing production processes that had not been available before in a specific location. Pearce and Papanastassiou (2009) adopt a slightly different typology of innovation, separating it into four component parts: basic research, applied research, product development, and adaptation and marketing. They claim that these stages often, but not always, happen sequentially. Multinationals participate in these stages at different levels in different countries, and some countries exhibit more of one type than another.

I have already outlined in chapter 2 the venerable international business literature concerning the various motivations for innovation abroad. There are powerful incentives for centralization of innovation in the home countries of multinationals. Innovation often requires protection of tangible and especially intangible assets in order for firms to remain competitive. Firms may therefore demonstrate a reluctance to spread these activities to other countries, even if innovation takes place within a strictly controlled firm hierarchy. However, there are additional motivations for firms to innovate abroad, and these incentives pull against centralization. Multinationals may establish innovation abroad in order to absorb new products and practices generated in other countries. Economies of scale may be attainable abroad,

1. As Fagerberg (2005) points out, this broader concept of innovation is also more useful in developing regions, where innovation often involves the diffusion of ideas developed elsewhere.

assuming a suitable number of trained personnel can be found. Local centers of excellence in developing countries, most often centered on universities, may offer opportunities for firms to establish research partnerships. Innovation abroad may be necessary for parent companies to adapt products to local conditions. This may be especially true for durable goods, which often necessitate more R&D in order to appeal to domestic markets in developing countries. Decentralized innovation may also reduce the need for royalty payments. One of the first studies to systematically investigate the incentives for multinational innovation was done by Pearce (1989), who outlined many of these countervailing incentives. Pearce categorized incentives as either “centripetal” or “centrifugal.” Centripetal motivations for innovation, such as the need to safeguard intangible assets, brought innovation closer to the central office of the firm. Centrifugal forces, such as the need to adapt products to local conditions, made innovation abroad more likely. Cantwell (1995) has argued that centrifugal forces are now creating new forms of innovation in developing countries, where firms not only adapt products to local conditions but rely on local resources to generate new knowledge. However, others have not found evidence for this diffusion of innovation. In their generally pessimistic account of multinational innovation in developing countries, Cassiolato et al. (2014) argue that innovation remains much more centralized than is commonly imagined. They point out that measurement of innovation is often flawed and that some activities commonly classified as innovative are not particularly so. For example, the focus on overall R&D spending levels misses an important distinction between research and development. Research, they find, is still highly centralized within multinational corporate structures. Development is more common in subsidiaries in developing countries, and sometimes involves activities with low innovation content.

Historical Patterns of Multinational Innovation

So, which is it? Are multinational firms engaging in innovation abroad, taking advantage of local talent in developing countries? Or are they hoarding these high value-added activities for various competitive reasons? According to the data used in this chapter, most innovation remains centralized in rich countries. However, there is undeniable evidence that different forms of innovation are taking place in the periphery, and at higher levels than in decades past. This section briefly considers historical trends in multinational innovation, before moving to empirical analysis of cross-national data in the following section.

The amount of innovation done by multinational enterprises in developing countries has increased rapidly in recent years. These activities have become more diverse, as well. However, companies have been conducting innovation abroad since before World War II. Early forms of innovation were almost entirely located in developed countries, and many of the motivations for international innovation remained the same throughout the postwar period. Reddy (2000) argues that the internationalization of corporate R&D proceeded in four temporal waves, roughly aligning with the last decades of the twentieth century. The first wave encompasses the period prior to 1970. Very few firms performed R&D abroad during this period. The firms that did so were motivated by specific and limited factors. Firms wished to gain entry into (often) protected markets, and once there used local R&D spending to adapt their products to local market conditions. These are what Ronstadt (1977) characterized as technology transfer units (TTUs), which would move technology from a parent to a subsidiary by establishing a local R&D presence (rather than transporting R&D from the headquarters). Just as tariff barriers gave incentives to early forms of FDI, local content requirements and various other regulations common in the early postwar period made local R&D more practical and sometimes essential.

In the 1970s, international innovation continued to grow, but was still almost entirely confined to rich countries. Firms continued to invest in local innovation in order to adapt to local conditions and to access growing markets. Whereas internationalized R&D in the 1960s was mostly limited to a few industries with significant mechanical and engineering attributes, in the 1970s other industries such as chemicals began to participate. The third wave of the globalization of R&D began in the 1980s. During this period, firms began to invest not only for market access reasons, but in order to rationalize production and take advantage of cost differentials. Scientific, or more pure and less applied, R&D processes became more prominent during this time, and the dividing line between research and development became less distinct. This trend continued into the fourth wave identified by Reddy, which occurred during the IT revolution of the 1990s. Reddy (2000) points to increased demand for skilled scientists and rising R&D costs as driving forces behind the migration of some innovation to developing countries during this most recent wave.

Up until the mid-1980s, internationalized innovation was confined to developed countries. Since that time, however, a number of centrifugal forces acting on firms have contributed to the spread of innovation to the periphery. According to an OECD report, between 1995 and 2004 the amount that Western European multinational firms spent on R&D beyond their home countries increased from 26 percent to 44 percent. Japanese multinational R&D spending rose from 5 percent to 11 percent during that same time period, and North American multinationals increased their R&D commitment from 23 percent to 32 percent (Hall 2010). Local adaptive work was and is still needed in order to adapt to conditions in unique markets. However, there were other trends driving this increase as well. Rapidly changing technology has reduced the time of product life cycles, forcing companies to develop new innovations at a rapid clip. Firms must also be able to distribute these innovations quickly. Innovations can emerge from any location, and they must quickly be distributed and adapted in alternate markets. Bartlett and Ghoshal (1989) argue that firms in the 1980s increasingly moved to decentralized innovation models, where centers of excellence produce and then rapidly disseminate new processes and products. In previous decades, the most common model was for a parent company to make a singular transfer of technology to a subsidiary in a developing country, which would then use any existing local innovation units to adapt the product to local market conditions. These were often small-scale operations. However, recent trends have allowed subsidiaries greater autonomy. National units within multinational governance structures are now more able to make distinct contributions to worldwide operations.[2] Parent companies also increasingly assign to a subsidiary responsibility for innovation and production of entire product lines, to be distributed globally. While this kind of transnational delegation is still relatively rare in developing countries, it represents an alternative form of subsidiary organization with substantial decentralized innovation mandates (Bartlett and Ghoshal 1989).

Changing international business practices also present opportunities for innovation in peripheral locations. Taken as a whole, businesses

2. This does not necessarily take place through vertical integration of supply chains, although that is common in some industries.

conduct more R&D in developing countries now than they did in the 1970s or 1980s. However, it is important to recognize that even with this diffusion of innovation, there are important complicating tendencies at work. Importantly, the spread of innovation is uneven across industries. Reddy (2000) argues that R&D activities in the ascending industries of the 1990s (biotechnology, pharmaceuticals, chemicals, and IT broadly defined) are more easily internationalized than innovation in other sectors, such as the automotive industry or light manufacturing industries. This stands to reason. In general terms, it is logistically easier to relocate an innovation unit for an IT firm than it is to move innovation units for an automotive firm. To the extent that the prominent sectors of the 1990s included industries with more mobile innovation footprints, the increase in decentralized innovation is understandable. In the following section of this chapter, I show that the sectoral distribution of FDI has changed in developing countries over time. In the following chapter, I evaluate the hypothesis that the sectoral distribution of economic activity in a country has an impact on the likelihood of local R&D.

It is also important to recognize that even within these more mobile and relatively innovation-intensive industries, not all innovation activities are equally internationalized. Lall (2003, 13) sounds a note of caution along these lines, arguing that while new technologies and liberal policies enable the spread of innovation to new locations, some kinds of innovation are more closely guarded and remain subject to centripetal forces. Lall argues that transfers of technology are either "internalized" (from parents to affiliates) or "externalized" (arm's-length transfers to independent enterprises). More valuable and novel technologies are more likely to be internalized, while less valuable technologies are more often externalized. In general terms, the more valuable an innovation, the more likely it is to be subject to tight control by the parent. Cassiolato et al. (2014) echo this point, arguing that a distinction exists between core R&D activities, which are more knowledge intensive, and noncore innovation activities, which are more sensitive to cost considerations. They argue that core R&D activities are still concentrated in developed countries, whereas the spread of innovation in developing countries is mostly noncore in nature. Both of the trends just identified may be true at the same time. In other words, rising sectors in the past quarter-century have had the ability to internationalize R&D to a greater extent than foreign investments of the 1960s and 1970s. At the same time, certain innovation activities remain more centralized than others. This does not mean that the innovations being carried out in developing countries in larger amounts are not beneficial to the enterprise or host country. This simply acknowledges that different forms of innovation are consistently subject to simultaneous centripetal and centrifugal forces.

Changes in the sectoral composition of foreign investment have made some forms of innovation more likely in developing countries. However, the global diffusion of innovation is not driven only by demand-side processes. There have also been important changes in the national systems of innovation in developing countries, which makes decentralized innovation more attractive for firms. Firms are increasingly driven to conduct R&D abroad by cost considerations, and developing countries offer ever-larger supplies of well-trained research personnel. Furthermore, some rich countries can no longer supply sufficient numbers of researchers for firms.[3] Just as firms have looked to developing countries as low-cost production locations, they increasingly consider developing countries as sources of potentially lower-cost innovation. With innovation, however, quality can matter just as much as cost considerations. These "supply-side" incitements to local innovation are recognized as increasingly important (Kuemmerle 1999). A separate and distinct literature has developed that analyzes national systems of innovation, not always in connection with multinational enterprise but certainly important for patterns of foreign investment (Nelson 1993; Carlsson 2006). In this regard, developing countries are increasingly offering large supplies of well-trained graduates and other advantages to multinational firms.

Some countries have had more success than others at linking their educational and technology systems with the needs of multinational firms. Countries like India and Brazil prioritized pure scientific research in their educational systems. As a result, graduates were not always in ideal positions to take on applied tasks demanded by multinationals. There are more science and engineering graduates in these countries than suitable jobs in these fields. Table 3.1 presents data from UNESCO and the World Development Indicators (WDI) on the national systems of innovation constructed in various countries by 2010. Data are not available for all indicators and countries; however, comparisons are possible. Developing countries have been producing well-trained science

3. Reddy (2000) points out that the two Swedish companies ASEA and Ericsson alone would require 150 percent of all electronics engineering graduates in Sweden.

Table 3.1
Innovation indicators in selected countries, 2010

	Brazil	Mexico	China	Malaysia	India	South Korea	Russia	Singapore
Nonresident patent applications as a percentage of total	83.09	93.48	25.08	80.71	77.74	22.51	32.42	90.84
Researchers in R&D, per million population	710	382	890	1459	160	5451	3078	6307
Technicians in R&D, per million population	656	178		130	103	981	474	461
R&D expenditure as a percentage of GDP	1.16	0.46	1.76	1.07	0.80	3.74	1.13	2.05
Percentage of students in tertiary education enrolled in science programs	6.34	10.52		11.25	16.46	8.79		15.12
R&D performed by business enterprise, %		38.4	73.4	65	34.8	74.8	60.5	60.8
R&D performed by government, %		32.4	18.1	6	61.1	12.7	31	10.4
R&D performed by higher education, %		27.8	8.5	29	4.1	10.8	8.4	28.8
R&D financed by business enterprise, %	45.4	36.2	71.7	59.6		71.8	25.5	53.1
R&D financed by government, %	52.7	60.5	24	36.4		26.7	70.3	40.2
R&D financed by higher education, %	1.9	2.3		3.5		0.9	0.5	1.8
R&D financed abroad, %		0.5	1.3	0.4		0.2	3.5	4.9

Sources: World Development Indicators, World Bank; UNESCO Institute for Statistics.

and technology graduates in larger numbers, and many of them now have large numbers of qualified scientists and engineers.

It is apparent that countries vary widely in terms of their national systems of innovation. Countries such as South Korea and Singapore have large numbers of researchers and technicians, given their smaller populations, and have developed science-intensive tertiary education systems. Their R&D is mostly performed by businesses, as opposed to the government. The countries of East Asia demonstrate significantly higher innovation propensities. Kosacoff, López, and Pedrazzoli (2008) note, based on UNESCO data, that the ratio between Sweden or Israel and Colombia in terms of private R&D spending as a percentage of GDP is 30 to 1. Between South Korea and Brazil the ratio is 5 to 1. Yet South Korea only spends 25 percent more than Brazil in R&D in the public sector. It is important to note that even though China and India have somewhat lower proportions of R&D researchers and technicians, their large populations mean that the absolute numbers are actually quite high. Brazil and Mexico, and Latin American countries in general, do not exhibit substantial R&D intensity compared with their Asian counterparts. Both China and South Korea accept a large proportion of their patent applications from domestic firms, suggesting more developed applied research programs for domestic firms in those countries. Another contrast between East Asian countries and other developing countries is evident in the financing of R&D. Most R&D effort in Brazil, for example, is financed by government, whereas a more prominent financing role for business is evident in East Asia.

The UNESCO Institute for Statistics maintains data on science, technology, and innovation for a large number of countries. The bottom half of table 3.1 relays information on gross domestic expenditure on research and development (GERD), separated by the source of funding. The East Asian countries selected display higher levels of business funding for R&D, as opposed to government funding. This is significant, because it shows that these countries are generating business interest in local R&D whether from domestic or foreign sources. While India does not supply adequate R&D financing data, other indicators suggest that the government is more active in performing R&D than in other emerging economies (Benoliel 2015, 157). Government funding for R&D is quite high in Russia and Mexico. These UNESCO data do not distinguish among domestic firms and multinational enterprise, so it is difficult to draw limited conclusions about foreign firms. Nonetheless, it seems that East Asian countries have more developed national systems of innovation than other developing regions. Based on patent applications data, these innovation systems appear to be broadly based in domestic firms in some countries in the region.

Recent Empirical Trends in Foreign Direct Investment

Up until the 1980s, innovation within multinational enterprises was almost exclusively confined to the industrialized world. However, a number of factors have contributed to the diffusion of innovation to developing countries since that time. Developing countries offer cost savings, often have well-trained scientists and engineers, and may bring additional competitive advantages to the practice of innovation (such as unique local knowledge). These factors and others have induced firms to set up innovation units in these countries in recent decades. As I have previously argued, it is important not to overstate this phenomenon. Many innovation activities remain highly centralized. Moreover, the innovation being done by multinationals in developing countries is still small compared with the innovation done in Europe, North America, and Japan. While vertical production chains with centralized R&D are still in evidence among the largest multinationals, many industries are moving to transnational production models where foreign subsidiaries have more responsibility for developing new products and perhaps even marketing them abroad. This is not the case in every industry, but it is common enough to be considered a trend (Pearce and Papanastassiou 2009).

Having traced the historical development of innovation among multinational enterprises, the remainder of this chapter is dedicated to more recent empirical developments. The first has to do with the sectoral distribution of FDI in developing countries. As previously noted, some forms of FDI are more likely to exhibit innovation-intensive profiles than others, although innovation is possible in any sector.[4] Foreign investment is traditionally divided into the categories of primary (agriculture and mining), secondary (manufacturing), and tertiary (services) investment. There are numerous subdivisions within each broad category, becoming more specific at each level of

4. R&D occurs in diverse sectors in developing countries. Just a few examples of this include General Electric's diverse interests in aircraft engines and medical equipment in India, Motorola's lab in China, and pharmaceutical companies such as GlaxoSmithKline, Pfizer, and Novartis conducting clinical research in India (UNCTAD 2005).

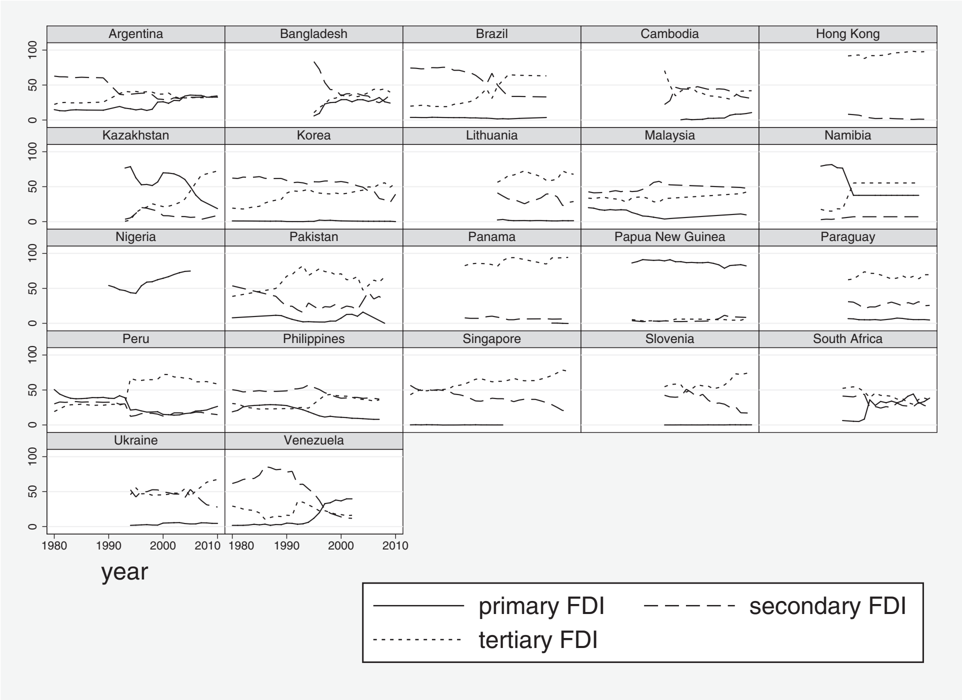


Figure 3.1
Sectoral evolution of FDI across sectors and countries, percentage of total FDI stock, 1980–2010.
Source: UNCTAD data for three major sectors.

remove.[5] The UN Conference on Trade and Development, Division on Investment Technology and Enterprise Development, has been recording sectoral FDI patterns for more than two decades in some countries. Figure 3.1 presents FDI data for a select group of developing countries, divided into primary, secondary, and tertiary sectors. FDI stock is recorded for each sector in millions of US dollars, and matched to total FDI stock for each year. Stocks are used as opposed to more volatile year-to-year flows, as stocks indicate the overall importance of sectoral FDI to the economy.

There have been important shifts in the sectoral composition of FDI during the period of liberalization, and these shifts are likely to

5. Statistics on sectoral investment patterns have historically been lacking, especially in developing countries. However, recent advances in data availability allow a more fine-grained analysis of the nature of foreign investment in developing regions.

affect the incidence of multinational innovation in emerging economies. Particularly after 1990, forms of inward investment in developing countries exhibited growing diversity. FDI in services expanded dramatically as a proportion of inward FDI. In a 2004 report on FDI, the UN Commission on Trade and Development noted that in 1970 service-oriented FDI accounted for a quarter of worldwide FDI stock. By 1990, that figure was almost one half, and by 2002 it had risen to 60 percent, or an estimated $4 trillion (UNCTAD 2004). Moreover, during the past two decades various service subsectors have seen dramatic internationalization, such as electricity, water, telecommunications, and business services. There are a number of reasons for this shift. First, trade is not an option for many of these locally provided services, and FDI is the default form of transnational exchange. Second, many countries opened up service industries to foreign investment during the political reform period of the 1990s and 2000s. Firms that were once state owned or limited to domestic ownership were auctioned off to foreign investors. Third, the expansion of market-seeking FDI in developing countries, some with rapidly expanding consumer classes, offset any dwindling demand for FDI in wealthy countries.

Figure 3.1 shows that the distribution of FDI stock has evolved in a variety of ways in different developing countries. Some of the countries shown are dominated by natural resource FDI, such as Nigeria. Others, such as South Africa, have evolved through time to a roughly even distribution of investment among the three sectors. This reflects one of Africa's most diversified economies. Some countries, such as Bangladesh, were initially dominated by one form of FDI (manufacturing), and developed toward a more equitable distribution. The general trend for most, but not all, states is an increase in the proportion of inward FDI stock represented by services. Smaller states are often dominated by service FDI, such as Singapore, South Korea, and Panama. These states are not attractive for primary FDI investments, but it is striking how often manufacturing falls in these cases and is replaced by services as the dominant form of investment. In the rare instances where service sector investment declines, such as Venezuela and Papua New Guinea, natural resource investment tends to dominate. This suggests a crowding-out dynamic for natural resource investment, as it overwhelms other forms of investment. In the next chapter, I evaluate whether the sectoral distribution of FDI affects the likelihood of innovation among multinational enterprises, and find some evidence of this effect.

The relationship between services FDI and innovation outcomes is a bit complex. Part of this is due to the extreme heterogeneity of the service sector. Multinational service firms encompass everything from hotels and fast food chains to knowledge process outsourcing among businesses. There are some reasons to suspect that service firms may be more reluctant, on balance, to internationalize R&D than manufacturing firms. Often, innovation among service firms depends on intangible resources. Copyrights and trademarks can be quite important for service innovation, and therefore a host country's intellectual property legal framework can become quite consequential. Dachs (2014) has argued that service firms in sectors with a low degree of appropriability might resist internationalizing R&D because these firms are not able to prevent unanticipated and unauthorized innovation spillovers. Historically, service innovations have been more difficult to protect in developing countries due to underdeveloped intellectual property protections. Some of the limited empirical research on specifically the service sector has pointed to lower levels of overall innovation than manufacturing. Licht and Moch (1999) find that R&D is less common in service firms than in manufacturing firms with similar size and characteristics. Indeed, service sector dummy variables in later models in this book show that service sector investments are less likely to spend on R&D in developing countries.

However, service firms probably engage in more innovation than is immediately apparent. As Miles (2005) notes, survey questions about R&D spending (including some of those used in this book) may under-represent the innovative activities of service firms. This is because many service subsectors adopt technologies and other innovations produced in other service or manufacturing subsectors. Firms may be quite innovative in their application of "modular" advancements from other locations, but these applications are not picked up in R&D statistics because the service firms themselves are not paying personnel or purchasing capital equipment, but are instead developing new applications for existing technologies. Yet other service sectors may pursue these more or less traditional R&D activities. Indeed, some service industries invest heavily in R&D at levels at least as high as manufacturing sectors. IT and software firms are excellent examples of these types of firms, and regularly appear among those companies with the highest levels of R&D spending, regardless of sector. Other service subsectors may not engage in R&D per se, but instead cross-pollinate with other service and manufacturing sectors for innovation in their business models.

Strict R&D spending is therefore not necessarily the most common source of innovation in many service sectors, which may nonetheless be quite innovative. Taxonomies of service innovation are still evolving, but the dynamic whereby service firms acquire external technologies and adapt them for internal use is perhaps best encapsulated by Castellacci (2008), who proposed that many service innovations exist on the "back end" of value chain processes. For example, advance knowledge providers and infrastructure service firms are types of service firms that develop specialized roles and provide innovation to a wide range of sectors, within and without services. These firms, which encompass everything from telecommunications firms to software (product) and consultancy (process) firms, provide the supporting infrastructure for business activities in the whole economy. These back-end firms pass on innovation to carrier industries such as mass-produced and personal services, which may themselves not devote significant resources to traditional R&D yet nonetheless exhibit a high degree of innovation content. This complexity within services suggests that innovation be conceptualized and measured in a broad way, recognizing that innovative outcomes are more common than traditional measures indicate.

UNCTAD has been able to collect sectoral FDI data from a variety of countries; however, the coverage of the data begins to diminish within the primary, secondary, and tertiary categories. These subsector data may have important implications for the likelihood of multinational-linked innovation in developing countries. Figure 3.2 presents time-series data for the manufacturing sector, divided into two components: textiles and chemicals. While there are numerous other manufacturing categories, these two industries in particular are interesting for comparing innovation outcomes. Historically, multinational textile investments have involved low wage competition among developing countries, with relatively little R&D component. These investments are especially mobile, and have not been considered a form of investment likely to lead to industrial upgrading. In Pavitt's (1984) influential taxonomy, textiles are considered one of the archetypical "supplier-dominated" industries. That is, product and process innovations in this industry come from suppliers and not from the firms themselves.

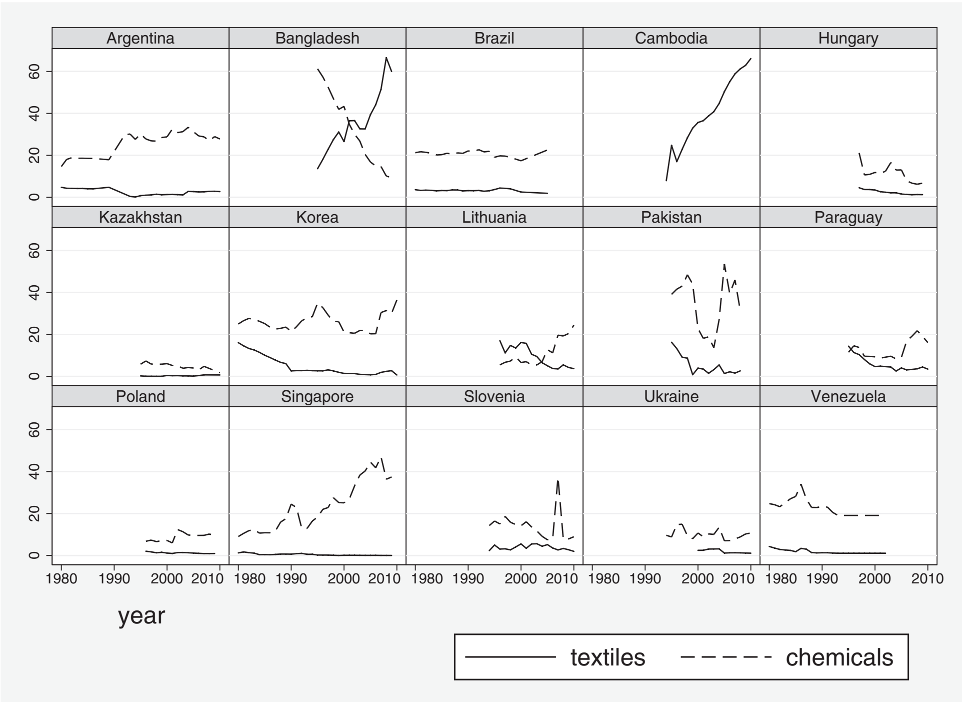


Figure 3.2
Evolution of FDI across countries, manufacturing subsectors as percentage of total manufacturing investment, 1980–2010.
Source: UNCTAD data.

In-house R&D and engineering capabilities are generally weak among these firms.

Chemical manufacturing investments, on the other hand, often involve significant capital and large sunk costs. They are often characterized by larger scale and higher R&D content, although this is not always the case. Specific subsectors, such as pharmaceuticals, are particularly R&D intensive.[6] Pavitt (1984) argues that chemicals (and the electronic sector) demonstrate a higher incidence of process innovation than other sectors. Chemicals and the electronic sector are classified by Pavitt as belonging most closely to the category of "science-based firms," in which the main sources of innovation are the R&D activities of the firms in the sector. Innovative firms within these sectors

6. Unfortunately, pharmaceuticals are not a separate category within the UNCTAD sectoral chemicals data.

have less incentive to look beyond the sector for further technological advancement, as there are significant barriers to entry and economies of scale and experience. Chemicals are also mentioned by Dachs (2014) as demonstrating a high degree of cumulative knowledge. In other words, future innovation depends on the knowledge that has been built up in the past. This may require specialization in R&D, but it also may promote the centralization of R&D within multinational firm structures.

The distribution of manufacturing investment between these two subsectors, therefore, presents an interesting contrast. According to figure 3.2, some countries' manufacturing sectors have been dominated by textile investment. This is especially true for Bangladesh and Cambodia, where textile investment stock as a percentage of total manufacturing investment increased dramatically in the 1990s. Cambodia did not collect data on chemical investments. However, by the end of 2010 textile investments represented more than half of all manufacturing investment stock. It is likely that any chemical investments would be small in comparison. A few countries were able to increase their chemical investment stock, as a percentage of total manufacturing stock. Singapore demonstrates the most dramatic increase, but it is important to bear in mind that its manufacturing investments are small in relation to services. Argentina, Brazil, and South Korea have demonstrated increases in chemical manufacturing investment and concomitant modest declines in textile investment. This could indicate a shift toward investments more likely to generate innovation, at least within the manufacturing sector. Other countries, such as Poland and Ukraine, have relatively low levels of both chemical and textile investment. Manufacturing investment in these countries is dominated by other industries, such as machinery and transport equipment investment. These data, however, are not shown because of deficiencies in data collection for these subsectors. To the extent that textile investments are not likely to lead to significant innovation in developing countries, large Latin American countries such as Brazil and some East Asian countries seem better positioned than countries like Bangladesh and Cambodia. The distribution of manufacturing investment through time suggests that textiles decline in more advanced developing countries, as a proportion of inward manufacturing FDI.

A number of developing countries also collected subsector data in services, during the time period of 1980–2010. As previously noted, service sector investment boomed in developing countries during the

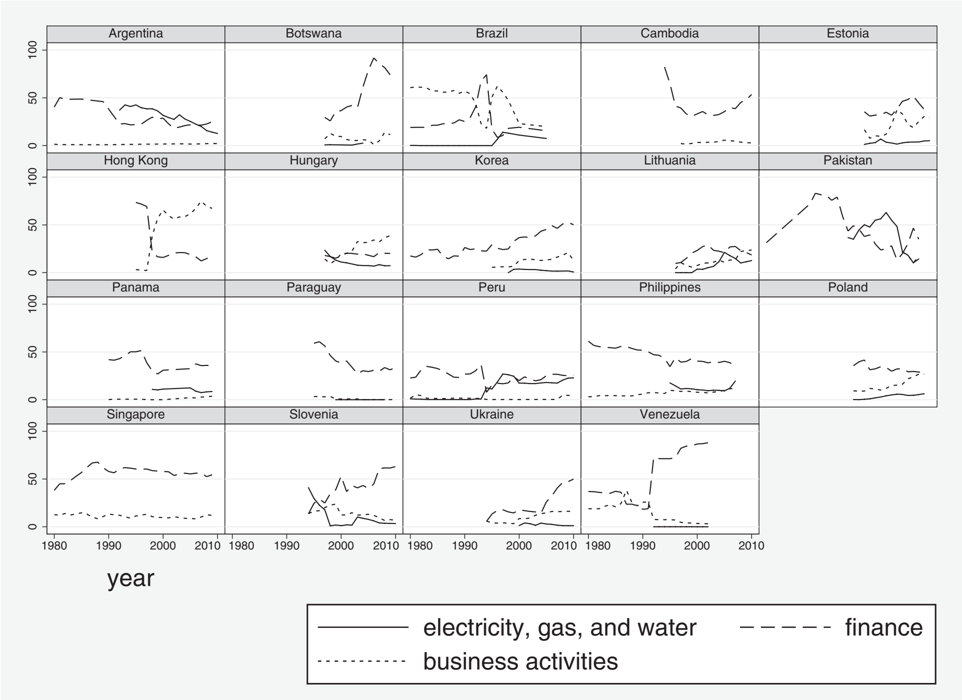


Figure 3.3
Evolution of FDI across countries, service subsectors as a percentage of total service investment, 1980–2010.
Source: UNCTAD data.

1990s. Figure 3.3 shows the distribution of investment for three service industries: electricity, gas, and water; finance; and business activities.[7] During the liberal reform period of the 1990s, many formerly state-owned utility firms were privatized and sold to foreign investors. In Brazil, the auction of Telebrás in 1998 was the largest telecom privatization in the world up to that point, and netted the government roughly US$22 billion (Kingstone 2003). Financial investment also increased dramatically in developing countries. Business activities encompass a great deal of service sector investments, from business/knowledge process outsourcing to call center operations. In many of the countries represented in figure 3.3, business process investment represents an increasing proportion of service sector investment throughout the time

7. Electricity, gas, and water are often grouped together as utilities.

period considered. Finance declines for many of the countries represented here.

It is important to again emphasize that the service sector is quite diverse. Some service sectors such as hotel and restaurant investments, not represented in figure 3.3 due to lack of data, contain relatively little potential for innovation in developing countries. Other service industries, such as knowledge process outsourcing, can be quite innovative. Indeed, process innovation in many services may very well be the "product" offered by multinational enterprises. While there is significant variation by country, these types of investments seem to be on the rise in developing countries, even within a booming service sector. There does not seem to be any significant upward trend in utilities investment, perhaps indicating that many of these investments are one-time opportunities for foreign enterprises.

It is quite common to encounter theory and evidence that one FDI sector or another has more innovation potential in developing countries. However, before proceeding it is important to acknowledge the essential point that innovation is possible in every sector. As Von Tunzelmann and Acha (2005) have shown, low- and medium-technology industries may still demonstrate high innovation content in developing countries. They argue that some low-tech industries such as food processing may be highly capital-intensive, and high-tech industries such as software production may be (skilled) labor-intensive in developing countries. To the extent that innovation may follow capital, it is important to not confuse the sector with the technology level in a deterministic fashion. Moreover, given that low- and medium-tech industries are often responsible for a great deal of employment in developing countries, governments may be better off pursuing innovation within these industries where it is possible. The sectoral distinctions presented here take this possibility into account. However, it is also the case that sectors differ in probabilistic fashion in the degree to which they exhibit innovation outcomes. In other words, it is possible to acknowledge the potential for innovation within the textile sector in developing countries while at the same time maintaining that, *on balance*, innovation there occurs less frequently than in the chemical sector.

It is apparent that foreign direct investment in developing countries has clearly shifted toward services in recent decades. While manufacturing and natural resource-oriented investments are still common in developing countries, and in some cases quite substantial, on the whole services represent a higher proportion of incoming investment than at any point in the past. There are ample opportunities for innovation within the service sector. However, aggregate FDI data, even when broken up by sector, tell us little about whether or not these investments contain a significant innovation component. Corporate R&D has traditionally been one of the most shielded and centralized activities. How do we know that firms are innovating more in peripheral economies? To answer this question, we must turn away from measures of overall FDI stocks and flows and toward multinational firm data. There are few reliable information sources of firm R&D spending through time except from the firms themselves. Cross-national differences in standards for how firms report innovation complicate the issue further.[8]

Innovation Patterns among Multinational Firms

Instead of looking to the host country for information on foreign firms' innovation patterns, we can instead look to the sending country for information. This approach offers several advantages, and one large disadvantage. One clear advantage is that sending countries have consistent accounting and reporting requirements for multinational firms. These reports are often required at regular intervals. While required data on innovation levels may contain errors or may omit important information, they are consistently applied across firms. Similarly, sectoral classifications of firms are similar across countries, so that cross-country comparisons of innovation efforts in a particular sector or subsector are possible. Also, sending countries collect data on how FDI and innovation activities are distributed in a global context, through time. This allows interpretation of the distribution of innovation activities among rich and poor countries, in addition to its absolute levels.

The major disadvantage is that by focusing on sending countries, we cannot know if the innovation activities of those firms are representative of FDI as a whole in a specific developing country. For example, if German IT service firms were especially innovative in Brazil in the 1990s, that does not necessarily mean that all foreign IT service firms in Brazil were innovative. Investment from one particular country may

8. Developing country governments do periodically conduct surveys of foreign firms within their borders and sometimes ask whether firms are conducting any local R&D. However, these surveys vary widely in quality from country to country, and often do not ask the same questions.

be concentrated in a specific sector or subsector in the host country, and these investments may not be representative of the sector at large. Multinationals from different parts of the world present different behaviors, sometimes based on their national systems of innovation at home. Pauly and Reich (1997) establish linkages between firm investment strategies (including R&D spending) and institutional characteristics in the home country of multinationals. Ambos and Ambos (2007) point out that the nationality of company directors in developing countries is an important predictor of whether or not that firm conducts R&D locally and of the extent of embeddedness in local supplier networks. Countries of origin do make a difference, and it is difficult to extrapolate from innovation data of one sending country to the innovative characteristics of the entire sector in a host country.

Despite this drawback, the next section presents innovation data reported by firms from one sending country, the United States. There are a number of reasons for this, the first of which is empirical. The United States is the country with the single largest amount of foreign investments in the greatest number of developing countries worldwide. While other countries' investments may be larger in specific developing countries, no country can match the United States for breadth of investment and overall levels of FDI. According to UNCTAD, the United States is responsible for the largest amount of FDI outflows of any country, sending out $328 billion in 2013 and $337 billion in 2014 (UNCTAD 2015, 8). Its outward investment is weighted toward Latin America and Europe, but it has aggressively expanded to Asia in recent years. Developing countries now routinely attract more than half of global FDI flows, and the United States is one of the dominant investors. The United States alone was responsible for 13.1 percent of all inward FDI stock in developing economies as of 2008.[9] So while US innovation and investment patterns should not be assumed to be representative of overall FDI patterns in these countries, these investments are substantial. The second reason for focusing on US data concerning American firms has to do with comparability. Even among German and Japanese patent offices, there are significant differences in categorization of sectors, firms, and patent criteria. These issues are largely avoided by focusing (at least for now) on US firms abroad and reports on their activities.

9. Based on calculations from UNCTAD's bilateral FDI statistics, available at http://unctadstat.unctad.org/wds/.

The American government has developed detailed records of the activities of US firms operating abroad, and these records are available for a large number of years. The Bureau of Economic Analysis (BEA) collects financial and operating data for US firms, which includes information on R&D expenditures in different host countries and regions. This allows regional and temporal comparisons of American multinationals' innovation efforts. Figure 3.4 presents BEA data for US firms' R&D spending, separated by region. Majority-owned nonbank foreign affiliates are included in the database. Unfortunately, the data after 2008 include banks and use a different sectoral classification system, which distorts the continuity of the data. Therefore, only the years 1999–2008 are shown in this figure. Nevertheless, this is a full decade's worth of data. Clear trends are apparent. First, innovation is concentrated in developed regions. Europe accounts for the largest share of US R&D spending, surpassing $25 billion by 2008. Second, innovation expenditures trend upward throughout the period. This is especially evident in Europe and Asia.

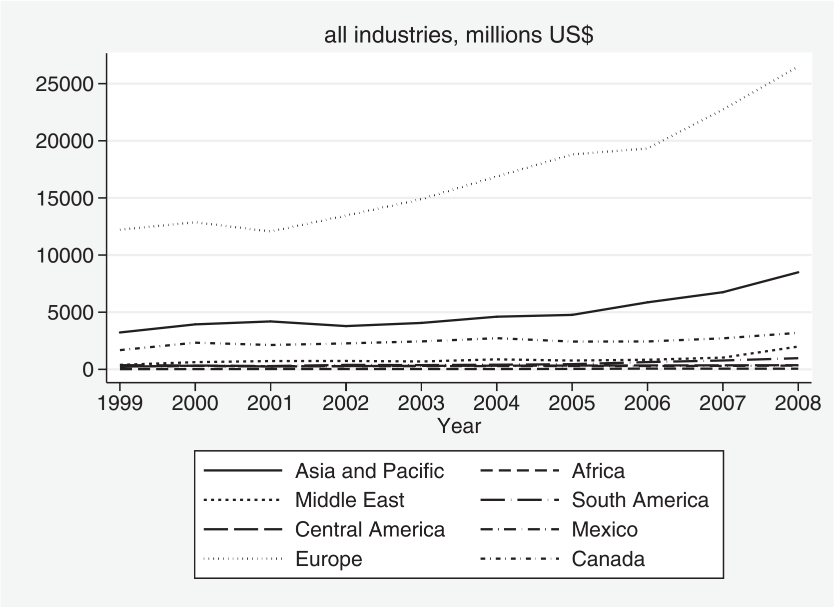


Figure 3.4
US direct investment abroad, majority-owned nonbank foreign affiliates, R&D expenditures, 1999–2008.
Source: BEA data.

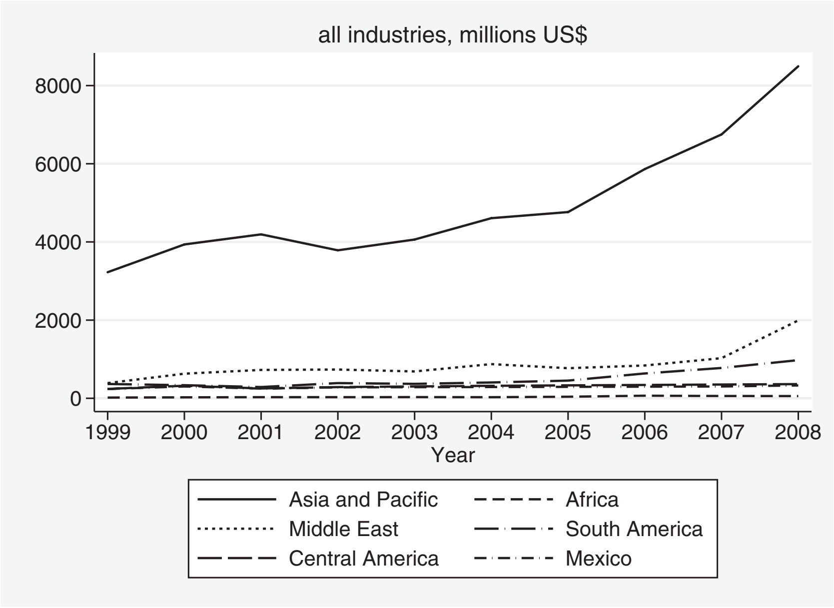


Figure 3.5
US direct investment abroad, majority-owned nonbank foreign affiliates, R&D expenditures, developing regions, 1999–2008.
Source: BEA data.

Figure 3.5 shows the same data, but limited to developing regions. The overall amounts of R&D spending are lower than in developed countries. However, it is immediately apparent that innovation is concentrated in Asia. The region attracts much more R&D expenditures than any other developing region.[10] There are recent increases in South America and the Middle East, but none is as dramatic as the increase in Asia. This underscores a central insight about the spread of innovation among multinational firms in developing countries: it is unevenly distributed. Others have recognized these distribution patterns as well. Reddy (2000) argues that China's market size gave it a great deal of leverage in not only attracting FDI, but also attracting innovative activities of multinational firms. Reddy goes on to argue that cost considerations, along with a large supply of qualified personnel, are among the most important factors pulling innovation toward

10. In 2005, six of the top 10 developing countries in terms of aggregate business R&D spending (not limited to multinationals) were located in South, Southeast, and East Asia. Much of this enterprise R&D spending is done by large multinational enterprises.

developing economies in Asia. Cassiolato et al. (2014) echo this point by noting that higher growth rates and lower wages for skilled workers in China and India have influenced R&D location decisions for multinationals. Lall (2003) notes that East Asian countries varied considerably in their openness to FDI during the 1990s. Certain countries, such as Singapore and Malaysia, were especially reliant on technology transfers from multinationals, while others, such as South Korea and Taiwan, built up domestic systems of innovation before partnering with foreign firms. China did not have substantial technology promotion policies for multinationals. However, its market conferred leverage and bargaining power over firms.

Some developing countries outside Asia do attract significant R&D effort on the part of American multinationals. This amount is small in comparison to developed states. Figure 3.6 considers individual countries in a single year, 2008. These countries are arranged by their representation in US firm R&D spending, as a percentage of total R&D spending for that year. Again, it is apparent that most innovation, when it is done abroad, is done in other rich countries. Germany takes

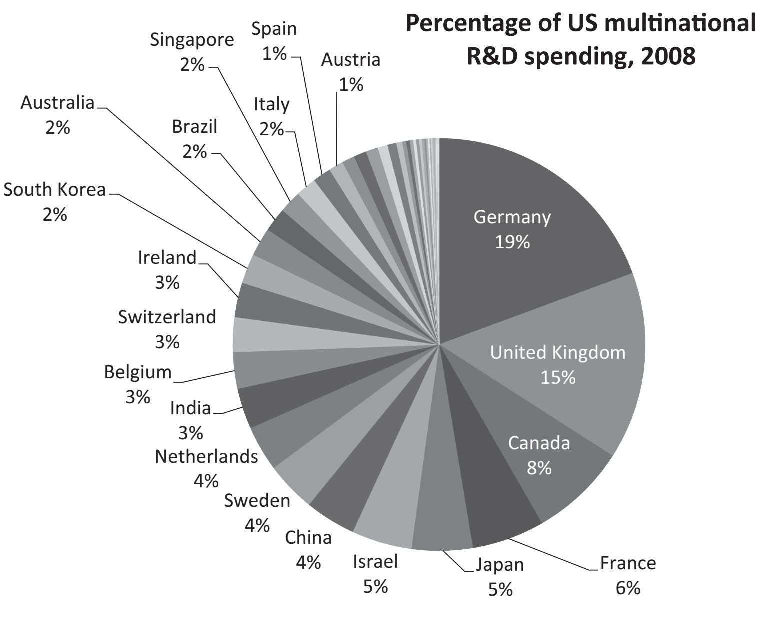


Figure 3.6
Relative R&D expenditures by US firms, state comparison.

in a full 19 percent of US R&D expenditure, and the United Kingdom is a close second with 15 percent. Developing countries are first represented by China, which is responsible for 4 percent of R&D spending. Only Brazil registers among those countries with more than 1 percent of American R&D spending, outside the developed world and Asia. Despite recent increases in the proportion of innovation done in developing countries, innovation for American firms is still regionally concentrated in Europe.

That innovation is concentrated in developed countries should not be surprising. Rich countries offer strong infrastructure, well-established educational systems, and numerous other advantages for firms. Developing countries offer other advantages, which may be present in developed countries but sometimes are not, such as potential cost savings and/or qualified workers. I have argued that while innovation is still concentrated in wealthy countries, developing countries are attracting more sophisticated activities from multinationals than in years past. Using BEA data, I have thus far concentrated on aggregate R&D spending levels, especially their distribution and patterns over time. But it is in relative terms that the increase in innovation becomes most clear. If we consider, for example, the amount of innovation that American firms perform abroad in its totality, we would imagine a steadily increasing number. But what of developing countries as a share of that amount? How has that changed through time? Figure 3.7 presents these data for five selected developing countries: China, India, Brazil, Mexico, and Russia. These lines represent R&D expenditures in each individual country as a share of total US R&D spending abroad, from 1999 to 2008. Not all of these countries increased their share of US R&D spending. Mexico displays a moderate downward trend, and Russia's low level increases only slightly. However, the other countries see increases. China's and India's increases in particular are dramatic. These lines indicate that innovation is being redistributed from other countries to these developing countries, even if the absolute amounts are not large compared with the amounts being spent in rich countries.

There are other ways to conceptualize relative R&D indexes as well. The BEA also keeps statistics on production by multinational firms, in a variety of formats. In firm-level innovation statistics, it is common for researchers to scale R&D expenditures for firms against overall sales, as one way to take firm size into account. This can be accomplished with aggregate BEA statistics as well. However, it is preferable to use

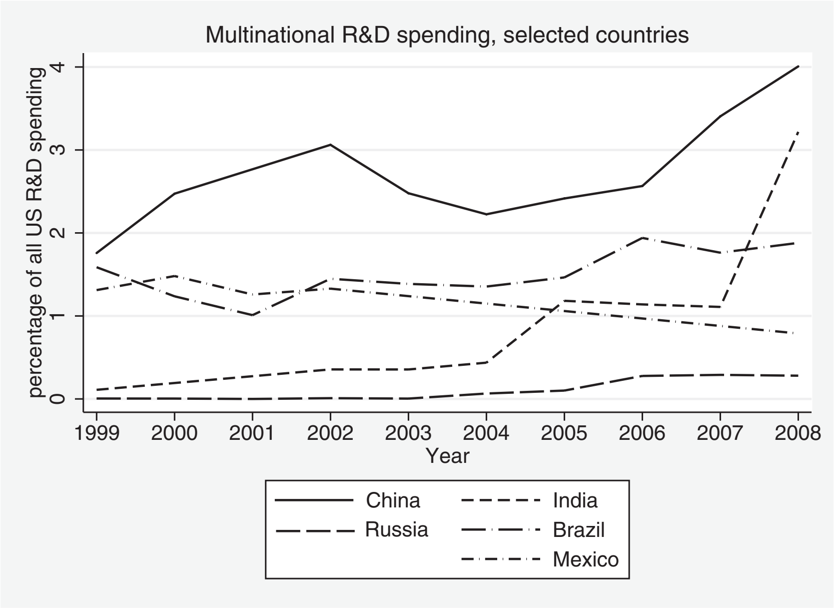


Figure 3.7
US foreign affiliates research and development expenditures, as a percentage of all US multinational R&D expenditures, 1999–2008.
Source: BEA data.

value-added figures instead of sales, when available. This is because value-added figures reveal the portion of the goods and services sold by a firm that reflects the production of the firm *itself*. Sales are certainly more common as a denominator, but may not accurately represent firm production in a specific location. Table 3.2 presents a variety of data points for foreign affiliates of American firms, taken from the BEA database for 2007. The first column indicates total R&D expenditures as a percentage of value added. South Korea scores highest on this indicator, followed by China and India. The next two columns indicate the percentage share of total R&D expenditures for that year and the percentage of total value added of US multinationals for that particular country. Note that for some countries the share of R&D is greater than the share of value added, and vice versa.

The last column in table 3.2 displays the ratio between the two previous columns. A higher ratio value demonstrates that a country exhibits more local R&D by American firms than its share of global American value added would suggest. Brazil, for example, is less

Table 3.2
R&D expenditures of majority-owned foreign affiliates of US multinationals, 2007

	R&D expenditures as a percentage of value added	Share in total R&D expenditures of US multinationals	Share in total value added of US multinationals	Share in R&D/Share in value added
Brazil	1.91	1.76	2.83	0.62
Mexico	0.99	0.88	2.74	0.32
China	5.47	3.41	1.91	1.78
Hong Kong	0.73	0.27	1.13	0.24
India	5.18	1.11	0.66	1.68
South Korea	7.64	2.69	1.09	2.48
Russia	1.43	0.29	0.62	0.46
Singapore	2.82	1.59	1.74	0.92
Taiwan	1.48	0.28	0.59	0.48
Total of all US affiliates	3.08	100	100	1

Sources: Bureau of Economic Analysis, financial and operating database for US multinational investment. Adapted from Hiratuka (2009), author elaboration of BEA data.

innovation-intensive than it is production-intensive (<1) in relative terms. China, Hong Kong, India, and South Korea all have ratio values over 1, suggesting more R&D intensity. That is, they are responsible for a greater share of American multinational innovation than the production distribution patterns would indicate. These ratios are helpful ways of identifying where in the world innovation is unevenly distributed among US multinationals. Again, it seems that Asian countries attract a disproportionate amount of innovation among American investments in developing regions.

Is the innovation conducted by American firms in Asia broadly based, or is it concentrated in a few particular sectors? The BEA data on the activities of US firms abroad allow us to begin to answer this question. Figure 3.8 shows R&D expenditures as a percentage of value added, separated by region and sector. Due to data limitations, only certain sectors and subsectors were available. Sectoral data for total manufacturing is presented, as well as three manufacturing subsectors: chemicals, computers and electronic products, and transportation equipment. In addition, one service subsector is presented: information services. These are all sectors and subsectors where

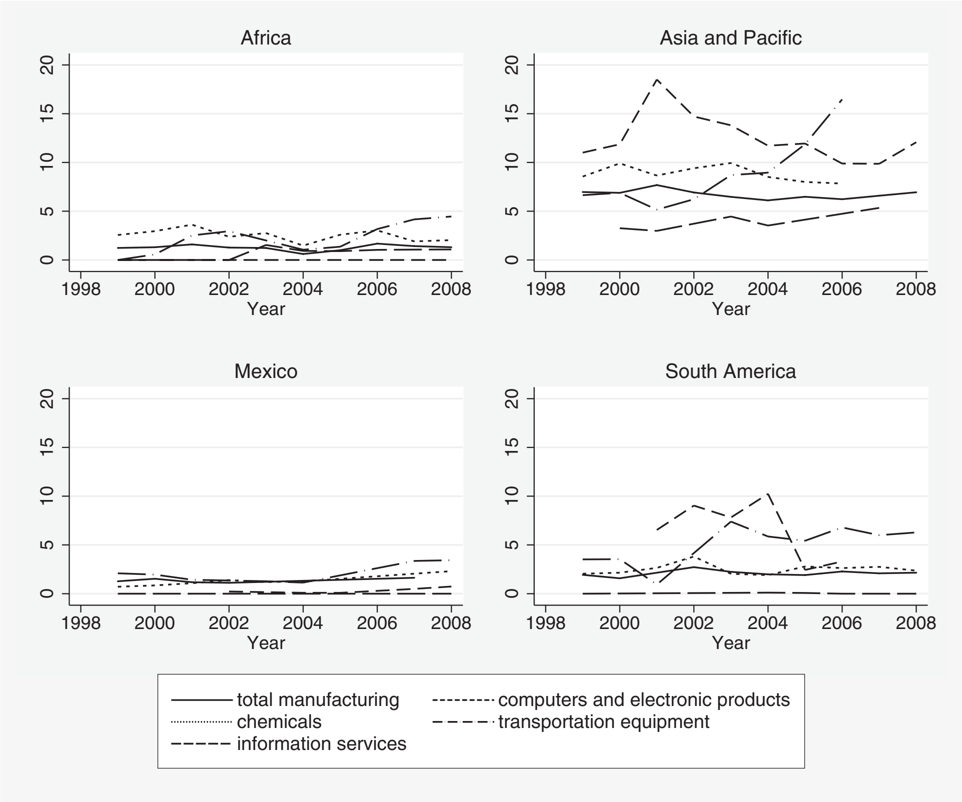


Figure 3.8
US foreign affiliates R&D expenditures, by region and sector as a percentage of sectoral value added, 1999–2008.
Source: BEA data.

innovation is possible and perhaps likely, yet we still see tremendous variation, particularly across regions. Asia displays relatively high levels in all sectors, compared with Africa, Mexico, and South America. No particular sector stands out as especially innovative in Asia; however, the increase in information services R&D throughout the period is impressive. Interestingly, Africa appears to have slightly more innovation intensity than Mexico, in select sectors. However, the amount of American investment going to Mexico is exponentially larger than the amount of investment going to Africa. The absolute amount of R&D being done therefore is much larger in Mexico. Nevertheless, Africa does display nonnegligible amounts of R&D

spending in proportion to value added, even considering the small amount of American investments on that continent. South America exhibits some substantial R&D investments as well, although this is not as broadly based as investments in Asia. Overall, these results based on still-emerging sectoral data suggest that Asia retains the highest levels of R&D from American firms relative to value added and that these activities are substantial across the sectors where data are available. While these sectors are admittedly more innovation-prone than others, American firms appear to have committed R&D resources to developing countries in a number of different areas of their economies.

American firms have invested a substantial amount in developing countries in recent decades. While investment patterns from the United States are not necessarily representative of investment patterns from all developed countries in developing markets, the United States remains the largest single investor. Developing country governments have used various strategies to attract American multinationals and have pursued technology-intensive sectors and firms. The data provided by the Bureau of Economic Analysis indicate that American multinationals' innovation patterns are still highly concentrated in Western Europe and other developed countries. However, it is clear that US firms are spending more on innovation in developing countries than they have in the past. Absolute and relative levels of R&D spending are increasing and are broadly based across sectors. Among developing countries, Asian countries attract the most innovation. These patterns are consistent with prevailing notions of the centripetal and centrifugal forces acting on firms in the global economy. Innovation has become more diffuse in general terms, and developing regions are taking advantage of this spread.

While R&D spending levels are not tracked in similar ways among the major sending countries, there are other ways to compare innovation outcomes cross-nationally. A number of recent studies rely on patent data to examine the potential for FDI-related innovation (Benoliel 2015; Blit 2016). Patent data also offer the opportunity to compare sending countries' patent propensity in similar domestic legal environments and may in many cases capture sources of innovation missed by R&D measures (Pavitt 1982). Motohashi (2015), in a recent examination of patenting activity by German, US, and Japanese firms in China, has argued that firms from different sending countries tend to innovate in different sectors and that multinationals from specific countries (Japan)

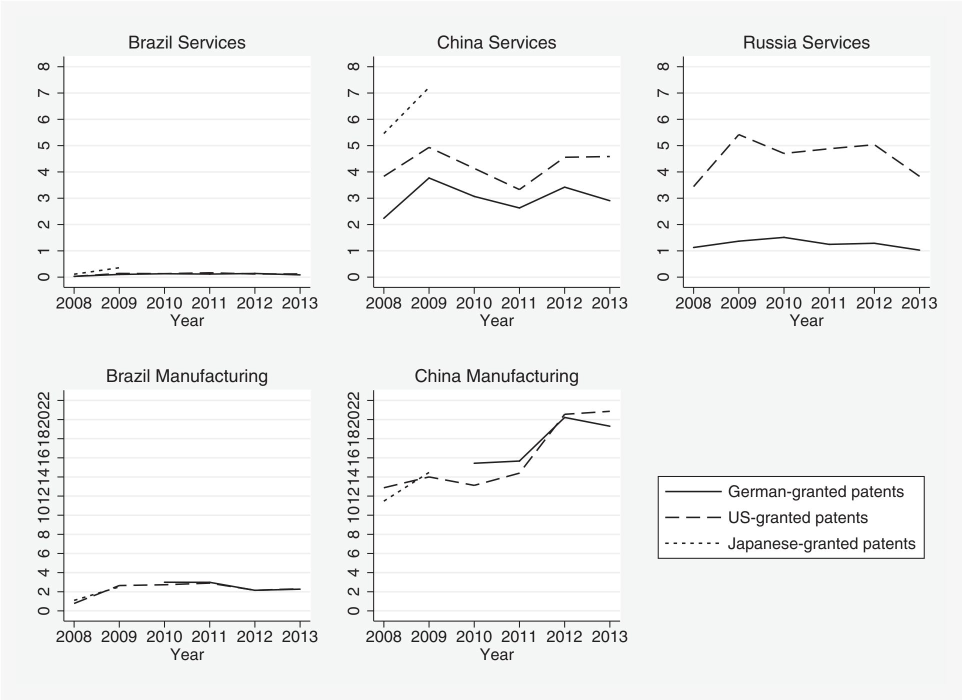


Figure 3.9
Patenting activity by registration country, sending country, and broad sectoral category.
Notes: Patents granted per year by host country patent authority, per thousands of persons employed by multinationals.

lag behind others in expanding innovation abroad, preferring instead to centralize. The World Intellectual Property Organization (WIPO) maintains a database on intellectual property protection, which includes data on patent grants by technological sector and information on the filing office and the patent applicant's origin. These patent counts are available in many of the largest middle-income countries. Figure 3.9 presents the number of patent grants from 2008 to 2013 in three country patent offices: Brazil, China, and Russia.[11] These patent grant data from WIPO are separated into two broad categories: services (categories 1–10, including digital communication and computer technology) and manufacturing (categories 11–35, including chemical engineering and civil engineering). The patent counts in each of these categories are then

11. India's patent data were incomplete and not arranged by sector, so they are excluded.

divided by thousands of multinational firm employees in the destination country, matched by broad services and manufacturing categories. The employment data come from the OECD's FDI statistics, which are also arranged by partner country and sector.

Figure 3.9 reveals that patenting activity is quite substantial in China and growing. American firms patent at a high level in both business services and manufacturing, as do German firms. Patenting activity in Brazil in both manufacturing and services is comparatively weak compared with China, though it is relatively higher in manufacturing compared with services. Unfortunately, Japanese patenting data are available only for the first two years of this time-series, so it is difficult to draw conclusions. Japanese firms do appear to patent at a high rate in China's services sectors, where geography likely plays a strong role. Russian patent data in the manufacturing sector indicated measurement error, and many years were missing. It is therefore excluded from the graph. While these patent data are incomplete, they indicate that firms with different countries of origin do differ in patenting practices, that patenting in manufacturing is in general stronger than it is in business services, and that patent activity is increasing in these countries, particularly China.

Empirical Trends in Innovation Spillovers and Linkages

While it is important to recognize where multinational firms are innovating and how those locations have shifted over time, there is a danger in fixating on pure R&D spending levels (or patenting, for that matter). These figures are easily comparable across countries; however, they do not capture the full scope of potentially mutually beneficial interaction between innovative firms and host countries. Scholars and policymakers have increasingly focused on the "embeddedness" of multinational firms in hosts' national systems of innovation and production.[12] This is partly based on the recognition that some firms, while perhaps innovative, do not make connections with various actors in the host economy. These actors, such as domestic supplier firms, universities, research institutes, and others, are instrumental in facilitating the spillovers from multinational investment to the local economy. Multinational firms that operate in isolation from the host economy are often productive, but

12. For a sampling of recent spillover-focused treatments of multinational investment in emerging economies, see Rugraff and Hansen (2011).

they may not add much beyond employment to a country's innovation trajectory. There are numerous examples of firms that behave in this manner in developing countries. Firms in export-processing zones can sometimes exhibit minimal connections to the host economy. While these firms generate needed foreign exchange, they may not offer as many developmental benefits. Firms taking advantage of favorable tax regimes, such as those in Ireland detailed in chapter 6, often fail to establish linkages with domestic suppliers and operate as "IT islands." While having these investments in country is perhaps better than not having them, they do not generate all of the benefits supplied by firms with substantial connections to the local economy.

One of the major implications of this book is that encouraging innovation-intensive investment is not enough for developing countries. In order to realize the greatest number of benefits from multinational investment, governments must put in place institutions and policy incentives that enmesh firms in local innovation systems. These connections between the firm and the domestic environment are known by many names: spillovers (which may be unintentional), backward and forward linkages (part of a firm's production process), technology transfer, and so on. Firms can be quite innovative in developing countries, but without developing local roots this innovation may not translate into substantial developmental outcomes. Thus far in this chapter I have concentrated on historical empirical patterns of innovation, sectoral distributions of FDI, and American R&D spending patterns. However, I have also emphasized that innovation is broader than R&D spending levels. In this section, therefore, I consider different data sources and different aspects of innovation. Specifically, I ask whether and how multinational firms are developing connections with local suppliers and perhaps using developing countries as export platforms for innovation-intensive products. I argue that backward and forward linkages among innovation-intensive firms are common but that the intensity of this embeddedness varies considerably by industry and country. Policy and institutional characteristics partially drive this variation.

The connections among multinational firms and various domestic actors in the host economy have long been recognized as important to development. Numerous studies have suggested that the development of local suppliers "upstream" in the value chain is as important as attracting the investment of the multinational in the first place (Rodriguez-Clare 1996; Markusen and Venables 1999). Productivity tends to increase for the multinational when there exists a compact network of local suppliers that are prepared to work closely with the foreign entrant and when R&D activity is taking place in the host country.[13] It is not guaranteed that these sorts of linkages will develop, but there are many factors that may facilitate their emergence. Understandably, numerous firm characteristics will impact the emergence of backward linkages. Giroud (2006) points out that when a multinational subsidiary in a developing country has greater autonomy, it is more likely to identify local suppliers and develop relationships with them. On the other hand, if multinationals operate with tightly controlled centralized and global purchasing systems, as is common in such industries as the automotive industry and electronics, subsidiaries will not have this freedom of movement and will instead construct international vertical supply chains. Pearce and Papanastassiou (2009) develop this idea further and propose a typology of different multinational subsidiaries and their roles. According to this framework, subsidiaries can range from truncated miniature replicas (TMRs), which reproduce in the national market all the parts from a parent multinational and have very limited innovation possibilities, to knowledge-seeking regional or world product mandate subsidiaries (RPMs/WPMs). These facilities have much more autonomy, are responsible for developing and marketing full product lines, and may export to additional markets. RPMs/WPMs tend to develop much more sophisticated domestic supply networks in developing countries, and in some cases maintain local in-house R&D labs. These subsidiaries offer much more potential for dynamism in the host country. While Pearce and Papanastassiou develop other typologies as well, they claim that many industries are shifting toward more independence for subsidiaries in developing countries, assigning them responsibility for the development and marketing of entire product lines. This shift presents opportunities for enmeshing multinationals in national systems of innovation in host countries.

Multinational firms may develop relationships with local suppliers, and these linkages may lead to technological upgrading in both

13. Coe and Helpman (1995), while focusing only on developed countries, demonstrate that there is a close link between productivity and R&D capital stock. That is, a country's total factor productivity depends not only on its own R&D capital stock, but also on the R&D capital stock of its trade partners. This is especially true for small countries, where foreign R&D capital stock is perhaps at least as important as domestic R&D capital stock.

the supplier and the multinational. However, formal agreements with local actors are only one possibility for innovation diffusion in the host country.[14] There is a large international business literature on the nature and determinants of innovation spillovers in host economies, both formal and informal. Knowledge spillovers from foreign investment take place when foreign firms equipped with better technologies and production processes increase the productive capacity of domestic firms.[15] Historically, in developing countries the experience has most often been one of absorption of new technologies from abroad. There are numerous ways in which these spillovers may take place, not all of them intentional. Blomström and Kokko (1998) argue that technology can be diffused from foreign firms in four ways: demonstration effects, competition effects, foreign linkage effects, and training effects. Demonstration effects occur when domestic firms in the host country learn superior production technologies and processes from arm's-length relationships with multinationals. Competition effects refer to the changes induced by foreign investment among domestic competitor firms in the host economy. Foreign linkage effects refer to the process described in above, where host country firms enter into partnerships with multinationals. The training effect occurs if highly skilled personnel move between multinationals and domestic firms. Caves (1996) slightly modifies these categories. Multinationals have access to firm-specific assets, such as better production models, a new management technique, or new technology. These assets motivate the firm to produce abroad, but may be intentionally transferred to firms in the host country or unintentionally "leaked." Demonstration effects, training effects, and foreign linkage effects are all possible ways in which FSAs may be transferred from the multinational to other actors in the domestic economy. Javorcik (2004) argues that foreign linkage effects are most important, as multinationals provide assistance to domestic suppliers in order to obtain high-quality inputs. Importantly, spillovers from foreign multinationals to domestic firms are not necessarily positive. Competition effects, as described by Blomström and Kokko (1998), can lead to negative spillovers if domestic firms, instead of becoming more competitive through imitation, lose markets

14. Dunning and Narula (1996) argue that multinationals are increasingly able to engage with domestic partners in nonhierarchical relationships, in what they call informal "alliance capitalism."

15. Spillovers may also happen in the opposite direction, from domestic firms to foreign entrants.

to foreign entrants. This is the so-called crowding out effect, whereby domestic competitors are not able to compete with foreign multinationals (perhaps with closely guarded and nonreplicable FSAs).

The empirical evidence on spillover effects in developing countries has been mixed, with recent work finding more evidence of positive technology spillovers than previous studies. Haddad and Harrison (1993) do not find evidence of spillover from foreign firms to domestic firms in Morocco, and Aitken and Harrison (1999) find very limited evidence of spillovers in their study of Venezuelan investments. Djankov and Hoekman (2000) find that FDI had a negative spillover effect on other firms that did not have foreign partnerships in the Czech Republic. Amsden (2001) has argued that crowding-out effects are real in developing countries. She maintains that multinationals control capital in near-monopolistic markets and limit the entry and competitiveness of domestic firms. In contrast, Javorcik (2004) finds evidence of increased productivity for domestic firms through backward linkages from FDI. Blomström, Kokko, and Zejan (2000) find evidence of beneficial technology spillover in a study of the Mexican manufacturing sector. In a study of 8,000 firms in eight advanced transition countries, Damijan et al. (2003) found substantial evidence for spillovers from multinational firms to locally owned firms, though the mechanisms for those spillovers varied in intensity. Aitken, Hanson, and Harrison (1997) find that foreign firms in Mexican manufacturing induce export spillovers among domestic firms, and argue that multinationals serve as conduits for information about foreign markets, new technologies, and logistical innovations. Damijan, Jaklič, and Rojec (2006), in a study of Slovenian firms from 1996 to 2002, find that increased foreign ownership enhances local firms' ability to innovate. The divergent findings of these various studies undoubtedly stem from differences in methodology, time frame, and data sources. Not all of these studies are primarily concerned with technological spillovers. Some are focused primarily on productivity, while others look at exports.

Foreign investment has the potential to lead to innovation spillovers in developing countries. Whether that potential is realized depends on a whole host of factors, from the national systems of innovation in host countries to the competitive strategies of the firms themselves. In order to discover the linkages taking place between foreign firms and domestic actors in developing countries, I now turn to a different source of data. BEA surveys, while conducted with regularity, do not contain detailed information about domestic linkages. As I have noted, they are also limited to American firms. Likewise, UNCTAD FDI data are too broad to derive meaningful conclusions about spillovers. The only viable alternative for cross-national data on spillovers comes from firm-level surveys. I use here the World Bank's Investment Climate Surveys. These surveys measure firm perceptions of business environments, while also collecting important operating data from responding firms. The surveys are not available every year, but are implemented sporadically in developed and developing countries. I use the surveys conducted from 2002 to 2005, as the standardized surveys for these years contain more detailed and anonymized firm operating data than surveys in subsequent years, including a great deal of information on innovative practices and various forms of linkages with domestic actors in host countries.[16] This also offers a similar time frame to the US BEA data.

Utilizing survey data involves some significant trade-offs when compared with the BEA reports used earlier in this chapter. On the positive side, the multinational investments are potentially more representative of foreign investment in each country because they come not only from the United States. Surveys also allow a much more detailed picture of firm activities to emerge. On the negative side, the temporal evolution of innovation is difficult to assess because these surveys are not administered every year, and they do not necessarily sample the same firms in subsequent years. The surveys are designed to be representative; however, countries vary greatly in terms of the number of foreign firms interviewed. Another drawback of the World Bank surveys is that firms are not obliged to answer every question. Indeed, some countries are more careful in the administration of these surveys than others, which can lead to discrepancies. Nevertheless, because of the resources of the World Bank these surveys constitute the most widely administered cross-national source of detailed information on multinational activities. The standardized format of the 2002–2005 surveys makes cross-national comparison possible. Within the surveys, there are a number of questions that address innovation and linkages with domestic actors. One question asks firms to identify the percentage of its material inputs and supplies that are purchased from domestic

16. I first eliminated all firms in these surveys that fell below the 10 percent foreign controlling interest criterion established by UNCTAD, in order to consider only those firms that could be classified as multinational. I also eliminated firms operating in those countries that could not be classified as developing countries. This left 5,942 firms in 71 countries.

sources. Another asks the firm how much it spent on design or R&D in the past year, including wages and salaries of R&D personnel. Table 3.3 displays responses on these questions, as well as information on firm exports as a percentage of sales, in a cross-tabulation by industry.[17] The columns of table 3.3 show the frequencies of observations, mean levels of indicators, and standard errors.

Multinationals from some industries are more innovative than others. Roughly half of the electronics firms surveyed spent some money on R&D in the host country. In textiles (roughly one-third) and garments (roughly one-quarter), the incidence of domestic R&D was much lower. In the first four columns of table 3.3, we see that the presence of domestic R&D is associated with increased local sourcing in some industries, and decreased local sourcing in others. In general terms, the industries with a higher technological component (such as IT services and chemicals and pharmaceuticals) display an increase in local sourcing when local innovation is in evidence. For example, there were 39 IT services firms in the sample with no domestic R&D spending, and 34 with domestic R&D spending. Among those with R&D spending, the mean percentage of domestic inputs was more than 10 points higher than among those without R&D spending. The jump is higher in electronics. Meanwhile, lower technology industries such as textiles exhibit the opposite pattern. The percentage of inputs from domestic sources tends to be higher in firms with no R&D. This suggests that sectors with higher technology content may be more likely to partner with domestic firms if local innovation does take place. It also seems that primary sector investments and light manufacturing are most likely to see decreases in domestic inputs when firms are innovative, while heavy manufacturing (for example, autos and auto components) and services see increases.

The four right-most columns of table 3.3 consider the relationship between R&D spending and exporting by sector. The surveys included questions indicating the percentage of firm sales derived from exports, either direct or through a distributor. Some firms did not answer the exporting question or the domestic input question, which explains the discrepancies between the frequency columns. In terms of exports, the pattern is less clear. The presence of local R&D spending does not seem to have a strong relationship with exporting propensity. In

17. It is important to note that the industrial classifications used in table 3.3 differ from the sectoral classifications used by UNCTAD earlier in this chapter.

Table 3.3
Sectoral breakdown of R&D incidence and exporting, domestic sourcing

Industry	Firms with no domestic R&D	Mean % of domestic inputs	Firms with domestic R&D	Mean % of domestic inputs	Firms with no domestic R&D	Mean exports as % of sales	Firms with domestic R&D	Mean exports as % of sales
Textiles	127	49.9 (41.6)	47	44.8 (35.2)	126	52.9 (44.0)	47	48.9 (34.9)
Garments	309	36.6 (41.5)	96	28.9 (36.9)	314	80.9 (35.8	103	75.2 (38.4)
Agroindustry	26	65.5 (41.4)	31	58.0 (43.1)	25	41.1 (43.3)	32	39.4 (43.8)
Food	123	67.8 (37.9)	93	68.6 (34.5)	122	38.4 (43.0)	94	39.5 (41.9)
Beverages	43	66.5 (39.0)	28	50.6 (33.8)	43	21.8 (34.7)	26	11.4 (15.9)
Metals and machinery	177	54.6 (39.4)	166	56.5 (36.2)	179	33.7 (38.6)	167	42.4 (36.7)
Electronics	237	46.8 (38.8)	214	61.7 (35.8)	235	58.3 (42.2)	212	46.6 (42.4)
Chemicals and pharmaceuticals	123	42.2 (38.0)	92	44.5 (35.7)	121	14.8 (23.6)	91	25.9 (31.0)
Wood and furniture	72	72.3 (35.2)	35	61.8 (40.4)	71	42.5 (41.6)	35	35.0 (39.9)
Nonmetallic and plastic materials	101	49.9 (43.1)	48	48.5 (37.3)	102	39.4 (41.4)	45	29.3 (29.0)
IT services	39	58.0 (44.9)	34	69.1 (38.2)	38	12.0 (27.2)	31	12.3 (26.4)
Retail and wholesale	194	27.4 (37.0)	19	32.1 (39.1)	195	8.1 (21.6)	19	12.1 (25.9)
Mining and quarrying	7	89.9 (12.8)	4	73.8 (27.5)	7	66.4 (40.1)	4	5.8 (10.8)
Auto and auto components	89	70.6 (35.8)	116	85.8 (19.6)	88	25.9 (32.5)	110	12.0 (23.0)

Notes: World Bank Investment Climate Surveys, 2002–2005. Standard errors in parentheses. Only multinational corporations operating in developing countries included.

some industries, for example, metals and machinery, R&D incidence is associated with greater exports. Chemicals and pharmaceuticals also see exporting increases when local R&D is present. IT services exhibit low levels of exporting, but this is due to the fact that it is a service industry by definition and oriented to the domestic market. Some of the higher value-added manufacturing subsectors, such as electronics, exhibit higher export propensities. This comports well with Lall's (2003, 14) point that high-tech manufacturing exports tend to grow faster than overall exports in developing countries.

When industries are lumped together across countries, the relationship between domestic sourcing and innovation becomes clearer. Figure 3.10 presents the median R&D expenditure (as a percentage of sales) for all firms in all countries, separated by decile of domestic material inputs. For firms exhibiting between 10 and 20 percent of their material inputs from domestic sources, the median R&D effort is just above 0.8 percent of sales. It is clear from this figure that greater domestic sourcing is associated with higher R&D efforts. As domestic

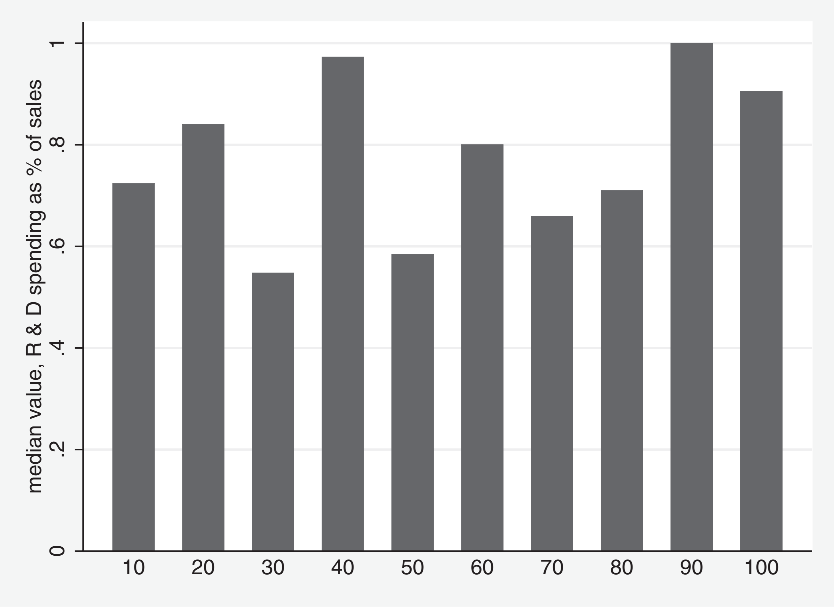


Figure 3.10
Median R&D expenditure by decile of domestic material inputs, 2002–2005 firm surveys.
Notes: World Bank Investment Climate Surveys. Domestic inputs refer to the percentage of material inputs and supplies purchased from domestic sources.

sourcing increases, R&D spending intensity tends to increase as well. This suggests that, in general, firms that develop backward linkages with domestic actors are more likely to devote resources to domestic R&D, across sectors. This correlation does not mean that innovative firms derive their innovations exclusively from domestic sources. However, it does indicate that backward linkages do exist for innovative multinationals, and this makes various forms of spillover more likely.

The relationship between exporting and local innovation is not as straightforward. It is true that developing countries often encourage multinationals to export, and incentives are sometimes available to that end. A highly innovative multinational that exports its product to nearby countries or farther afield is often held as the ideal investment. However, for many innovative firms, market-seeking may be the primary motivation for investment. Many of the most innovative subsectors, such as IT knowledge process outsourcing, are in the service sector where traditional exporting is rare. Furthermore, multinationals looking for export platforms may be primarily motivated by cost considerations and not the supply of highly educated workers or the presence of research institutes nearby. This is the case for the export of textiles, for instance.

The relationship between export activity and R&D intensity is further illustrated in figure 3.11, which collects survey data from select countries and displays individual firms as dots. Only six countries are represented here, but they are among the largest regional economic powers. The countries are displayed, along with the year in which the surveys were completed and the number of firms interviewed. Countries vary in terms of the frequency of observations. Only 25 multinationals provided information in India in 2002, whereas 422 multinational representatives were interviewed in China. However, even with this limited information, certain patterns emerge. China is the only country in which significant numbers of interviewed firms exhibited strong R&D intensity *and* strong export intensity. Even in China's case, firms with high innovation intensity were not especially likely to be exporters. Different sample sizes limit the number of inferences that can be drawn—it may be that more firms surveyed in Brazil or India would have turned up more associations between exporting and domestic R&D. In general, firms in all six countries were more likely to export than conduct local R&D.

Multinationals in developing countries still use these countries as export bases, but innovation and exporting do not seem to go hand in

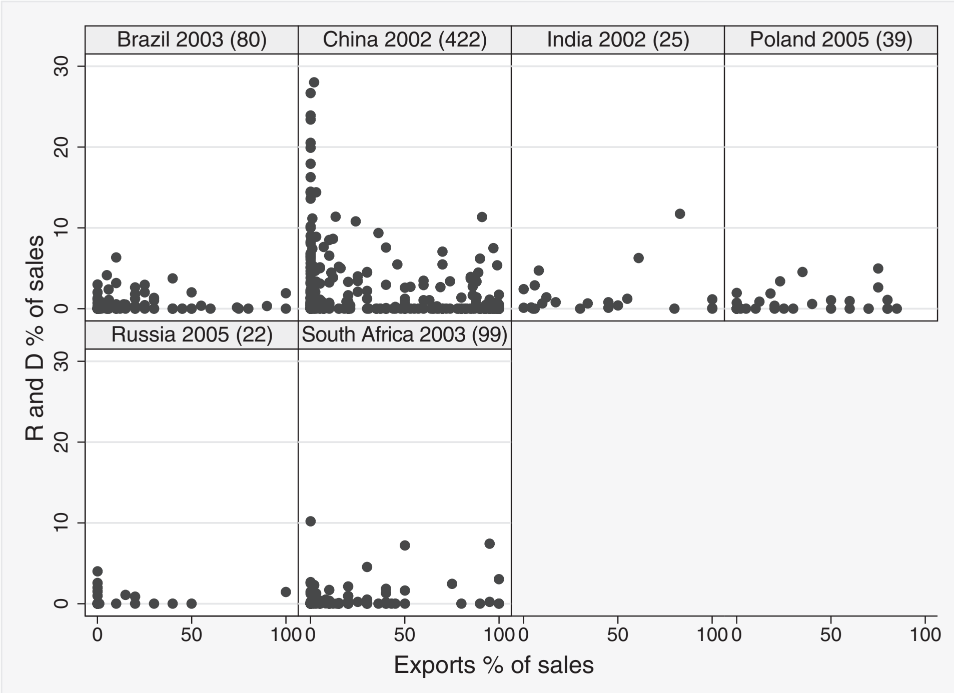


Figure 3.11
Relationship between export intensity and R&D intensity, select countries, 2002–2005 firm surveys.
Notes: World Bank Investment Climate Surveys. Exports can refer to direct exports or through a distributor. Number of multinational firms shown in parentheses.

hand the way innovation and domestic inputs do. Of course, this will vary by country; some large developing countries are prized for their domestic markets, while others are export bases. In general terms it seems fair to say that multinationals conducting innovation in developing countries are still more likely than not to adapt their products for local markets rather than exporting. There are some examples of firms where innovation and exporting are combined. However, this is not the dominant paradigm across sectors.

Figure 3.12 combines the exporting and local sourcing data and separates firms by world region. For each region, firms are separated into two categories, those that evidence R&D spending locally and those that do not. For each of these categories, the mean levels of exports and domestic inputs are then calculated. This figure illustrates a few important points, and summarizes the domestic spillover patterns already discussed. Multinationals in East Asia and the Pacific are

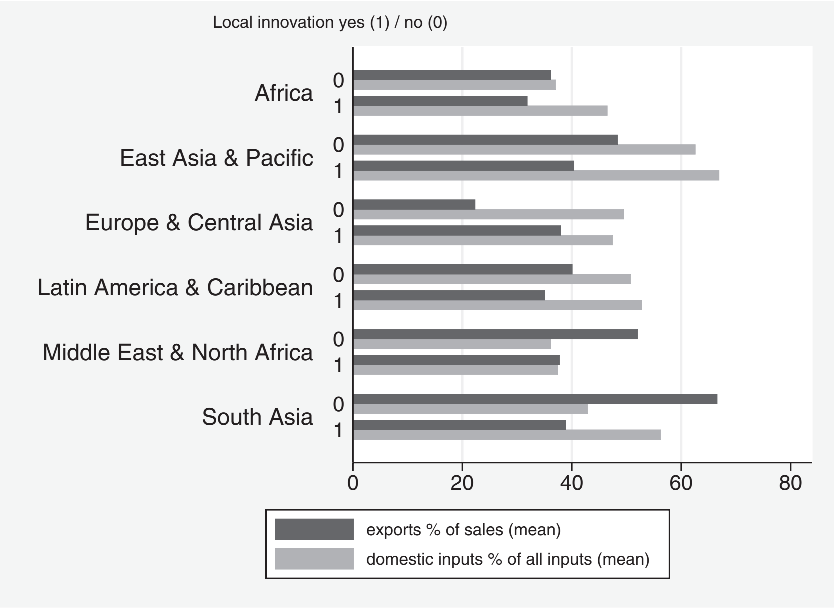


Figure 3.12
Mean levels of exports and local sourcing by region and presence of local innovation, 2002–2005 firm surveys.
Source: World Bank Investment Climate Surveys.

most likely to have domestic inputs, whether they innovate locally or not. Noninnovative firms in South Asia generally export more than firms in other regions. In every case except Europe and Central Asia, the presence of innovation is associated with higher levels of domestic sourcing. The decline in Europe and Central Asia is not great. Likewise, the presence of innovation is associated with decreases in exports in every region except Europe and Central Asia. It should be acknowledged that exports in Eastern Europe are more likely, as the countries are quite small and geographically close to one another. However, multinational firms seem less likely to pair local innovation with exports in most regions of the world. Where multinationals do innovate, it seems more likely to service domestic markets. Upstream linkages with local suppliers do not discourage innovation. On the contrary, the two often go hand in hand. This is encouraging for developmental prospects, as it does not appear that innovative multinationals are more likely to function as islands in developing countries. Instead, embeddedness in local systems of innovation is possible and perhaps even likely.

The data from the Investment Climate Surveys suggest that linkages between innovative multinationals and domestic firms in host countries are not uncommon. Multinationals investing in developing countries often need to adapt products to local conditions, and R&D spending can be a part of that process. However, upstream linkages and spillovers more broadly can often go beyond this process and involve the development of increasing competencies for multinational subsidiaries and their local firm partners. Dachs and Ebersberger (2006), in their case study of multinational investment in Austria, argue that this knowledge and technology transfer can be a two-way street, that multinationals and host country firms constantly exchange knowledge and participate in mutual skill upgrading. While the authors focus on a developed country, that same process can exist in developing countries as well. In the subsequent chapters, I continue to focus on the embeddedness of multinational firms in host economies as an important barometer for industrial upgrading and broader development.

Conclusion

In this chapter, I have proposed broad conceptualizations of innovation within multinational firms. I have traced the history of multinational innovation in developed and developing countries, noting its recent expansion. Innovation is still mostly located in wealthy countries. However, multinationals are irrefutably expanding innovative activities into the developing world. These activities are in turn concentrated in Asia, but there are nonnegligible amounts of innovation happening in all developing regions. I have also noted that backward linkages with host country firms and other forms of spillover are in evidence in developing countries. These activities, often important for the developmental contribution of FDI, are not limited to market-seeking adaptation. Furthermore, foreign firms are often moving toward decentralized and often independent innovation models, developing product mandates independently of head offices in rich countries. These polycentric innovation models look to continue in a new era of multinational production, where traditional manufacturing is gradually superseded by more innovation-suffused and often less tangible products, such as IT services.

Multinationals in developing countries do not operate in a vacuum. They constantly interact with their hosts. The popular image of rote manufacturing tasks performed by poorly compensated and isolated workers is but one possibility of multinational production, and limited to a few sectors. The next chapter begins to evaluate the question of what determines the innovation content of foreign investment. There are numerous answers, from firm characteristics and ownership structure to sectoral particularities and country-level economic profiles. However, I pay special attention to the "pull" factors present in developing countries. Pearce and Papanastassiou (2009), as they detail the emergence of independent multinational subsidiaries with substantial design and development mandates, take great pains to acknowledge the importance of supply-side factors. They point out that the increasing presence of innovation in nontraditional locations reflects the ability of countries to supply high-quality scientific inputs, such as research labs and well-trained personnel. As they explain it, "supporting this it is then argued that a vital factor affecting the value of these MNE [multinational enterprise] labs is the extent and richness of their interaction with the host-country science-base and technological community" (163). This is an essential point: innovation diffusion in developing countries is not solely the result of firm strategy. It is also due to the institutional and policy constraints in host countries and policy choices made by those countries, sometimes going back decades. This summons the earlier and venerable literature on National Systems of Innovation (Lundvall 1992; Nelson 1993), which highlighted how much institutions designed to promote education and innovation can differ and the important roles they may play in a country's development trajectory. Multinational firms are actors in these systems of innovation as well, and are affected by them. Moreover, they exert more influence than in decades past and now serve as focal points in various countries' industrial policies. In the following chapters, I argue that host country institutions and policies are essential determinants of the innovation patterns I have described in the present chapter. I evaluate the theoretic hypotheses generated in chapter 2 and explain how firm-level outcomes are influenced by country-level variation in investment promotion and integration.

4 The Determinants of Multinational Innovation in Emerging Economies

One of the central arguments of this book is that innovation abroad is motivated not only by firm characteristics but by the attributes of host countries. The spread of multinational production presents opportunities for developed countries and emerging economies, whereby all actors stand to benefit. These opportunities are not necessarily realized, but they are present. Multinational firms are not largely motivated by the prospects for economic development in host countries. Profit of course is a much stronger motivation. However, both outcomes are possible. As multinationals consider polycentric innovation structures, developing countries have unique opportunities to enmesh foreign firms in domestic innovation networks and perhaps stimulate virtuous cycles of technological upgrading. In chapter 2 I outlined the theoretic rationales for conducting innovation abroad, and the ways in which various literatures have discussed firm–host country interaction. This chapter considers the tremendous diversity of multinational production and innovation in developing countries and makes claims about its determinants. Whereas the previous chapter described historical trends and current distributions of multinational-linked innovation, this chapter subjects those data to some of the hypotheses derived from chapter 2.

There is a great deal of variation in innovation outcomes. In many developing countries, multinational firms do not innovate. This is sometimes true even for sectors where large amounts of inward investment are evident. In other countries, innovation is more common regardless of sector. What determines these variations? The data presented in chapter 3, while interesting, do not allow us to systematically test which factors are most important for inducing innovation. In order to more fully account for variation, we must turn to the tools of econometric analysis. This chapter therefore subjects firm data to a number of tests. The models assembled here rely primarily on three datasets: the US Bureau of Economic Analysis data on multinational corporations abroad, patent data from the US Patent and Trademark Office and the World Intellectual Property Organization, and the World Bank's Investment Climate Surveys. As previously noted, the BEA data contain information on US firms alone. The patent data take into account patenting of US firms abroad and patents generated by foreign affiliates of all origins in foreign patent offices. The World Bank data come from a variety of countries. There are advantages and disadvantages to all of these data sources. The BEA data are available in time-series format from 1999 on, which is especially useful for tracking how changes in host country variables affect changes in firm-level innovation patterns. The World Bank data are more comprehensive in the sense that they contain more detailed information about the business activities of surveyed firms. They also contain investment information from a variety of origin countries. In this chapter, I supplement these datasets with firm, sector, and country-level variables from other sources, such as the World Development Indicators. I employ various dependent variables in this chapter, all measuring innovative activity on the part of firms. I employ cross-sectional time-series models for the BEA data, count models for patent data, and multilevel models for the World Bank data, where firm-level data is nested within country-level variation. The countries represented in the analysis come from all regions of the world.

In this chapter I employ a variety of independent variables common in the political economy literature on foreign direct investment in developing countries. I do not include many institutional or policy variables, as that is the focus of the next two chapters. However, the models contained in this chapter reveal some interesting patterns. I find that in countries with larger numbers of bilateral investment treaties, aggregate innovation among American multinationals is more common. This is not necessarily true of American firms when a developing country has a bilateral treaty with the United States. I find that trade openness is not consistently related to innovation intensity. This is consistent with much of the literature on trade barriers and local innovation, in which trade can substitute external value-added activities for local ones. I find that entrenched democracies are associated with more innovation. Unsurprisingly, the level of a host country's development is a reliable predictor of innovation. More-developed host countries exhibit higher levels of innovation from multinationals operating within their borders. I also test arguments regarding the production and export profiles of developing countries. I find that countries with relatively larger agricultural and mining sectors have lower levels of multinational innovation. I also find that larger higher-technology manufacturing sectors go hand in hand not only with higher innovation in those sectors, but also with higher levels of innovation in the service sector. In other words, if innovation is present in chemicals manufacturing, it is likely to be higher in higher value-added services as well, even while controlling for level of development.

I also include a number of firm-level variables in the models, particularly those using the investment climate surveys. I find that increased foreign ownership is associated with a decreased likelihood of innovation. I argue that the more control the multinational has over a firm operating in a developing country, the higher the likelihood that innovation will be centralized in the multinational's country of origin. I link this finding to the global value chain literature on vertical production networks, where efficiency-seeking investments can at times create incentives for centralized innovation. I find that market-seeking investments have a tendency to conduct more local innovation. I also find that many of the above relationships apply when alternate measures of firm innovation, such as patenting activity, are used. Overall, the results from the various quantitative models in this chapter point to a multifaceted relationship between host countries and multinationals. I connect these findings to ongoing debates about the how host countries might best attract multinationals and enmesh them in local systems of innovation for development purposes.

For ease of interpretation, I consider the BEA data, patent data, and World Bank surveys separately and in that order. For each, I first describe the dependent and independent variables, the methods employed, and the results obtained. In most models, either the presence of local innovation as a dichotomous yes/no variable, patent counts, or R&D spending (as a percentage of sales or value added) are used as the dependent variables. Because of the unique data structures in both datasets, I dwell on the econometric models used and the reasons for their use. For the theoretically important independent variables, I also outline the mechanisms linking their variation with innovation changes. In the conclusion to the chapter, I synthesize the findings from both datasets and place them in the larger context of the book. Chapter 5 then extends the theory and analysis to consider the role of domestic institutions in host countries.

BEA Data on American Multinational Innovation Patterns: Variables and Data Sources

In this chapter, innovation effort on the part of multinational firms serves as the dependent variable. For the first set of econometric models, I use BEA data on American multinational R&D spending as a percentage of value added. These data are available from 1999 to 2008. The BEA records R&D spending after 2008, but changed its accounting practices that year. Therefore the 10-year stretch between 1999 and 2008 represents the longest uninterrupted time-series of comparable data across firms. All American multinationals are obliged to provide information to the BEA on their overseas activities, including spending on R&D. Importantly, the BEA divides firms into sectors and subsectors. It is therefore possible to compare R&D activity across countries and sectors. I use value added as the denominator for the dependent variable simply because it is available, and because it represents a common quantification of multinationals' local production. In the case of the investment climate surveys later in this chapter, value-added statistics are not available and sales figures are used as scalars. It is important to note that the BEA data on R&D spending are more complete in certain sectors and subsectors than in others. For example, it is more likely that the BEA will have complete information on total R&D spending in the manufacturing sector for a given country than complete data for the transportation equipment manufacturing subsector. In the statistical analysis that follows, positive coefficients correspond to increases in overall local R&D spending by US multinationals.

The R&D spending data are arranged into country-years for 30 developing/transition countries from 1999 to 2008. These values fluctuate from year to year. For example, in 2002 US multinationals in Egypt spent 3.007 percent of value added on R&D, in all manufacturing sectors. In 2003, that same figure was 2.703 percent. The developing countries represented in the models come from a variety of geographic locations. They are mostly middle income.[1] Most countries

1. A complete list of the countries used in the models is available in appendix A.

exhibit more comprehensive overall R&D spending data and data from major sectors such as overall manufacturing, but some countries did not have adequate subsector data and are therefore dropped from subsequent models. The transportation equipment manufacturing subsector, for example, contained only enough data to include 22 of the 30 countries.

For the time-series analysis of US BEA data, I include a series of potentially important independent variables. In the literature on the determinants of FDI flows in developed and developing countries, there are a number of control variables that consistently appear (Chakrabarti 2001). There are a number of core demographic and socioeconomic variables that represent potential influences on R&D effort by US multinationals. The first of these, population, is a potentially important predictor. Of course, there is a great deal of cross-unit variation for this measure. Countries with larger populations may attract more innovative activity, as they have larger domestic markets. Firms may want to adapt products for local markets, and larger populations may offer larger pools of qualified scientific and research personnel. Countries with smaller populations, on the other hand, may be able to carve out niches as locations for innovative FDI of one particular kind or another. I include the natural log of a country's population, taken from the WDI.

I also include per capita income and the economic growth rate as potential influences on R&D spending. For multinational investors concerned with potential markets for innovative products, market size is important. The level of per capita income represents the potential purchasing power of foreign consumers and is a potential proxy for the skill level of a population. Richer countries potentially offer a consumer base with wider access to new technologies, and these populations may be more ready to incorporate innovative products into their spending patterns. There is some conflicting evidence regarding the general relationship between GDP per capita and incoming FDI. Asiedu (2002) and Jaspersen, Aylward, and Knox (2000) find that in Africa, real GDP per capita is inversely related to FDI as a percentage of GDP. Schneider and Frey (1985) find the opposite, that wealth increases incoming FDI relative to economy size. Tsai (1994) also finds that higher GDP per capita is associated with higher levels of foreign investment. In this analysis, I expect the latter effects to take hold with innovation spending patterns. Increases in country wealth in host countries should make innovation more likely among American multinationals. Based on the results relayed in the previous chapter, richer countries command the most R&D spending among American multinationals. I expect that among developing countries, wealth should remain an important positive predictor of R&D spending levels. Positive economic growth rates should also positively affect R&D spending. Schneider and Frey (1985) argue that growth rates serve as signals of development potential and make it easier for firms to contemplate long-term investments. In a similar way, positive growth rates may indicate that developing countries are fertile ground for innovation-intensive forms of investment. In the following models, I use the previous year's growth rate as taken from the World Bank's WDI. To measure income, I use the natural log of GDP per capita, in constant dollars and with a purchasing power parity adjustment. These also come from the WDI.

Two other variables, a measure of infrastructure development (internet users per 100 people) and a measure of human capital, displayed close correlation with GDP per capita, as indicated in appendix A. These measures were therefore included in separate models to avoid problems of multicollinearity. The infrastructure measure comes from the WDI and is increasingly used as an indicator of infrastructure development, particularly in contrast to more traditional measures such as port access and highway development (Doh et al. 2005). The measure of human capital comes from the widely used Barro–Lee educational attainment dataset (Barro and Lee 2001; Lee and Lee 2016). While it is exceedingly difficult to compare educational outcomes across countries, this data project has developed numerous indicators of school enrollment, attainment, and human capital. I employ the alternate aggregate human capital stock measure contained in the long-run dataset, described in detail in Lee and Lee (2016). This measure is available in five-year increments. Therefore, in order to complete the time-series, multiple imputation was used with the 1995, 2000, 2005, and 2010 human capital measures as reference points. While it is unfortunate that yearly human capital data are not available, the Barro–Lee data are carefully constructed and represent an important potential influence on R&D levels. This is the only variable in the time-series for which multiple imputation was employed.

The variation in institutional quality in developing countries, and its impact on innovation patterns, is considered in chapter 5. However, I do include a measure of democratic durability as a predictor in the models in this chapter. There are a number of reasons for this. First, the literature on the relationship between democracy and incoming foreign investment in developing countries is quite robust, and measures of democracy are among the most common predictors of FDI. Second, the relationship between democracy and FDI is often quite strong in other econometric studies and is therefore an important control. Third, and perhaps most important, democratic governance has potentially important impacts on local innovation by American multinationals, coming themselves from a democratic context. The debate about whether democracies or authoritarian regimes attract more FDI (Oneal 1994; Jensen 2003; Li and Resnick 2003; Kenyon and Naoi 2010) asks, at its most fundamental level, which form of government lowers uncertainty for firms. Brunetti and Weder (1998) show that political instability can scare off investors by threatening the predictability of the business environment. According to these studies, it is the consistency and stability of governments that gives potential investors the assurance that their long-term investments will not be threatened.

The question as to whether democracies or authoritarian governments provide more of this stability to firms has not been settled. Li and Resnick (2003) argue that investment results when democracies bring respect for property rights to developing countries but that strong property rights may be present in authoritarian regimes as well. Jensen (2003) argues that voters will punish leaders who neglect to attract or keep needed investment from abroad, and both he and Busse (2004) find that multinationals are attracted to countries where democratic rights are protected. Henisz (2000) makes the important point that democracies typically offer more veto points in their legislative process, which enhances the predictability of policy and risk minimization. Democratic regimes also rely on broad bases of support, which can make property rights more secure in the long term.

The arguments that authoritarian regimes are more hospitable for FDI typically refer to these regimes' insulation from societal pressures. Whereas elected leaders must contend with pressure for higher wages and other demands of organized labor, autocracies can ignore these demands. In this role, an authoritarian state can protect investors against expropriation or other harmful policies, while also providing guarantees of property rights or other incentives (Haggard 1990). Oneal (1994), in a cross-national study of 48 countries from 1950 to 1985, argues that foreign firms enjoy greater returns in developing countries ruled by authoritarian governments. In the case of authoritarian regimes, the minimization of uncertainty stems from the autocrat's ability to disregard popular pressure. More recently, Pandya (2013) argues that foreign investment does generate popular pressure in the direction of loosening FDI restrictions, as labor is the primary beneficiary of incoming foreign investment. In this interpretation, the proposed relationship between greater democracy and increased investment is not due to minimization of risks for the investor but instead due to demand-side interests in the host country.

Most of the literature considering the impact of democracy on foreign investment considers aggregate flows and stock of FDI. However, the theoretic arguments are directly applicable to levels of multinational innovation in developing countries. The question of risk minimization becomes more important when innovation is introduced. If democracies do indeed provide stronger guarantees that innovation will be protected with secure property rights, we may expect a general association between democratic governance and R&D incidence and/or intensity. On the demand side, workers and consumers in host countries should prefer innovation-intensive investment, which often brings higher salaries. These groups should therefore lobby for high-tech investment in democratic settings. While authoritarian regimes can also be expected to seek out innovation-intensive investment, leaders in democracies answer to a larger group of people and should therefore be loath to violate investors' trust by expropriating technology. I therefore expect that democratic governance should be associated with higher R&D intensity. This should be the case for American firms, as democratic governance in the home country of firms may be associated with an affinity for democracy in the host country. To measure democracy, I employ the democratic longevity measure developed by Cheibub, Gandhi, and Vreeland (2010). This is simply the number of years the host country has been a democracy, and is coded 0 if the country has a nondemocratic regime.

In addition to the democracy variable, I also include a measure of the degree to which countries have controlled corruption. Corruption increases risk for foreign investors and may be especially sensitive for multinationals considering R&D activity, given the risk of appropriation. The following chapter contains several additional measures of corruption and a more extensive discussion of its possible effects on innovative activity. Most corruption measures are not available in time-series format and tend to be issued in five- or 10-year increments. However, corruption is one of the components considered in the annual measures of the International Country Risk Guide (ICRG), now offered by the Political Risk Services (PRS) Group. The ICRG is a long-running source of aggregated opinion on country risk. For this measure, I used the annual values of the control of corruption rating provided in the ICRG Researcher's Dataset. These annual measures are available since 1984 and include expert assessments of governmental stability, corruption, ethnic tensions, and nine other components. The ICRG is marketed to multinational firms, banks, and equity and currency traders and purports to serve as an "early warning system for opportunities and pitfalls."[2] Higher values on this measure indicate better control of corruption.

I also include as predictors a set of variables that collectively refer to a country's economic "openness." These are common determinants of FDI stocks and flows in political economy literature, and they have added relevance for R&D intensity among multinational firms. The three areas of economic openness I include are trade, financial openness (capital controls), and openness to FDI in general. There is a small but important body of work on the relationship between capital controls and overall volume of FDI. Gastanaga, Nugent, and Pashamova (1998) find a consistent positive relationship between reduction of capital controls and aggregate incoming FDI in their study of 49 less-developed countries. Asiedu and Lien (2004) argue that this relationship works for some time periods and countries, but not for others, and that sub-Saharan African FDI is not adversely affected by capital controls. Desai, Foley, and Hines (2006) show that multinationals in countries with higher capital controls must confront higher interest rates when borrowing locally than firms in similar countries with fewer controls. This serves as a deterrent effect for incoming FDI and promotes capital account liberalization as a relatively easy policy change that may have a significant impact on foreign investment. Montiel and Reinhart (1999) discuss the impact of different kinds of capital controls on not only the volume but also the composition of incoming investments. The literature is fairly consistent that the presence of capital controls is associated with lower levels of FDI.

But what of innovation levels? Do capital controls stifle innovation among multinationals? Here the existing literature is smaller still. In one study on China's efforts to loosen financial restrictions, He, Sun, and Zou (2013) argue that financial deregulation has not been among the most influential factors behind China's recent FDI surge.

2. See http://www.prsgroup.com/ICRG.aspx.

However, the authors note that financial deregulation allows China to exploit FDI more efficiently by enhancing the country's technological absorptive capacity. That is, firms rely on access to domestic capital to develop new technologies. Capital controls simply increase the cost of capital movement. It seems reasonable to suppose that capital account openness will be associated with more R&D spending on the part of American multinational firms, as these firms will have increased access to funding from domestic and international sources. To measure capital account openness, I utilize the Chinn and Ito de jure index of financial openness (Chinn and Ito 2008).

I also include the overall level of American FDI stock, as a percentage of GDP. I am ambivalent as to whether larger amounts of FDI will be connected to more innovation. As noted in the previous chapter, some countries attract large amounts of American investment without this investment necessarily having a high R&D content. Nevertheless, overall levels of American FDI relative to GDP are potentially important indicators of openness.

The last measure of openness is trade. Here I use exports plus imports as a percentage of GDP, taken from the WDI, as a standard measure of trade openness. Trade is different from other forms of openness and has a potentially more complicated relationship with innovation within multinationals. Unlike financial openness, expectations regarding the relationship between trade and innovation are not straightforward. During more protectionist periods after World War II, tariffs were an important motivator for direct investment in developing countries (the so-called tariff-hopping FDI) and horizontal forms of investment. In this role, FDI served as a substitute for trade. However, trade liberalization offers more possibilities for vertical forms of investment and the development of global production chains. There have been a number of efforts to measure the overall relationship between trade and FDI (Gastanaga et al. 1998; Morisset 2000; Noorbakhsh et al. 2001). Most studies find some limited evidence that trade openness is associated with increased levels of foreign investment. However, trade should have a more ambivalent relationship with levels of innovation among multinationals. This is because trade can serve as a substitute for innovative activity, particularly in multinationals with vertical production networks. Almeida and Fernandes (2008) find that majority-owned firms are less likely to engage in technological innovations than minority-owned firms, and reason that intrafirm trade makes it less likely that multinationals will innovate locally. That is, multinational affiliates in developing countries may simply import inputs with high technological content instead of developing them in partnership with local firms. Dachs and Ebersberger (2006), in their study of multinational affiliates in Austria, argue that firms in vertical production networks have more of a temptation to collaborate with their vertical partners, focusing on internal sources of innovation. This may be beneficial for the economy as a whole; imports of state-of-the-art capital goods can boost productivity. However, the multinationals involved will not be engaging in innovation in the host country.

The association between general openness to trade and innovative activities of multinationals is therefore complicated. If firms are engaged in vertical production networks, trade may serve as an effective substitute for local innovation. The likelihood of this outcome increases if the firms are majority owned. However, trade also has the potential to bring capital goods and new products to affiliates. My general expectation is that trade openness will be negatively associated with innovation among multinationals in developing countries. In addition to the WDI measure of overall trade openness, I include a measure of US-specific trade, consisting of current US imports and exports as a percentage of domestic GDP. If US trade is large as a percentage of GDP, I expect local innovative effort on the part of multinationals will be lower.

While there are a number of internal policy reforms that may impact the innovative content of incoming FDI in developing countries, it is important to also consider how international agreements may affect investment characteristics. I concentrate in this chapter on the type of international agreement most likely to impact multinational decision-making: bilateral investment treaties (BITs). BITs were originally designed to protect investors (typically large companies) from expropriation in other countries. While few in number in the 1960s, they grew exponentially in the 1990s and continued to increase in recent years, totaling over 2,500 in 2010 (Tobin and Rose-Ackerman 2011, 3). BITs typically include protection against arbitrary or discriminatory policies in the host country, protection against performance requirements, and freedom in hiring practices. BITs also often include protections against violations of intellectual property and international patent recognition. When firms perceive violations of these agreements, they may take their cases to international arbitration venues, most often the International Centre for Settlement of Investment Disputes (ICSID). BITs are very common in countries with substantial amounts of foreign investment; however, as Milner (2014) and Büthe and Milner (2008) note, similar provisions are also increasingly evident in preferential trade agreements (PTAs).

Scholars of foreign investment have built a substantial literature around BITs, though most of this literature concentrates on the question of whether BITs lead to more incoming foreign investment overall. Elkins, Guzman, and Simmons (2006) argue that BITs "tie the hands" of host countries, reducing their freedom of movement and potentially making foreign investors less nervous about investment. Simmons (2014) has argued that because a robust multilateral framework governing FDI does not exist, BITs are attractive for firms because they allow a solution to the time inconsistency problem. That is, they reduce the possibility that host states may renege on their commitments to investors, years after the initial investment is made. BITs allow states to make more credible commitments to multinationals, and these commitments allow for the possibility of future litigation through defined venues. By this logic, BITs should also serve the host country's interest, as a relatively quick way to prove a hospitable investment environment. There is some recent suspicion that developing countries have refused to sign BITs based on concerns about a loss of sovereignty and in some cases have refused to sign BITs that include third-party arbitration clauses. However, the overall number of BITs continues to climb if at a slower pace than in the 1990s.

The relationship between BITs and the overall level of foreign investment is contested. There are a number of studies that find positive correlations between the number of BITs signed by a country and FDI flows (Neumayer and Spess 2005; Büthe and Milner 2008; Kerner 2009). Tobin and Rose-Ackerman (2011) argue that BITs are effective when institutional quality in developing countries is high enough and that BITs have decreasing marginal effects on overall FDI levels. However, other studies have failed to find a strong relationship (Hallward-Driemeier 2003) or argue that BITs increase investment only between the signatory countries. Yackee (2008) finds no clear link between investment treaties and investment decisions and goes further to argue that formally strong agreements—those that should theoretically be most attractive to FDI—are in fact not associated with increased investment.[3]

3. Simmons (2014) echoes this point by demonstrating that the strictest BITs are signed by weak countries at moments of economic distress, suggesting power relationships between home and host countries are important to the form of BITs.

Overall levels of FDI are the focus of these and other works. Yet innovative activity on the part of multinationals should also be affected by the presence or absence of BITs. If BITs are indeed credible commitment mechanisms for host countries, the proliferation of BITs should be associated with an increase in innovative activities. Firms should be more willing to locate potentially sensitive innovation in countries with strong legalistic commitments to settling investment disputes. BITs often contain language about protecting intellectual property of firms. The alternative interpretation is that BITs make it easier for firms to locate innovation in home countries, and then import those innovative products to the developing country. This is because BITs ostensibly allow more freedom of movement to firms, particularly minority-owned firms. Firms may be better able to resist host country pressures for local innovation in countries that have signed agreements with the multinationals' home country.

These two countervailing hypotheses are plausible, and the subsequent analysis includes two different measures of BIT prominence in order to determine which, if either, of these relationships is more likely. First, I include a count of the number of BITs signed by each country in each given year. This simple measure comes from ICSID's online database, and ranges from 0 to 76 in the time frame considered. The other measure is a binary variable indicating whether the host country has a BIT with the United States or not. This measure comes from the UN Conference on Trade and Development's international investment agreements navigator, which contains data on what year American BITs went into force in a variety of developing countries. This measure is doubly important because all of the firms in the first analysis in this chapter are American. My expectations differ for each of these measures. I do expect to find that as the number of BITs signed by a country increases, the innovation level of American multinationals will increase. I suspect that large numbers of BITs signed by a country do signal a credible commitment to investors that their innovations will be protected. However, I expect that the presence of a specifically American BIT will not have an association with increased innovation, or perhaps even a negative association.[4] The second measure is more likely than the first to have a negative association, because an American agreement increases the likelihood that the American multinational

4. Tobin and Rose-Ackerman (2011) were similarly unable to find that signing a BIT with a specific country was associated with more FDI from that country.

will located its innovative activities in the United States instead of in the host country. This is similar to the hypothesized dynamic with ownership patterns. Increased freedom of movement for firms, whether through increased local control or international legal commitments, may result in increased centralization of innovation.

Because all of the data for the first models in this chapter are in time-series format, they appear 10 times (1999–2008) for each of the 30 countries in the analysis. Some vary more than others. Summary statistics, including the BEA data on R&D intensity, are presented in appendix A. Some countries have missing data in some of the indicators. However, data coverage is generally good.

BEA Data on American Multinational Innovation Patterns: Statistical Methods

Because there are multiple data points for each country, corresponding to the 10 years in the analysis, traditional regression methods are not appropriate. Time-series approaches for panel data routinely result in autocorrelation problems and distortionary effects across units (countries, in this case), which can result in bias for the estimators. Fixed effects models utilizing dummies for each of the panels go some way toward solving the problems of time-series cross-section data but do not adequately address problems with endogeneity common to many of these analyses. Furthermore, as Beck and Katz (1995) have noted, fixed effects models do not adequately tackle the problem of autocorrelation in the dependent variable.

I instead opt for ordinary least squares (OLS) with panel-corrected standard errors and a number of other corrections. These include an autoregressive specification and heteroskedastic errors across panels (variance specific to each country). A test developed by Wooldridge (2002) reveals autocorrelation in panel data models, and in this case the test revealed the presence of serial correlation.[5] I therefore assume first-order autocorrelation within countries (an AR(1) process). Because many of the predictors used in these models change slowly over time yet vary greatly between countries, I opt against the fixed effects specification. The resulting random effects models assume that country-specific errors do not correlate with the model's independent variables. This assumption is not warranted in most cross-sectional time-series

5. This test was implemented using a tool developed by Drukker (2003).

data, and it is not supported in the data used here. I therefore use the heteroskedastic option for these models. That is, the variance is assumed to be specific to each country. The general form of the model is as follows:

$$y_{it} = \boldsymbol{x}_{it}\boldsymbol{\beta} + \varepsilon_{it}$$

where $i = 1, \ldots, m$ is the number of units (countries), $t = 1, \ldots, n$ is the number of time periods (years) in panel i, and ε_{it} is a disturbance that is autocorrelated along t. As autocorrelation is specified in these models, the estimates of the parameters are conditional on the estimates of the autocorrelation parameters. More specifically, the common correlation coefficient is determined as

$$p = \frac{p_1 + p_2 + \cdots + p_m}{m}$$

where p_i is the estimated autocorrelation coefficient for panel i and m is the number of panels. The covariance of the Prais–Winsten (unbalanced) coefficients is determined as

$$\mathrm{Var}(\beta) = (\boldsymbol{X'X})^{-1}\boldsymbol{X'\Omega X}(\boldsymbol{X'X})^{-1}$$

where $\boldsymbol{\Omega}$ is the covariance matrix of the disturbances.[6] To summarize, the use of panel-corrected standard error models with autoregressive corrections, with country-specific variance, reduces the potential for bias and inefficiencies from unit effects and inefficiencies from autocorrelation and heteroskedasticity.

BEA Data on American Multinational Innovation Patterns: Results

Table 4.1 presents the results of eight models of up to 30 developing countries from 1999 to 2008, 10 years inclusive. The dependent variable in all of these models is US firm R&D spending as a percentage of total value added from those same US firms. That is, the measure indicates the percentage of their local production US firms invested in R&D in a given year. Positive coefficients imply that as levels of the predictors rise, levels of R&D rise as well. Columns two through four of table 4.1 present results for all industries aggregated. These models separate the GDP per capita, human capital, and infrastructure

6. See Beck and Katz (1995) for additional detail on the determination of the covariance matrix.

Table 4.1
Determinants of US firm R&D spending as a percentage of value added, 1999–2008, cross-sectional time-series analyses

					Manufacturing			
Independent Variable	All Industries			Total Manufacturing	Computers and electronic products	Chemicals	Transportation equipment	Information services
GDP per capita (logged)	1.374*** (0.529)			1.535** (0.684)	1.960 (1.307)	0.375 (0.383)	1.513** (0.763)	0.427 (0.343)
Human capital (interpolated)		0.287 (0.337)						
Internet users per 100 people (infrastructure)			0.001 (0.031)					
Population (logged)	0.445 (0.273)	0.778*** (0.173)	0.001 (0.357)	0.766* (0.431)	0.464 (1.144)	0.141 (0.258)	1.010** (0.413)	0.066 (0.091)
GDP growth	–0.016 (0.024)	0.003 (0.010)	–0.010 (0.019)	–0.010 (0.032)	–0.020 (0.106)	–0.066* (0.034)	0.095 (0.082)	0.003 (0.008)
Number of bilateral investment treaties	0.065*** (0.020)	0.033*** (0.012)	0.067*** (0.023)	0.080*** (0.028)	0.164** (0.064)	0.053*** (0.015)	0.006 (0.022)	0.010 (0.010)
Bilateral investment treaty with United States (dummy)	–1.780*** (0.628)	–0.519* (0.279)	–2.232*** (0.779)	–1.797** (0.819)	–5.899** (2.862)	–0.869 (0.606)	1.591* (0.912)	–0.222 (0.335)

Trade	0.0043	0.0081*	0.008	0.008	–0.005	–0.004	–0.005	–0.000
	(0.005)	(0.004)	(0.006)	(0.010)	(0.021)	(0.003)	(0.011)	(0.002)
Capital account	0.095	–0.119**	0.094	0.259	0.916	0.120	0.005	0.022
	(0.143)	(0.052)	(0.129)	(0.202)	(0.604)	(0.185)	(0.331)	(0.076)
US FDI	–0.004	0.001	–0.008**	–0.004	0.138	–0.003	0.047	0.006
	(0.003)	(0.002)	(0.003)	(0.004)	(0.121)	(0.002)	(0.062)	(0.009)
US trade	0.033**	0.027***	0.006	0.048**	0.166*	–0.003	–0.002	–0.001
	(0.015)	(0.008)	(0.016)	(0.023)	(0.097)	(0.013)	(0.034)	(0.011)
Democracy length	0.085***	0.009	0.072**	0.094**	0.249***	0.053***	0.042*	0.025
	(0.029)	(0.010)	(0.028)	(0.039)	(0.069)	(0.018)	(0.022)	(0.017)
Control of corruption index	–0.034	0.096	–0.056	0.084	–0.096	0.139	–0.046	0.031
	(0.150)	(0.089)	(0.146)	(0.202)	(0.676)	(0.225)	(0.374)	(0.059)
Constant	–22.09***	–15.35***	–1.21	1.535**	1.96	0.37	1.51**	0.42
	(7.14)	(3.57)	(6.40)	(0.68)	(1.30)	(0.38)	(0.76)	(0.34)
N	241	207	250	230	153	240	139	189
Countries	29	25	30	29	25	29	22	28
R^2	0.166	0.455	0.135	0.120	0.268	0.149	0.090	0.105
Rho	0.788	0.689	0.821	0.809	0.734	0.536	0.676	0.734
Wald chi-square	32.4	53.8	27.62	22.05	35.65	39.30	31.03	8.68

Notes: BEA Data. Standard errors are in parentheses. ***$p < .01$, **$p < .05$, *$p < .1$. Panel-corrected standard errors with AR(1) correction and heteroskedastic panels.

measures due to high correlations among these predictors. The next four columns are for only manufacturing firms, and columns six through eight are for manufacturing subsectors. These manufacturing subsectors (computers, chemicals, and transportation equipment) are among the sectors with higher possible technological content than other manufacturing sectors. The last column is a service subsector, information. There are 300 potential country-year observations. The models presented have no fewer than 150 observations. In columns two through four, there are a number of statistically significant predictors. The GDP per capita indicator is highly significant, positive, and substantively important. A standard deviation increase in the natural log of GDP per capita (0.783) is associated with an increase of 1.07 in the percentage of value added devoted to R&D by US multinationals. GDP growth is not related to R&D intensity, at least in the short term. The number of bilateral investment treaties signed and ratified by the host country is positively related to R&D intensity. Each additional treaty signed is associated with an increase of 0.065 in the R&D measure. While this may not seem like a substantively important amount, the mean number of BITs in force in these countries is 26, suggesting that the cumulative effect of BIT participation could be quite important for R&D intensity. However, the existence of a bilateral investment treaty with the United States is associated with lower R&D spending levels, by about 1.8 percentage points. How are these two results simultaneously possible? American firms in countries that have signed BITs with the United States have more protections for their R&D activities. They are arguably more likely to construct more deeply integrated production chains because they feel protected by the BIT, and these (perhaps vertical) chains are perhaps more likely to centralize R&D in the home country of the multinational. This proposed relationship is corroborated by subsequent models later in this chapter, where increased ownership levels are shown to be associated with less local R&D. At the same time, countries with many signed BITs are attractive locations for R&D, due to the commitment mechanisms implied by such agreements and corresponding protections for intellectual property rights. Overall, it is more understandable that we should see the negative relationship between BITs and R&D levels when the BIT is signed with the country of origin for the multinational, which is exactly what these results convey. These results suggest that BITs have countervailing effects on R&D intensity. On the one hand, BITs are commitment mechanisms designed to ease risk perception among multinationals, and this may potentially increase local R&D. On the other hand, BITs may make it easy for multinationals to centralize higher value-added activities such as R&D by increasing incentives to deeply integrate value chains and perhaps engage in efficiency-oriented production, of which domestic R&D may or may not be a part.

The models contain a number of indicators for economic openness, centered on trade, capital controls, and overall openness to FDI. These measures are not reliably associated with R&D intensity among American multinationals. The specifically American trade indicator demonstrates inconsistent signage and lack of consistent levels of significance, which makes it difficult to make any definitive claims about the relationship between trade openness and innovation intensity. I hypothesized that trade openness would make it easier for firms to centralize R&D in the home country, as firms would simply import innovation-intensive products. The results here do not indicate strong support for this hypothesis, but neither do they support the claim that trade liberalization increases innovation among American multinationals. The other economic openness indicators are not strongly related to R&D intensity. The amount of US FDI flowing into the country does not have a consistent relationship with innovation. This suggests that the size of US investment is not a real factor for its innovation content. This stands to reason, as some countries attract a large amount of noninnovative FDI, while small FDI flows may have a high R&D content.

The durability of democracy in a host country is consistently and positively related to innovation levels, across sectors. The longer a host country has been democratic, the more likely it is that US multinationals will locate innovative activities in that country. While this result does not distinguish whether democracies offer risk minimization to firms (Henisz 2000), it does seem to corroborate the general argument that democracies offer more protections for foreign investors (Jensen 2003; 2006). To the extent that democratic governance and property rights are codetermined, democracies should provide more hospitable environments for local innovation. However, it is important to emphasize that the sending country in this analysis is a democracy itself and therefore its firms may have an affinity for democratic host countries as locations for innovations.

Overall, these time-series results from US firm data suggest that multinational firms' innovation patterns are influenced by a number of external factors. In particular, richer and more durable democracies attract more innovation from American firms. This is not surprising. More intriguing are the results that various measures of economic liberalization do not consistently impact innovation. Countries that open to trade do not necessarily see more multinational innovation. Similarly, capital account liberalization and overall FDI penetration do not consistently link to increased innovation. The overall number of bilateral investment treaties signed by a country may increase innovation from US firms, but a BIT signed with the United States does not. More established democracies attract more innovation from US firms, suggesting that host country political institutions matter for investment models. This theme will be further developed in the next chapter. It is important to note that in all these models, firm R&D spending is aggregated to the national level through time.

While panel-corrected standard errors help solve some issues stemming from time-series analysis of panel data, they are not particularly well suited to deal with problems of endogeneity. There are several potential sources of endogeneity in the models presented in table 4.1. As an additional set of robustness checks for the results presented here, appendix A contains a set of models coming from the generalized method of moments (GMM) framework, which relies on deep lags of variables as instruments. These models also contain a lagged dependent variable as a predictor, exclude outliers using Cook's D criteria, and contain a number of additional tests for serial correlation. The models replicate columns two through four of table 4.1, within the GMM framework. The results from these GMM models are largely consistent with those presented in table 4.1. Interestingly, the human capital measure is significant (still positive) in the GMM robustness checks. However, these models are included in large part to demonstrate that the results are robust to the inclusion of a lagged dependent variable and while accounting for endogeneity and outliers. The next section of this chapter returns to the panel-corrected standard error approach, builds off the models in table 4.1, and asks whether firms in different sectors conduct innovation, and whether those patterns depend on sectoral production profiles.

Sectoral Heterogeneity and American Multinational Innovation Patterns

The previous chapter noted in detail how FDI has changed in low and middle income countries since the 1980s. Service sector investments have become more important, while manufacturing investments have exhibited growing diversity. The chapter also noted that countries differ considerably in the degree to which they are dominated by one form of investment or another. Some countries, such as Singapore, are dominated by service sector investment. Other countries, such as Papua New Guinea, continue to be dominated by primary sector investments. These investment profiles often mirror the dominant sectors of production in these countries. It stands to reason that countries with significant natural resource endowments should exhibit corresponding distributions of FDI stock. Indeed, the sectoral distribution of economic activity in a country often impacts the dominant forms of investment, though this relationship is not deterministic. It also stands to reason that the sectoral distribution of economic activity should impact overall innovation levels by multinational firms in these countries, both through the direct effect that certain sectors are by their nature more innovation prone and through the indirect effect that certain sectors nurture transferrable expertise and general skill levels. I have thus far concentrated on broad economic indicators as determinants of R&D activity. But the specific sectoral economic profile of a country, and the extent to which the dominant sectors are those in which innovation is more or less likely, should also have an impact.

While it is certainly true that countries at similar levels of development can have very different sectoral profiles in terms of economic activity, it is also the case that lower income countries are more often characterized by a reliance on agriculture and light manufacturing industries, such as textiles. In 2010, agricultural workers still accounted for 25 percent of all employment in low- and middle-income countries, whereas in high-income countries the figure was 4 percent.[7] More wealthy developing countries are more likely to have developed diversified manufacturing and service economies, and the industries within these broad sectoral categories are also more likely to have

7. The World Development Indicators did not have data for low-income countries alone.

higher value-added characteristics. The differences among countries' economic profiles should have important implications for how multinational firms invest. To put it differently, the economic profiles of countries should have an impact not only on the dominants types of FDI, but also on the likelihood that firms are engaged in innovative activities when they invest.

Developing countries vary a great deal in their sectoral economic production profiles and in the composition of inward FDI. However, it would be wrong to assume that these profiles are static. Indeed, many developing countries exhibit rapid shifts in production profiles and dominant forms of FDI, sometimes concurrently. The histories of rapid industrial transformation in the countries of East Asia have been well documented (Amsden 1989; Gereffi and Wyman 1990; Haggard 1990; Wade 1990; Amsden and Chu 2003). The so-called tigers of the region experienced profound structural changes in their economies as they navigated the process of industrial upgrading. As developing countries improve their productive capacity, education systems, and physical infrastructure, they typically move from economic models that emphasize agriculture to those that emphasize light manufacturing and then heavy manufacturing. The service sector, while incredibly diverse, also tends to increase in importance as countries become wealthier. The surge in service sector investment is a common story among middle-income countries in the 1990s and 2000s, irrespective of region. In South Africa, for example, the stock of manufacturing FDI has decreased relative to service sector FDI. By 2012, finance and business services accounted for the major portion of inward FDI stock at 36 percent (UNCTAD 2015, 36).

FDI flows and stock often mirror these sectoral changes. Many countries undergoing rapid development experience rapid shifts in the composition of incoming FDI. Some of these shifts can be influenced by policies designed to promote industrial upgrading. As one example, Taiwan in the 1970s displayed characteristics not unlike other developing countries. As Wade (1990, 149) points out, foreign investment as a source of capital accounted for only 3–10 percent of domestic capital formation in the 1970s, which was in line with Brazil and Mexico. Only 20–25 percent of manufacturing exports came from foreign firms in the 1970s. Taiwan developed a number of investment incentives during that decade, including tax holidays, accelerated depreciation for capital goods, and guarantees against expropriation. More importantly, Taiwan became increasingly discriminating about what kind of foreign investment was allowed in over the course of the 1970s. In 1973, labor-intensive industries such as textiles were excluded from export-processing zones altogether, as the government placed more emphasis on capital and skill-intensive industry (Riedel 1975). In 1983, policymakers even contemplated a blanket requirement that foreign investors should be required to export no less than 50 percent of their production. The tough bargaining between the government and firms continued into the 1990s, as Taiwan sought to prioritize higher value-added industries and extract concessions from firms regarding local content and export operations (Amsden and Chu 2003).

Chile serves as another example of industrial transformation mirrored by FDI transformation. Chilean FDI had been consistently dominated by natural resource investments for much of the postwar period. The transition to democracy in 1990 prompted a surge in inward investment, which increased from 48.1 percent of GDP in 1990 to 59.6 percent in 2008 (UNCTAD 2009). Most FDI in the early 1990s revolved around the processing of Chile's significant natural resources for export. Mining accounted for 58 percent of total FDI flows in the period from 1990 to 1995 (ECLAC 2000, 92). However, in the latter half of the 1990s new patterns of investment emerged. As in other Latin American countries, the privatization of services such as telecommunications and energy brought a wave of new investment to Chile.[8] A number of multinational companies in the IT sector established technical support/call centers in Chile, and a few established software development subsidiaries.[9] Call centers and shared services were both forms of investment that the Chilean government had specifically targeted as uniquely well suited to Chile's economic characteristics. The Chilean investment-promotion agency, CORFO, established a consistent set of incentives for nontraditional FDI. Unlike other Latin American countries, very few of the special incentives established for FDI were tax-based. Instead, CORFO concentrated on offering training incentives for prospective employees and subsidizing property leases. Nelson (2007, 150) notes that by 2005 CORFO had managed to attract at least 20 technology-intensive investments totaling just under US$100 million and employing approximately 2,180 people. While natural resource exports still figure prominently in both Chile's production profile and investment patterns, new service

8. Unlike previous patterns of investment, which had been dominated by North American firms, the service FDI was primarily European in origin. Spain accounted for around a third of FDI inflows in the second half of the 1990s (ECLAC 2000).

9. These companies included Banco Santander, BBva Bank, and Citigroup (Nelson 2007).

sector investments have been established. Many of these new service sector investments are oriented to the domestic market, though some have a regional outlook as well.

There are many component parts to a country's economic profile. Developing countries vary a great deal in terms of their sectoral production patterns and how these patterns change through time. There are various signals of these changes as they happen. Some of the most obvious are changes in value added or other production measures as a percentage of GDP. However, there are other indicators as well. If we consider a country's export profile, here again we can observe changes across countries and as individual countries go through processes of industrial upgrading through time. Even among countries with similar characteristics, the differences in the composition of exports can be profound. For example, Botswana and Zambia are both landlocked countries in the southern region of Africa. Both are similar size and subject to roughly comparable climate conditions. Botswana's development has been remarkable in the postwar period, even though the reasons for that development are still debated (Good 1992; Acemoglu et al. 2003;). Zambia is more on par with its regional peers in terms of economic development. In Zambia, agricultural raw materials accounted for 7.02 percent of its exports in 2005. In Botswana, the corresponding figure was 0.14 percent.[10] Both countries display some dependence on mining exports, with fuels and ores exports combining for 67.43 percent of exports in Zambia and 12.09 percent in Botswana in the same year. However, the dependence is much greater in Zambia, suggesting a more diversified export base in Botswana. Indeed, there is a strong negative correlation between level of development and reliance on primary sector exports overall among developing countries. These differences in export profiles should also have impacts on how much innovation is contemplated by multinationals.

It seems likely that variation in the sectoral distribution of both production and export activity among developing countries and within countries through time will matter for innovation patterns. But how, specifically? In the next section I add sectoral production and export data to the determinants of innovation using BEA data for American multinationals from 1999 to 2008. I expect that countries with sectoral profiles dominated by natural resource (agriculture, mining) production and export will be less likely to exhibit investments with high

10. Data are from the UN Comtrade database, commodity trade statistics.

innovation content. This has partly to do with the nature of these industries and partly to do with the level of development in countries where these industries predominate. Agriculture and mining require workers with relatively fewer skills than other industries, although there are some exceptions. Historically, these industries have dominated in countries with low levels of development and have diminished in importance as countries develop through time. I expect that this relationship will hold for both production and export measures.

In the case of manufacturing (secondary) and services (tertiary) sectors, I expect that much will depend on the subsectors within these broad categories. If a country's economic profile contains a heavy role for chemical manufacturing and export, for example, the likelihood for increased innovation on the part of American multinationals increases, particularly in that subsector. Similarly, if particular services are an important part of a country's economy, then R&D spending may increase in that sector. It is important to note here that while many sectors have the potential for export, not all do. Services, by their very nature, are almost always dependent on the local market. Therefore the consideration of exports is limited to manufacturing and the primary sector.

Table 4.2 adds consideration of sectoral profile variables to the previous models in this chapter. Once again, I rely on time-series BEA data on the innovative activities of US multinationals abroad. The models are identical in all aspects to the models of table 4.1, but each adds a sectoral production variable and is limited to those countries and observations where such data are available. This constricts the sample, sometimes considerably. The production data come from the WDI and appear in value-added form. For example, agriculture value added as a percentage of GDP is one production profile variable considered. The export data come from the UN Comtrade database, which contains information on the sectoral composition of trade flows through time. These data are more limited for some developing countries and are not available for all sectors and subsectors. The sectoral export data are scaled as a percentage of total exports.

I again employ panel-corrected standard error models with autoregressive corrections and country-specific variance. The dependent variables also change by limiting them to only those firms in specific industries. For ease of interpretation, the full models are not reported, which include all of the covariates in table 4.1. Instead, table 4.2 presents

Table 4.2
Innovation, sectoral profiles, and sectoral exports, cross-sectional time-series analyses

Dependent Variable	*Independent Variable*	β	Countries	Observations
R&D spending as % of value added, all industries	Agriculture, value added as % of GDP	–.020 (.015)	27	224
	Fuels, ores, and metals exports as % of total exports	–.028** (.011)	29	238
	Manufacturing, value added as % of GDP	–.004 (.022)	27	221
	Services, value added as % of GDP	.020** (.009)	27	224
R&D spending as % of value added, total manufacturing	Agriculture, value added as % of GDP	–.018 (.028)	27	213
	Manufacturing, value added as % of GDP	–.006 (.040)	28	242
	Fuels, ores, and metals exports as % of total exports	–.027* (.015)	29	227
	Manufactured goods exports as % of total exports	.008 (.036)	27	210
	Services, value added as % of GDP	.010 (.019)	27	213
R&D spending as % of value added, computers and electronic products	Agriculture, value added as % of GDP	–.018 (.122)	24	145
	Manufacturing, value added as % of GDP	–.107 (.097)	24	142
	Fuels, ores, and metals exports as % of total exports	–.112*** (.036)	25	150
	Services, value added as % of GDP	.012 (.052)	24	145
R&D spending as % of value added, chemicals	Agriculture, value added as % of GDP	–.041* (.025)	27	224
	Manufacturing, value added as % of GDP	.001 (.031)	27	221
	Fuels, ores, and metals exports as % of total exports	–.020* (.012)	29	237
	Services, value added as % of GDP	.039** (.019)	27	224
	Chemical product exports as % of total exports	.278** (.126)	29	237

Table 4.2 (continued)

Dependent Variable	*Independent Variable*	β	Countries	Observations
R&D spending as % of value added, transportation equipment	Agriculture, value added as % of GDP	–.189* (.114)	20	130
	Manufacturing, value added as % of GDP	.137 (.133)	20	127
	Fuels, ores, and metals exports as % of total exports	–.014 (.021)	22	137
	Services, value added as % of GDP	.041 (.039)	20	130
	Transportation equipment as % of total manufacturing	.162*** (.050)	21	109
	Transportation equipment exports as % of total exports	.028 (.023)	22	137
R&D spending as % of value added, information services	Agriculture, value added as % of GDP	–.005 (.017)	27	180
	Fuels, ores, and metals exports as % of total exports	–.006 (.006)	28	189
	Manufacturing, value added as % of GDP	–.009 (.010)	27	177
	Services, value added as % of GDP	.007 (.007)	27	180

Notes: BEA data. Standard errors are in parentheses. ***$p < .01$, **$p < .05$, *$p < .1$. All models contain all other covariates in table 4.1, except human capital and infrastructure measures (due to collinearity). Panel-corrected standard errors with AR(1) correction and heteroskedastic panels. Full models are available online at http://mitpress.mit.edu/globalizing-innovation.

the new predictors and their associated coefficients in relation to the different dependent variables of interest. In the first four rows of table 4.2, overall R&D spending by American multinationals is the dependent variable, as in table 4.1. Here the fuels, ores, and metals exports measure is negatively related to general American multinational R&D spending. This means that if countries export these natural resources intensively, American multinationals are less likely to conduct R&D locally regardless of industry. The opposite is true in the service sector. If services account for a larger share of value added in relation to GDP, the likelihood that American multinationals devote more attention to local R&D increases. Both the fuels and ores export measure and the services measure have a statistically significant relationship with overall American multinational R&D spending. These two measures capture in a clear and straightforward way the impact of economic transformation across and within developing countries. As natural resources become less important for a country's export profile, innovation becomes more likely. These are signals of both varying levels of development across countries and industrial upgrading within countries.

The rest of table 4.2 considers alternate dependent variables, limited by sector and subsector. While the BEA data are quite complete for most developing countries and rely only on reports from American firms, they become less comprehensive as smaller groups of industries are considered. For instance, there was only one service subsector with enough data from multinationals to construct a measure across 28 countries: information services. Manufacturing industries were generally better reported. In table 4.2, one major sector (manufacturing), three manufacturing subsectors, and one service subsector are considered as alternate dependent variables. In the case of total manufacturing, again the export of fuels, ores, and metals has a negative relationship with local innovation. This suggests that natural resource export intensity is associated with lower levels of manufacturing innovation. Though these are separate industries, a dependence on these kinds of natural resources may well "crowd out" innovation in manufacturing. Indeed, the crowding-out logic features prominently in much of the so-called resource curse literature (Sachs and Warner 2001; Frankel 2010). While this literature does not often refer specifically to innovation on the part of multinationals, the same principle may apply. Natural resources, especially gas and oil, have the potential to absorb large amounts of incoming investment. This may then reduce the appeal of investment in manufacturing, render exports uncompetitive through Dutch disease dynamics, and prejudice workers against investing in other skills training.[11] To this we may add disincentives toward local R&D efforts, both in general and in specific industries.

When the models are limited to the three manufacturing subsectors—computers and electronics, chemicals, and transportation equipment—the sectoral profile measures return some interest-

11. Dutch disease refers to the discovery of large oil reserves in the Netherlands in the 1950s and 1960s, which subsequently made manufacturing exports less competitive through upward pressure on the exchange rate. The term has often been used to explain the decline in manufacturing in various countries after substantial investments in natural resources.

ing results. Unsurprisingly, the bigger the transportation equipment subsector, the higher the likelihood that American multinationals will devote significant resources to R&D. Interestingly, innovation in chemicals is associated not only with greater chemicals exports but also with service sector investment overall. The larger the service sector, the more probable it is that American multinationals in the chemicals manufacturing sector will conduct local R&D. This is likely due to the fact that chemicals manufacturing and export happens at greater levels in more developed countries, which in turn also display larger service sectors. In other words, higher value-added sectors and subsectors hang together in more wealthy developing countries and in countries that have successfully undergone industrial transformations. Less developed countries, in turn, are characterized by larger primary sectors and lower levels of local innovation from multinationals.

This analysis suggests overall that American firms commit resources to innovation in developing countries in specific patterns. Developing countries with large natural resource exports are less likely to exhibit innovation-intensive investment profiles. Similarly, if more sophisticated manufactures (such as some chemicals) account for a larger proportion of the economy, innovation is more likely to be present. These results strongly suggest that the sectoral economic profile of a country, including its export profile, is likely to impact aggregate amounts of innovation.

Extension of Time-Series Analysis: Patenting as an Alternate Dependent Variable

The preceding section in this chapter has focused on US firm R&D spending levels, aggregated across firms and scaled against value added, in various developing countries. The BEA data are certainly useful and allow cross-national comparisons. However, R&D spending levels are only one way of measuring multinational innovation. Patent data, though not without their own limitations, are easily incorporated into time-series analysis across countries (Ginarte and Park 1997; Benoliel 2015). The comparison of patent propensity rates resulting from yearly patent counts can shed additional light on the determinants of innovation. These patent counts can substitute for R&D spending, without changing possibly influential independent variables. The structure of these patent data, in addition to their sometimes limited availability, requires limited models and different econometric methods. Certainly, patenting activity may also vary considerably by sector. However, even in the aggregate patents serve as an additional indicator of local innovation accomplished by multinationals.

For the purposes of folding US firm patent data into the existing time-series (1999–2008), three separate patent count measures were developed in increasing order of inclusivity. In all three instances, patents originating from American firms operating in foreign countries were targeted. This necessarily generates some conceptual difficulties. First, host countries vary considerably in their legal framework for intellectual property. This is especially true for developing countries. Patents applied for or granted in some middle-income countries can indicate only nominal protection, incremental or negligible innovation, or some combination thereof. Cross-national comparisons of domestic patenting activity are notoriously difficult, let alone patenting activity of multinationals. For this reason, the first and most restricted patent measure used here considers only those patents assigned by the US Patent and Trademark Office (USPTO). These patent data were accessed from the National Bureau of Economic Research (NBER)'s Patent Data Project, which compiled patent assignees from 1976 to 2006. One of the unique features of the NBER patent data is that it eliminates duplicate patents and measurement error using a unique assignee number.[12] These data also separate patent assignees according to their type, whether individuals, corporations, or government bodies. The time frame of the existing analysis limits the patent counts to 1999–2006. NBER patent data were supplemented with origin data from Li et al. (2014), who disambiguate author attributions of patents using the NBER framework. This additional information clarified country of origin for a number of indefinite patents in the NBER database.[13]

The NBER data essentially relay the patent counts, per year, for American firms operating abroad, whose subsidiaries in turn register their patents at the USPTO. In other words, these are innovations originating in the offices of American firms abroad that are in turn registered in the United States. This obviously disregards innovations that are patented only in the country where the firm is operating. However, there are good reasons to prioritize these limited parameters.

12. These numbers, coded as pdpass, also allow comparison across datasets without generating duplicate observations (for example, due to misspellings of company names).

13. This is similar to the approach used by Blit (2016).

First, as Benoliel (2015) notes, the USPTO process is relatively rigorous and its requirements homogenous, and the office functions as a patenting clearinghouse for many innovations generated outside the United States. Second, in using only USPTO data, I force a homogeneity on the data and increase the likelihood that only multinationals enter the dataset. To that end, only those patents with an original assignee code of 2 (firms) were considered. While these patents are by no means a comprehensive count of innovation done abroad by American firms, they do reveal what innovations make it back to registration with the USPTO from American subsidiaries abroad. These patents are organized in yearly count format (not cumulative).

The second source of patent count data comes from the World Intellectual Property Organization. WIPO maintains a database of patents organized by country of origin and country of application/grant. This measure considers all patents in force of American origin, registered in the destination country. This cumulative measure is then scaled against GDP in US$100 billion (inflation adjusted). The resulting measure is not by definition limited to multinational firms, but it is likely that a large majority of these patents are in fact from American multinational firms. Of course, this measure is subject to the diverging standards countries apply to their patenting regimes.

The third and final source of patent count data is also from WIPO and is the most expansive definition of patenting activity. WIPO catalogs a category of patents granted known as foreign-oriented patent families. Patent families are a set of interrelated patent applications filed in one or more countries to protect the same invention. Foreign-oriented patent families are a subset of these patent families in which at least one filing office is different from the applicant's origin. If an American firm files a patent in a foreign office, this qualifies as a foreign-oriented patent family. However, with this measure there is less likelihood that the patent originated in the country where it is registered. In fact, many of these patents are likely to be American firms registering innovations abroad for competitiveness purposes, without necessarily having done the innovation in the affiliate location abroad. This indicator is presented as the natural log of foreign patent filings of US origin. Again, this measure is affected by differences in patent registration practices across developing countries.

Each of the three patent count variables is used as a dependent variable in table 4.3. Unfortunately, many of the variables used in the

Table 4.3
Determinants of US-origin patent counts, cross-sectional time-series analyses

	Model: zero-inflated negative binomial count model with robust standard errors	Model: OLS with panel-corrected standard errors, AR(1) correction and heteroskedastic panels	Model: log-linear with panel-corrected standard errors and heteroskedastic panels
	DV: Yearly USPTO patent application count, US firms from locations abroad	DV: US-origin patents in force in patent offices abroad, per constant GDP, US$100bn	DV: natural log of foreign-oriented patent filings of US origin in foreign filing offices
Independent Variable			
Population (logged)	0.805*** (0.112)	207.604 (148.758)	1.152*** (0.139)
GDP growth	–0.12 (0.080)	–60.058 (54.173)	–0.046 (0.054)
Trade	0.000 (0.003)	–8.02 (6.895)	–0.000 (0.003)
Control of corruption index	0.415*** (0.147)	489.050** (210.132)	0.736*** (0.211)
GDP per capita (logged)		571.279*** (183.344)	0.617* (0.327)
Number bilateral investment treaties			0.003 (0.007)
Bilateral investment treaty with US (dummy)			–0.134 (0.314)
Capital account			0.066 (0.129)
US FDI			0.010** (0.004)
US trade			0.028*** (0.010)
Democracy length			0.009 (0.008)
Constant	–12.665*** (2.298)	–953.806 (3445.455)	–22.153*** (4.626)
Inflation Equation			
GDP per capita (logged)	–1.234*** (0.326)		
Constant	11.892*** (3.423)		

Table 4.3 (continued)

	Model: zero-inflated negative binomial count model with robust standard errors	Model: OLS with panel-corrected standard errors, AR(1) correction and heteroskedastic panels	Model: log-linear with panel-corrected standard errors and heteroskedastic panels
	DV: Yearly USPTO patent application count, US firms from locations abroad	DV: US-origin patents in force in patent offices abroad, per constant GDP, US$100bn	DV: natural log of foreign-oriented patent filings of US origin in foreign filing offices
alpha	0.811***		
	(0.212)		
N	292	138	231
Countries		47	27
Zero observations/ nonzero observations	187/105		
Log likelihood	–531.174		
R^2		0.312	0.302

Notes: Standard errors are in parentheses. ***$p < .01$, **$p < .05$, *$p < .1$.

previous models do not have enough observations to be included in the more limited patent count models, or severely restrict the number of the models. Because the last WIPO patent measure is the most expansive, it includes many observations and covariates. The first column of table 4.3 presents the patent count data as a dependent variable and employs a zero-inflated negative binomial regression model. This is due to the preponderance of zeros in the model (187 of the 292 observations are zeros).[14] The model is estimated with robust standard errors for the Poisson regression coefficients. In the inflation (logit) portion of the model in the bottom half of table 4.3, it is apparent that GDP per capita has a significant effect on the likelihood of a patent registration with the USPTO. The negative coefficient on the log of GDP per capita indicates the probability of zero patents, as negative logit coefficients actually *increase* the probability of a patent being registered. To put it differently, the log odds of being an excessive zero would decrease by

14. See appendix A for more detailed information on zero-inflated binomial regression models.

1.2 for every unit increase in the log of GDP per capita. In the negative binomial (upper) portion of the table, the coefficients are interpreted as usual, with positive (negative) coefficients increasing (decreasing) the expected count of patents. Both population and the control of corruption index have a positive and significant relationship with patent count. In substantive terms, a unit increase in the corruption control index would be associated with a 1.51 factor change in the expected count of patents. In terms of predicted counts, an increase from 1 to 5 in the control of corruption index would in itself be associated with an expected increase in patent count from 2.01 to 10.58, ceteris paribus.

The second two models use the WIPO patent counts as dependent variables, and return similar results. Because the cumulative patents in force measure does not contain zero measures, I employ here a panel-corrected standard error time-series model similar to those in tables 4.1 and 4.2. It is important to bear in mind the scale of the dependent variable for this model, as it can be quite large even when scaled against GDP. Increases in the control of corruption index and the log of GDP per capita are positively and significantly associated with patents in force, as would be expected. The third model in table 4.3 is the same as the second, except the dependent variable is not scaled against GDP but is instead log-transformed. This log-linear model includes many of the covariates in previous models, as the dependent variable displays better coverage. Interestingly, both US trade and US FDI are significant predictors in this model. It seems probable that American firms are more likely to file patents in countries where the United States has larger trade and investment presence. It is important to again point out that in this last case, the patents may or may not have foreign affiliate origins. What matters here is that American firms register patents in foreign patent offices.

The models with patent data return results slightly different from the R&D models earlier in the chapter, though there are significant similarities. It is noteworthy that the ICRG control of corruption index is highly significant when it comes to patenting, and not so with R&D spending. This may indicate that firms are hesitant to register patents in countries with corruption problems, whereas R&D spending may be more palatable. The bilateral investment treaty variables are not influential for patent activity, though this conclusion is limited as the BIT variables are available in only one of the three models.

Overall, the patent count data do suggest that socioeconomic and politicoinstitutional variables have some revealed influence on patenting activity, even if only apparent at the aggregate (not firm) level. The next section brings in firm-level variables to the analysis of innovation determinants, principally by employing another dataset in a series of multilevel models. Because this next dataset offers firm-level responses and not only aggregate statistics, additional variables can be considered.

World Bank Survey Data: Variables and Data Sources

Thus far in this chapter I have relied on American BEA country-level data through time and patent data (again at the country-year level) to examine the determinants of multinational innovation in a time-series of cross sections format. However, I have noted that these data do suffer from a few shortcomings that threaten broad inference. Most importantly, the data contain information only on US firms. They are also not firm-level data, but aggregated information, available by sector, on the amount of R&D spent by American multinationals in different countries, or the number of patents applied for or granted in the United States and abroad. While this allows a time-series approach, the data do not allow answers to other important questions about the determinants of innovation in developing countries. I now turn to consideration of World Bank survey data for individual firms as an additional test of the hypotheses advanced. As noted in chapter 3, these surveys measure firm perceptions on business environments and contain important information on operations for each firm respondent. In this chapter, I utilize the surveys taken from 2002 to 2005. The standardized surveys conducted during these years were longer and more detailed than those in subsequent years. This has the added benefit of matching up with a portion of the period under consideration in the time-series analysis. I consider only those firms that report a more than 10 percent foreign controlling interest, and only in developing countries. This results in 5,942 firms in 71 countries.

Firm surveys provide additional information that aggregated FDI data simply cannot provide. Rather than overall levels of R&D investment, survey data allow us to consider the decision on whether or not to conduct innovation, as revealed through firm responses. Firm-level attributes may now be considered, in conjunction with country-level determinants of innovation.[15] The multilevel models detailed in the next section allow inclusion of both the country-level variables from the other models in this chapter and firm-level survey responses. Individual firm characteristics likely influence innovation, and I include some of the potentially most important attributes. The industry or sector of each firm should be quite influential in determining whether that firm does R&D domestically. I therefore include sector dummy variables to isolate the effect of sector norms. The size and degree of foreign control for each individual firm are also controlled in these models. Firm size is measured in hundreds of employees and foreign control is measured as percentage (with 10 percent representing the minimum value and 100 percent the maximum).[16]

World Bank Survey Data: Statistical Methods

In the last set of models in this chapter, I employ multilevel maximum likelihood models of aggregated firm investment profiles and governance indicators assembled by outside observers. The dependent variable is a dichotomous one: the simple presence of local innovation by the firm. The data used in this analysis are measured at two different levels. The survey data present firm-level responses to questionnaires, and I have supplemented these data with country-level data from a variety of sources. The model employed must therefore capture the layered structure of the data, in which one level (firms) is nested within another (countries). OLS approaches will therefore not be appropriate and would result in incorrect standard errors and increased possibilities for type-1 error rates. More specifically, OLS approaches to these data structures violate the assumption of independent errors, as firms clustered within countries often exhibit correlated errors. The inclusion of dummy variables for cluster units (countries in this case), while solving some statistical issues, does not allow the researcher to

15. Some of the country-level variables are slightly modified due to the static nature of the survey data. Because the analysis is no longer time-series, the democracy variable is not cumulative years of democracy but a dummy variable indicating the presence or absence of democracy. GDP growth is from the year prior to the survey year.

16. For firm size, I also created a size variable based on the log of annual sales. However, this variable was difficult to construct due to the fact that sales were reported in the surveys in local currency units and therefore not comparable across countries. I constructed ratios based on average sales figures for country groups, but opted for the more easily interpretable (and more available) employee figures. However, the sales indicators did not return results inconsistent with the employees measure in other models.

include country-level variables that may be of interest (Steenbergen and Jones 2002). Multilevel models accommodate substantive explanations associated with second-level variables, while at the same time taking the hierarchical nature of the data into consideration.[17] As the primary dependent variable in this analysis is the binary decision of the firm to engage in R&D spending in the developing country, the model required is a multilevel logit. In this case, we have firms (level 1) within countries (level 2). If we wish to relax the assumption of independence among firms in the same country, incorporate the potential effects of unobserved country-specific variables in the model, and allow the odds of engaging in R&D to vary among countries, the general form of the model is as follows:

$$logit\{\Pr(y_{ij}=1|\, x_{ij}, \zeta_j)\} = \beta_1 + \beta_2 x_{2j} + \beta_3 x_{3ij} + \zeta_j$$

where $\zeta_j \sim N(0,\psi)$ represents a country-specific random intercept, y_{ij} is the response of firm i in country j, x_{2j} are the country-level covariates for country j, and x_{3ij} are the firm-level covariates for firm i in country j. This approach allows the interpretation of increasing firm-level predictors without changing country and holding all other variables constant, and also increasing country-level predictors while holding firm-level covariates fixed.

World Bank Survey Data: Results

Table 4.4 presents the results of five multilevel models with a dichotomous dependent variable: the presence of local R&D spending. Coefficients associated with the predictors are reported with standard errors and significance levels, but because this is a logit model, additional transformation of these values is required for substantive interpretation. A positive value for coefficients indicates an increase in odds of domestic R&D taking place given an increase in the independent variable. A negative value indicates a decrease in the odds of domestic R&D taking place. For purposes of brevity, the odds ratios associated with the variables are not reported in the tables. Columns two through four of table 4.4 contain two firm-level variables that are likely to influence whether or not a firm conducts local R&D in a developing country. The first of these is the degree of foreign ownership. Based on the results, it appears highly likely that more foreign control is associated with a

17. In the present analysis, an analysis of variance (ANOVA) test revealed significant (at the .01 level) variation in R&D effort at both levels of analysis (firm and country).

Table 4.4
Determinants of R&D incidence, 2002–2005 firm surveys

	Manufacturing firms only	Manufacturing firms only	Service firms only	Market-seeking manufacturing firms	Efficiency-seeking manufacturing firms
Firm-Level IVs					
Foreign ownership (%)	–0.008***	–0.008***	–0.008	–0.008***	–0.006**
	(0.002)	(0.002)	(0.005)	(0.002)	(0.003)
Size of firm (hundreds of employees)	0.049***	0.049***	0.040*	0.048***	0.092***
	(0.007)	(0.007)	(0.023)	(0.009)	(0.020)
Percentage of sales sold domestically				0.004***	
				(0.001)	
Percentage of domestic sales to parent company or affiliated subsidiaries					–0.007
					(0.004)
Country-Level IVs					
Log population	0.169	0.075	0.437	0.123	0.086
	(0.131)	(0.119)	(0.275)	(0.109)	(0.151)
GDP growth (previous year)	0.053	0.051	–0.351***	0.047	0.054
	(0.056)	(0.055)	(0.133)	(0.054)	(0.056)
Trade	0.002	–0.001	0.017*	0.001	0.002
	(0.005)	(0.005)	(0.010)	(0.005)	(0.005)
GDP per capita (logged)	0.402***	0.346***	0.591*	0.328***	0.146
	(0.138)	(0.131)	(0.359)	(0.120)	(0.138)

Democracy (dummy)	0.107	0.069	1.552	0.144	0.166
	(0.329)	(0.341)	(1.042)	(0.321)	(0.380)
Manufacturing sector as percentage of total value added	−0.036				
	(0.032)				
Manufactured exports as percentage of total exports		−0.003			
		(0.006)			
Service sector as percentage of total value added			−0.016		
			(0.049)		
Variance Components					
sd (country-level)	0.870	0.891	0.847	0.870	0.830
	(0.124)	(0.122)	(0.290)	(0.123)	(0.141)
Log likelihood	−1270.73	−1292.19	−185.108	−1079.52	−635.828
N	2123	2154	459	1811	1027
Countries	61	64	30	64	56

Notes: Table entries are coefficients for multilevel logit models, with standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Outliers were identified using Cook’s D criteria for multilevel models and excluded.

reduced likelihood of local innovation. Among manufacturing firms (columns two and three), an increase in foreign ownership is associated with a statistically significant drop in the odds that a firm will devote resources to local R&D. Among service firms, the odds are similarly reduced but not significant. Increased foreign control seems to be reliably associated with a lower incidence of R&D. This is congruent with the argument made by Amsden (2001) that in countries where locally owned firms tend to have higher shares of value added in manufacturing, such as China and India, R&D expenditures tend to be marginally higher. In countries where foreign firms tend to exert more control over their operations, such as Brazil and Mexico, R&D expenditures are lower.[18] This result also suggests that firms that operate wholly owned subsidiaries in developing countries may be more likely to centralize R&D efforts in the home country of the multinational. Global value chain analysis also suggests that higher levels of foreign control may lead to more rigid hierarchies (Gereffi et al. 2005). The second firm-level variable in all models is the size of the firm, in hundreds of employees. Here the results indicate that larger firms are more likely to undertake R&D in developing countries. The results are consistent across sectors, and significant. Larger firms are generally more likely to contain diversified production structures, and decentralized R&D efforts are potentially part of these structures.[19]

In addition to these firm-level variables, I also include many of the country-level variables found in the time-series analysis earlier in this chapter. The democracy dummy variable is again consistently associated with innovation, although the relationship is not significant. The natural log of GDP per capita is again strongly and positively related to the presence of innovation, as expected. A unit increase in the log of GDP per capita increases odds that local R&D will take place (1.49 odds ratio when the coefficient is transformed), the largest substantive effect among the predictors.[20] I also include variables that measure the size of the manufacturing and service sectors in the countries where the

18. Damijan, Jaklič, and Rojec (2006), in their study of foreign firms in Slovenia, also find that foreign-owned firms demonstrate proportionally less R&D expenditures compared with indigenous firms, but they do not consider degree of foreign ownership.

19. It is important to acknowledge, however, that this overall effect of size is likely to be contingent on sector. Pavitt (1984) notes that mechanical engineering firms are likely to be smaller and still innovation-intensive, while chemical firm innovations likely require economies of scale.

20. However, it should be noted that the population measure is the only other variable that is logged.

surveys take place. The second column in table 4.4 includes a measure of manufacturing value added as a percentage of GDP, from the World Development Indicators. The size of the manufacturing sector does not appear to affect the incidence of R&D among individual firms. In the same way, the manufacturing export variable, constructed from the UN Comtrade database, does not influence R&D incidence. These results all highlight just how important the attributes of the firm (size, ownership) are to the presence or absence of local R&D.

The last two columns of table 4.4 bring in two additional firm-level variables that serve as rough proxies for potentially important determinants of innovation. In chapters 2 and 3, I discussed how innovation among multinationals has changed over time, and how the motivations for that innovation have changed as well. In the 1980s, almost all innovation undertaken in developing countries was done to adapt the products of multinationals to conditions in local markets. As such, this innovation was wedded to market-seeking forms of investment. Bartlett and Ghoshal (1989) pointed out that while firms did develop decentralized innovation models in the 1980s, it was almost always with the purpose of rapidly moving new products to markets through local subsidiaries. Since the 1980s, however, the motivations for innovation have become more varied. To what extent does market-seeking investment still drive innovation in developing countries? Thus far, I have had to rely on country-level variables such as size of the local population to approximate this effect. However, the firm surveys allow a more specific test of the relationship between market-seeking investment and the likelihood of innovation. One of the survey questions asked the responding firms to indicate the percentage of sales sold in the domestic market. The fifth column in table 4.4 includes this response, for all manufacturing firms in the sample.[21] Domestic sales clearly increase the likelihood that domestic R&D will take place, supporting the notion that market-seeking investment is still an important determinant of local innovation. While the unit effect is not large, it is highly significant. Moreover, the cumulative effect of moving from 20 percent local sales to 60 percent local sales (for example) would increase the odds of local R&D by more than 15 percent, all else equal. This suggests that domestic market-oriented firms are still more likely to exhibit local R&D spending than firms with no domestic sales. In

21. Only manufacturing firms are used for comparison purposes and because they are more likely to have material inputs and outputs than service firms.

chapter 3, I relayed some descriptive statistics showing that multinationals conducting innovation in developing countries were still more likely than not adapting their products for local markets. This result lends support to that claim.

In chapter 2, I also raised the notion that firm innovation should be affected by the general motivations for investment. It appears that market-seeking investments are still more likely to result in local innovation. But what about other forms of investment? The tradition is to separate motivations for multinational investment into categories of market-seeking, natural resource-seeking, and efficiency-seeking (and sometimes knowledge-seeking). I have already addressed the first two. The third is more difficult to theorize, and especially difficult to test. Vertical forms of multinational investment, where different tasks are performed in different geographic locations in order to take advantage of local endowments, are common in some large-scale industries, such as the automotive industry. However, it is difficult to know if these kinds of investments are more or less likely to produce innovation in developing countries. Verticality is separate and distinct from ownership patterns. While wholly owned subsidiaries may be more likely to centralize innovation in the home country of the multinational, vertically organized production chains need not be wholly owned by the multinational. Ownership and verticality are correlated but are not necessarily deterministic. In their study of multinational firm innovation patterns in the United Kingdom, Pearce and Papanastassiou (2009) argue that efficiency-seeking forms of investment have more limited innovation potential than independent and creative world product mandate (WPM) firms, which use local expertise and resources to develop new products for export. Damijan, Jaklič, and Rojec (2006) suggest that vertical integration creates more temptation to collaborate with the vertical partners within the corporate structure, and perhaps substitute imported innovative inputs for local innovation in the developing country. For these reasons, we might expect that verticality imposes some constraints on local innovation.

The degree to which a multinational firm in a developing country is part of a vertical production chain is difficult to quantify. Nevertheless, in the last column of table 4.4 I include a survey question that comes closest to the idea of verticality. Firms were asked what percentage of sales were to a parent company or affiliated subsidiaries. Again, I consider only manufacturing firms. The sample size is significantly reduced when this question is included, suggesting that many firms did not respond. To the extent that this question can approximate vertical production chains (and perhaps efficiency-seeking motivations), it appears that no reliable relationship exists between efficiency-seeking forms of investment and innovation. It is difficult to draw conclusions from this result. The survey question leaves much to be desired as a proxy for vertical production chains. As an example, firms may be selling finished products and still respond in the affirmative. Moreover, internal transfer pricing practices could complicate responses to this question. To the extent that efficiency-seeking firms usually display higher foreign ownership levels, this other variable may be a better indicator of these dynamics.

World Bank Survey Data: Alternate Innovation Indicators

Throughout this chapter I have used the presence of R&D spending and its overall levels among multinationals as dependent variables. This continues into the next chapter, where I consider the institutional determinants of innovation in host countries. There are a number of reasons why R&D incidence and intensity are the focus of investigation. First, R&D spending is a common point of reference across existing studies and serves as a focal point for contending theories. Second, it is easily quantifiable and subject to more or less strict accounting standards. Third, it is a tangible commitment on the part of firms. However, I have noted in chapters 2 and 3 that the concept of innovation is broader than the financial commitment to R&D from individual firms. However constrained researchers may be by the need to generate cross-firm and cross-country comparisons, all recognize that innovation is a multifaceted concept. Fagerberg (2005) advocates moving away from a strict focus on R&D spending toward a broader conceptualization of innovation, involving everything from new ways of producing goods to new managerial techniques. Dunning (1993) saw new technologies as embracing all forms of a corporation's physical assets, human learning, and capabilities. While R&D spending certainly indicates innovation, there are many other potential indicators as well.

For most cross-national research, data limitations force a focus on R&D spending. In the World Bank surveys, however, there are a few additional questions that may serve as alternate indicators of innovation. Table 4.5 presents an extension of the multilevel firm survey analysis in this chapter, with these alternate innovation indicators used as

Table 4.5
Determinants of alternate innovation indicators, 2002–2005 firm surveys

Has your company undertaken any of the following initiatives in the last three years?	DV: Developed a major new product line	DV: Upgraded an existing product line	DV: Introduced new technology that has substantially changed the way that the main product is produced
Firm-Level IVs			
Foreign ownership (%)	0.000 (0.001)	–0.004*** (0.001)	–0.004*** (0.001)
Size of firm (hundreds of employees)	0.030*** (0.005)	0.050*** (0.007)	0.044*** (0.005)
Country-Level IVs			
Log population	0.002 (0.057)	0.032 (0.072)	–0.041 (0.053)
GDP growth (previous year)	0.003 (0.024)	–0.021 (0.031)	–0.004 (0.023)
Trade	0.001 (0.003)	0.003 (0.003)	–0.001 (0.003)
GDP per capita (logged)	0.127 (0.100)	0.070 (0.130)	0.198** (0.098)
Democracy (dummy)	0.200 (0.182)	0.586** (0.229)	0.170 (0.172)
Variance Components			
sd (country-level)	0.459 (0.058)	0.649 (0.074)	0.437 (0.055)
Log likelihood	–2362.48	–2552.15	–2669.47
N	3551	4162	4139
Countries	67	69	69

Notes: Table entries are coefficients for multilevel logit models, with standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Outliers were identified using Cook's D criteria for multilevel models and excluded.

dependent variables. The analysis is once more a multilevel logit model, with both firm-level and country-level predictors. The responses for all three alternate dependent variables are binary, indicating presence or absence of these activities. The 2002–2005 surveys asked firms whether or not they had, in the past three years, undertaken any of the following activities: developed a major new product line, upgraded an existing product line, or introduced new technology that has substantially changed the way that the main product is produced. The independent variables are the same as those in table 4.4, excluding the sector-specific analysis and the variables meant to approximate market-seeking and efficiency-seeking strategies.

Overall, the results in table 4.5 are consistent with earlier models on the determinants of innovation among multinational firms in developing countries. Once again, the size of the firm is linked to the incidence of innovation, with larger firms more likely to innovate. The degree of foreign ownership has a negative relationship with these other forms of innovation. Increased foreign ownership is linked to reduced odds of upgrading existing product lines and introducing new technology. Among the country-level independent variables, democracy seems to be positively related to innovation, though this relationship is significant only for upgrading existing product lines. The level of development, proxied by GDP per capita, loses its consistent strong positive relationship with the incidence of innovation in these new models. There are a number of possible explanations for this difference. For example, developing a major new product line is an activity that may or may not imply a substantial investment of money in local R&D. Reproducing new products designed in the home country of the multinational would satisfy this yes or no question, and may not involve any commitment to local R&D. In this situation, the new product line would be an innovation without R&D commitment. There are other potential explanations as well, but it is noteworthy that some of the strong effects observed with the R&D variable are not as strong with the less tangible innovation indicators. Overall, these results confirm the strong impact certain firm-level variables have on the incidence of local innovation, broadly construed. While R&D commitments remain the focus of the cross-national econometric models in this chapter and the next, I will return to alternate indicators of innovation when discussing the case study of Ireland in chapter 6.

Conclusion

This chapter goes beyond patterns of multinational innovation outlined in chapter 3, using the tools of statistical analysis to identify prominent determinants of innovation at the aggregate and at the level of the firm. These models build on the hypotheses and theory derived in chapter 2. I have relied on a number of large datasets: time-series BEA data on American multinational investment abroad from 1999 to 2008, patent data from American firms and patent offices in the United States and abroad, and the World Bank Investment Climate surveys carried out between 2002 and 2005. The dynamic nature of the BEA and patent data allow a longitudinal analysis of changes in aggregate R&D spending done by multinationals in a variety of developing countries, while the World Bank surveys allow inclusion of several firm-level variables that have direct impact on firm R&D commitments. These surveys are quite detailed and contain a wealth of firm operating data. The World Bank data also represent multinationals from all countries of origin, not just the United States. I have separated multinational firms by economic sector and included a variety of country-level variables in the models.

The analysis supports a number of important claims regarding the determinants of innovation in multinational production networks. Among the country-level variables, GDP per capita emerged as a reliable predictor of multinational innovation. This is not surprising. Richer developing countries are more attractive locations for innovation for a number of reasons, including worker skill levels, available infrastructure, and larger consumer classes. This result held in both the US firm time-series analysis and in most of the firm survey data. Measures of economic liberalization did not demonstrate consistent relationships with innovation. Trade openness was not a consistent predictor of innovation. Democracy length in the time-series analysis and the binary measure of democracy in the investment climate surveys both exhibited positive relationships with firm innovation, but the effect was significant in the time-series analysis. In the sectoral extension to the main analysis, I have argued that large primary sectors and exports are associated with lower innovation propensities overall among multinationals across sectors. By contrast, when higher value-added sectors increase in prominence within economies, innovation increases among multinationals. This is true for multinationals not only in those sectors but in other sectors as well. The sectoral production and export profile of a country will matter for the likelihood of multinational innovation. Among the firm-level variables in the survey data, I find that increased foreign ownership is associated with a decreased likelihood of local innovation. Market-seeking investment is also more likely to generate local innovation in developing countries.

The results in this chapter suggest a number of potentially productive research agendas. Large-sample quantitative analyses such as those pursued here are inherently limited. Firm-level case studies, especially through time, would allow a more thorough accounting of the interaction between the various firm and country characteristics and innovation patterns. Firm case studies might also cast light on the mixed results linking bilateral investment treaties to innovation patterns. These treaties often contain specific references to intellectual property rights. Therefore, a more legalistic approach to the question of innovation might illuminate the relationship between BITs and multinational innovation in developing countries. Yackee (2008) has already taken this approach and considered the relationship between the text of BITs and resulting overall flows of FDI. However, the relationship between multinational innovation and BITs is understudied. Future research will examine the innovation outcomes connected to these increasingly important documents, and their enforcement mechanisms through international organizations. Analysis of the links between sectoral investment patterns and innovation outcomes will also undoubtedly improve as more fine-grained sectoral FDI data become available to researchers. In particular, it would be beneficial to know whether innovation conducted in traditionally lower value-added sectors, such as agriculture, can lead to technological upgrading in countries still relatively dependent on these sectors. As Von Tunzelmann and Acha (2005) note, innovation is still possible in what are traditionally considered "low-tech" industries. In many developing countries with large agricultural sectors and corresponding FDI profiles, investment data are only now becoming more comprehensive.

All of the results in this chapter collectively paint a picture of the kind of investment most likely to exhibit innovative characteristics. R&D spending among American firms and firms from around the world has increased in developing countries, but it has never been distributed evenly. Both overall innovation levels and firm-specific innovation decisions are affected by a combination of firm attributes and country characteristics. In this chapter I have considered the most likely internal and external influences on the firm decision to commit resources to innovation abroad. In the next chapter I add consideration of institutional characteristics in host countries. I argue that the character and quality of political institutions in developing countries have an important effect on the innovative efforts of multinational firms, both in the decision to invest in R&D and in the intensity of that innovative effort.

5 Innovation-Intensive FDI and Host Country Institutions

As the previous chapters have made clear, multinational firms have a number of potentially powerful motivations to engage in innovation abroad. There are also incentives to keep innovation close to home. But other countries offer a number of enticing advantages, from potential pools of highly skilled labor to local market knowledge and experience. In previous chapters, I have discussed how various country- and firm-level characteristics affect the likelihood that firms will conduct innovation in emerging economies. Yet one set of factors has been conspicuously absent from these models. I have not yet considered the role of host country institutions as determinants of multinational innovation. While I did include democratic longevity and control of corruption as influences on innovation patterns in chapter 4, I did not dwell on their impact or explain how firms might respond to other host country political characteristics. This chapter fills that gap. I have separated cross-national institutional analysis from other subjects in the book because I feel it is important that they are given separate consideration, in isolation. As this book advances, first and foremost, a political economy argument about the spread of multinational innovation, I believe it is appropriate to emphasize just how important domestic institutions in emerging economies are to the attraction and integration of innovation-intensive FDI. The message of this chapter is that multinationals consider the quality of host country institutions and that countries with well-regarded institutions are much more likely to host innovation-intensive investments. While this result is not entirely surprising, it is noteworthy that institutions have such a strong effect on the incidence and intensity of innovation, even while controlling for other firm and country characteristics. This chapter continues the cross-national focus of the previous two chapters, and I carefully construct and justify models that capture institutional variations across countries. While there are a number of potential pitfalls in the cross-national comparisons of institutional quality, I argue that these concerns should not prevent us from acknowledging that the form and function of the state matters not only for domestic firms but also for patterns of multinational investment.

As the next few sections in this chapter make clear, there is precedent for this argument. This chapter builds on previous international business and international political economy literature, which has sometimes linked institutional environments to different firm investment models. As just one example of this kind of analysis, Pauly and Reich (1997) established linkages between firm investment strategies (including R&D spending) and institutional characteristics in the home country of multinationals. However, they did not consider the same characteristics in the host country. Host country institutions figure prominently in the branch of business "entry mode" literature. But these studies mostly employ different dependent variables, such as whether firms build something new (greenfield investment) versus take over something else (mergers and acquisitions, M&A) (Meyer and Nguyen 2005; Dikova and van Witteloostuijn 2007; Meyer et al. 2009). Other international business scholars have often asked what determines whether multinationals engage in joint ventures or wholly owned subsidiaries (Gatignon and Anderson 1988; Kogut and Singh 1988; Hill et al. 1990; Agarwal and Ramaswami 1992). Institutional characteristics of host countries are often important predictors of various outcomes in these and other works. But these are not the only sources of variation in firm modes of entry. Innovation is not among the common dependent variables in this tradition. It is, however, equally plausible that institutions in host countries should have a substantial impact on whether firms perhaps engage in virtuous cycles of technological upgrading or simply engage in rote reproduction. By concentrating on firm-level innovative activity, this chapter adds another dimension to institutionalist studies of foreign investment.

This chapter retains the cross-national emphasis of the preceding two chapters. I develop a series of econometric tests that link measures of institutional efficacy and quality in host countries with firm investment profiles using large-sample surveys of multinational firms in developing countries. In this chapter I exclusively rely on the World Bank's Investment Climate Surveys, which formed part of the empirical basis for the preceding chapter. This chapter subjects these surveys to a further battery of tests, but crucially adds a number of different institutional measures as independent variables. I also discuss the various controversies surrounding these cross-national assessments of institutional quality and consider the problem of nonresponse to survey questions when dealing with sensitive topics such as the quality of state oversight of business. The chapter is organized as follows. In the next section, I clarify what is meant by institutions in host countries. I then present the extant literature on firm entry models and domestic institutions in developing countries. A discussion of research design follows, including brief explanations of key dependent and independent variables. The first part of the empirical analysis concentrates on the incidence of innovation among firms in emerging economies, that is, whether or not innovation is happening and how institutions affect these patterns. I then move on to a secondary extension of the analysis in which I consider the intensity of innovation. In both cases, I find that institutional quality matters. Firms commit resources to innovation, and do so in larger quantities, when they perceive the institutions of the state to be consistent, predictable, and effective. Following this extension of the analysis, I conclude by discussing the implications of these findings for host country investment promotion strategies and how countries might best promote spillovers in the domestic economy.

Conceptualizing Institutions

Before proceeding, it is necessary to briefly reconsider the meaning of "institutions" in the context of this book. As explained in the introduction, I opt for a more restricted definition of institutions than is common in much of the broader institutionalist literature in political economy. My approach is similar to that of Williamson (2000), who concentrated on formal and organizational characteristics of governmental bodies. Neither Williamson nor I deal with normative or belief systems, culture, or other informal elements of institutions that vary from country to country. I have instead focused on the existing, formal governmental bodies and agencies designed to exercise authority. Whereas in the subsequent chapter I limit institutions to state bodies and agencies, in this chapter I slightly expand the definition of institutions to accommodate rules and regulations affecting multinational firms. I retain the emphasis on formality. North (1990) refers to formal institutions as determining the "rules of the game," which of course encompasses a great deal of potential influences, including policy initiatives and changes in legal frameworks. This more narrow focus avoids conceptual stretching while simultaneously facilitating econometric tests of the links between assessments of governmental institutions as distinct entities and the innovative activity of multinational firms.

Institutions are enjoying somewhat of a renaissance in international business studies and have been consistent objects of inquiry in political economy. In the early 1970s, authors such as Behrman (1971) made the case that multinational corporations should recognize how important policies and institutions were in shaping the investment environment. However, most international business scholars subsequently looked toward firms for explanations, spurred on by transaction cost approaches. Institutions external to the firm, when they were considered, were often assumed to be static. This continued arguably until the end of the twentieth century, when a new emphasis on the political economy of institutions emerged. This was part and parcel of a broader movement toward institutional analysis spanning the social sciences. In development studies, works by Acemoglu, Johnson, and Robinson (2002) and Rodrik, Subramanian, and Trebbi (2004), among others, asserted the primacy of institutions in determining development trajectories through history. Geography and factors of production were no longer destiny, or at least their influence could be modified by different institutional configurations. While institutional definitions were often much broader in these studies than in more narrow international business literatures, the emphasis on variation in "rules of the game" was similar. In international business, scholars after 2000 increasingly looked to institutional variation as a critical explanation for investment profiles. Dunning (2005) argued that a country's institutional infrastructure was critical for both its overall productivity and its drawing power to attract incoming FDI and demonstrated that countries at similar levels of development would attract varying levels of investment depending on the quality of that institutional infrastructure. While institutional analysis may not be a paradigm shift in international business studies, these factors are certainly more often acknowledged as important influences on firm behavior now than in decades past.

Institutions and Firm Entry Modes

This chapter poses the question: do host country institutions impact the innovation characteristics of inward FDI? As such, it necessarily contemplates a number of diverse literatures from international business studies and international political economy. In the field of international business studies, scholars have long debated the reasons why firms adopt the investment models they do. Naturally, much of this literature concentrates on factors internal to firms that determine firm strategy. Dunning's (1988) influential ownership, location, and internalization (OLI) framework is an enduring taxonomy of investment motivations and has informed much subsequent research on why firms invest abroad. Host country institutions are often grouped into the locational factors that influence firm behavior. In international business studies, firm entry mode is often used as a dependent variable. The independent variables can typically be divided into three rough categories. In the first category, there are those who, absorbing the main conclusions of Hymer (1976), emphasize internal firm characteristics, not host country characteristics, as determinants of firm investment models. These analysts tend to rely on transaction cost explanations for firm investment models. Scholars have proposed different relationships between transaction cost strategies and resulting firm ownership patterns (Gatignon and Anderson 1988; Meyer 2001; Brouthers 2002).[1] The second broad category of entry mode analysis asserts that national cultural characteristics in the firm's country of origin have an important impact on firm strategies (Agarwal 1994; Hennart and Larimo 1998). Kogut and Singh (1988) argue that cultural distance and attitudes about uncertainty avoidance impact firm ownership patterns.[2]

The final category establishes links between institutional characteristics in host countries and modes of entry, most often the choice between joint venture and wholly owned subsidiary (Javorcik and Wei 2000; Kogut et al. 2002; Meyer and Nguyen 2005; Meyer et al. 2009). These works claim that firm entry modes depend crucially on host country institutions such as infrastructure quality (Wheeler and Mody 1992), the rule of law and government policy (Asiedu and Esfahani 2001), and political hazards (Henisz 2000). In some ways institutional explanations for firm entry modes are not new. Kobrin (1976) asked about the political determinants of manufacturing FDI long ago. However, institutionalist explanations have enjoyed a notable resurgence in recent

1. Other firm-centric analysts have suggested it is not transaction-costs in individual countries but global firm strategies that determine the entry modes of firms (Hill et al. 1990).

2. Brouthers (2002) also considered home country cultural influence on entry modes, ultimately deciding that transaction cost explanations were more convincing.

years in the entry mode literature. Recent studies have considered how institutional environments in host countries determine the likelihood of greenfield investments (Dikova and Van Witteloostuijn 2007) and foreign control (Meyer et al. 2009; Slangen and van Tulder 2009). Dunning and Lundan (2008, 580) expressed enthusiasm for the revival of institutionalist arguments within the eclectic (OLI) paradigm for multinational enterprises: "We think that there is no reason why this kind of institutional reasoning should not be extended to analyzing the cognition, motives and behavior of multinational enterprises." Similarly, Dikova and Van Witteloostuijn (2007, 1014) noted that institutionalist arguments were "long-neglected" in the mode of entry literature and that new research in this vein was welcome.

While international business scholars have (re)discovered institutions as important predictors of firm investment strategies, the application of these ideas to specific investment outcomes has been somewhat limited in scope. There are a handful of analyses that link firm diversification and product differentiation to institutional variables (Peng et al. 2005; Peng and Delios 2006). However, most studies in the entry mode literature still use the joint venture versus wholly owned subsidiary or greenfield versus M&A as the primary dependent variables. If, as Dunning and Lundan (2008) suggest, there are numerous other potential linkages between institutions and aspects of multinational behavior, it seems logical to extend institutional analysis to other kinds of investment model variation. In extending the entry mode logic to these variations, new associations between institutional characteristics and investment models may be uncovered.

Institutions and Innovation

There are few works in the existing international business literature that link institutional configurations to innovation patterns among firms, perhaps because the internationalization of multinational R&D in the developing world is a relatively new phenomenon. In an early attempt at linking institutional attributes with R&D outcomes, Davidson and McFetridge (1985) argued that cultural and geographic proximity increases the chances of internal technology transfer to subsidiaries of multinational firms and that policy initiatives such as equity controls decreased the probability of transfer. Oxley (1999) argued that technology-intensive firms adopted hierarchical models when intellectual property protection was weak in host countries. Doh et al.

(2005) evaluate the influence of host country factors on foreign R&D investment and affirm the importance of institutional quality (though they assign more influence to local development factors and scientific output). More recently, Álvarez and Marín (2010) argued that both institutional "stability" and the consolidation of national systems of innovation are important drivers of inward FDI.

A small number of econometric studies have identified factors that lead to increased local innovative activity among multinationals.[3] These studies all adopt a micro-level approach to innovation, using firm case studies and country-specific data to show the economic determinants of firm investment profiles. However, few of them consider political/institutional variables. Indeed, more often than not innovation has appeared as an independent variable in the mode of entry literature. Analysts have used innovation in multinational firms (most often measured as the R&D spending to sales ratio) as an important predictor, sometimes alongside institutional variables, of ownership patterns (Gatignon and Anderson 1988; Javorcik and Wei 2000) or the decision to invest abroad itself (Kimura 1989).

One potential reason for this underexplored relationship comes from the historical record of multinational investment in the developing world. For a long time, it was simply assumed that the obstacles to innovative multinational investment in developing countries were too big to overcome. Peter Evans argued in 1979, as did Paul Baran (1957) before him, that multinationals did not make good entrepreneurs in developing countries. Decision-makers within multinational firms exhibited "bounded rationality": investment decisions were made with incomplete information and subject to significant uncertainty. Because of this, Evans argued that multinational firms consistently overestimated the risks of investment in peripheral countries and were extremely reluctant to commit resources to local innovation. According to this line of reasoning, powerful forces kept innovation in central countries, where intangible assets could be better protected. In the international division of labor, R&D (at least within multinationals) was not distributed widely.

While multinationals from developed countries still do most of their innovating in their home countries, the global spread of R&D signals that the old equilibrium is changing. There are a number of broad reasons for this, explained more fully in previous chapters. First, firm

3. See Cohen (2010) for a review of these and other studies, many of which are case studies of individual developing countries.

incentives for decentralized innovation exist and are increasing. Multinationals may establish innovation abroad in order to absorb new products and practices generated in other countries. Economies of scale may be attainable abroad, assuming a suitable number of trained personnel can be found. Local centers of excellence in developing countries, most often centered on universities, may offer opportunities for firms to establish research partnerships. R&D that was cutting edge or experimental in previous years may subsequently become routinized enough to be done abroad and perhaps at lower cost. As Von Tunzelmann and Acha (2005) note, traditional "low-tech" and "medium-tech" industries may still have ample opportunities for innovation, even when they are relatively mature industries. Decentralized innovation may also reduce the need for royalty payments.

Related to all of these factors, however, is the possibility that firms are becoming more comfortable with innovation in the periphery. Host country institutions, as the primary points of contact for firms, are critical to reducing firm uncertainty associated with innovation-intensive investment. The functioning of these institutions, and how firms interact with them, serve as signals to the multinationals of the risk associated with investment, and also the form that investment should take. Multinational firms make decisions about where to locate the specific activities of their value chains based on a wide variety of factors. Among the largest multinationals, the potential location options for an R&D center, for example, might include countries on every continent. These decisions are made based partly on internal firm characteristics. However, as Dunning and Lundan (2008) point out, the institutional environment in host countries should be considered an important component of "locational" incentives in Dunning's (1988) OLI framework. That is, variations in institutional structures should, alongside other traditional locational advantages such as wage rates and worker skill levels, present both benefits and drawbacks for firm investment models. Other works in the entry mode literature refer to more narrow "political risk," defined as an unfavorable change in regime or policy, as affecting firm investment models (Agarwal and Ramaswami 1992; Henisz 2000). This kind of risk can also derive from the characteristics of host country institutions, even if institutions are not explicitly acknowledged.

Among the works considering the impact of domestic institutions on firm entry mode, many have pointed out that institutions can serve an important role in reducing risk and uncertainty for overseas investments. Slangen and Van Tulder (2009), for example, argue that low institutional quality in host countries drives firms toward joint venture models of investment, as firms in these environments are concerned about a variety of expropriation risks and policy instabilities, therefore preferring to partner with local firms. Limited legal infrastructures, corruption, and inconsistently applied policy serve to increase uncertainty, and therefore impact firm decisions. Meyer (2001, 358) argues that institutional weakness means that firms must "negotiate with agents inexperienced in business negotiations; they face unclear regulatory frameworks, inexperienced bureaucracies, underdeveloped court systems, and corruption." These characteristics of weak institutions necessarily increase transaction-costs for foreign firms and affect not only ownership structures but other investment characteristics. The previous chapter showed that wholly owned subsidiaries are less likely to engage in local R&D spending. If low institutional quality leads to joint ventures, does this mean that it can also lead to decentralized innovation? This chapter contends that this process is unlikely and that high institutional quality may in fact lead firms to be more comfortable with lower ownership shares.

Beyond the firm entry mode literature, much work on the political determinants of FDI revolves around uncertainty-minimization strategies of firms. As mentioned in previous chapters, much recent work on the institutional determinants of FDI flows has examined political variables as potentially important predictors. Work on state corruption (Wei 2000) demonstrates a link between corrupt political institutions and decreased foreign investment. The debate about whether democracies or authoritarian regimes attract more FDI (Oneal 1994; Jensen 2003; Li and Resnick 2003; Kenyon and Naoi 2010) asks which form of government lowers uncertainty for firms. Busse and Hefeker (2007) argue that, among other factors, governmental stability and the absence of internal political conflict are associated with more investment from abroad. Brunetti, Kisunko, and Weder (1998) and Schneider and Frey (1985) echo these findings, showing that political instability can scare off investors by threatening the predictability of the business environment. All of these works share a concern with how institutions in host countries may reduce risk for multinationals. As innovation abroad usually carries a not-insignificant amount of risk for firms, the arguments translate directly. Multinational firms considering developing countries as platforms for innovation must consider institutional characteristics to a greater degree than those firms considering pure market-seeking strategies. When confronted with choices for where to locate R&D activities, the institutional environment in potential host countries looms especially large. Meyer (2001) notes that a poor institutional framework in developing countries may not provide adequate protection for intellectual property rights. If a judicial system is corrupt, or property rights are not consistently enforced, a technology-intensive firm may not be able to effectively transfer intellectual property (Oxley 1999). Furthermore, as Dikova and Van Witteloostuijn (2007) point out, R&D-intensive firms are likely to benefit from well-administered labor markets, which strong institutions can provide. The bottom line is that innovation-intensive investment is especially risky, especially if the firm has proprietary rights over intangible assets. Well-functioning institutions should help to reduce the risk for these kinds of investment, and may facilitate technology transfer without the danger of unauthorized diffusion of intellectual property. To the extent that institutions matter for aggregate inflows of FDI, this effect should be magnified for innovation.

If we move from the perspective of the firm considering investment to the perspective of the country attempting to attract investment, there are yet more reasons to suppose that institutional quality matters. Developmentally minded governments have long prioritized technology-intensive forms of investment. Changes in worldwide production networks have increased the importance of innovation as an external catalyst for development. The location of innovative activities within multinational firms may now be subject to many of the factor-price competitive pressures previously associated with labor. Many developing countries now compete to attract innovation centers as strongly as some competed on the basis of unskilled labor price in the past. I have already discussed at length in previous chapters the many potential benefits from local innovative activities. Firms may move to higher value-added products and engage in a virtuous cycle of technological upgrading. Countries have limited tools at their disposal to attract these kinds of investment, but institutions are among the factors over which host governments have control. Different institutional qualities and characteristics may therefore constitute a source of comparative advantage for countries in the race for innovation-intensive foreign investment.

Taken together, the diverse strands of literature suggest that firms are interested in lowering uncertainty and that strong institutions send a positive signal to firms interested in consistency and predictability.

As R&D or other forms of innovation can be substantial commitments, which involve longer time horizons than other forms of investment, institutions should assume greater importance. Research and development activities in developing countries move firms away from a basic horizontal approach to investment: reproduction of a product for sale in a domestic market. Firms choosing to locate innovative activity outside their headquarters must contemplate the possibility that their innovations may not be protected from theft or that foreign regulations may reduce their capacity for commercial application of innovations. As Oxley (1999) argues, weak institutional protection for innovation increases the chance that firms will adopt hierarchical models, in which innovation is centralized. In the opposite situation, strong institutions in the host country should make firms more comfortable with polycentric models of innovation and partnership with domestic firms. In all of these cases, the characteristics of domestic institutions should have important implications for investment models. Firm perception is key; firms should be more likely to make innovation-intensive investments when they perceive domestic institutions as well-functioning and responsive. For this reason, firm-level analysis is essential to unpacking the relationships between firm investment models and institutional characteristics.

Research Design

The analysis in this chapter makes use of the same World Bank firm survey data used in chapters 3 and 4 to test the impact of domestic institutions in developing countries on multinational firm investment models. Perceptions of institutional coherence among outside experts and among the firms themselves are added to the models developed in previous chapters as additional independent variables and are hypothesized to have a reliable association with local R&D effort. In the main analysis, I employ multilevel maximum likelihood models of aggregated firm investment profiles and governance indicators assembled by outside observers. The dependent variable in these models is a dichotomous one: the simple presence of local R&D spending by the firm. In a subsequent extension of the analysis, I also consider the intensity of R&D spending, measured as a percentage of the firm's sales. In the sections that follow, I detail the data chosen for the dependent variables, independent variables of interest, and the control variables. I then elaborate on the model used for the estimation, and after a short discussion of methodological concerns I relay the results of the analysis.

Dependent Variables

Various analysts have pointed out that aggregate yearly FDI data used in many existing studies are often used to test what are essentially firm-level hypotheses (Haggard 1989; Jensen 2006). Yet this is far from ideal. Firms make individual decisions about, for example, whether a democratic country is more enticing as a location than an authoritarian alternative. Many of the decisions about specific modes of investment, in fact, are based on firm perceptions of the investment climate in host countries. Therefore it seems appropriate not only to look at overall FDI levels in countries from year to year, but also to examine available firm surveys. These surveys can reveal common modes of investment in different country contexts. Although there are numerous problems with the design of many firm surveys, the problems can be circumvented with appropriate precautions.[4]

The World Bank Group's Productivity and Investment Climate Surveys provide comprehensive data on over 85,000 firms in 106 countries. The surveys measure firm perceptions of business environments, while also collecting important operating data for each firm. The surveys were periodically implemented in a large number of developing countries between 2002 and 2005. As was the case in chapter 3, I do not consider surveys conducted after 2005 as these later surveys contain less information about innovative activities and general firm operating data. All firms that fell below the 10 percent foreign controlling interest criterion established by UNCTAD were again eliminated, in order to consider only those firms that could be classified as multinational by this commonly used cutoff. I also eliminated firms operating in those countries that could not be classified as developing countries.

Just as in previous chapters, I use indicators of R&D effort as dependent variables in firm investment models. To operationalize these activities, I follow the approach advocated by Martincus and Carballo (2008) in their study of export promotion policies in Peru. I include both the decision to engage in R&D spending as a binary variable and

4. Kurtz and Schrank (2007) take issue with a number of the measurement mechanisms used in surveys of firms by international organizations such as the World Bank.

Table 5.1
R&D indexes for Investment Climate Surveys, by region

Region	Total Firm Observations	"Yes" to Local R&D Question	"Yes" Proportion of Total R&D Responses	Mean R&D Intensity (% of sales)	R&D Intensity Observations
Sub-Saharan Africa	684	179	0.396	2.013	160
East Asia	1734	526	0.406	3.385	503
East and Central Europe	2511	212	0.305	3.043	203
Latin America and Caribbean	582	167	0.369	3.365	165
Middle East and North Africa	263	22	0.142	0.776	21
South Asia	168	42	0.294	1.395	42
Total	5942	1148	0.360	2.992	1094

the intensity of R&D spending as a percentage of sales. The binary R&D variable serves as the main variable of interest, and the R&D intensity variable is treated in a separate extension of the analysis. The econometric models substantially limit the number of firms and countries, due to data coverage limitations. However, as appendix B demonstrates, the models still contain countries and firms from a wide variety of developing regions. Table 5.1 breaks down the R&D variables by region. Overall, the sample is weighted toward firms in East Asia and East and Central Europe. Table 5.1 indicates that 3,161 of the 5,942 multinationals responded to the R&D question, of which 1,148 were positive responses. For the R&D intensity indicator, only 1,094 variables could be constructed based on survey responses.[5] The summary statistics of R&D effort for firms in the Middle East and North Africa and South Asia should therefore be treated with caution, as they are based on small samples.

5. The R&D intensity variable also had to be constructed from two survey responses: sales in the previous year (measured in thousands of local currency units) and R&D spending in the previous year (measured on the same scale). This, coupled with the relative lack of prominence of the R&D question in the surveys, reduced the sample size for this indicator.

Independent Variables

Studies that consider the characteristics of state institutions in the developing world inevitably face tough questions about how to define "well-functioning institutions." There are, however, some measures of institutional coherence and efficacy that manage to convey important information about the responsiveness and reliability of the state. This study utilizes eight measures of institutional quality. Three of these come from the World Governance Indicators (WGI), published by the World Bank (Kaufmann et al. 2009). Two others come from the International Country Risk Guide (ICRG), published by Political Risk Services (PRS) group. The other three are from other sources. I describe below each of these briefly in turn. The three WGI measures are their Government Effectiveness, Regulatory Quality, and Control of Corruption indexes. All of these measures are formed by aggregating a large number of independent assessments of institutional quality and other aspects of governance, many of which come from expert surveys. Though there are a number of possible objections to the WGI data, they do enjoy support as one of the few reliable and transparent attempts to compare governance across countries.[6] The WGI are based exclusively on "perceptions-based data on governance reflecting the views of a diverse range of informed stakeholders, including tens of thousands of household and firm survey respondents, as well as thousands of experts working for the private sector, NGOs, and public sector agencies" (Kaufmann et al. 2009, 4).

The government effectiveness component of the WGI serves as the first independent variable of interest and is also employed in subsequent tables as it best approximates the theoretic linkage between institutional quality and innovation outcomes. Kaufmann, Kray, and Mastruzzi (2009) define the government effectiveness measure as follows:

> The quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

6. These measures are often used in the mode of entry literature to convey institutional quality. Both Dikova and Van Witteloostuijn (2007) and Slangen and Tulder (2009) have recently used these indicators to predict ownership patterns and establishment modes of multinationals.

The government effectiveness measure is constructed by gathering assessments of government quality from a variety of expert surveys, which come from government, NGO, and commercial providers. These expert surveys are complemented by popular surveys, such as the Gallup world poll.[7] The indicators from each of these sources are then combined into a single variable using unobserved components models. This is also true of the regulatory quality and control of corruption indexes. These models work through the following three-step process: standardizing the data into comparable units, constructing an aggregate indicator as a weighted average of the underlying source variables, and constructing margins of error that "reflect the unavoidable imprecision in measuring governance" (Kaufmann et al. 2011, 2). The scale of the indicator conforms to a standard normal distribution in each year, with higher values indicating better quality governance.

The regulatory quality measure involves a similar process of standardization, constructing weighted aggregate indicators, and completing margins of error. However, the source surveys are different and reflect concepts such as regulatory burden and tax inconsistency. Representative sources include the Economist Intelligence Unit and the Institutional Profiles Database. The measure is defined:

> Regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

The final WGI indicator is the control of corruption index. This index is based heavily on surveys from the World Economic Forum Global Competitiveness Report, which in turn tracks (to the extent possible) irregular payments in export and import, irregular payments in public utilities and public contracts, and so on. The Gallup World Poll question asking respondents whether corruption in government is widespread is also included in the construction of this variable. Formally, the WGI define the control of corruption index as:

7. For the government effectiveness measure, the specific sources used are the following: the Global Insight Global Risk Service, the Economist Intelligence Unit, the World Economic Forum Global Competitiveness Report, the Gallup World Poll, the Institutional Profiles Database, the Political Risk Services International Country Risk Guide, and the Global Insight Business Conditions and Risk Indicators. For the specific elements from each of these sources used in the construction of the variable, see www.govindicators.org.

capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

The Worldwide Governance Indicators have been criticized recently on a variety of fronts, and it is important to recognize that these are imperfect measurements of governance.[8] However, the measures are useful in that they provide very broad country coverage and because they average many different information sources and thus simultaneously summarize much existing knowledge on governance and reduce the dangers of relying on any one source. Even critics of the measures have acknowledged that the WGI are "probably the most carefully constructed governance indicators" (Arndt and Oman 2006).[9]

The two ICRG measures are the bureaucracy quality and corruption components of the overall ICRG risk rating. PRS is a private firm, and offers its ratings compiled by PRS analysts to firms primarily as a quantification of risk. Points in each category are assigned by ICRG editors on the basis of a series of predetermined questions for each component, though these questions are not available as the indexes are proprietary. Along with other sources such as the Economist Intelligence Unit and the Business Environment Risk Intelligence (BERI) ratings, the ICRG represents one of the most widely applied quantitative assessments of foreign investment risk in the world (Oetzel et al. 2001). The bureaucracy quality measure assigns higher values when the bureaucracy is "somewhat autonomous" from political pressure and when it exhibits established and consistent mechanisms for recruitment and training. When changes in government are traumatic and lead to dramatic changes in day-to-day administrative functions, countries

8. The WGI has been criticized for not adequately comparing values over time (Langbein and Knack 2010). As this is not a dynamic analysis, this criticism matters less in the present context. The measures have been criticized also for potentially relaying expert judgments on past economic growth instead of present governance assessment (Kurtz and Schrank 2007). The architects of the measure have found little evidence of this so-called halo effect. Finally, and most important for this analysis, some have faulted the measure for relying too heavily on business opinions, which may introduce bias (see the exchange between Kurtz and Schrank and Kaufmann, Kray, and Mastruzzi in the *Journal of Politics* 2007). Kaufmann, Kray, and Mastruzzi counter that the empirical sources for the indicators are much broader than the business community, integrating popular opinion polling and other sources. They also contend that there is little evidence of systematic bias among business responses or within the risk assessment community. The Kurtz and Schrank (2007) criticisms are especially relevant to this study, as they focus on the government effectiveness component of the WGI used here.

9. For additional discussion on the construction of governance indicators and recent efforts in this area, see Munck (2003).

receive lower scores on this indicator. The corruption measure comes from PRS expert assessments of the political system. Higher scores indicate more control over corruption. Interestingly, this measure is most concerned with "actual or potential corruption in the form of excessive patronage, nepotism, job reservations, secret party funding, and suspiciously close ties between politics and business."[10] Both the ICRG indexes are available in time-series format (the only governance indicator for which this was the case), which is why the corruption index was used in the previous chapter. However, given the static models in the present chapter these measures are matched to the year the survey takes place.

The last three institutional quality measures come from sources outside the WGI and ICRG datasets. As a third measure of corruption, I also collected Transparency International's Corruption Perception Index. The CPI was available for almost all country-years, but has slightly more limited coverage. Similar to other indexes, CPI takes data sources from different institutions, standardizing these various corruption scores and reporting standard errors and confidence intervals along with the core indicator. Higher CPI scores indicate less corrupt environments.[11]

The last two institutional measures are narrower and more specific to the concerns of multinational enterprise. The Logistics Performance Index (LPI), from the World Bank, is a relatively new tool that compares countries on six dimensions of trade, including customs performance, infrastructure quality, and timeliness of shipments. The LPI is constructed through surveys of logistics professionals and aggregated into a single index comparable across countries. The first LPI was available in 2007, which is two years after the last of the firm surveys used in the analysis were completed. While the other indicators are coterminous with the surveys, the LPI is a carefully constructed measure of infrastructure development and therefore merits inclusion even with the time gap. It is important to also acknowledge that the LPI goes beyond governance issues to assess broad infrastructure quality, including dimensions such as port access and highway networks. However, governance elements such as the efficiency of customs and border management are also included.

The final institutional measure has special relevance to the question of multinational innovation. Ginarte and Park (1997) developed

10. See https://www.prsgroup.com/wp-content/uploads/2012/11/icrgmethodology.pdf.

11. The CPI methodology is available at http://www.transparency.org/news/feature/.

a cross-national index of intellectual property protection, updated by Park (2008). This index of patent rights was developed as an unweighted sum of five separate scores for "coverage (inventions that are patentable); membership in international treaties; duration of protection; enforcement mechanisms; and restrictions (for example, compulsory licensing in the event that a patented invention is not sufficiently exploited)" (Park 2008, 761). The global spread of intellectual property rights protection, aided by the proliferation of international agreements such as the TRIPs framework, have arguably made firms more comfortable with engaging in innovation abroad. As this index specifically focuses on cross-national comparisons of patent protection, it is especially useful as a potential predictor for firm-level innovation.

It should come as no surprise that these various measures of institutional quality are correlated with one another. Indeed, the average correlation among these eight predictors, as used in subsequent models, is 0.632, with many individual correlations above 0.8. Because of this and in order to maximize sample size, the various measures are implemented in separate models. While the measures differ slightly in scale and considerably in thematic focus, in all cases higher values on the indexes correspond with higher evaluations of institutional quality.

Control Variables

There are a number of host country characteristics and firm-level characteristics that can potentially impact R&D incidence, and many of these are present in the econometric exercises in the previous chapter. At the country level, socioeconomic characteristics such as trade openness and the rate of economic growth have been found influential in previous studies of FDI. Chakrabarti (2001) and Jun and Singh (1996) both identify export orientation as a significant predictor of FDI flows. From the World Bank's World Development Indicators, I include trade openness, measured as imports plus exports as a percentage of GDP. This measure was matched to the year of the survey. Trade openness may indicate a welcoming policy environment for FDI, but it also may induce firms to conduct innovation abroad and to import, as discussed in chapter 4. I include the natural log of the host country's population, matched to the year of the survey. I also include the rate of GDP growth from the year prior to the year of the survey. We might expect that faster growing countries attract more innovation-intensive investments. The mean levels and other descriptive statistics for these variables from the World Development Indicators are found in appendix B.

The multilevel model detailed in the next section allows inclusion not only of country-level indicators such as GDP growth, but also of firm-level variables from the surveys themselves. Firm-level data contain potentially important controls, and I include a number of them. The industry or sector of each firm should be quite influential in determining whether that firm engages in R&D domestically. I therefore included sector dummy variables to isolate the effect of sector norms in manufacturing from services. Much of the mode of entry literature in international business studies examines ownership patterns of multinational firms and finds that R&D intensity can influence whether an investment is undertaken as a wholly owned subsidiary or a joint venture (Gatignon and Anderson 1988; Javorcik and Wei 2000). Other studies have considered the effects of firm size on investment patterns (Kimura 1989). Therefore, the size and degree of foreign control for each individual firm are also controlled in these models, as in the multilevel models in chapter 4. Firm size is measured in hundreds of employees and foreign control is measured as percentage (with 10 percent representing the minimum value and 100 percent the maximum).

Estimation Methods

The data used in this analysis are measured at two different levels. The survey data present firm-level responses to questionnaires, and I have supplemented these data with country-level data from different sources. The data are therefore layered, with one level (firms) nested within another (countries). OLS approaches would result in incorrect standard errors and increased possibilities for type-1 error rates. As in the previous chapter, I therefore opt for a set of multilevel models for the World Bank survey data. These models allow the researcher to find second-level associations, while at the same time acknowledging the hierarchical nature of the data. The primary dependent variable in this analysis is the binary decision of the firm to engage in R&D spending in the developing country. This, combined with the multilevel structure of the data, requires a multilevel logit model, the same approach described in chapter 4.

Before proceeding to the results of the analysis, it is important to acknowledge the potential bias created by nonresponse in survey data such as these. This is especially important when dealing with firm evaluations of governance and other sensitive topics. The overall average response rate to the R&D question was 54 percent. The response rate varies by country. The problem of nonresponse in firm survey data is a serious one. In a recent article addressing this issue, Jensen, Li, and Rahman (2010) argue that firms sometimes fail to respond in systematic ways. The nonresponse rate for the R&D question in this analysis is potentially problematic, especially given the potential political sensitivity of institutional questions. However, the problem is somewhat limited. There is some evidence that increased firm size leads to a higher response rate. Within country samples, the correlation between the percentage of respondent firms with 50 or more employees and the percentage of firms responding to the R&D question is 0.263. The correlation between the percentage of firms with 100 or more employees and the R&D response rate is 0.271. Thus it does appear that larger firms are slightly more likely to provide responses to the R&D question. This stands to reason. Larger firms have more personnel who can answer surveys and may have more detailed data on R&D expenditures. However, even if we assume that larger firms are disproportionally represented in the analysis, this is not necessarily problematic to the theory. Multinational firms are usually larger than their domestic counterparts. Moreover, larger multinationals may not conduct more R&D than smaller multinational firms. Therefore, it is unlikely that the potential overrepresentation of larger firms would lead to a false positive error. More worrisome would be an association between response rates and the quality of institutions. This would indicate a possible connection between poor institutions and nonresponse, perhaps based on a fear of government retaliation. This would result in biased inferences. However, the average correlation between the WGI measures and the R&D response rate is only 0.072. The other governance indicators' correlations did not substantially differ.

Jensen, Li, and Rahman (2010) suggest a number of remedies for nonresponse in firm surveys. The first of these remedies is already built into the present analysis. The authors suggest using only multinational firms, as they presumably feel freer to answer politically sensitive questions. They also suggest the use of analytic weighting schemes, which account for the number of observations through various means. This is approximated in the context of the present analysis through the use of multilevel models, which allow inference at the firm and country level. Finally, the authors suggest comparing response rates on benign questions in the survey to response rates for politically sensitive questions. In the case of this analysis, the potentially sensitive questions in the survey do not appear to be significantly related to nonresponse.

Results

Table 5.2 presents the results of eight multilevel models with a dichotomous dependent variable: the presence of local R&D spending. Again, it is important to point out that direct interpretation of the coefficients associated with the predictors is not straightforward, but the direction of association and the coefficients' standard errors and significance levels are informative. A coefficient value above (below) 0 indicates an increase (decrease) in odds of domestic R&D taking place given an increase in the independent variable. Overall, the results are consistent with the argument that positive evaluations of institutional quality are associated with local innovative activity among multinationals. Two of the three WGI measures positively associate with R&D incidence among multinational firms, at a statistically significant level. The Corruption Perception Index achieved similar results, as did the ICRG corruption measure. All three indexes of control of corruption (one WGI, one ICRG, and the CPI index) had a positive and statistically significant relationship with R&D incidence, though the CPI association was not as strong. This suggests that improvements in curtailing corruption can have dramatic impact on the likelihood that multinational firms engage in domestic R&D. In substantive terms, a unit increase in the WGI control of corruption index more than doubles the odds that a firm will engage in domestic R&D (2.43 odds ratio). Both the Logistics Performance Index and the Intellectual Property Index also had positive and statistically significant relationships with the likelihood of domestic R&D taking place. In the case of the Intellectual Property Index, the lack of coverage on this variable brought the sample size down to only 28 countries. However, the total number of firm observations (1,648) was similar to other models. This is because larger countries (with more firms contained in the surveys) are overrepresented in the Intellectual Property Index. Nevertheless, it is noteworthy that the Intellectual Property Index measure retains significance even with the smaller sample size.

While collinearity between the institutional measures and GDP per capita figures prevented the inclusion of both variables in the same

Table 5.2
Determinants of R&D incidence, 2002–2005 firm surveys

	DV: Firm R&D Binary	DV: Firm R&D Binary	DV: Firm R&D Binary	DV: Firm R&D Binary	DV: Firm R&D Binary	DV: Firm R&D Binary	DV: Firm R&D Binary	DV: Firm R&D Binary
Firm-Level IVs								
Foreign ownership (%)	–0.010*** (0.002)	–0.010*** (0.002)	–0.009*** (0.002)	–0.009*** (0.002)	–0.009*** (0.002)	–0.009*** (0.002)	–0.010*** (0.002)	–0.010*** (0.002)
Size of firm (100s employees)	0.045*** (0.010)	0.051*** (0.007)	0.055*** (0.009)	0.055*** (0.009)	0.050*** (0.008)	0.050*** (0.008)	0.045*** (0.010)	0.048*** (0.008)
Service sector (dummy)	–1.954*** (0.217)	–1.325*** (0.169)	–2.121*** (0.233)	–2.074*** (0.230)	–1.899*** (0.240)	–1.939*** (0.246)	–1.969*** (0.219)	–2.194*** (0.262)
Country-Level IVs								
Log population	–0.006 (0.121)	–0.001 (0.116)	–0.019 (0.111)	–0.032 (0.121)	0.004 (0.105)	–0.056 (0.119)	–0.089 (0.125)	0.024 (0.111)
GDP growth (previous year)	0.031 (0.059)	0.035 (0.063)	0.036 (0.059)	0.067 (0.068)	0.140** (0.058)	0.138* (0.073)	0.068 (0.056)	0.018 (0.056)
Trade	–0.001 (0.006)	0.000 (0.005)	–0.004 (0.005)	–0.001 (0.006)	0.000 (0.004)	–0.004 (0.005)	0.002 (0.005)	–0.005 (0.005)
WGI government effectiveness	0.563** (0.264)							
WGI regulatory quality		0.234 (0.248)						
WGI control of corruption			0.886*** (0.288)					

Corruption Perceptions Index				0.288*				
				(0.151)				
ICRG control of corruption					0.774***			
					(0.242)			
ICRG bureaucratic quality						0.482		
						(0.312)		
Logistics Performance Index							1.132***	
							(0.347)	
Intellectual Property Index								0.383*
								(0.210)
Variance Components								
sd (country-level)	0.781	0.881	0.747	0.850	0.637	0.756	0.753	0.531
	(0.124)	(0.131)	(0.125)	(0.143)	(0.136)	(0.144)	(0.127)	(0.122)
Log likelihood	–946.154	–1447.12	–1056.5	–1065.21	–1022.71	–1026.16	–936.483	–970.063
Observations	1667	2483	1845	1858	1724	1724	1654	1648
Groups	41	44	40	41	35	35	41	28

Notes: Table entries are for multilevel logit models, with standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Manufacturing is base category for sector dummy. Outliers were identified using Cook's D criteria for multilevel models and excluded.

model, other possible correlations are quite low in the samples used in the various models. For instance, the overall correlation between the trade variable and the WGI government effectiveness indicator in the first column is 0.138. The general correlation between trade openness and the population measure is trade and GDP growth is –0.074. This minimizes problems of multicollinearity in the models. Additional diagnostic tests for these and other models are available in appendix B, including details on residual intraclass correlations. It is worth highlighting that in all cases, the addition of the random intercepts to more limited (not multilevel) logit models is supported by likelihood ratio tests. This indicates that the likelihood of domestic R&D taking place varies by country, even once we take into account all the country- and firm-level predictors in the model.

We can also interpret the effects of the institutional variables by calculating predicted probabilities of a positive outcome (R&D spending) based on the coefficients and parameters of the models. According to the second column in table 5.2, a unit increase in the WGI government effectiveness indicator almost doubles the odds that domestic R&D takes place (odds ratio of 1.75). Using this model as a base for calculations, the predicted probability of domestic R&D taking place when the WGI government effectiveness measure is held to –1 is 0.257. On changing the WGI government effectiveness measure to 1 and holding all other predictors constant, the predicted probability of domestic R&D taking place increases to 0.481. This is a substantial increase.[12] While other predictors in the model, such as the degree of foreign ownership and the sector of the firm, have highly significant effects on R&D incidence, the significance and positive influence of the institutional variables, even in the presence of influential firm-level variables, is impressive.

The other predictors in the eight models return some interesting and at times counterintuitive results. Increased foreign control does not translate into increased odds for domestic R&D, just as in the models of chapter 4. The likely explanation for this is that as foreign control grows, so does the propensity to site R&D facilities in home countries. Larger firms exhibit higher R&D propensities. This result likely indicates greater capacity for innovation among bigger multinationals. Trade openness does not appear to be positively or reliably associated

12. This calculation of predicted probabilities is derived from the fixed (not random) portion of the model. In other words, this does not account for the random intercepts that vary by country.

with R&D incidence. The relationship between GDP growth and trade does not appear especially strong; however, there is some evidence that economic growth increases the likelihood that domestic R&D takes place in columns six and seven. It is striking that the firm-level variables are consistent and strong predictors of the likelihood of domestic R&D. The country-level variables do not generally exhibit strong and significant effects. However, the various measures of institutional quality demonstrate a consistent positive association with R&D incidence, and most are statistically significant. The regulatory quality and bureaucratic quality measures (which have similar thematic emphasis) fail to achieve significance. However, the corruption measures have a strong effect, as do the measures of government effectiveness, the Logistics Performance Index, and the Intellectual Property index.

The models presented in table 5.2 contain a number of predictors at both the firm and country level. However, there are other variables that may impact the propensity of firms to engage in R&D. In previous models in chapter 4, I included some of these other predictors, such as democratic governance and human capital. Unfortunately, some of these variables have limited coverage and/or exhibit collinearity with other predictors. However, it is important to account for their potential influence. Table 5.3 presents additional results, adding in education and human capital measures to other models while retaining the WGI government effectiveness measure.[13] These measures serve as rough proxies to test for knowledge-seeking investment motivations, as hypothesized in chapter 2. In some cases, this drops the number of observations considerably. In columns two and three of table 5.3, I include average years of schooling and the alternative human capital index from the Lee and Lee (2016) dataset as additional country-level predictors. As these data are only available in five-year increments, the 2000 values for both human capital and education were used for surveys conducted in 2002 and 2003, whereas the 2005 values were used for surveys conducted in 2004 and 2005. These are the same measures that were interpolated for the time-series models in chapter 4, but are not interpolated in this context. Higher values therefore represent higher educational attainment for this population and higher stocks of human capital. Higher values on this measure should correspond to increased incidence of domestic R&D. However, there are a couple

13. The selection of this institutional measure is somewhat arbitrary, as the other institutional variables behaved in similar fashion when the additional covariates were added to the models.

Table 5.3
Alternate determinants of R&D incidence, 2002–2005 firm surveys

	Education	Human Capital	Manufacturing Firms Only	Service Firms Only
	DV: Firm R&D Binary	DV: Firm R&D Binary	DV: Firm R&D Binary	DV: Firm R&D Binary
Firm-Level IVs				
Foreign ownership (%)	–0.009*** (0.002)	–0.009*** (0.002)	–0.010*** (0.002)	–0.01 (0.007)
Size of firm (hundreds of employees)	0.047*** (0.008)	0.047*** (0.008)	0.048*** (0.012)	0.062* (0.034)
Service sector (dummy)	–1.992*** (0.264)	–1.999*** (0.264)		
Country-Level IVs				
Log population	0.039 (0.098)	0.047 (0.099)	0.036 (0.118)	–0.209 (0.250)
GDP growth (previous year)	0.071 (0.065)	0.042 (0.062)	0.060 (0.059)	–0.176 (0.117)
Trade	–0.010** (0.004)	–0.009** (0.004)	–0.005 (0.006)	0.006 (0.010)
WGI government effectiveness	0.624** (0.283)	0.502* (0.271)	0.706** (0.277)	–0.186 (0.437)
Years of schooling, population aged 15–64	0.049 (0.071)			
Human capital, population aged 15–64		0.082 (0.281)		
Variance Components				
sd (country-level)	0.447 (0.110)	0.452 (0.112)	0.707 (0.134)	0.184 (0.793)
Log likelihood	–949.07	–954.19	–749.569	–104.48
N	1602	1609	1201	255
Groups	25	26	40	22

Notes: Table entries are coefficients for multilevel logit models, with standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Manufacturing is base category for sector dummy. Outliers were identified using Cook's D criteria for multilevel models and excluded.

of important caveats for these indicators. First, cross-national comparisons of educational attainment are not comprehensive. Although the Barro and Lee (2001) approach represents an improvement over other educational measures, including those of the World Development Indicators, there are still significant gaps in the data. Furthermore, the use of the average years of education measure does not assess the quality of education and involves trade-offs when compared with other educational measures, such as international test scores. The sample size of the general model is reduced significantly with the inclusion of educational and human capital measures. Only 26 countries are available for these two models, represented in columns two and three of table 5.3.

Column two of table 5.3 includes the Lee and Lee (2016) education measure, which reduces the sample size to 25 countries. Yet even with the reduced sample size, the WGI government effectiveness measure remains positive and highly significant. The education measure fails to achieve significance. It is puzzling that the educational measure does not demonstrate a clear positive relationship with the incidence of domestic R&D. Other models assembled with other educational measures, including the more limited metrics found in the World Development Indicators, returned similar results. Educational measures in developing countries (at least those that are available) do not seem to reliably associate with multinational R&D activity. This is congruent with the time-series results relayed in chapter 4. The human capital index exhibits similar associations. While we would expect increased human capital stock to be associated with R&D activity, the relationship is not robust. Nevertheless, the WGI government effectiveness indicator remains significant and positive.

The last two columns of table 5.3 separate the manufacturing sector from the service sector in the countries under consideration. Sectoral distinctions are important, as the dummy variable for the service sector has consistently shown in previous models. By far the most common sectors in the country samples were the manufacturing sector and the service sector. The fourth column in table 5.3 considers only manufacturing firms, and the fifth column considers only service sector firms. Service firms are underrepresented in the sample – the fifth column contains only 255 observations. Partly because of this, we can draw stronger conclusions about the impact of institutional characteristics in host countries among manufacturing firms than among service firms. I have already noted in chapters 2 and 3 the increased attention paid to service firms in developing countries, and their innovative propensities. Unfortunately, the surveys do not contain enough service firms to form strong conclusions about the impact of institutional variation. The only reliable conclusion that we can draw from these surveys seems to be that service firms are on balance less likely to engage in domestic innovation compared with manufacturing firms.

Extension of the Analysis: R&D Intensity

Thus far this chapter has utilized a dichotomous variable indicating the presence or absence of local R&D spending by the multinational. The multilevel model approach has allowed the simultaneous consideration of firm- and country-level influences on firm investment modes. However, this is admittedly a rather blunt instrument, and not the only possible indicator of a firm's innovative activities in the host country. As an additional robustness check of the link between institutional quality and firm innovation, I also constructed an indicator of R&D intensity from firm survey responses: R&D spending as a percentage of sales. This extension of the analysis therefore considers not only the possible impact of institutional quality on the decision to participate in domestic R&D, but also the intensity of R&D activity among innovative firms. Because this part of the analysis considers only those firms that are already innovative, it reflects a set of questions slightly different from the first part of the analysis and a more limited set of observations. Patterns of R&D incidence can be thought of as demonstrating firm selection effects; that is, a firm selects a country for innovation-intensive investment in part because of institutional characteristics. In the case of R&D intensity, the firms are already innovating and it becomes more of a question of repeated firm–state interaction. Ideally, time-series data would track firm responses to institutional changes over time. However, even with static data the relationship between state institutions and already-innovative firms should reveal consistent associations.

Partly in response to the altered context for the analysis, I use different indicators for some of the independent variables. The firms considered in this part of the analysis are already innovative. Whether they spend more or less on R&D is at its heart a firm-level question. For this reason, and also as an additional robustness check on the country-level WGI measure, I utilize a separate proxy for institutional coherence, contained within the survey itself. The survey question

I selected conveys a theoretically more direct relationship between institutional coherence and intensity of R&D effort. One section of the 2002–2005 surveys contains questions regarding firm–government relations. Though this portion of the Investment Climate Surveys primarily deals with legal dimensions of investment governance, there are a small number of questions that can serve as reasonable operationalizations of institutional effectiveness. I selected a question that best approximated ideas about the strength and quality of state institutions, broadly defined. The wording of the question is as follows:

> In general, government officials' interpretations of regulations affecting my establishment are consistent and predictable.

The six possible responses in the 2002–2005 surveys range from "fully disagree" to "fully agree." A positive response to this question can be broadly interpreted as a perception of competent institutions by the firm. If positive responses on this question are indeed associated with higher levels of R&D spending, the conclusions associated with the institutional measures in this chapter would be corroborated by individual, *firm-level* responses.

Moving beyond the changed dependent variable and changed independent variable of interest, there is only one other variable with a source different from the previous models. In order to test more conclusively the finding that education was not connected to R&D incidence, I included in this second analysis a different measure of educational attainment, this time at the firm level. An additional set of questions within the surveys asked firm representatives about the education levels of their workforce. I used the percentage of the workforce with some university as a proxy, expecting that increases in workforce education should be associated with greater R&D intensity. This perhaps serves as a more proximate, firm-level indicator of knowledge-seeking motivations among firms than the country-wide education and human capital measures employed in previous models.

The dependent variable in this secondary analysis is not binary, but a continuum. The model used is therefore a linear mixed model, containing both fixed and random effects. The R&D intensity measure is bounded between 0 and 5 percent of sales, in part to approximate normality in the data and eliminate the influence of outliers.[14] The

14. In practice, 45 out of 451 observations demonstrated R&D between 5 and 100 percent of sales, but these observations were identified as influential outliers and excluded from the model.

values provided by all independent variables were again matched to the year of the survey, except for the GDP growth measure, which was taken from the previous year.

As previously mentioned, the nonresponse rates for the R&D intensity question are potentially problematic. As there are nondemocratic developing countries in the firm survey datasets, firms could also potentially be avoiding the politically charged question of government effectiveness. In the context of firm-level analysis, it is doubly important to ensure that patterns of nonresponse are not correlated with the variables of interest, especially the politically sensitive government effectiveness question. In this case, however, there appears to be no strong association between response rates and government characteristics. Firms responded to the government effectiveness question in large numbers: the overall response rate in the 2002–2005 surveys was 97 percent. The correlation between the dichotomous democracy measure from Cheibub, Gandhi, and Vreeland (2010) and a country's response rate average to the government effectiveness question was 0.012, suggesting that nondemocracies did not have significantly different response rates than democracies. Comparing country average response rates for the government effectiveness question with the WGI indicator, we see a correlation of 0.068 for the 2002–2005 surveys. This indicates that countries with higher quality institutions did not see higher response rates. Finally, it seems that firm size is not strongly correlated with response to the government effectiveness question. The correlation between hundreds of employees and response to the government effectiveness question (within the surveys) is only 0.015 for the 2002–2005 surveys. All told, the response rates to the government effectiveness question in the survey do not present significant obstacles to inference. Firms almost always answered the government effectiveness question, and whether they did or not appears to have little to do with the quality of institutions or firm size.

Model and Results

Because we are no longer dealing with a dichotomous dependent variable but are still interested in both firm- and country-level effects, we require a slightly different model. The multilevel logit approach is therefore discarded in favor of a multilevel random-intercept model with a continuous dependent variable:

$$y_{ij} = \beta_1 + \beta_2 x_{2j} + \beta_3 x_{3ij} + \upsilon_{0j} + \varepsilon_{ij}$$

This model includes a set of beta coefficients associated with various predictors at the country and firm level, but also a random intercept υ_{0j}, which varies from one country to the next. The random intercept allows for the possibility that the mean percentage of R&D spending is systematically higher or lower among different countries.

The results of the secondary analysis using the alternate proxies for government effectiveness, education, and R&D effort are presented in table 5.4. The firm-level measure of institutional consistency is positively related to R&D intensity. Firms that perceive host country institutions to be consistent and predictable are more likely to adopt R&D-intensive investment models. If a firm moves one unit on the six-point question used in the surveys, for example, from "tend to agree" to "agree in most cases," this should be associated with a 0.08 increase in R&D intensity. While this may not seem significant, it is important to note that the mean R&D effort of innovative firms is only approximately 1 percent.

The other variables in the model relay some interesting information. The firm-level education measure returns the same result as the country-level education measure: higher education within the firm does not correspond with increased R&D intensity, at least not at any level of statistical significance.[15] Larger countries exhibit less R&D-intensive investments. This stands to reason, as much investment in these larger countries may be market-seeking and the sales denominator of the R&D intensity measure would therefore be larger. In similar fashion, the negative and significant coefficient associated with the firm-level size variable (hundreds of employees) is not as surprising as it first appears. The denominator of the R&D intensity measure is linked to the size of the firm (in sales), and therefore larger firms with larger sales may have trouble scoring high on the R&D intensity measure. The result that more open economies see less R&D-intensive investment may loosely corroborate the logic of the earlier models: that R&D can be done abroad and brought in. However, this variable has not been strong in previous models. GDP per capita is included in this model, as it does not demonstrate collinearity with other predictors (as was the case with the institutional measures in table 5.2). This variable fails to achieve significance, which again may have to do with the scale

15. However, it should be noted that the relationship between domestic innovation intensity among multinationals and employee education is likely to be endogenous.

Table 5.4
Determinants of R&D spending intensity in innovative firms, 2002–2005 firm surveys

Dependent Variable	R&D intensity, measured as percentage of sales
Firm-Level IVs	
Consistent and predictable governance	0.083**
	(0.039)
Education of workforce (% with some university)	0.001
	(0.002)
Foreign ownership (%)	–0.001
	(0.002)
Size of firm (hundreds of employees)	–0.016***
	(0.006)
Country-Level IVs	
Log population	–0.172**
	(0.081)
GDP growth (previous year)	0.151***
	(0.036)
Trade	–0.006*
	(0.003)
Log GDP per capita	0.053
	(0.075)
Random-Effects Parameters	
sd (constant)	0.477
	(0.106)
sd (residual)	0.994
	(0.036)
Log likelihood	–648.259
Observations	442
Groups	54

Notes: Table entries are coefficient estimates with standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. All firms with reported R&D intensity between 0 and 5 percent of sales.

of the dependent variable. If sales are strong due to a rich consumer base (or a large country), R&D expenditure scaled against sales may diminish.

The significance of the government effectiveness variable in the presence of these important controls suggests that the characteristics of government institutions do matter for firm investment models, not only for the decision to invest in R&D but also for how much R&D spending is done. This is further illustrated by figure 5.1, which simply

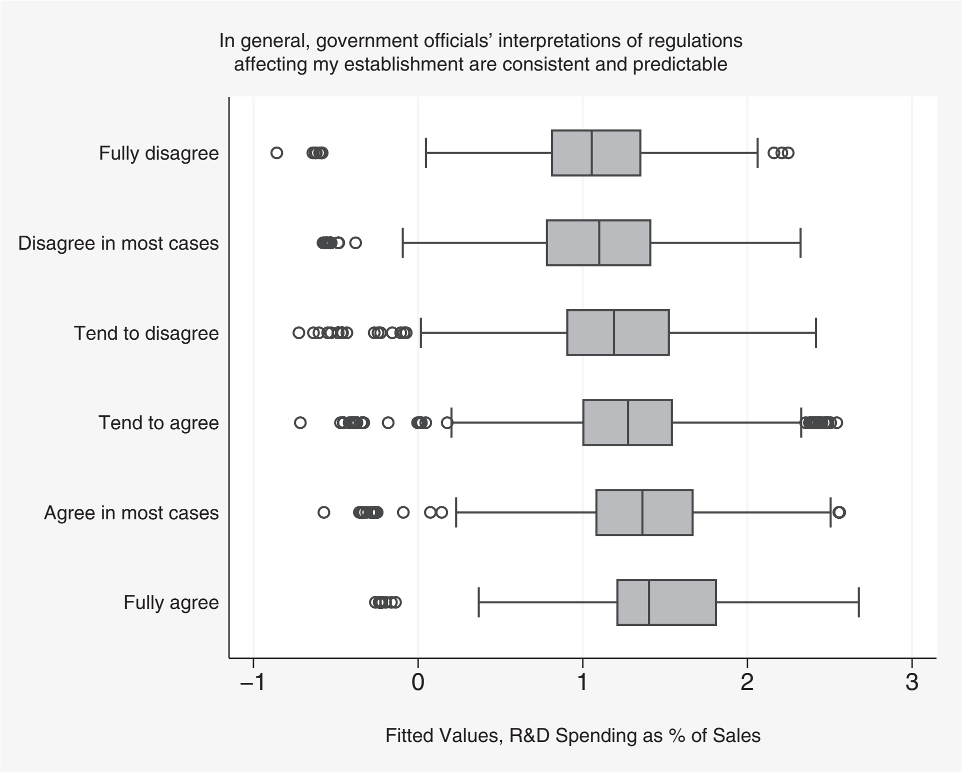


Figure 5.1
Consistent and predictable governance and R&D intensity.

plots the fitted values of the model in table 5.4 against the six-response question in the firm surveys on government effectiveness. As indicated earlier, the responses for this question range from "fully disagree" to "fully agree."[16] Upward movement on the scale is associated with upward movement in R&D intensity, even while taking the other predictors in the model into account. While R&D intensity is affected by dynamics different from the simple decision to conduct R&D in the developing country, it is important that in both circumstances the variables that measure institutional coherence are significant.

16. Because of the large number of data points in each category, horizontal boxes are used in this figure. The lines within the boxes represent the median value for each category, the ends of the boxes represent the 25th and 75th percentiles, and the whiskers represent the upper and lower adjacent values. Hollow dots are outside values.

Discussion

Academics and policymakers alike have long understood that politics does impact multinational firms' investment decisions. Firms consider not only economic conditions in potential host countries, but also the political stability of the country and many other factors, including institutional characteristics. Recent work in international political economy and in institutional business literature has begun to unravel the complex relationship between host country institutional characteristics and FDI. However, scholars have not asked many questions about the *types* of activities pursued by multinational firms or the ways in which the policies and institutions of the host country may affect these investment models. International business studies have preferred to concentrate on the determinants of firm ownership and greenfield/M&A entry models. Other economic studies have sought to determine the economic motivations for various models of investment, including innovation-intensive investment. However, the links between institutional variables and these investment outcomes remain underspecified. This chapter fills a gap in this understanding. Given the limitations of the surveys used in this analysis, the arguments advanced here may be investigated in the future with more detailed data.

Multinational firms attempt to minimize risk in developing countries. Though the incidence of outright expropriation has declined (Minor 1994), investing abroad is still subject to many uncertainties.[17] Local R&D can increase the risk for firms. Firms engaging in local R&D activity are exposed to potential theft of intellectual property or domestic patent regulations that may adversely affect the firm. Based on the results of this analysis, the host country's institutional setting is one area where this risk may be reduced. Indeed, it appears that firms with innovation-intensive options are even more attuned to the institutional environment in host countries, because the nature of these activities creates more risk than other forms of investment. In more general terms, institutional variation may affect more than ownership patterns. It also affects the types of activities pursued by firms. This process also may be additive. In other words, well-functioning institutions may make joint ventures with local firms more palatable to multinationals,

17. There is some more recent debate about whether instances of expropriation/nationalization have increased again after decreasing for most of the 1990s; see Hajzler (2014).

which may in turn lead to more local innovation. This sequence is not tested in the current analysis, due to its static nature. However, higher foreign ownership is consistently associated with lower incidence and intensity of innovation. If poorly functioning institutions lead firms to internalize transaction-costs that the state cannot provide, more rigid hierarchies and centralized innovation are likely. In addition to the incentives offered by a whole host of economic pressures, firm investment models are also affected by the characteristics of state institutions in host countries.

This chapter and its conclusions are subject to a number of limitations. I have already noted that the relationship is evident only for developing countries once they attain an intermediate level of development; very poor developing countries do not appear in these samples (due to data limitations) and may not exhibit the same dynamics. Other work on FDI traces the development of firms' R&D activities through time, proposing links between institutional settings and evolving firm investment models. Because the firm-level data employed in this study are cross-sectional but not temporal, the dynamic interaction between firms and institutions is not measured. Ideally, to counteract this problem we would be able to access a survey that tracks individual firms both across countries and through time. Unfortunately, these data are not available in a cross-national context. The next chapter adds this time element as it considers the experience of multinational firms in a specific economy, Ireland. As another potential complicating factor, the firm entry mode literature ostensibly deals with initial models of investment, and the firm survey data used here include interviews with some firms that have been active in developing countries for years. The present analysis captures both initial entrants and established firms, and this brings up difficult questions about whether institutional quality is attracting already innovative firms or whether high-quality institutions encourage innovation to develop over time. Again, a temporal perspective would be useful. However, the positive associations between institutional quality and specific activities of firms should be additive in both groups. In other words, the hypothesized relationship between institutional quality and R&D activities should not vary based on how long a firm has been in country. Moreover, the lack of time-series firm-level data is a common problem for most studies; most adopt a static specification for their models. In the firm entry literature, various studies have boosted the sample number of econometric analysis by considering firms that are active in countries, without dwelling on when the investment was made (Asiedu and Esfahani 2001; Meyer 2001).[18] Cross-national studies of the economic determinants of export orientation and innovation among multinationals (Kumar 1994; 2002) have also adopted a static approach due to data limitations. Neither approach is entirely satisfactory, but the lack of time-series, cross-national survey data on firm activities necessitates trade-offs.

Another possible objection to the analysis in this chapter is the possibility of correlation between the country-level indicators of institutional quality (WGI, ICRG, etc.) and the firm-level survey responses. I have proposed in the theory section that institutional quality matters for aggregate investment patterns and for individual firm action. Within countries, there is a great deal of variation in firm perceptions of institutional effectiveness and consistency. When country averages of responses to the government effectiveness question are compared with the WGI government effectiveness measure, the correlation is 0.304. While this correlation is significant, it is not deterministic. That is, firm perceptions and responses vary even in countries with well-regarded institutional frameworks. More importantly, these perceptions are related to differences in firm profiles in significant ways. The institutional environment may not vary within countries, but firm *perceptions* of that environment do vary. These perceptions matter for the amount of innovation, as indicated by R&D spending levels. The analysis presented here demonstrates that firms with a more favorable perception of state institutions are more likely to innovate locally. This occurs within countries that receive a high WGI score (or any other country-level score) and those that do not.

Conclusion

This chapter provides support for comparative institutionalist notions about the importance of the state in explaining investment outcomes. State institutions should not be "black-boxed" or dismissed as unimportant. Based on the results of this analysis, firms are more likely to commit resources to innovation in host countries when institutions in those countries are perceived to be well-functioning, consistent, and credible, by the firms themselves or by outside observers. Perhaps most

18. As another example, Meyer et al. (2009), in their ambitious entry mode study, collect ownership data on firms registered between 1990 and 2000 and acknowledge the bias that may exist based on surveying firms that entered too far in the past.

surprisingly, institutional quality has a more reliable positive association with R&D incidence and intensity than education measures in host countries, even while acknowledging the shortcomings of the education measures. This signifies that some level of institutional coherence is beneficial for taking full advantage of the possibilities offered by global economic integration. Firms do not solely react to economic developments and internal dynamics, but also consider the domestic institutional context for investment projects in emerging economies. For multinationals, institutions are the focal points for interaction with host country governments. As such, there is little reason to doubt that the characteristics of these institutions can have a substantial impact on firm decision-making.

The internationalization of R&D is no longer limited to developed countries. More and more, multinational firms are choosing to locate their innovative activities in emerging economies. This happens for a variety of reasons, including cost reduction and the search for research talent abroad. However, the special and often sensitive characteristics of innovative activities within multinational firms change the dynamics of investment in other ways. Unlike basic manufacturing activities, where competition on price may be the driving determinant of investment location decisions, innovative activities require special attention to host country attributes, such as the rule of law or responsiveness of governmental institutions. I have argued in this chapter that these institutional attributes have an important impact on the form investment takes in developing countries. This has important implications not only for studies of FDI, but also for developing countries' strategies in the competition for innovation-intensive investment. In previous and subsequent chapters, I argue that discriminating investment promotion policies are not enough anymore. Investment promotion agencies may have some success in attracting nontraditional forms of investment. However, unless those efforts can be coupled with active promotion of backward linkages to supplier firms, educational institutions, and research bodies within the country, those investments may operate as islands. The current chapter emphasizes that this is a two-way street. Just as developing country governments are paying more attention to the industrial upgrading potential of multinational firms, firms are also paying attention to the institutional infrastructure in potential investment locations. Firms may therefore be more willing not only to contemplate innovation abroad, but also to enmesh that innovation within the economy of host states. This will require substantial assurances on the part of the state that these investments will be protected by a robust institutional framework. This includes intellectual property laws, consistent tax regimes, a robust supply of appropriately skilled labor, and an overarching regard for the rule of law.

This chapter has demonstrated broad associations between institutional characteristics in host countries and specific innovative activities of multinational firms. Institutional quality, as perceived by the firms themselves and by neutral observers, is associated with more innovation-intensive patterns of investment. This conclusion has been supported by a variety of econometric exercises utilizing the World Bank Investment Climate Surveys. The cross-national focus of this chapter is abandoned in the next chapter, where I focus on the experience of Ireland with FDI over the last quarter-century. The case study that follows is intended as a complement to the conclusions advanced in this chapter and in previous chapters. While analysis of firm survey data is interesting, it leaves some very important questions unanswered. Most importantly, it is important to understand how specific governmental policies are channeled through existing governmental institutions to affect incoming investment patterns and firm behavior. It is also important to consider how investment patterns evolve through time, partly in response to these stimuli. The current chapter does not afford this temporal dimension. However, case studies of individual country experiences through time can be illuminating for these questions. The next chapter takes advantage of a shift in methodological approach to answer additional questions about multinational innovation and state institutions.

6 Chasing the Tiger: Is Ireland's Experience with FDI a Model for Developing Countries?

This book is primarily dedicated to the analysis of innovation in multinational production networks across countries. This is for various reasons, not least of which is the desire to make broad claims about how innovation is distributed and changes in response to varying host country characteristics, which themselves change over time. I have employed various firm- and country-level statistics to make arguments about the determinants of innovation in developing countries. I believe that various international and domestic factors have important impacts on innovation decisions, and I have argued that innovation is more likely when these factors combine in particular ways. However, this approach to the analysis of innovation suffers from a number of limitations and is unsatisfying in some quite specific ways. Some of these limitations are well rehearsed in the ongoing (and never-ending) methodological debates in political science and to a somewhat lesser extent the subfield of international political economy. Without going into too much detail regarding these larger fights, it seems evident that cross-national analyses have a number of important limitations that are important to the study of innovation among multinationals and that motivate the case study of the Irish experience contained in this chapter.

First is the role of policy. In the preceding chapter and at other places in this book, I have concentrated on the role of institutions in host countries as having a strong impact on the innovation patterns of multinationals. On the whole, this book can be appropriately categorized as institutionalist in its fundamental nature. However, I have consciously avoided bringing policy into the working definition of institutions in some chapters, even though there are authors who do include policy

(North 1990).[1] Countries employ various regulations, incentives, and requirements in their interactions with multinational firms, and these policies are often enacted in the very hope that developmental spillovers will result. There also can be no doubt that many of these policies, such as the corporate tax rate on innovative expenditures, can have dramatic impact on the likelihood and intensity of innovation. However, it is especially difficult to make policy comparisons in studies with large samples, because policies themselves are not easily comparable across countries. Even something as seemingly simple as the corporate tax rate can be fraught with difficulties when subjected to cross-national comparisons, as these rates are rarely the rates paid in some countries (because of deductions, credits, and so on), whereas in other countries they are quite close to effective tax rates. In-depth analysis of policy differences is incredibly important, but it is better suited to a smaller number of individual case studies than the econometric exercises common in this book. Indeed, two or three individual country cases, even with similar arguments and conclusions, might have resulted in a very different book! Yet this choice would involve another set of trade-offs.

This chapter attempts to account for some of the limitations of cross-national work by emphasizing both policy and institutions in the case of Ireland. In doing so, I am more able to emphasize the long-term nature of the relationships between host countries and foreign firms and to apply some of the theories developed in this book to a well-known case of foreign investment. The process by which host country institutions and policies affect the innovation patterns of multinational firms is a long one, and it is interactive. Though I have employed time-series data periodically in this book, I have not yet had the opportunity to explain how specific policies and institutions affect these patterns in a particular context. Qualitative analysis of country experience is an important complement to the methods employed in other chapters. Not every hypothesis advanced in previous chapters is supported in the case of Ireland, though many are. But part of the essential contribution of the case study is its recognition of unit heterogeneity. The relationship between host country institutions and multinational

1. Dunning (2005, 57) acknowledges that the distinction between a policy and an institution is sometimes not easy to make. However, he characterizes policy as referring "only to government action." One can have inappropriate policies within a sound institutional framework, but strong policies can also be made ineffective by poorly designed or functioning institutions.

innovation patterns *should* vary across countries, and explaining the idiosyncrasies in different country contexts is nothing more or less than a contribution to comprehensive understanding.

Of course, labeling this chapter a single case study is both accurate and reductive. Both Rueschemeyer (2003) and Gerring (2004) make the crucial point that individual cases should not be confused with single observations. When the analysis does take place within a single country (or whatever the case unit is), there is often tremendous variation within that case at lower levels of analysis. In this particular example, there are numerous sources of variation among firms, many of which are integrated into the various theoretical mechanisms linking institutions and innovation. Variations in government effectiveness through time, institutional coherence and consistency, variations in firm profiles, and variations in economic sectors all play roles in the layered arguments presented here. It is therefore misleading to suggest that single case studies display insufficient variation. That is not the case in this chapter, as will become apparent.

This chapter uses Ireland as an illustrative and analytically important case for a number of reasons. Ireland has demonstrated remarkable success in attracting FDI, and much of this investment is from sectors that developing countries prioritize as potential conduits for industrial upgrading and development. Ireland is not a developing country. However, it is a peripheral European country and in its more recent past was quite far below its European peers in various measures of development. As recently as 1990, Ireland had a GDP per capita of US$13,892 (inflation-adjusted), which was good for only 62 percent of the average of high-income OECD countries (Paus 2012, 163). In the mid-1980s, some estimates of unemployment were at 20 percent and above, a figure surpassed in the EU only by Spain. Between 1982 and 1993, over 470,000 people emigrated from Ireland, continuing trends that had been in place since the end of World War II (O'Hearn 1998, 51). In the early 1990s, however, Ireland's economy turned a corner and took off. The story of the "Celtic tiger" is well known and too involved to reproduce here in entirety.[2] However, there is near unanimous agreement among scholars that FDI played a crucial role in this phenomenon, with the only real source of disagreement being the extent of this contribution. From net averages of US$100 million to

2. See O'Hearn (1998), MacSharry et al. (2000), Ó Riain (2004), and Ruane and Uğur (2005) as a representative sample.

$200 million per year in the 1970s and 1980s, FDI inflows averaged almost $5 billion in the 1990s. Living standards increased dramatically in the second half of the 1990s and convergence with European norms was rapid. More than anything else, however, Ireland's experience with FDI is fascinating because of the kinds of FDI the country attracted. Ireland became known in the 1990s as a destination for high-tech FDI. Numerous high-profile investments by well-known firms such as Intel and Apple increased the investment profile of the country at a particularly auspicious time in its history, and the unique characteristics of the IT industry allowed a rapid inflow of investment. These IT investments were followed by investments from medical supply companies and business service firms. Ireland quickly developed a reputation as a country that had "got it right" with FDI promotion, and managed to land some of the most sought-after investments. Even today and in the aftermath of the severe housing and financial crisis in 2008, developing countries look to Ireland and its institutions as a model for FDI-led development.

It is certainly true that developing countries do not have the resources that Ireland did in the 1980s and 1990s. Ireland was and is blessed with certain structural head starts, including proximity to major markets in Europe, an English-speaking workforce, and other advantages. However, in this case it may be less important where the starting line is and more important how the race plays out through time. The semantic distinctions among developing, emerging, and middle-income countries are important, to be sure, but the fact remains that Ireland experienced rapid convergence with EU standards of living and successive governments viewed FDI as a vehicle to achieve this. Of course, every country is unique, but among those in the FDI community Ireland is often considered to be *the* example of innovation-intensive FDI and FDI-driven development. The country is often held up as a possible example for developing countries (Paus 2015). As I explain in this chapter, the relationships among institutions, policies, and innovation outcomes are complicated in Irish case. However, the country did indeed have some significant commonalities with peripheral emerging economies in the 1980s and achieved rapid growth partly based on inward investment.

However, and as this chapter will demonstrate, the Irish experience with FDI is not as clear cut as the popular narratives suggest. More importantly, this chapter gives many of the hypotheses and relationships described earlier in the book additional scrutiny in the historical experience of an FDI-dominated economy. I have argued throughout this book that foreign investors are influenced by the institutional environment in host countries and that innovation patterns among firms can be partly explained by the attributes of the countries in which they operate. In this chapter, I examine relationships among firm- and country-level variables and resulting patterns of innovation. Crucially, I am able to evaluate policy changes and initiatives and their effects of innovation patterns. I find that public support for innovation, in the form of grants, partnership incentives with local firms and universities, and other government tools do have an impact on the incidence of innovation among foreign firms. I also find evidence that Irish institutions have had a substantial impact on the characteristics of incoming foreign investment. The Industrial Development Authority, now known as IDA Ireland, in particular, was instrumental in attracting investment from new sectors in the 1990s. However, other institutions have also been essential to the effort to integrate foreign multinationals into the domestic economy through backward linkages and other kinds of spillovers. This effort has borne fruit more recently, and only after substantial efforts on the part of the Irish government. This chapter therefore continues the previous chapter's focus on domestic institutions and their effects on FDI, while also integrating specific policies promoted by successive Irish governments. As a case study, this chapter lends support to many of the hypotheses advanced in the cross-national chapters, while also acknowledging the unique nature of the Irish experience with foreign investment.

FDI and the Role of Irish Institutions

While FDI assumed a larger role in the 1990s, Ireland's economy has been disproportionally influenced by multinational corporations for most of the postwar period. The country's English-speaking environment, relatively skilled workforce, respect for the rule of law, and geographic location as a bridge between Europe and North America were all factors that encouraged multinationals to invest in Ireland, particularly US firms. By 2007, foreign enterprises accounted for approximately 50 percent of Irish manufacturing employment, and inward FDI stock per capita was more than four times the EU average (Barry 2007, 263). In 2010, foreign affiliates accounted for 80 percent of manufacturing value added (OECD 2010) and for almost 80 percent of Irish exports (Barry and Bergin 2013). At the height of the Celtic tiger phenomenon, the IT and software sector broadly defined was responsible for nearly 8 percent of Ireland's GDP and almost 10 percent of its exports.[3] Ireland's dependence on FDI continued through the great recession, and by some accounts the export performance of multinationals in Ireland kept the country from an even worse economic cataclysm (Barry and Bergin 2010).

While geographic and cultural factors undoubtedly played a role in the dramatic increase of FDI intensity in the Irish Republic, much of the credit has gone to Irish institutions. IDA Ireland, in particular, has been held up as an example of an investment promotion agency par excellence, the first of its kind and immensely successful in bringing high-quality investment to a country that had often struggled. Other credit has gone to the development of the Irish educational system, which laid the groundwork for much of the knowledge-intensive investments in the 1990s. By many popular accounts, the Irish experience with FDI is an unqualified success story, one that developing countries would do well to emulate.

I argue that the relationship between Irish institutions and the quality of FDI is more complicated and in some ways directly contradicts the conventional narrative. This chapter builds on previous work that has questioned the innovative characteristics of FDI in Ireland and the degree to which multinational firms are providing forward and backward linkages to indigenous firms.[4] I argue that recent advances in the innovative intensity and general quality of FDI in Ireland are directly attributable to institutions moving *away* from the set of industrial and innovation policies common in the 1990s and prior. While previous, sectorally discriminating but also passive investment promotion policies based on tax arbitrage generated investment, it was only with the establishment of a truly active innovation promotion policy package in the late 1990s that innovation-intensive and linkage-rich investment patterns began to emerge. Moreover, Ireland arrived late at this station, and potentially innovative indigenous industry suffered as a result. Ireland's record of FDI attraction, for all its successes, is also a story of missed opportunities.

I utilize two firm-level survey sets to advance the argument that R&D among multinationals has improved in recent years and that

3. GDP figures must be treated with care in Ireland, as transfer pricing practices among multinationals often distort values. The gap between GDP and gross national income has important implications for calculating FDI (Barry and O'Mahony 2005).

4. See O'Hearn (1998), Kirby (2002), and Breznitz (2007) as examples.

numerous new forms of linkages have surfaced despite still low levels. The Community Innovation Survey (CIS), carried out by all EU member countries, measures innovative activities among firms of all origins. I use the 2006 and 2008 CIS surveys administered by the Central Statistics Office (CSO) in Cork. I also employ the Business Expenditure on Research and Development Surveys from 2007 and 2009. These surveys, also firm-level and administered by Forfás in cooperation with the CSO, are more specifically focused on R&D activities of enterprises in the Irish Republic. These surveys were accessed in compliance with CSO's confidentiality policy for proprietary firm-level data, and they allow a more specific and complete picture of the innovative activities of multinationals in Ireland. This in turn reveals numerous subtleties in the relationship between Irish institutions and resulting investment patterns.

The chapter proceeds as follows. In the next section, I briefly summarize extant literature on the political economy of multinationals in Ireland, concentrating on the literature surrounding the evolution of Irish industrial policy and the innovative activities of firms. I then move to a short historical treatment of the quality of FDI in Ireland, emphasizing that despite the nature of investment in Ireland, foreign firms did not exhibit high levels of R&D spending or local linkages even into the 1990s. I then examine the current state of innovation among multinationals and employ data from the firm-level surveys to argue that highly innovative firms are gradually becoming more embedded in domestic networks. Following this, I turn to the institutional constellations that have contributed to this recent turnaround, acknowledging successes such as Science Foundation Ireland (SFI) and Enterprise Ireland's belated emphasis on indigenous firm development. I also identify in this section remaining deficiencies with respect to encouraging innovation. I employ the CIS and BERD databases here again to emphasize the relationship between state support for innovation and the investment strategies of firms. A conclusion follows, summarizing the findings of the chapter and proposing potential policy implications.

Multinational-Led Development?

Development theorists have naturally gravitated toward analysis of Ireland's transformation. The role of the state in attracting high-tech FDI is a matter of considerable debate, often entwined in larger arguments about the role of industrial policy in developing countries. Writing during the IT boom, Krugman (1997, 51) argued that a combination of "good luck, good timing, and good policy" turned Ireland into an attractive location for export-oriented FDI. Yet scholars differ on how much to emphasize the good policy part of that equation. For analysts who prioritize institutionalist explanations, the evolution of IDA Ireland's investment promotion activities from the 1970s on is quite important. Nelson (2009) emphasizes the autonomous, meritocratic, and networked characteristics of the agency and contrasts its successful attempts at sectoral targeting with other investment promotion agencies in Latin America. Ó Riain (2004) characterized Ireland in the 1990s as a "developmental network state,", with a high degree of Weberian competency and mostly streamlined institutions. Kirby and Murphy (2011) referred to the "capable technocratic developmentalism" of insulated institutions such as the IDA. The optimism of the early tiger years prompted a number of more or less complimentary analyses of Irish state institutions, many of which emphasized the ability of autonomous institutions such as the IDA to bring in investment and wring from multinationals substantial innovation and linkage spillovers (Breathnach 1998; MacSharry et al. 2000).

While favorable judgments of Irish institutions were (and remain) common, a not insignificant number of analysts have called into question both (1) the viability of an FDI-centric strategy for development and (2) the degree to which Irish institutions have been truly developmental and/or interventionist. On the first dimension, numerous studies have pointed out the dual nature of the Irish economy and questioned the quality of FDI-linked jobs, whether multinationals are actually engaging in innovation locally, and the development of extensive forward and backward linkages with Irish firms.[5] This chapter will have more to say about these studies and the quality of FDI in recent years. On the second dimension, concerning the developmental nature of the Irish state, some recent studies have advanced rather pessimistic assessments of the innovative characteristics of inward FDI, while also characterizing Irish institutions as largely "hands-off" or even counterproductive. Breznitz (2007) argues that Ireland in the 1990s focused on bringing in multinationals, without paying much attention to their embeddedness with local industry. He also argues that

5. See, for example, Murphy (1998), O'Hearn (1998; 2001), and Kirby (2002). Fink (2004) even went so far as to suggest reliance on FDI constitutes the Irish version of Dutch disease.

the Irish state was late in supporting the indigenous software industry, which managed to succeed in spite of this. O'Hearn (1998) and Fitzgibbon (2011) voice similar complaints about Ireland's innovation policies, arguing that the state did little to encourage linkages. Fink (2004) argues that adherence to liberal industrial policies, including a diminished role for the state, caused irregular and even dependent development. Echoing this sentiment, Ornston (2012) characterizes Ireland as a "competitive corporatist" state with more in common with the United Kingdom's industrial and investment policies, and links low levels of FDI-related R&D and domestic linkages with this institutional background.

Given these recent and variably revisionist accounts of Ireland's success, can we label Ireland's FDI policy regime as truly developmental? The answer to this question is complicated. On the one hand, there can be little doubt that institutions such as the IDA display the embeddedness and autonomy Evans (1995) characterized as necessary. The IDA has certainly been sectorally discriminating in its approach to incoming foreign investment, and the success of some indigenous industry groups such as the software industry seem to point to well-executed policies. The efforts of the state to improve the Irish educational system as far back as the 1960s were instrumental in attracting higher-quality FDI, though these policies sometimes did not truly bear fruit until the 1990s. However, it is also difficult to escape the conclusion that Irish institutions did little to generate linkages between multinationals and domestic industry, thus contributing to the dual economy for much of the 1990s and 2000s. Even during the height of the IT boom, foreign firms did not conduct a great deal of R&D locally, concentrating instead on adapting software and hardware packages for the growing European market. Given the successes other small, open European countries have had in generating forward and backward linkages from foreign investment, it is hard to maintain that the Irish state has not missed some opportunities.

The case of Irish investment promotion institutions is intriguing precisely because it blends elements of success in FDI attraction and failure in FDI integration. Moreover, there are signs that the FDI policy regime has shifted in recent years in the direction of incentivizing spillovers. Irish policy seems to have recently recognized the limits of nonintervention in the context of FDI integration. This chapter, building on preceding chapter's consideration of the incentive structures facing multinationals, rests on the central theoretic claim that spillovers from multinational investment do not happen automatically. I argue that while the institutional framework for FDI has contributed to the dual nature of the Irish economy and hence its vulnerability, recent policy shifts indicate a willingness to move away from the model of investment promotion that has been so successful in generating investment yet so unsuccessful at generating spillovers from that investment. This shift constitutes not a wholesale break with passive investment policies, but rather a gradual implementation of more interventionist industrial policies designed to coax multinationals into partnerships with local firms and to conduct more R&D locally. A number of recent works have conveyed these policy shifts, which include such diverse mechanisms as tax incentives and university grants.[6] On the institutional side, the establishment and strong support of Science Foundation Ireland (SFI) in 2000 was instrumental in increasing the research profile of Irish firms, and Enterprise Ireland is generating more venture capital than in years past.[7] This chapter examines how firms are responding to these various initiatives. Yet even though Ireland's belated conversion to an interventionist investment promotion framework is generating results, Ireland remains behind many other FDI-intensive economies in Europe and elsewhere.[8]

The Quality of Inward FDI in Ireland: A Brief History

Ireland got a late start on industrialization. The country manifestly failed to develop a national system of innovation before World War II. This was facilitated if not actively encouraged by a succession of postindependence governments that emphasized the agrarian nature of the Irish economy (often in willful contrast to British industrialization). After a brief postwar dalliance with import substitution, the Irish government moved decisively to economic openness in 1958 after the publication of Ken Whitaker's *Economic Development*, a document that outlined the potential benefits of free trade and export-oriented

6. Paus (2012) notes the increase in R&D expenditures during the course of the 2000s, following on increases in financial incentives for innovation-based activities. O'Malley, Hewitt-Dundas, and Roper (2008) note that foreign firms are increasingly using local sourcing and better integrating indigenous suppliers into global production networks.

7. Ó Riain (2014) notes that Enterprise Ireland provided about a third of all venture capital funding in the 1990s.

8. O'Malley et al. (2008, 164) show that Ireland lags behind many OECD countries on innovation indicators such as business expenditure on R&D and patent activity.

industrial policy. A favorable environment for international investment was an important part of the policy package, mostly because foreign firms held the promise of well-paying jobs to a country that had endured cyclical and persistent bouts of unemployment. Yet while the primary goal was employment, it was quickly recognized that FDI could have other benefits as well. During the premiership of the economic nationalist Sean Lemass (1959–1966), foreign firms were promoted as "pump-primers" for indigenous dynamism and growth (Jacobsen 1994, 70–71). Despite these goals, foreign investors did not reliably bring innovation-intensive investments to Ireland. The Cooper–Whelan study, undertaken in 1973, already recognized that Ireland relied on technology produced abroad and imported through multinationals, which were basically local production units. Business R&D levels remained low for most the second half of the twentieth century.[9]

Irish efforts to attract foreign investment were (and still are) channeled through one organization of exceptional autonomy: IDA Ireland. The IDA (at the time the Industrial Development Authority) was established in 1949 as a development agency, but quickly focused its energies on promoting Ireland as an investment destination. The IDA became directly involved in the provision of land to multinationals. By 1960 the organization was the largest owner of industrial space in Dublin (Ó Riain 2004, 72). The IDA worked especially hard at pursuing multinationals through its network of international offices and consistently demonstrated a high degree of sectoral targeting. The organization developed extensive personal linkages with private industry, and most of its leadership had private sector experience (Arora et al. 2001). Firms, or "clients," are guaranteed significant post-investment attention and follow-up, and the institution itself serves as a "one-stop shop" for all firm–state interactions.[10] Importantly, the IDA imposed few requirements on firms and devoted relatively little attention to developing relationships with indigenous firms. The institution did prioritize exports from industries such as electronics and

9. Fitzgibbon (2011, 131) shows that total R&D in Ireland has consistently lagged far behind the average for OECD members and behind other small European countries such as Finland, Denmark, and Switzerland (see also Ornston 2012).

10. Gleeson, Ruane, and Sutherland (2006) identify a four-step process used by the IDA, where the organization would identify markets with global growth potential, generate information on multinationals in these sectors that were considering a European export base, persuade them to consider Ireland, and, last, secure an investment incentive package and agreement.

pharmaceuticals, but this meant that many of the firms locating in Ireland were end-stage manufacturing or assembly plants, decreasing the potential for linkages (Fitzgibbon 2011). The IDA was greatly assisted in its efforts to entice multinationals to Ireland by the tax regime, which remains one of the largest (if controversial) selling points for potential investors. While the nominal corporate tax rate was once as low as 10 percent (since 2003 it stands at 12.5 percent per EU directive), the effective tax rate for Ireland at 13.86 percent is about one-half the EU average (Barry 2007, 276).

In the 1970s and 1980s, multinationals were increasingly involved in more technologically advanced products such as electronics and pharmaceuticals. These sectors, because of their relatively high-skill qualities and relatively low transport costs, were particularly well suited to relocation in peripheral economies with access to larger markets. Between 1970 and 2000, the manufacturing employment share of office and computing machinery, professional instruments, radio, TV and communications, and machinery and equipment had grown from 11 percent to almost 30 percent and represented almost half the jobs in foreign-owned manufacturing firms (Barry 2007, 274). However, the activities conducted in Ireland were still mostly production.

The Celtic tiger phenomenon of the 1990s was intense. Firms including Sun Microsystems, Novell, and Symantec established productive capacity in Ireland. IBM, Lotus, Microsoft, and others had entered in the 1980s, and expanded operations during the 1990s. The development of the multinational IT and indigenous software industry in Ireland has been well documented elsewhere and is beyond the scope of this chapter.[11] However, it is important to acknowledge a few key attributes of this industry during the boom years, as they relate to the innovative activities and linkages of these firms. First, most R&D conducted by these firms, at least in the early years of the Celtic tiger, focused on software localization, packaging, and adapting finished products for European markets (Arora et al. 2001; Ó Riain 2004). There were some notable exceptions.[12] However, Irish subsidiaries of IT multinationals underperformed in innovative terms when compared with subsidiaries in places such as India and Israel (Giarratana et al. 2005, 216).

11. O'Hearn 1998; Fanning and Murphy 2002; Ó Riain 2004; Sterne 2004; Breznitz 2007.

12. Sun Microsystems had by 2001 opened an internet software development center in Ireland, and Motorola had constructed a cellular phone software development center (Arora et al. 2001, 13).

The second important thing to emphasize about the IT multinationals is that they did generate a few linkages to the local economy, in the form of supplier relationships and in the form of spinoffs. There were some examples of successful indigenous companies supplying to or absorbed by multinationals, such as Baltimore Technologies, Riverdeep, and Aldiscon.[13] Indeed, a number of analysts have suggested the best thing that the IT behemoth Digital ever did for the domestic software industry was close the doors of its plant in Galway, thus distributing IT experience and expertise through the west of Ireland (Sands 2005, 51; Ornston 2012, 150). Giarratana, Pagano, and Torrisi (2005, 216) document the importance of multinationals in Ireland as incubators for domestic firms. According to their survey of 36 Irish software firms in the 1990s, two-thirds of the entrepreneurs had worked for a multinational corporation at some stage in their careers. Ó Riain (2004, 91) corroborates this story, detailing the high rates of pass-through between the multinational and indigenous technical communities.[14] Breznitz (2007) describes the sometimes symbiotic relationship that existed between multinationals and temporarily successful indigenous software companies such as Glockenspiel.

The success of the domestic software industry in Ireland might seem to contradict the general trend of low R&D, low-linkage foreign investment since the 1990s. However, it is crucial to recognize Breznitz's (2007) point that in most cases these indigenous companies succeeded without the efforts of the IDA and in some cases *in spite* of them. The IDA did not prioritize linkages with domestic firms in its interactions with multinationals. Venture capital for indigenous spinoffs or new entrants was in extremely short supply, even during the Celtic tiger period.[15] The cross-pollination that did occur between domestic software and multinational firms was limited by a state that adopted an arm's-length relationship with indigenous firms, even as it aggressively courted IT multinationals. Moreover, the spinoffs and indigenous linkages that did develop were not extensive and were limited to the IT sector.

13. The flagship company of the domestic software industry in Ireland, IONA, began as a university project at Trinity College Dublin, was assisted greatly by EU ESPIRIT grants, and was eventually listed on NASDAQ. While not initially linked to multinationals, the company became an important supplier *and* customer.

14. See also Arora et al. (2001, 24).

15. In some cases, organizations like Enterprise Ireland exchanged venture capital for ownership shares or demanded it as a condition (Breznitz 2007).

The generally low levels of local R&D conducted by multinational firms in Ireland and the lack of linkages to the local economy did not go unnoticed. As early as the late 1970s, policymakers and analysts observed that multinationals were not becoming enmeshed in the local economy. In 1980, an outside consulting group was commissioned to evaluate Irish industrial policy and its effects. The resulting Telesis report, released in 1981, found that Ireland had become overly dependent on foreign-owned industry and was not doing enough to develop linkages between foreign and domestic firms. The report also concluded that most of the high-skill activities within multinationals were done abroad and the products of these activities were being imported. It was recommended that the IDA begin requiring foreign firms to establish R&D facilities in Ireland and set up a separate entity to encourage and fund linkages with local industry (Fink 2004, 91).

While the Telesis report generated a great deal of attention, the Irish government did not respond until three years later, in July 1984 (Fitzgibbon 2011, 113). The IDA did set up the National Linkage Program, but this body did not enjoy substantial resources. A decade later, the Culliton report (released in 1992) concluded that very little progress had been made. The Culliton report did lead to a substantial restructuring of bodies responsible for industrial policy. It resulted eventually in the creation of Enterprise Ireland, a body designed to support indigenous industry. Both EI and IDA were placed under the nominal control of Forfás. These restructuring moves were resisted by many within the IDA. A more recent industrial policy review, known as the O'Driscoll report, was released in 2004. It recommended that Enterprise Ireland focus on developing a support structure for market-led applied research, to close the link between R&D and the creation of new products and services. However, this recommendation was not implemented (Fitzgibbon 2011, 124).

In the decade from 1997 to 2007, numerous sectors exhibited continuous productivity growth, increases in investment, and export stability. This all came to an end with the housing and financial crisis of 2008, tied to worldwide economic recession. Ireland entered a bailout program engineered by the IMF in 2010 and has struggled to regain its footing in a postcrisis environment of austerity. While external volatility certainly played a role in the dramatic economic crisis in Ireland and other peripheral European economies, it is not the only reason Ireland succumbed to its deepest postwar economic crisis. Ó Riain

(2014) argues that the country moved away from industrial policy and developmentalism after the 1990s and toward financialization of the economy, facilitated by the euro and a similar process of financial growth in Europe. In addition, excessive and irresponsible financial speculation in housing led to a massive property bubble, compounded by a lack of governmental oversight. In essence, the government abandoned export-oriented industries and IT services to focus on building financial sector competency. This reorientation was a strategic mistake, as the sectors and firms most responsible for the tiger era were continuing to receive inflows of investment and sporadically develop linkages with local firms.

The pattern that emerges from this brief history of foreign investment and industrial policy is one of aggressive sectorally discriminating investment promotion coupled with low levels of linkages and local R&D. Successive industrial and investment policies did not require or in many cases even encourage multinationals to become enmeshed in local networks of production or innovation. Only at the end of the 1990s did these kinds of policies and activities begin to emerge. The next section examines the innovative characteristics of FDI in the second half of the 2000s, following a number of new policy initiatives and institutional changes that have moved Ireland more in the direction of an activist innovation policy and selective intervention. While these new activities represent a shift away from the low-innovation, dual-economy paradigm of foreign investment, their belated arrival has left Ireland at a disadvantage compared with other FDI-intensive economies.

Current Characteristics of FDI

Ireland has continued to attract large amounts of FDI in the past decade, led by proactive investment promotion policies and institutions. Multinationals have created jobs and growth that would not have materialized in their absence. However, other looked-for benefits of FDI have been slow to materialize, including significant local R&D activities and forward and backward linkages with local firms. This has been the case even in the IT industry, the backbone of the Celtic tiger. This section takes stock of current innovative activities among multinational firms, utilizing two recent firm-level datasets collected and maintained by the Central Statistics Office located in Cork.

There are only a small number of firm-level analyses related to multinational innovation in Ireland, and they have different objectives. Ruane and Uğur (2005) use data from the Irish Census of Industrial Production (CIP) in the 1990s, and find only weak evidence of productivity spillovers. Görg and Strobl (2003) examine local firm survival in sectors impacted by multinational investment and find that local firms have the highest odds of survival in the IT industry but are quickly drummed out of low-tech sectors by multinationals. These earlier studies, while retaining the advantage of longitudinal analysis, often employ indirect and imperfect proxies for measuring spillovers due to data limitations. Moreover, increases in productivity are not the only indicators of spillovers and present an overly narrow view of how multinationals can contribute. Here the CIS and BERD surveys, which are available only after 2006, offer numerous advantages and a few trade-offs.[16] Both sets of surveys directly ask firms about diverse forms of partnership with local enterprises and collect firm-level data on R&D expenditure. However, the lack of longitudinal continuity does represent a disadvantage.[17] In recent years, more researchers have begun to employ these databases to measure innovative activity in Ireland. Doran and O'Leary (2011) use the CIS 2006 data to argue that multinationals are more likely to innovate than domestic enterprises. Siedschlag, Shang, and Cahill (2010) use the 2006 and 2008 CIS surveys to investigate the service sector, where they find the same dynamic but also argue that domestically owned exporters are more likely to innovate than nonexporters.

R&D Expenditure among Multinationals: Evidence from Firm Surveys

Scholars looking for evidence of direct local R&D spending among multinationals in postwar Ireland have been largely disappointed. Many of the major works considering the development of the Irish economy in the 1990s have discounted the innovation contributions

16. There are two earlier versions of the CIS, conducted in the 1990s in all EU member countries. However, there is a large gap between the earlier versions and the current surveys. The earlier versions also changed their definitions of innovation and were less comprehensive. See O'Malley et al. (2008, 158–160).

17. The CIS and BERD surveys change incrementally from year to year, are conducted only biannually, and do not track the same firms through successive surveys. While the same firms may appear in consecutive surveys and are tagged with unique identifiers, not all firms are represented.

of multinationals.[18] However, a number of more recent works have documented an increase in local R&D, which may be traced generally to the end of the 1990s. Barry (2007, 271) shows that gross R&D expenditures were rapidly converging with EU15 averages after 2000 and that business expenditures were increasing more rapidly than in other EU countries.[19] While R&D levels as a percentage of GDP were relatively low in the 2000s compared with other OECD countries, Ireland had one of the highest growth rates in R&D personnel and spending during this decade (Ó Riain 2014, 191). The large majority of private sector R&D spending (70 percent) is accounted for by multinational corporations. He attributes this partly to changes in tax laws to allow R&D credits and deductions. Similarly, Paus (2012, 174) points out a doubling in R&D expenditures in the 2000s. O'Malley, Hewitt-Dundas, and Roper (2008, 161) note that while gross expenditure on R&D remained flat in the 1990s, public R&D investment rose from 0.08 percent of GNP in 1999 to 0.13 percent in 2001, due mostly to increased allocations to third-level institutions. Some of this has made its way to multinationals.

Is there any evidence of increased R&D commitment on the part of multinationals, judging from the two firm-level surveys? Figures 6.1 and 6.2 display information from the 2008 CIS about the proportion of multinational firms engaging in domestic innovative activities, separated by sector. The figures represent only foreign-owned firms, first separated by major economic sector, which includes manufacturing as a category (figure 6.1) and then by manufacturing subsector (figure 6.2). The bottom bars in each category indicate the number of firms that indicated in the survey that they had produced product or process innovations within the past three years (2006 to 2008). It is apparent that a greater proportion of firms are innovative in the information and communication sector, as would be expected. Within manufacturing (figure 6.2), the pharmaceutical sector is quite

18. See O'Hearn (1998; 2001). Even Ó Riain (2004), while generally more optimistic about the contributions of FDI, finds less evidence of direct R&D activity than local linkages in the software sector.

19. Barry (2007) argues that R&D figures are sometimes artificially deflated when measured against sales, because many multinationals use Ireland as a venue for tax arbitrage and report large sales revenues in Ireland in order to take advantage of low tax rates (a popular strategy is the "double Irish with a Dutch sandwich" scheme). The sales figures thus inflate the denominator of scaled R&D figures, making actual R&D investment appear smaller than it actually is. Barry advocates using R&D expenditure per employee as an alternate measure, although this also has disadvantages.

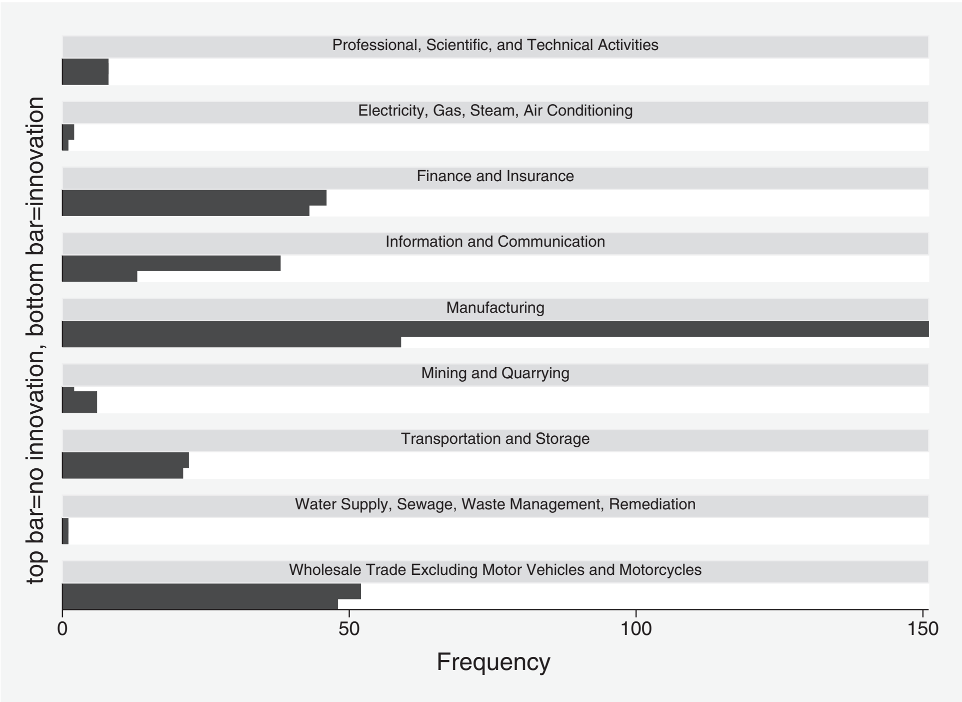


Figure 6.1
Incidence of innovation among foreign-owned firms, 2008 CIS.
Notes: Binary variable coded as 1 if firm indicated product *or* process innovation during the three years from 2006 to 2008. NACE two-digit sectoral categories used.

innovative relative to other sectors, and the chemical, computer, and electrical equipment manufacturing subsectors also contain large proportions of innovative firms. While these figures contain information only about the incidence of innovation and not its scale, the sectoral distribution of innovation largely conforms to the expectations outlined in chapters 3 and 4.

There is a variety of information contained within the CIS and BERD that might indicate direct innovative activity in Ireland, besides the presence or intensity of R&D spending. Ornston (2012, 129) has documented the relatively low level of patent activity in Ireland, especially compared with countries such as Denmark and Finland.[20] O'Malley, Hewitt-Dundas, and Roper (2008) argue that Irish patent activity is low

20. Ornston argues that this gap was especially pronounced in the filing of high-tech patent applications, with both the European Patent Office and the US Patent Office.

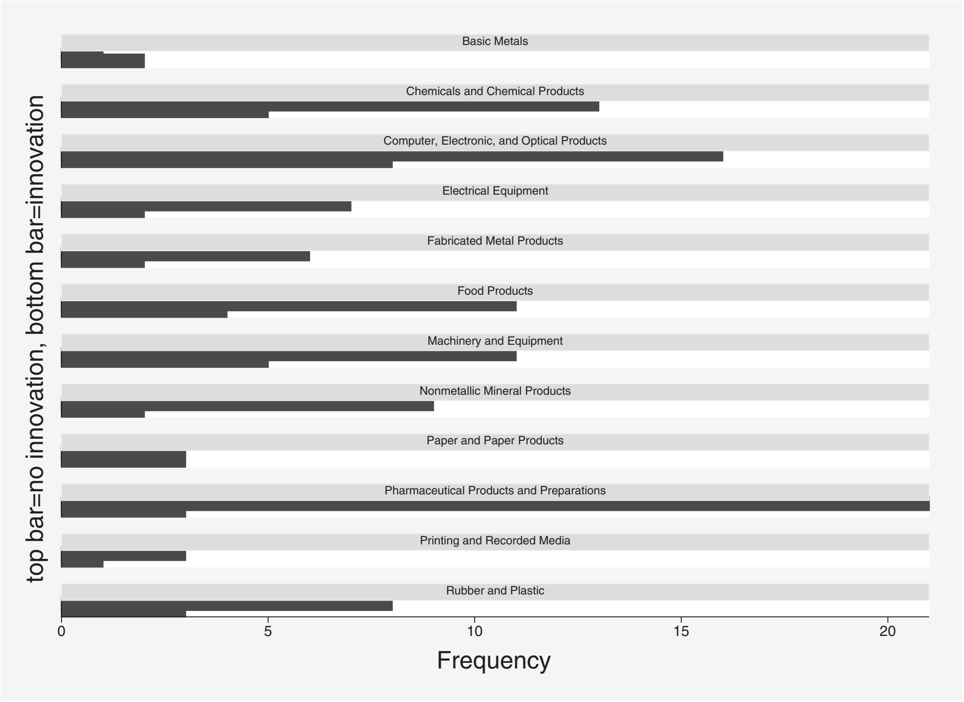


Figure 6.2
Incidence of innovation among foreign-owned firms in manufacturing subsectors, 2008 CIS.
Notes: Binary variable coded as 1 if firm indicated product or process innovation during the three years from 2006 to 2008. NACE two-digit sectoral categories used.

by international standards but that multinationals in Ireland apply for patents at a higher rate than domestic firms. Table 6.1 presents patent and other innovation registration activity from the 2006 CIS, divided by sector and ownership.[21] While multinationals did score better on some of these measures than domestic firms in certain sectors (manufacturing industrial design registration), in other areas domestic firms outperformed multinationals (financial trademark registration). On the whole, innovation registration seems to remain low across sectors and ownership patterns, and multinationals are not better situated in this regard than domestic firms.[22]

21. The patent section was omitted from the 2008 CIS survey, so the earlier survey is used.

22. It is important to note that the firm surveys did not ask firms the country of their patent activity, so patents may exist at the European and/or American level.

Table 6.1
Patent activity by sector and nationality, 2006 CIS

European industrial activity classification (NACE) sector	Enterprise applied for a patent		Enterprise registered an industrial design		Enterprise registered a trademark		Enterprise claimed copyright	
	Irish owned	Foreign owned	Irish owned	Foreign owned	Irish owned	Foreign owned	Irish owned	Foreign owned
Finance and insurance	2/19 (10.53%)	2/34 (5.88%)	0/19	0/33	6/17 (35.29%)	1/32 (3.13%)	4/17 (23.53%)	0/33
Information and communication	1/17 (5.88%)	1/11 (11.11%)	1/17 (5.88%)	0/9	3/17 (17.65%)	1/8 (12.50%)	2/17 (11.76%)	0/9
Manufacturing	20/90 (22.22%)	27/120 (22.50%)	5/85 (5.88%)	13/119 (10.92%)	14/86 (16.28%)	15/118 (12.71%)	6/86 (6.98%)	13/116 (11.21%)
Professional, scientific, and technical activities	5/20 (25%)	3/15 (20%)	0/19	1/15 (6.67%)	1/19 (5.26%)	1/15 (6.67%)	2/19 (10.53%)	1/15 (6.67%)
Wholesale trade excluding motor vehicles	1/19 (5.26%)	3/19 (15.79%)	2/19 (10.53%)	0/19	4/19 (21.05%)	3/20 (15.00%)	1/19 (5.26%)	1/19 (5.26%)

Note: Only firms with over 100 employees used.

Appendix C relays the results of four additional OLS firm-level regression analyses, including potential determinants of innovation intensity found in the 2008 CIS surveys. While these are relatively simple models that do not capture a great deal of variance, they do indicate that foreign ownership increases R&D intensity, corroborating the findings of Siedschlag, Shang, and Cahill (2010), who argue that multinationals in Ireland spend more on R&D than domestic firms. Foreign ownership is also associated with an increase in external R&D. This contradicts the findings of earlier chapters in this book, where foreign ownership was associated with decreased innovation. However, the measures used in chapters 4 and 5 were continuous, not binary, and were limited to firms with a minimum of 10 percent foreign ownership. This makes a difference, as some foreign control does not necessarily mean that a firm is considered to be foreign owned. Second, there are many more foreign-owned firms in Ireland than in almost all of the developing countries considered in the cross-national models in earlier chapters, and multinationals in Ireland are more likely to be in sectors where innovation is more likely (IT, pharmaceuticals, etc.). Finally, I have noted elsewhere in this chapter that domestic firms in Ireland tend not to be very innovative.

Domestic Linkages and Innovation, Evidence from Firm Surveys

Besides direct R&D spending and patent activity, innovation linkages with domestic partners are another dimension of multinational investment that has numerous potential benefits for the host country. Here again, many analysts have been pessimistic about the linkage record of multinationals in Ireland, even during the Celtic tiger period. O'Hearn (1998; 2001) documented the low levels of domestic inputs among multinationals and argued that the employment created in supporting firms was part-time, casual, and poorly remunerated. Fink (2004) argues that despite recent linkage increases, the innovative quality of linkages has not been especially high. In other words, foreign firms are depending on domestic partners not for innovation-intensive inputs or processes but rather for low-tech content, with the possible exception of the indigenous software sector. There have been a few differing interpretations of realized linkages in the Irish economy, despite the dual-economy reputation. I have already noted the extensive literature on the indigenous software industry, where linkages with multinational firms have played a role. Ó Riain (2004, 113), while acknowledging that many multinationals did not engage with Irish partners in any high-end processes, nevertheless points out that there was substantial cooperation and co-development between Irish firms and multinationals as the software industry developed. Görg and Ruane (2001) found that foreign firms in Ireland tend to purchase an increasing proportion of inputs from local sources over time. Gleeson, Ruane, and Sutherland (2006) have argued that the spatial and sectoral clustering of high-tech sectors has increased over time in Ireland, in part due to proactive industrial policies.

To assess the extent of domestic innovation linkages between multinational firms and Irish partners, I utilize the Business Expenditure on Research and Development (BERD) survey conducted in 2007. The BERD, unlike the CIS, contains more detailed questions about the nature of firm innovation, the sources of funding for that innovation, and the extent of innovative networks. Like the CIS, the BERD surveys classify firms by ownership patterns, sales, sector, and employment data. Figures 6.3 through 6.6 contain information about linkages in the four sectors with the highest degree of multinational penetration: information and communication; manufacturing; professional, scientific, and technical activities; and wholesale trade. In these surveys, firms were asked whether they engaged in joint research projects with any of the following parties in 2007: other firms in Ireland, firms outside Ireland, higher education institutions in Ireland, and higher education institutions outside Ireland. Firm responses (no or yes) were then coded as binary variables, and separated according to ownership. “No” responses dominate, but the proportion of “yes” responses reveals some interesting patterns and suggests that domestic linkages are perhaps more common than previously thought. In all four sectors, foreign-owned firms were at least as likely to partner with Irish universities as Irish-owned firms, and in some cases more likely. This is undoubtedly partly due to size, but the differences are apparent. Multinationals appear more likely to partner with firms outside Ireland, as we would expect. However, in at least one case (wholesale trade), foreign-owned firms were substantially more likely to partner with domestic firms and universities than their Irish counterparts. In general, multinationals seem to have developed more linkages with Irish higher education than with other Irish firms, a point I shall return to in the next section.

The innovation data presented in this section do not suggest that multinationals have since 2000 become thoroughly integrated or that

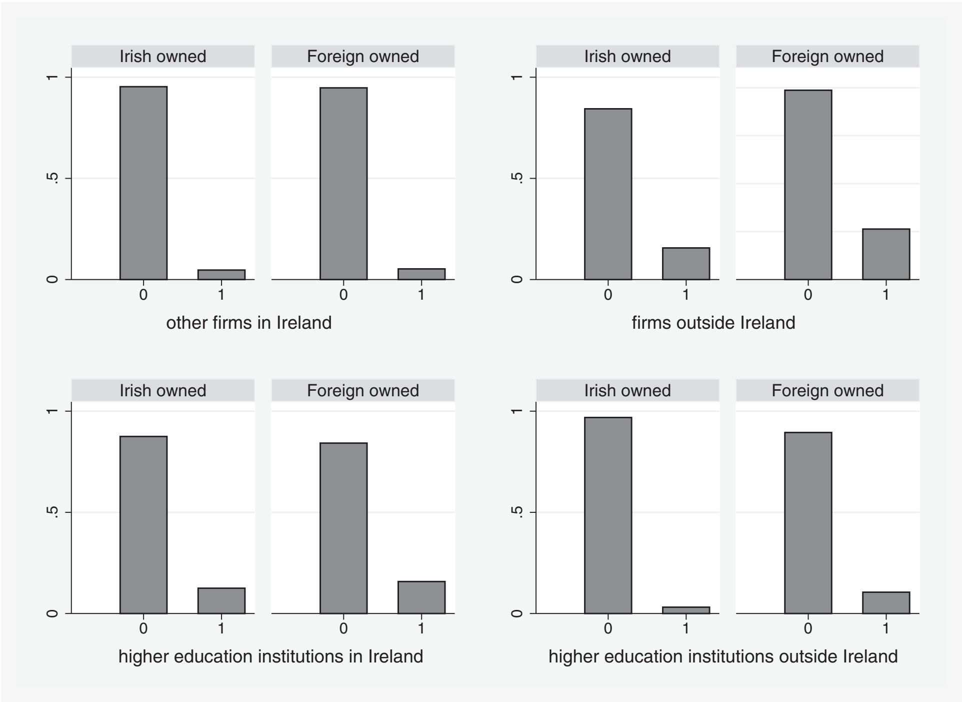


Figure 6.3
Incidence of innovation linkages among information and communication firms, 2007 BERD.
Notes: Binary variables constructed based on firm responses to the question: Did your company engage in joint research projects with any of the following parties in 2007?

the dual economy is a thing of the past. However, R&D efforts and innovative local linkages are not extremely rare. For decades, the strategy of the Irish state has been to chase multinationals in specific rising sectors, entice them to invest, and not ask much of them in return other than jobs. This strategy resulted in substantial investment, but little in the way of innovation-intensive activity or linkages. If this is changing, what accounts for the change? The next section proposes an institutionalist answer.

Irish Institutions and the Evolution of Innovation-Intensive FDI

Given the uneven track record of multinational-linked innovation in Ireland, it seems somewhat incongruous that Ireland has developed such a reputation for successful investment promotion. That this

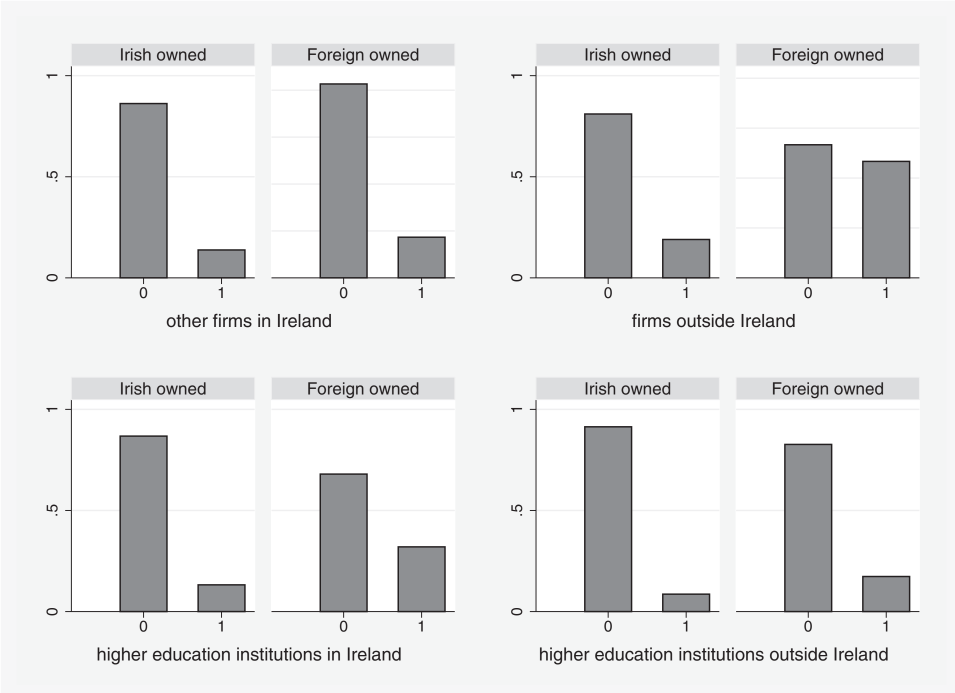


Figure 6.4
Incidence of innovation linkages among manufacturing firms, 2007 BERD.
Notes: Binary variables constructed based on firm responses to the question: Did your company engage in joint research projects with any of the following parties in 2007?

reputation is exists is partly due to the history of IDA Ireland, which for decades has been the body most responsible for ensuring not only a steady flow of investment, but also Irish economic development. The IDA is well known not only among the world's largest corporations, but also among public policy experts and within investment promotion agencies in countries all over the world. This section assesses the legacy of Irish institutions on the innovative behavior of multinationals. While I argue that the institutional determinants of innovation go far beyond the IDA, it seems fitting to start with the best-known institution.

The Role of the IDA

The IDA's legacy for incentivizing innovation in Ireland is mixed. On the one hand, the agency's autonomy allowed it to successfully pursue

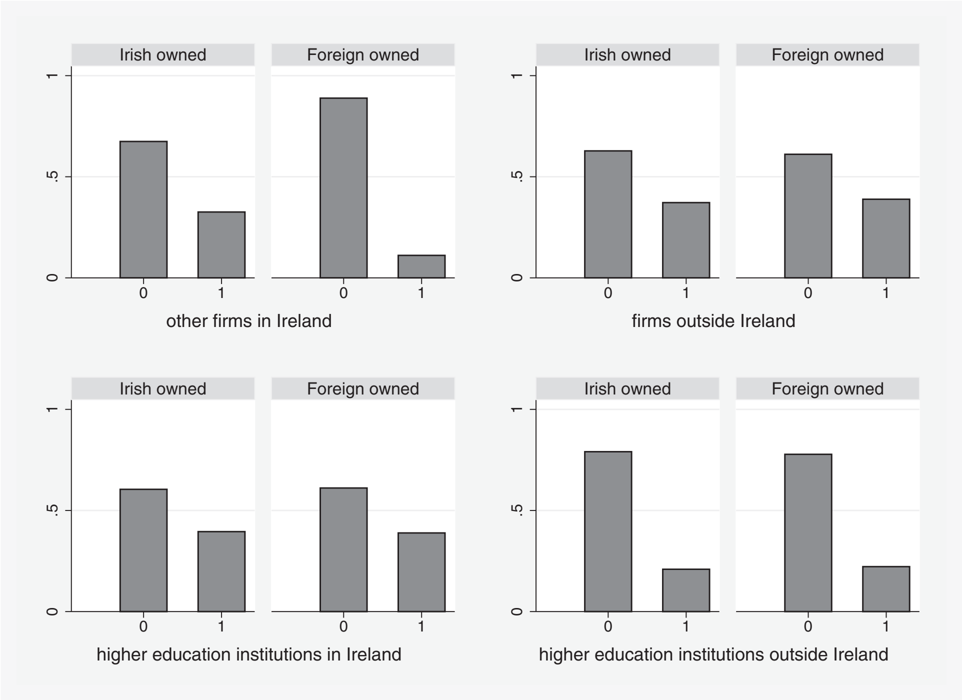


Figure 6.5
Incidence of innovation linkages among professional, scientific, and technical activities firms, 2007 BERD.
Notes: Binary variables constructed based on firm responses to the question: Did your company engage in joint research projects with any of the following parties in 2007?

a number of objectives that eventually led to increased local innovation. The IDA was instrumental in identifying shortcomings in Ireland's telecommunications system in the 1980s, recognizing that high-tech multinationals would not come if the communication infrastructure was not developed (Sands 2005, 60). The IDA lobbied hard also for upgrades to the educational system. The agency was especially adept at sectoral targeting and correctly identified up and coming industries. The IDA concentrated its efforts on sectors with long-term innovative growth potential, such as electronics, pharmaceuticals, and health care. It was also deeply embedded in corporate networks.[23] Without

23. Ó Riain (2004, 155–156) documents the close connections between multinational managers and IDA officials, and how the IDA used its knowledge of what companies wanted to influence policy.

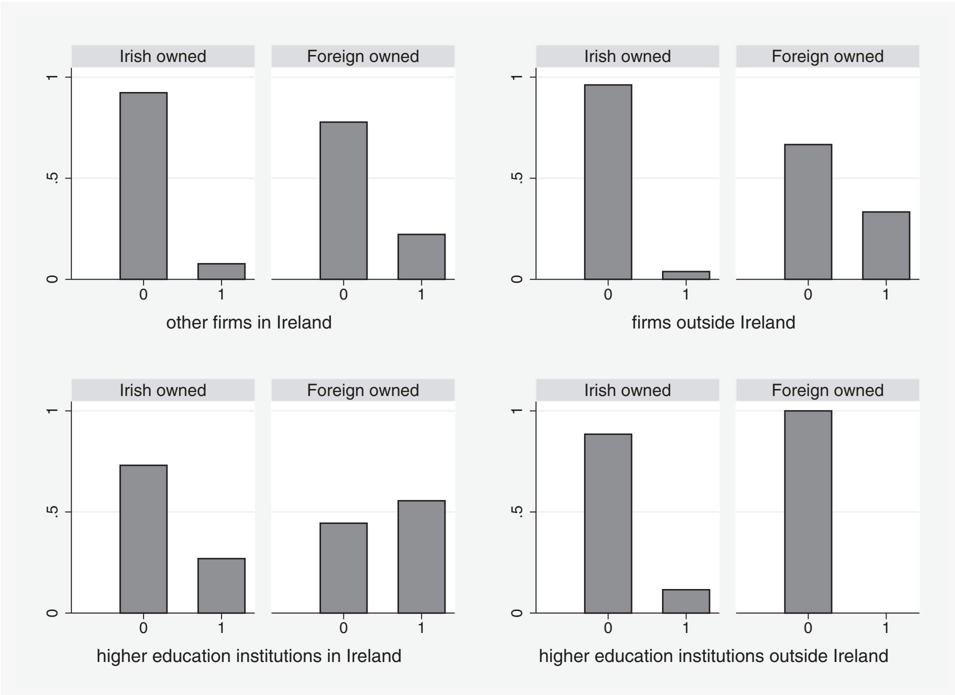


Figure 6.6
Incidence of innovation linkages among wholesale trade firms, 2007 BERD.
Notes: Binary variables constructed based on firm responses to the question: Did your company engage in joint research projects with any of the following parties in 2007?

this deep knowledge, and especially without its strategy of sectoral targeting, it is less likely that these firms with at least high innovation potential would have found their way to Ireland.

On the other side of the coin, the IDA has not often prioritized local linkages or innovation and has not required or incentivized these activities from multinationals. Its priority in the early decades of its existence was job creation, and this priority stayed put as the agency transitioned to an investment-promotion body. This was partly due to political necessity. Politicians were eager to announce the creation of new jobs in districts outside Dublin, even if those investments were not especially tied to the local economy. When the institution was tasked in the 1980s with running the National Linkage Program, it did not handle the task well and was blamed for some of the economic woes of that decade (Jacobsen 1994, 174–175). More generally, the agency was infused with what Breznitz (2007) has termed "neoliberal interventionism," or the contradictory characteristics of free-market ideology and a strong role for government in enhancing Ireland's competitiveness. In the case of the IDA, this meant aggressive pursuit of select investments with the full backing of the state. However, once the investments had arrived they were not pressured to develop linkages or conduct R&D locally. This set of priorities remains in place today; the IDA pays little attention to what happens after the investment is made, at least with respect to innovation.[24]

Education Reform

Given the IDA's complex legacy for foreign investment and its character, we cannot assign it total credit for new forms of innovation. To do this, the list of institutions must be expanded and incorporate older and more recent developments. No institutional reform has done more to lay the groundwork for innovation in Ireland than education reform. In 1965, the OECD issued a report on the Irish educational system entitled *Investment in Education*, and the report was not at all favorable. One of the more dramatic results of the study was that half of all Irish children left school by the age of thirteen (Barry 2007, 282). Partly in response to this study, the Irish government dramatically increased funding for education. According to Arora, Gambardella, and Torrisi (2001, 15), the share (in GNP) of public expenditures for education doubled during the 1960s, from 3 percent in 1961 to 6.3 percent in 1973/74. In addition to increasing spending, the state undertook radical third-level reforms in the 1970s. It created a network of thirteen Regional Technical Colleges and two National Institutes of Higher Education. These colleges were particularly notable because they were run by the state, as opposed to existing parochial schools and universities. They were also intended to directly increase the supply of technical-trained labor in the workforce, in anticipation of future needs (Sands 2005). The IDA worked with educational institutions through a body called the Manpower Consultative Committee, to identify gaps in the supply of graduates in specific fields. The decision to abolish university fees in the 1990s led to further increases in tertiary enrollment. Importantly, the IDA and politicians from the major parties supported the establishment of regional colleges so that

24. Author interview, IDA executive officer (July 10, 2012, Dublin).

young adults from more rural communities could remain close to home rather than travel to Dublin. This increased the base level of educational attainment throughout the country, while also making it more likely that multinationals could access a well-trained workforce if they located away from Dublin. Many did. However, this also had the effect of not concentrating educational improvements in the Dublin area, which likely contributed to the relative lack of innovation-intensive investment. Despite the excellent universities in the larger Dublin area, the political constituencies of Irish politicians remained largely rural. Diverse regional interests, focused on employment outcomes, were therefore prioritized in the improvements to the educational system. This is certainly understandable, given the high unemployment rates of the 1980s.

As a result of these decades-long reforms, Ireland enjoys a strong position in base levels of educational attainment and qualification. By the mid-1990s, over 80 percent of those who left school had completed secondary education and 50 percent had at least some third-level education (Breathnach 1998, 307). The number of engineering graduates increased by 40 percent between 1978 and 1983, and the number of computer science graduates increased by a multiple of ten during the same interval (Barry 2007, 283). Currently, Ireland scores highly among OECD countries in rankings of educational attainment, particularly those that measure science and engineering outcomes, or other qualifications that figure prominently in information economy jobs. Sands (2005) credits the decision to invest heavily in human capital, rather than physical infrastructure or other priorities, as one of the most influential factors in successful investment promotion and the development of local innovative networks. That this commitment was sustained through decades is particularly important. Certainly, there are remaining problems with the educational system in Ireland.[25] However, the increased levels of educational attainment and particularly the proportion of enrollees in science, technology, and engineering programs have been helpful for innovation networks. Gunnigle and McGuire (2001), in a survey of ten major US multinational corporations in Ireland, noted that all of them cited skilled labor supply, quality of human capital, and

25. Ornston (2012, 140–141) points out that the Irish educational system falls short in certain aspects, including ongoing training and education. Also, although the technical colleges supply graduates, they are not as tightly connected to the front end of industry. In other words, there are limits to what kinds of training these institutions can provide, and four-year schools are often sought out for more advanced training.

labor flexibility as key factors working in Ireland's favor as a location for high-tech foreign investment.

Innovation and Linkage Promotion Institutions

In 2000, the state support network for innovation was transformed by the establishment of Science Foundation Ireland (SFI). This organization, with its initial budget of over €600 million, dwarfed existing institutions, in terms of both resources and mandate. Before SFI, the institutions supporting indigenous innovation were weak and often uncoordinated. Fitzgibbon (2011) provides a thorough history of the development of Irish science and innovation institutions, but a few key characteristics stand out. First, innovation promotion institutions were chronically underfunded. Second and related to the first, institutions had no permanence. The National Board of Science and Technology (NBST), established in 1977, was tasked with a broad range of responsibilities, including the promotion of research and the provision of grants. However, it was not autonomous, and it, along with the Institute for Industrial Research and Standards (IIRS), was folded into the new science and technology agency, Eolas, in 1988. Both the IIRS, which supported indigenous industry with technical programs, and the NBST suffered from lack of capital.[26] With the establishment of the EU structural and cohesion funds in the 1980s, more money was available.[27] Eolas expanded the budget for the Programs in Advanced Technology (PATs), which were established in a range of sectors. These programs, however, suffered from unrealistic earning targets and were eventually discontinued by the new indigenous development agency, Enterprise Ireland, which was itself established in 1998. Enterprise Ireland initially struggled to generate significant upgrading within indigenous industry. In the second half of the 1990s, a number of reports from inside and outside Ireland drew attention to the critically low levels of government support for research, and linked this omission to low levels of R&D in Irish industry.[28]

---

26. Fitzgibbon (2011, 116) claims that the agencies were also subordinated to the IDA's wishes to prioritize foreign investment over the development of indigenous industry.

27. The EU ESPIRIT funds were also especially helpful in funding academic software research.

28. Breznitz (2007, 177–178) and Sands (2005, 59) have both noted the almost complete absence of venture capital funding in the 1990s, when it was needed most by indigenous software and other industries.

In addition to these economy-wide institutions, there were a number of smaller-scale institutions designed to promote the development of specific industries. In the software industry, the National Software Center (NSC) was established in 1984 and aided indigenous startups with marketing, technical, and other forms of assistance. However, this organization lasted only four years. Breznitz (2007, 167) has argued that the organization's focus on developing domestic companies "cost it its IDA support." The NSC was eventually replaced by the National Software Directorate (NSD) in 1991, subordinated to the IDA, and eventually transferred to Forbairt and then to Enterprise Ireland after the mid-1990s restructuring of the IDA. The NSD served as a focal point for the monitoring of the indigenous software industry, and linked the industry with the larger government development agencies (Ó Riain 2004, 119–120). The IDA itself has not been an especially effective organization in promoting innovation from multinationals. Part of this, as has been noted, was due to political expediency. While the IDA is an autonomous organization, it is not immune to political pressures. Dublin might have transitioned to an innovation center earlier, but more innovation targeting probably would have meant more firms in Dublin and fewer jobs in Athlone. In the case of both economy-wide and sector-specific institutions, the lack of state support for indigenous industry, innovation, and linkage promotion, especially in contrast to direct foreign investment promotion resources, had undeniable impacts on domestic industry. This was the state of affairs right until the end of the 1990s, when more substantial resources became available and results began to change.

New Funding Patterns and Institutional Changes

Earlier in this chapter, I detailed the incidence of direct multinational innovation and domestic linkages among multinationals. I have argued that while Ireland's dominant mode of investment in the postwar period has been low R&D and low linkage, there are signs this is changing. Especially since the economic crisis, jobs and more innovative FDI have been arriving in the country in larger numbers. Most of this activity is concentrated in Dublin, and the city has witnessed substantial positive spillovers and agglomeration effects around the "silicon docks." There are numerous signs of change in the institutional environment as well, changes that represent a move away from the hands-off approach of the 1990s. I contend that these two developments are linked.

The Office of Science and Technology (OST) develops and promotes science, technology, and innovation policy in Ireland. It is advised by the Irish Council for Science, Technology and Innovation (ICSTI), which was established in 1997. This council is made up of experts from industry, academia, and the public sector. Forfás, as the government’s catch-all development directorate, also has input. The three agencies charged with implementation are the IDA, Enterprise Ireland, and the new (since 2000) Science Foundation Ireland. SFI, modeled on the US National Science Foundation, has assumed a leading role in guiding science and technology policy. The institution also finally has the funds to match that mandate. SFI has recently funded Centres for Science, Engineering and Technology (CSETs), which may involve awards of €1–5 million per year for up to five years, with industry contributing 20 percent of project costs. In 2011, there were nine CSETs and 20 strategic research clusters, also funded by SFI programs (Paus 2012, 174). SFI has placed particular emphasis on industry–university collaboration, together with its sister organization, the Program for Research in Third-Level Institutions. This program began in 1998 and invested over €600 million in third-level research infrastructure between 2000 and 2006, mostly by funding research institutions within universities around the country (Ó Riain 2014, 74). SFI has already established research partnerships with corporations such as Intel, Procter and Gamble, Bell Labs, and HP (O’Malley et al. 2008, 187). Both Enterprise Ireland and IDA Ireland have also been changing their grant practices to support R&D in both domestic and foreign-owned firms. Table 6.2 presents information on the incidence of public sources of funding for already innovative firms, according to the results of the 2007 BERD survey. While both Irish-owned and foreign-owned firms received funding across sectors, it is striking how similar the proportion of funding is, regardless of ownership category. This suggests that indigenous firms are receiving more funding attention than in decades past.

The level of private venture capital has increased in recent years, as firms recover from the 2008 financial crisis. In addition to new public and private funding sources for innovative activities, multinationals have also taken advantage of recent changes in Ireland’s tax regime. Beyond the already rock-bottom corporate tax rates, Ireland in 2004 introduced a 20 percent tax credit for R&D, which was then raised to 25 percent in 2009. There is also a tax deduction of 12.5 percent for R&D expenditure (Paus 2012, 174). There many signs that the R&D commitment of multinationals in Ireland is rising in tandem with this

Table 6.2
Incidence of public sources of funding for innovative firms, 2007 BERD

	Number of innovative firms that received funding from Irish government grants or other public funding for in-house R&D undertaken in 2007	
NACE sector	Irish owned	Foreign owned
Finance and insurance	3/5 (60%)	1/2 (50%)
Information and communication	20/63 (31.75%)	5/16 (31.25%)
Manufacturing	49/171 (28.65%)	18/68 (26.47%)
Professional, scientific, and technical activities	15/38 (39.47%)	6/17 (35.29%)
Wholesale trade excluding motor vehicles and motorcycles	8/23 (34.78%)	3/8 (37.5%)
Total	95/300 (31.67%)	33/111 (29.73%)

institutional support. Barry (2007, 271) notes that a number of multinationals have established local R&D sites in recent years: Intel has located an innovation center at its site outside Dublin; Bell Labs is partnering with Lucent to establish an R&D facility; HP has a technology development center at its manufacturing facility; both Microsoft and IBM have announced software development facilities in Dublin as well. O'Malley, Hewitt-Dundas, and Roper (2008) count more than 300 externally owned firms with some Irish R&D function. Ireland is increasingly taking advantage of its potential as an attractive location for the offshoring of R&D activities.

Table 6.3 presents BERD data, again from 2007, indicating the sources of funding for innovative activities across sectors and ownership patterns. A number of interesting patterns emerge from these data. First, sources of funding are more varied for domestic firms, as one might expect from an Irish survey. However, government funding for innovation is substantial in all sectors, among both foreign and domestic firms. Though most of the funding for in-house R&D undertaken by multinationals in Ireland comes from within the company (both in Ireland and abroad), Irish government grants do contribute. The dependence on Irish government funding is larger in domestic firms, hovering around 10 percent across sectors. While this is substantial,

Table 6.3
Sources of funding for in-house R&D, by sector and nationality, 2007 BERD

	Information and Communication		Manufacturing		Professional, Scientific, and Technical Activities		Wholesale Trade Excluding Motor Vehicles and Motorcycles	
	Irish owned ($n = 64$)	Foreign owned ($n = 16$)	Irish owned ($n = 171$)	Foreign owned ($n = 70$)	Irish owned ($n = 37$)	Foreign owned ($n = 17$)	Irish owned ($n = 23$)	Foreign owned ($n = 8$)
Own company/internal funds (Ireland)	81.7	66.5	86.8	84.9	64.9	61.4	82.4	68.4
Own company/internal funds (foreign)		24.0		9.7	0.6	27.6		24.1
Other companies (Ireland)	1.9		3.8	0.7	11.2		4.3	0.3
Other companies (foreign)	1.6			0.1	2.9			1.0
Government grants (Ireland)	8.5	4.2	8.0	3.8	9.1	5.5	12.2	6.1
Government grants (foreign)			0.1	0.6	0.3	1.0		
Other public funding (Ireland)	1.8	0.1	0.2		1.9		1.1	
Other public funding (foreign)								
Higher education (Ireland)	1.1				0.4			0.3
Higher education (foreign)								
Private nonprofits (Ireland)					0.7			
Private nonprofits (foreign)								
Other sources (Ireland)	3.3	5.1	0.2	0.1	2.6	3.3		
Other sources (foreign)			0.8	0.1	5.4	1.2		

Notes: Entries indicate average percentage of funds.

Table 6.4
Determinants of joint R&D projects with Irish universities and other firms, 2007 BERD

	Did your company engage in joint research projects with other firms in Ireland?		Did your company engage in joint research projects with higher education or other institutes in Ireland?	
Dependent Variables	Irish owned	Foreign owned	Irish owned	Foreign owned
Presence of government grants or other public funding for R&D (binary)	0.532 (.363)	0.779 (.540)	0.705** (.338)	1.417*** (.510)
Turnover (thousands of euros, logged)	0.089 (.105)	–0.182 (.162)	0.142* (.083)	0.121 (.134)
100s of employees	–0.157 (.210)	0.104 (.070)	–0.006 (.053)	0.141* (.077)
Constant	–15.768*** (1.655)	1.309 (2.483)	12.185*** (1.444)	–2.275 (2.314)
Observations	296	111	292	111
Log pseudolikelihood	–112.321	–45.638	–124.766	–57.517

Notes: Logit models. Sector dummy variables based on NACE alphabetic classifications omitted from table. Robust standard errors. ***$p < .01$, **$p < .05$, *$p < .1$.

it is far lower than in many developing countries, where government funding for R&D among domestic firms and multinationals can regularly exceed 50 percent.[29]

It seems evident that both domestic and foreign firms are taking advantage of funding opportunities for innovation and that these opportunities are applied broadly. However, the question of whether increased support leads to innovation linkages, not just spending on innovation, is more complex. Table 6.4 presents a limited attempt to test whether funding can induce innovation linkages, using answers to BERD survey questions as independent and dependent variables. The four firm-level models presented are logit models, with binary dependent variables, based on firm answers to two separate questions: Did your company engage in joint research projects with other firms in

29. As demonstrated in chapter 3, governments rather than private firms or universities, are often the main sources of funding for R&D in less developed countries. Generally speaking, as countries exhibit less wealth, government support for R&D increases. Benoliel (2015, 157) notes a WIPO report demonstrating that the share of public-sector R&D in countries such as Argentina, Bolivia, Brazil, and India often exceeds 70 percent of total R&D. In countries such as Burkina Faso, the public sector funds essentially 100 percent of R&D.

Ireland? and Did your company engage in joint research projects with higher education or other institutes in Ireland? The main independent variable of interest is also binary, based on a survey question that asks the firm whether it has received government grants or other funding for R&D. Sectoral dummy variables were included in these models, but are not reported in the results. These are therefore models with a binary dependent variable (yes or no) and a binary independent variable of interest (whether or not the firm received public funding), along with a limited number of controls such as size and turnover. Robust standard errors are reported.

The results of the four simple models suggest that these funds did have an effect on innovative linkages, among both domestic firms and multinationals. The presence of grants or other public funding is strongly and positively associated with innovative partnerships with Irish universities, controlling for size and sector. Answering "yes" to the grant question increases the log odds fourfold that a multinational firm will partner with an Irish university. While the effect is smaller with domestic firms (the odds ratios slightly more than double), it is still significant. This suggests that public funding for innovation linkages is having its intended effect. Grants and other public funding are also positively associated with joint research projects with other firms in Ireland, but the effect is not statistically significant. This hints that innovators are perhaps more likely to have developed linkages with Irish universities than Irish firms. Whether this is the result of public policy is a question that cannot be answered by the surveys. However, given the substantial resources devoted to SFI and other recent efforts to increase research funding at the tertiary level, it would not be altogether surprising. Even with these new sources of science and innovation funding, however, Ireland is still playing a game of catch-up with peers. As Ó Riain (2014) notes, the Irish science budget was one of the fastest growing in the OECD from 2002 to 2006, but lagged behind EU25 averages during this time.

Conclusion

Altogether, the Irish case supports the conclusion that innovative spillovers from multinational investment do not occur automatically. Ireland attracted a great deal of FDI after the 1950s, and a great deal of IT FDI after the 1980s. Yet the innovative activities of multinationals in Ireland remained low and linkages to the local economy were weak. I have argued that after 2000, Irish efforts and results began to improve on both fronts. This is happened partly because of institutional and policy changes to the investment promotion regime. The state is now funding innovation at a greater rate than in decades past, and is paying more attention to what multinationals are actually doing once they arrive. Using firm-level surveys from the CIS and BERD initiatives since 2005, I have argued that innovation and linkages are evident and that changes in policies and institutions are contributing to this resurgence.

In chapter 2, I summarized the centrifugal forces affecting the innovative activities of multinationals. Kuemmerle (1999) argues that multinationals increasingly conduct R&D away from their home offices, in order to take advantage of local skill and/or cost conditions. Pearce (1999) argues that geographic positioning of R&D networks has become more strategic, as firms try to get a leg up on the competition. It seems clear that the old model of "development at home, production abroad" is no longer dominant, and firms are moving to polycentric innovation models. Ireland seems well positioned to take advantage of these trends and exploit its position to attract higher value-added activities. However, this requires not only a discriminatory approach to investment promotion, but also attention to how firms are partnered with research bodies and domestic firms in country. As I have explained elsewhere in this book, it is more difficult to embed multinational companies in domestic economies and to stimulate a virtuous cycle of industrial upgrading than it is to attract multinationals in the first place, even with sectoral targeting.

The Irish case is a kind of paradox. In order to take full advantage of its economic openness and exploit its dependence on FDI, the state is gradually moving away from industrial policies that have been so productive in generating that investment. Ireland for years targeted high-tech sectors with discriminating investment promotion policies, and then did relatively little to enmesh them in the local economy. While it is certainly true that institutions such as IDA Ireland were successful in their meeting their objectives, and while it is true that Ireland attracted a wider range of higher quality FDI than many other countries managed, these investments did not automatically bring substantial spillovers. In many important ways, Ireland's FDI regime resembled an enclave or dual economy for much of the 1990s and into the new millennium. Numerous analysts have noted that funding to support domestic firms in the software sector, by far the biggest success story of the Celtic tiger, did not arrive until after indigenous firms were already successful (O'Hearn 1998; Breznitz 2007; Fitzgibbon 2011). Irish institutions, being late to support innovation among multinationals and domestic firms, have begun to realize these kinds of activities. However, it is easy to wonder if perhaps there were missed opportunities along the way. Moreover, the innovation and domestic linkages now in evidence are quite concentrated in the Dublin area, and there is political peril in this. While the results of the 2016 election cannot be attributed solely to recent experiences with FDI, there is some evidence of rural discontent with the uneven spread of benefits. Fianna Fáil, with its strong base of rural votes, performed better than in previous recent elections.

The Irish case illustrates well many of the themes central to this book. Ireland has had to move beyond a successful sectorally discriminating investment promotion strategy in order to promote embeddedness. For many years of the Celtic tiger, local R&D efforts of multinationals were relatively low. In the aftermath of the housing and financial crisis, attention has shifted back to FDI as an important contributor to Ireland's uneven success. However, it is likely that governments will continue to focus on policies for developing linkages and incentivizing innovation. Ireland satisfies many of the important preconditions for the successful exploitation of multinational investment. Its continued reputation as a success story for FDI will depend on those multinationals putting down real roots and continuing the developing partnerships with indigenous firms and research institutions.

7 Conclusion

Lee Kuan Yew was the first Prime Minister of Singapore. He served in that post for three decades and oversaw the country's transition from British rule. He also presided over a dramatic economic transformation, as the former colonial backwater became an economically vibrant country in a relatively short amount of time. Though his premiership was not without controversy and exhibited some authoritarian tendencies, the economic ascent of Singapore remains unparalleled. In his memoir (2000), he describes a meeting between one of the directors of Singapore's famed Economic Development Board (EDB), Ng Pock Too, and Chinese premier Ziang Zemin in 1980, before Zemin became general secretary. Zemin had been on a two-week visit to Singapore. At the time, Singapore was well into its sustained economic growth spurt, while China had not yet realized its full potential as an economic powerhouse. Their interaction is worth quoting in full:

> Toward the end of the two weeks, Jiang had looked Ng Pock Too in the eye and said, "You have not told me everything. You must have a secret. China has cheaper land, cheaper water, cheaper power, cheaper labor. Yet you get so many investments and we don't. What is the secret formula?" Nonplussed, Ng explained the key importance of political confidence and economic productivity. He pulled out his copy of the Business Environment Risk Index (BERI) report, and pointed out Singapore's rating as 1A on a scale of 1A down to 3C. China was not even included in the rating. Singapore was safe and favored for investments because of safe political, economic, and other factors (Yew 2000, 637–638).[1]

China of course went on to become not only a destination for massive flows of inward FDI, but also an attractive location for R&D centers of multinational firms (Chen 2008; Fu 2008; Fu et al. 2011).

1. A portion of this quote appears also in Robock (2005, 387).

This anecdote notwithstanding, it is important not to overstate the reliability of ratings such as those offered by BERI. Oetzel, Bettis, and Zenner (2001) find that commercially available measures of "country risk" perform poorly in predicting realized risk for investments. Yet these risk ratings are influential. There is a documented, consistent link between commercial risk evaluation and flows of foreign investment (Schneider and Frey 1985; Jun and Singh 1996). It appears that even though these evaluations of investment risk perform poorly in predicting actual risk, they are still quite influential for foreign investors. Why is this the case? It is because multinational firms operate in environments of uncertainty. Political risk is quite important to multinationals, yet they often have little to go on in assessing that risk. Kobrin (1976) notes findings that in the 1960s and 1970s firms frequently made judgments about potential host countries based on ignorance, generalizations, anecdotes, and personal experience. Demand for quantitative assessment of political hazards from seemingly authoritative sources drove the expansion of risk analysis as an industry and created diverse (and often opaque) evaluation products (Egan 2012). Firms want evaluation of risk, even if those evaluations are not always trustworthy. In this sense, critics of institutional analysis and quantification sometimes miss the point (Kurtz and Schrank 2007). Even if these indicators suffer from methodological and measurement flaws (and they do), they are *influential*. Firms want to know about the environment in which they are operating, and they will rely on imperfect measures if necessary.

In this book, I have argued that host country institutions and policies can help explain not only the amount of foreign investment entering emerging economies, but also the composition of that investment and the innovative characteristics of firm investment models. The argument that host country institutions matter for inflows of FDI is not new; the debate about whether or not democracies attract more FDI has a long history (Jensen 2003; Li and Resnick 2003; Kenyon and Naoi 2010; Pandya 2013). However, institutional analysis has not often been extended to the investment models of firms or the sectoral distribution of FDI, partly due to data constraints. Host country institutions help determine the types of investments dominant in emerging economies, and also what firms are comfortable doing in those economies. I have argued that as important as institutions are for the amount of incoming investment, they are doubly important influences on the likelihood of domestic innovation taking place. Innovation is among the most risky activities a multinational can consider. While there are now strong motivations for the decentralization of innovation within multinational production chains, these motivations must overcome much older centripetal forces acting on firms. Host country institutions are quite important to firms and may serve as part of this effort. The remainder of this chapter restates the problems this book is intended to address, the central contributions and argument, and summarizes the empirical findings. I also highlight some of the theoretic lessons that may be drawn from the book, as well as potential policy implications. I conclude with a brief discussion of the ways in which this kind of analysis may be challenged and extended in the future, and the new empirical realities of foreign investment that will warrant further investigation.

This book began with a kind of conundrum. Throughout most of the postwar period, multinationals were motivated to invest abroad primarily because they desired access to raw materials, markets, and/or efficiencies offered by emerging economies. There were few examples of firms with innovative capacity in developing countries, unless mandated by host governments. That is changing. While most business R&D still takes place in wealthy countries, developing countries have seen their share rise. Multinationals increasingly look to emerging economies as sources of innovations, not only for use in domestic markets but also to incorporate in externally competitive products and services. Chapter 3 documents this expansion and relays information about its limits. This spread of multinational R&D does not comport with longstanding theories about how internationally active firms innovate. I have proposed a multifaceted argument to explain the variation in innovation intensity among firms, sectors, and countries. I have incorporated various firm-level explanations and discussed the importance of international and domestic economic factors. However, I have repeatedly emphasized the need to include domestic institutions and policies among the locational advantages that may incentivize innovation. Multinational firms consider, as always, the likelihood of expropriation. But there are many other institutional characteristics, from intellectual property rights protection to democratic governance, which may influence firms' investment models. I have argued that the perception of domestic institutions, by firms themselves and by outside observers, impacts the likelihood of local innovation in various forms. I have argued as well that domestic institutions impact the intensity of innovation and the likelihood of spillovers and linkages in the domestic economy. These effects are present even when accounting for various firm and international factors that may influence innovation.

I have shown the expansion of multinational innovation in emerging economies using a variety of data sources. I have relied primarily on innovation data from the US Bureau of Economic Analysis, firm surveys conducted by the World Bank in a variety of developing countries, patent data, and various other country-specific data sources. These data show the dispersion of multinational innovation to be uneven. Much of it takes place in Asian countries, and some sectors with higher value-added characteristics are more likely to exhibit decentralized innovation than others. I have relied on UNCTAD data to show the shift in the sectoral distribution of FDI in developing countries. Services now represent a larger portion of overall FDI flows. Some countries have exhibited growing diversity in their FDI profile, while others continue to rely on primary or light manufacturing investments. While I argue that the general sectoral redistribution toward services may increase opportunities for local innovation, I have also cautioned that investments in nontraditional sectors are not necessarily more innovative, only that they are more likely to be more innovative. Far from being mutually exclusive, I have demonstrated that R&D spending and local sourcing tend to hang together and that firms with significant local innovation can also be export oriented, although this is not common. Most innovative multinational firms in emerging economies produce for the local market, which is understandable, particularly in the service sector. However, there are important exceptions to all of these trends.

I have employed multinational innovation as a dependent variable in a number of econometric exercises. In some cases, I was able to obtain time-series data on R&D spending and patent counts in a variety of countries. In other cases, I relied on static firm survey responses in different countries. Each data source has advantages and disadvantages. However, they lead to some firm and sometimes surprising conclusions regarding the determinants of innovation abroad. As expected, established democracies exhibit more local innovation than nondemocracies. Trade openness does not associate with innovation-intensive forms of investment. In the early postwar period, much FDI in developing countries took the form of "tariff-hopping" FDI, especially market-seeking investments. As tariffs have dropped significantly in many emerging economies as part of reform programs, trade volumes have increased. I have proposed that when countries open to trade it may increase the chances that multinationals import innovative inputs instead of manufacturing them in country. However, firm case studies would bear this proposition out and supplement the broad empirical association I observe here. I have also argued that cumulative bilateral investment treaties may signal a less risky environment for multinationals, but that a bilateral investment treaty with the multinational's country of origin may not incentivize local innovation. Indeed, bilateral investment treaties often address protection of innovation. While this certainly can reduce risk for firms, these approaches may also dissuade local firms from entering into partnerships with multinationals for risk of international litigation. Simmons (2014) argues that the BITs with the strictest language are signed when emerging economies have little negotiating power, and this suggests that firms operating from the richer party to the BIT will enjoy more protections. The analysis in chapters 4 and 5 points to a complicated relationship between BITs and multinational innovation.

I have argued that there are clear relationships between patterns of sectoral production and exports within countries and resulting levels of multinational innovation. In general, countries with larger natural resource sectors exhibit lower levels of multinational-linked innovation. Within both manufacturing and services, certain kinds of subsector investments were associated with higher levels of innovation both in those sectors and in others with higher value-added characteristics. The larger the chemical manufacturing sector, for example, the more innovation is likely to take place in chemicals and certain service sector investments. This is not surprising, but it is noteworthy that the negative effect of the primary sector was not limited to ores and metals but also obtained with agriculture.[2] This suggests that it is difficult for emerging economies to shift to innovation-intensive models of foreign investment when their economies are still dependent on the primary sector. Industrial transformation, and the growth of the heterogeneous manufacturing and service sectors in particular, seems more likely to associate with substantial innovation-intensive investments. Of course this is likely to be an endogenous process, but it suggests that a focus

2. There have been some interesting treatments of the so-called global land grab in emerging economies, as foreign investors from land-scarce countries search for food security (Von Braun and Meinzen-Dick 2009; Hallam 2011). Some of this recent wave of foreign investment in agriculture has been technology intensive, but much of this production is designed for external consumption.

on natural resource investments is unlikely to generate innovation-intensive investments, especially in other sectors.

In both chapters 4 and 5, I employed firm surveys from the World Bank as data sources. I have underscored throughout this book the importance of firm-level analysis, aggregated across countries, as a means to understanding the political economy of foreign investment. Too often social scientists have shied away from firm-level data, believing it perhaps to be the exclusive domain of international business studies. However, there are various ways to integrate firm data into existing political economy approaches to FDI. The further development of multilevel modeling will inevitably aid this goal. I have argued that various firm attributes, such as the degree of foreign control, affect the likelihood of local innovation alongside country-level variables. I find that as foreign ownership increases, local innovation decreases. I also find that market-seeking forms of investment (proxied by domestic sales) are more likely to exhibit innovative characteristics. These findings suggest that the forces of centralization are alive and well and that firms with rigid hierarchies based perhaps on vertical production and efficiency-seeking investments (sometimes at the same time) may be less likely to diffuse innovation. This is reflected in the literature on global value chains (Gereffi and Kaplinsky 2001; Gereffi et al. 2005) and in the broader international business literature, where innovation is seen as more likely when local affiliates have some degree of autonomy (Giroud 2006; Pearce and Papanastassiou 2009).

In chapter 5, I demonstrate a clear link between evaluations of institutional quality in host countries, by firms themselves and by outside observers, and local innovation. This is the case for both the incidence of innovation and the intensity of innovation. Importantly, I include many of the firm- and country-level variables that have been found to be influential determinants of innovation. Institutional variables remain important even while controlling for such factors as foreign ownership and various measures of openness. I have approached the conception of institutional quality from a number of different angles, and I argue that firm perceptions are often just as important as other, more "objective" measures. Clearly, institutional characteristics deserve to be included as a "locational incentive" for not only inward investment but the operational attributes of that investment. I have argued that high institutional quality makes firms more comfortable with joint ventures and that these joint ventures (as opposed to total multinational control) are associated with higher levels of innovation. There are a number of characteristics that may in certain countries hang together and reinforce one another in generating more local innovation: joint ventures, market-seeking motivations, and strong institutions. I argue that weak institutions, in contrast, lead to more centralized innovation patterns and are associated with higher levels of foreign control.

Ireland's experience with inward foreign investment is likely to be quite different from that of many emerging economies in other regions of the world. Ireland has built-in advantages, from its geographic location between American and European markets to its English-speaking workforce. Nevertheless, its transformation from an economic backwater on the periphery of Europe to an example of rapid FDI-driven development is relevant for other economies. Chapter 6 extends my arguments in new ways, as case study analysis allows the examination of policy changes through time and a more in-depth treatment of specific firm and sector histories. I have argued that the Irish experience with multinational innovation is more complex than the popular narrative suggests. For much of the 1990s, Ireland's policies toward FDI did not result in significant local innovation, and there were few spillovers and linkages given the amount of investment flooding the country. Ireland missed many opportunities to embed multinationals more fully in the domestic economy and did little to incentivize local innovation until recently. The government's current efforts at correcting these omissions have begun to generate results, but it has required a transformation of select policies and institutions.

The experience of Ireland is doubly important because it conveys just how difficult it is to facilitate the international transfer of knowledge through multinational firms. While there may be a range of mutually acceptable investment models between firms and states, realizing those models with sufficient technological spillovers is quite tricky. Multinationals can be an excellent source of innovation spillovers, but there is no guarantee that they will be. The "natural state" of multinational investment may be to limit spillovers, even when incentives for decentralized innovation are strong. Ireland is not a developing country, but its experience with innovation-intensive FDI may be quite replicable in developing countries, and this may not lead to positive developmental outcomes. It is therefore important for scholars and policymakers to outline the unique alignment of political factors in host countries that may give rise to developmental spillovers from foreign investment while learning from prior examples. Ireland's experience suggests that domestic institutions and policies will be a big part of that alignment.

This book advances the study of the political economy of foreign investment in a number of different ways, but scholars should continue to pursue some of the underexplored aspects of this work. I have made a deliberate effort to highlight the heterogeneous nature of inward investment in emerging economies. Most comparative and international political economy literature treats FDI as uniform, but this lacks depth. The specific kind of FDI a country attracts is immensely important for its development trajectory, and we should expect governments to continue to discriminate among forms of FDI and target those forms most likely to generate spillovers. While not every developing country is an immediate candidate for a large software development facility, there are ample opportunities for developing embeddedness and spillovers in diverse sectors. I have argued repeatedly that scholars should make efforts to complicate our investigations of FDI by considering economic sectors and subsectors.

I have also emphasized firm-level analysis in this book. Many of the theories about FDI in comparative and political economy are firm-level theories but are tested with aggregated data at the country level. While this may yield important insights, scholars can easily complement country-level analysis with firm data, including survey data and case study data. While some of the more influential works in trade politics rely extensively on firm-level theory and data (Milner 1989; Alt and Gilligan 1994; Scheve and Slaughter 2001), it is somewhat surprising that political economy literature on FDI largely avoided this methodological focus until perhaps the last five years. I utilize a micro-level perspective in this book to ask what exactly multinational firms are doing in developing countries. The question of whether firms conduct research and development locally, and how they integrate with local economies, is immensely important for scholars from diverse fields. Yet too often scholars simply make assumptions about the behavior of foreign firms and the effects of investment. It is important not only to disaggregate the impact of FDI in different sectors but to do so in such a way that recognizes how different levels of analysis (firms, sectors, governments, international factors) interrelate. This is challenging, but there is no reason why different levels of analysis should be under the responsibility of different academic fields.

Related to this point, I have attempted to approach the questions in this book from an interdisciplinary perspective, and I believe this helps strengthen both the claims advanced here and the utility of the overall exercise. I have mentioned before that the field of international business studies has tended to de-emphasize political institutions in host countries, though they are quite important. I have also pointed out that development theorists have belatedly recognized the importance of multinational firms to host country development strategies. In political science, scholars have not often recognized the heterogeneity of FDI. While all of these literatures have their blind spots, they all have important insights in their approaches to the study of foreign investment. By synthesizing these literatures, I have aimed for a comprehensive approach that acknowledges the contributions of each. While there are important disciplinary traditions that must be acknowledged, I hope that other scholars might follow this approach in the study of foreign investment.

Lessons for Theory

The analysis of state institutions has not always been at the forefront of political economy, and there still exists a debate about their relative importance. In the 1980s, neoclassical interpretations conceived of the state as an abstract entity, not particularly worthy of investigation and in practice little more than a central locale for the collection of societal interests. Neoclassical theorists, and their normative counterparts espousing neoliberal policy, believed that any state interference in a functioning market necessarily indicated an attempt to subvert global gains for local privileges. By reducing societal interaction to an accumulation of individual utility maximizers, the state became little more than a venue. While most neoclassical theorists accepted this role as the normal vocation of a flawed bureaucracy, some scholars turned this interpretation into a direct attack on the state itself. The state, in other words, was captive to distributional coalitions and prone to failure. In retrospect, the neoclassical approach was too quick to blame a large number of societal ills on bureaucratic failure (as opposed to market failure). Yet this movement also generated a contradictory set of ideas that affirmed the importance of analyzing the state as an actor capable of overriding societal demands.[3] The state-centric school challenged

3. See Evans et al. (1985) and Evans (1995).

the neoclassical theorists' efforts to explain away the state and sought to bring the analysis of institutions back to the forefront of academic discourse. Hailing mostly from the social sciences, these theorists claimed that effective institution building was a key variable that set countries with high growth rates apart from those with low growth rates.[4] These theorists insisted that state agency did exist and that effective bureaucracy could also exist, independent of societal pressures.

This book sits firmly in that theoretic tradition. While societal interests are incredibly important, comparative institutional analysis is arguably more important for this particular subject matter. Institutions serve as the points of contact between governments and firms. While patterns of domestic political support certainly play a role in increasing or decreasing a state's leverage on multinationals, it seems likely that these societal coalitions hold less influence on multinational firms than they have displayed with domestic firms in decades past. In other words, the element of "multinationality" creates a level of remove between societies and firms that increases the importance of state institutions. It is easy to imagine, for example, that domestic labor groups might be less influential in negotiations with multinational firms than they would be with domestic firms, ceteris paribus. This does not mean societal groups are powerless. However, the level of remove from societal interests that multinational production brings does mean that scholars must pay closer attention to the character of state institutions charged with firm relations. Institutions function as intermediaries between societal interests and multinational firms, and yet they have their own independent influence as well. There are many interpretive frameworks in international political economy, including those that emphasize societal interests or international politico-economic determinants. However, domestic institutional analysis is particularly suited to the study of foreign direct investment, especially when considering investment outcomes.

4. There were also dissidents within economics. See Nelson (2005).

Policy Implications

What are the lessons of this book for policy in emerging economies? Here I highlight some of the more important trends in investment promotion, though policy reform is not the central theme of this book. I mentioned in the introduction that FDI is not a precondition for rapid development, and pointed out the historical experiences of countries such as Japan and South Korea that developed quickly while restricting FDI. However, the window of opportunity for that kind of development strategy may have closed. It is difficult to imagine a modern emerging economy growing quickly while erecting and maintaining significant barriers to foreign investment. For good or ill (and there has definitely been lots of both), FDI seems to be part of the fabric of development at this point in time. However, I have also argued periodically that FDI can be an asset to state development strategies under certain conditions. These conditions may include investment activity that results in significant spillovers and linkages in the local economy, domestic actors such as firms and universities that have the absorptive capacity to utilize investment, increased employment, and institutions and policies that incentivize innovation and provide an environment in which multinationals and domestic partners can flourish. That may seem like a lengthy list, but it is becoming more common in emerging economies, and many countries are reaping the rewards of substantial inward FDI. Foreign investment is more likely to contribute to development now than at any point in history, although it still fails to do so at times. Countries must be able to take advantage of the opportunities presented by the spread of innovation, and many governments seem now to recognize this.

One area where governments have an especially important role in their relationship with multinationals is in the creation and maintenance of investment promotion agencies (IPAs). These organizations have become more common in developing countries, and many IPAs now function as “one-stop shops” for potential investors to learn more about potential hosts (Harding and Javorcik 2011). As these kinds of organizations have increased in number, they have also developed reputations for best practice and communicate and compete with one another. IPAs have also become more discriminating in their approach to foreign investment in the last two decades. Initially, most IPAs produced general arguments about the suitability of the investment climate in their countries. However, these organizations have increasingly targeted high value-added investments, and they have become much more strategic about the use of limited resources to attract "higher quality" FDI, as they define it. As a result, the largest multinationals receive a great deal of attention and competition.[5] Even as new forms of economic nationalism provoke calls for reducing outsourcing in wealthy countries, developing countries continue to pursue inward investment.

Almost all developing country governments now make distinctions among different types of FDI and attempt to attract investments in those sectors known to have higher value-added characteristics. Some countries concentrate more on active strategies (committing resources), while others rely on mainly passive strategies (reducing barriers). However, countries often fail on two other dimensions of effective FDI integration. First, they often target investments that they may have no realistic possibility of landing. Most developing country governments would welcome a Pfizer R&D facility; few are actually equipped to handle such an investment. Governments must make sure that they are targeting investments that may lead to industrial upgrading. However, there may be some constraints on the number of appropriate investments given infrastructure, education outputs, and other factors. IPAs must be able to diagnose investment needs and not chase popular but inappropriate firms for the country's specific circumstances. As Von Tunzelmann and Acha (2005) note, there are ample opportunities for innovation in what would usually be considered "low-tech" industries more common in developing countries. IPAs need not shoot for the moon in investment promotion, but can construct careful strategies to match FDI possibilities to local capabilities and host country advantages. If employment generation is of primary concern, governments can also consider how output and employment can continue to grow in industries that allow dynamic comparative advantage.

The second common mistake in investment promotion is the lack of attention to linkages and spillovers. I have explained in detail the ways in which Ireland's investment promotion strategies assumed that technology transfer would take place. These kinds of transfers did not take place in large quantities until Ireland moved to an institutional and policy regime that incentivized them. Unfortunately, many other developing countries have duplicated this mistake. This stems

5. Harding and Javorcik (2011) argue that when IPAs are able to handle investor queries in a more professional manner (for example, through high-quality websites), the volume of FDI tends to increase.

in part from the overzealous effort to reduce the state's role in the supply of important public goods, often encouraged by international financial institutions as part of economic reform programs. Yet even when states successfully target specific kinds of foreign investment, it cannot be assumed that such investments will develop the embeddedness so helpful for development. States cannot rely on sectorally discriminating investment policy to do the trick. They must augment this strategy with additional initiatives to encourage multinationals to develop roots in the domestic economy. As Castellacci (2008, 992) notes, industries that have fewer intrinsic opportunities for interaction with information technology (such as supplier-dominated, scale-intensive, and other "mature" industries in developing countries) can be supported by public policies that support the acquisition of advanced machinery and software, for example, and by "increasing the intensity of supplier–producer interactions." There are very few industries in developing countries that do not demonstrate opportunities for this kind of innovation infusion, and policies can offer incentives for multinational embeddedness in diverse contexts.

This may seem like an argument in favor of a return to active industrial policy, but there are important differences between industrial policy as it was practiced in the 1970s and the kind of policies needed to take full advantage of innovation-intensive FDI. Moran (2014, 1) describes a kind of "light-form" industrial policy for FDI, which involves state funding of industrial parks, reliable infrastructure, and vocational training. These serve "to harness FDI to development and generate backward linkages as deep as possible into the host economy." However, he also cautions against other kinds of industrial policy, shown to be ineffective in the past, that pick domestic industries to subsidize, discriminate against foreign investment, mandate domestic content or joint ventures, or otherwise impose constraints on foreign and domestic firms. Positive discrimination in favor of foreign-owned firms, in the form of special financial stimuli that benefit only multinationals, are similarly discouraged. The new industrial policy context, while it does require more of an active commitment on the part of states, also recognizes the realities of global production and places much more of an emphasis on incentives rather than requirements. This is a difficult needle to thread. However, governments in emerging economies have made similar shifts in the past, for example, from prioritizing domestic content to emphasizing development of human capital. In a broader sense, this approach represents a correction to the oversteer of neoliberal reform, without duplicating the mistakes of the import substitution era. However, many countries have still not embarked on these kinds of institutional and policy reforms. As I have argued throughout this book, policies that discriminate among different forms of investment can take a country only so far. The barriers to the international transfer of knowledge are real. Multinational firms, even those in high-tech sectors, have incentives to spread innovation to affiliates in developing countries, but they also have incentives to centralize innovation. Host country institutions and policies can tip the balance and lead to a virtuous cycle of industrial upgrading, but only if they are constructed in a way that prioritizes linkages with the domestic economy. Host country policies must go beyond attracting the "right" kind of investment and also incentivize embeddedness. There is still a prominent role for industrial policy, even in the age of multinational production.

As a final caveat, I emphasize that there may be multiple ways to extract developmental benefits from multinational production. One of the mistakes of the neoliberal reform period, promulgated by international financial institutions, was the adoption of one-size-fits-all reform agendas. If there is one thing comparative institutional analysis teaches us, it is that institutions can lead to failure and success through many different channels. I have argued in this book that longstanding democracies are more likely to exhibit innovation-intensive innovation patterns. Yet one need only look at the example of China to see that this relationship is probabilistic and not deterministic. In a similar way, I have argued that countries are more likely to realize developmental benefits from investment when they pursue active, sectorally discriminating polices that prioritize embeddedness. However, just as innovation is diverse, institutions and policies are diverse as well. There is room for experimentation, and future analyses will undoubtedly reveal diverse institutional pathways to FDI-linked development.

Issues for the Future

There are a number of issues surrounding multinational innovation in developing countries that I have not addressed in this book, some due to space constraints and some due to strategic choices regarding theoretic emphasis. This is inevitable in any book project, but I want to emphasize that these other approaches deserve (and have received) consideration. I have made a choice to emphasize domestic institutional factors in host countries as explanations for innovation outcomes, because these factors have not received adequate attention and because I believe they have significant impacts. However, there are other broad categories of influences on multinational behavior that have not been considered here. I have not paid much attention to international influences on multinational innovation patterns, outside of firm explanations and an examination of bilateral investment treaties. I believe that international influences on multinational behavior are important and represent a likely avenue for future research on innovation outcomes. This is for a few reasons. First, international treaties regarding patent protection and intellectual property are increasing in number, and BITs often contain extensive language on these issues. Second, international institutions, particularly the WTO, have increased their surveillance of foreign investment and trade-related aspects of FDI. Third, international law has been more robust on economic issues than almost any other area of jurisprudence, and this looks set to continue.

Intellectual property rights (IPR) standards and norms have become important to the WTO over time. In the 1980s and 1990s during the Uruguay Round of trade negotiations, debates over productivity and transnational appropriation of intellectual property culminated in 1995 with the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs). This changed 157 countries' national patent rules to conform to a minimum unified standard. Progress on international law regarding intellectual property subsequently stalled in the Doha Round, as many developing economies expressed hesitation about further legislation and enforcement. Common sources of ambivalence included fear that losses from further legislation would outweigh gains and that economic development would slow if technological transfer was partially blocked by these international laws. There has been an interesting academic debate about the impact of IPR standards, whether multilateral or bilateral, on both the behavior of multinational firms in emerging economies and on overall development. Javorcik (2004) argues that if a country has a weak IPR regime in place, this will deter foreign investors in technology-intensive sectors from investing in the first place, because they depend on intellectual property protections. When these firms do invest in countries with weak protections, they tend to have light footprints and focus on distribution. Schmiele (2013) takes this a step further and argues that the risk is much higher for firms contemplating R&D activities abroad when IPR protections are weak.[6] Branstetter et al. (2006) make the case that once a country signs on to an intellectual property rights agreement, local affiliate R&D expenditures go up and these affiliates begin to make more foreign patent applications. In all these works, IPR agreements are essential for the diffusion of multinational innovation. In other words, their absence makes centralization of innovation more likely, and may even preclude investment from firms in technologically sensitive sectors. It is worth noting, however, that many of these works look at the effects of legal reforms within countries prompted by multilateral agreements, including TRIPs. They do not often consider the effect of language within bilateral investment treaties, which in many cases is more complex and requires far-reaching reforms.

On the overall relationship between IPR agreements and development, the literature is more mixed. Dinopoulos and Segerstrom (2010) develop a theoretic model in which they argue that higher levels of IPR protection will lead to technology transfer to developing countries, decreases in wage inequality, and increases in innovation expenditures of multinationals. Branstetter et al. (2011) argue that IPR strengthening will have mixed effects in developing countries but that increases in industrial activity offset any losses in imitative activity. However, Hudson and Minea (2013) are more pessimistic, arguing that IPR regulations increase wealth transfers from poor countries to rich ones and that homogenous IPR protection has a different (and not necessarily beneficial) effects in industrialized and developing countries. Sweet, Mehlig, and Maggio (2015) advance a similar contextual argument: that countries with above-average levels of development enjoy benefits from stronger IPR protections but that in developing countries IPR protections demonstrate neutral or (more often) negative effects on economic complexity. These more recent works propose a more nuanced relationship between IPR protection and growth in developing countries.

I believe there are two important opportunities to expand this literature on international intellectual property rights standards, as they relate to multinational innovation. Much of the literature looks at the timing of host country reforms and resulting patterns of firm innovation and spillovers (or larger development metrics). However, the proliferation of bilateral investment treaties, and their incorporation of

6. Specifically, R&D activities in countries with weak IPR regimes are at increased risk for intellectual property infringements (not only piracy), and may in fact lose technological knowledge to local competitors.

IPR, suggests that analysts may benefit from an approach that looks at the characteristics of investment flows between the two partners to the BIT. In other words, it may not be the timing of overall reforms but the specific bilateral investment relationship that is altered by international agreements on intellectual property. Multinational firms originating in one of the BIT countries may exhibit different characteristics once the treaty goes into effect. The multilateral reforms of the 1990s, while important, have in many ways been superseded by bilateral agreements that often go further than the TRIPs baseline.

There are also opportunities to investigate the linkage/spillover question as an alternate dependent variable. Many of the firm-level studies look at levels of R&D spending or changes in sectoral patterns of incoming investment. However, IPR policies cut directly to the heart of multinational embeddedness. It would be interesting to know, for example, whether these multilateral and bilateral agreements lead firms to feel more comfortable lessening their ownership shares and/or partnering with local firms and universities. It would also be interesting to discover whether enclave investments (or perhaps intrafirm trade) increase or decrease when these agreements are signed. Perhaps the value chain perspective on firm governance could be linked to IPR protections, if these international agreements make hierarchies more or less likely. Whatever the outcome, it would be surprising if international pressures were not associated with changes in how innovative multinational firms are organized and whether they embed themselves more in local economies as a result.

In a broader sense, IPR protections are part of the institutional environment in host countries and are captured to an extent by the measures used in this book. However, they also contain an international dimension, as does the influence of the WTO in general. These international political influences on innovation patterns remain underexplored in this book and represent a potentially fruitful path for future research. For now, it is enough to emphasize the potential contributions of FDI to development and to highlight once again the importance of domestic political institutions in realizing that potential. Virtuous cycles of innovation, industrial upgrading, and multinational embeddedness are all possible outcomes of foreign investment. Institutional analysis helps us understand why and when these outcomes occur.

Appendixes

Note: Additional content can be found online at http://mitpress.mit.edu/globalizing-innovation.

Appendix A

Table A.1
Variable descriptions for BEA and patent count time-series, tables 4.1–4.3

Variable	Measure and Source	Mean (Standard Deviation)	Minimum	Maximum
R&D intensity, all industries	R&D spending as a percentage of value added, US firms, BEA data	2.009 (4.902)	0.000	33.359
R&D intensity, total manufacturing	R&D spending as a percentage of value added, US firms, BEA data	2.712 (6.092)	0.000	39.434
R&D intensity, computers and electronic products	R&D spending as a percentage of value added, US firms, BEA data	4.006 (8.726)	0.000	50.276
R&D intensity, chemicals	R&D spending as a percentage of value added, US firms, BEA data	1.788 (2.584)	0.000	22.137
R&D intensity, transportation equipment	R&D spending as a percentage of value added, US firms, BEA data	1.532 (2.889)	0.000	12
R&D intensity, information	R&D spending as a percentage of value added, US firms, BEA data	0.814 (0.813)	0.000	9.424

Table A.1 (continued)

Variable	Measure and Source	Mean (Standard Deviation)	Minimum	Maximum
Population	Natural log of population, World Development Indicators	17.281 (1.521)	14.912	21.009
GDP per capita	Natural log of GDP in constant dollars, PPP adjustment, World Development Indicators	9.371 (0.783)	7.842	11.622
Human capital (interpolated)	Lee and Lee (2016) alternate measure of aggregate human capital stock, 1995, 2000, 2005, and 2010 measures	4.899 (0.661)	3.418	6.346
Internet users per 100 people (infrastructure)	World Development Indicators	14.760 (14.827)	0.041	69.9
GDP growth	GDP growth rate, World Development Indicators	4.955 (3.892)	–8.855	33.736
Number of bilateral investment treaties (BITs)	Yearly number of cumulative BITs in force, International Centre for Settlement of Investment Disputes (ICSID) online database	25.991 (19.788)	0	76
BIT with the US	Dummy variable indicating presence of BIT with US, UNCTAD international investment agreements navigator	0.236 (0.426)	0	1
Trade	Exports plus imports as a percentage of GDP, World Development Indicators	90.361 (70.503)	20.227	430.357
Capital account	Kaopen normalized measure of capital account openness, Chinn and Ito (2008)	0.556 (1.354)	–1.875	2.422

Table A.1 (continued)

Variable	Measure and Source	Mean (Standard Deviation)	Minimum	Maximum
US FDI	Current US FDI flows as a percentage of current GDP, BEA and World Development Indicators	8.816 (26.830)	0.285	292.354
US trade	Current bilateral US imports and exports with destination country as a percentage of current GDP, BEA and World Development Indicators	15.784 (16.074)	0.906	94.613
Democracy length	Length in years of democracy, 0 if nondemocratic; Cheibub et al. (2010)	16.639 (18.678)	0	61
Control of corruption index	International Country Risk Guide (Political Risk Services) corruption component	2.451 (0.881)	1	5
Patent count	NBER Patent Data Project, supplemented with data from Li et al. (2014) on patent disambiguation; yearly patent applications from American firms abroad (type 2) registered with the US Patent and Trademark Office	7.472 (28.304)	0	254
Patents in force	World Intellectual Property Organization statistics database; patents in force in foreign filing offices with US origin, scaled against GDP in US$100 billion (constant)	1867.508 (2337.359)	3.106	9756.703

Table A.1 (continued)

Variable	Measure and Source	Mean (Standard Deviation)	Minimum	Maximum
Foreign-oriented patent filings	World Intellectual Property Organization statistics database; natural log of foreign-oriented patent filings of US origin in foreign filing offices. A patent family has at least one filing office that is different from the office of the applicant's origin.	5.935 (2.361)	0	10.396

Note: Countries included in models (note not all countries appear in all models due to missing data): Argentina, Brazil, Chile, China, Colombia, Costa Rica, Czech Republic, Dominican Republic, Ecuador, Egypt, Honduras, Hungary, India, Indonesia, Israel, Malaysia, Mexico, Nigeria, Panama, Peru, Philippines, Poland, Russia, Saudi Arabia, Singapore, South Africa, Thailand, Turkey, United Arab Emirates, Venezuela.

Generalized Method of Moments (GMM) Estimators for Dynamic Panel Data

Panel data in time-series format create a unique set of challenges for researchers hoping to separate effects of predictors from idiosyncratic factors not contained in the model. Moreover, OLS estimates of these data can lead to inconsistent and biased estimates, as the explanatory predictors in the model are rarely independent of the error term. Fixed effects models utilizing dummies for each of the panels go some way toward solving the problems of time-series cross-section (TSCS) data, but do not adequately address problems with endogeneity common to many of these analyses. Furthermore, fixed effects models based on a generalized least squares framework do not adequately tackle the problem of autocorrelation in the dependent variable.

Some researchers have adopted two-stage least squares models to combat these problems. These models utilize instrumental variables highly correlated with the potentially endogenous predictor and simultaneously uncorrelated with the error term. However, it is often difficult to find instruments that have the necessary qualities to serve this purpose. Instruments with even trivial levels of correlation with the error can cause real problems with inference. Instruments that are only approximately exogenous are often no better than the initial predictor.

GMM models are useful in situations common to time-series cross-sectional models, where independent variables are not strictly exogenous, fixed effects exist, and heteroskedasticity and autocorrelation are common within panels. This family of models, initially developed by Holtz-Eakin, Newey, and Rosen (1988), and greatly expanded by Arellano and Bond (1991) and Arellano and Bover (1995), uses deep lags of the variables already in the model as instruments, while also controlling for panel- (in this case, country-) specific effects and autocorrelation by way of a lagged dependent variable. In the case of this analysis, the general model takes the functional form:

$$Y_{it} = \beta_1 Y_{it-1} + \beta_2 X_{it} + \eta_i + \varepsilon_{it}$$

where η_i is the effect of the country; this allows the model to accommodate measurement error and other idiosyncratic factors specific to each country. The GMM process used in this analysis is the “system” one-step procedure, which combines both differences and levels simultaneously, using lags 2 and deeper as weak instruments to remove correlation from the error term. Eliminating the country-specific effects and first-differencing the equation above brings the first part of the GMM system process:

$$Y_{it} - Y_{t-1} = \beta_1 (Y_{it-1} - Y_{it-2}) + \beta_2 (X_{it} - X_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1})$$

To cope with the correlation between the dependent variable and error term inherent in the above, the GMM estimator adopts the following moment conditions:

$$E[Y_{it-n}(\varepsilon_{it} - \varepsilon_{it-1})] = 0 \qquad \text{for all } n \geq 3$$

$$E[Y_{it-n}(\varepsilon_{it} - \varepsilon_{it-1})] = 0 \qquad \text{for all } n \geq 2$$

These conditions produce the GMM estimator for the differences half of the process. For the levels portion of the combined system GMM, the moment conditions are as follows:

$$E[(Y_{it-n} - Y_{it-n-1})(\eta_i + \varepsilon_{it})] = 0 \qquad \text{for } n = 2$$

$$E[(X_{it-n} - X_{it-n-1})(\eta_i + \varepsilon_{it})] = 0 \qquad \text{for } n = 1$$

This takes into account the country-specific effect. Lagged levels are used as instruments in the differenced equation, but only the most recent difference is used in the levels equations.

When the moment conditions are applied to the construction of a GMM estimator, consistent estimates of the parameters of interest take the following functional form:

$$\boldsymbol{\beta} = (\mathbf{X'ZA}^{-1}\mathbf{Z'X})^{-1}\mathbf{X'ZA}^{-1}\mathbf{Z'Y}$$

where $\boldsymbol{\beta}$ is the vector of the parameters of interest, **A** is a consistent estimate of the variance-covariance matrix of the values that satisfy the moment conditions, **X** is the matrix of explanatory variables (first in differences and then in levels), **Y** is the vector of dependent variables, also first in first differences and then in levels, and **Z** is the matrix of instruments derived from the moment conditions.[1]

The analysis used in this study adopts one-step system GMM, as outlined by Roodman (2006). As the potential for reverse causation is present between the R&D spending and some of the predictors, both the lagged dependent variable and six of the independent variables are treated as potentially endogenous regressors.[2] These variables are therefore adopted as GMM-style instruments. The rest of the predictors are used as IV-style variables, indicating the assumption of exogeneity.

The ability of GMM models to cope with endogeneity and fixed effects in dynamic panel data is impressive, but there are a number of potential hazards in their use. Two key specification tests relay information on the model. The Arellano–Bond test statistic examines the null hypothesis that the error term is not serially correlated. Failure to reject the null supports the model specification. If second-order correlation of the differenced residual exists, this indicates the error term contains some remaining correlation, and the null is rejected. The models perform well in this regard, but there is some basis for concern in two models.

The Sargan test for overidentifying restrictions originates from the concern that models with larger time dimensions or a large number of predicted variables can result in an overabundance of instruments created by the GMM procedure, which, in turn, can increase the distance of the GMM estimators from the asymptotic ideal. Instrument proliferation is difficult to combat, but it does not dramatically affect parameter estimates. In this analysis, the longer time dimension does

1. See Arellano and Bond (1991) for further elaboration on the derivation of the instrument matrix, including assumptions of the GMM model family.

2. GDP per capita, human capital, internet users, the number of BITs, US FDI, and US trade are all treated as potentially endogenous regressors.

overfit the models (rejection of the null Sargan statistic), but the parameter estimates remain robust to alternative specifications including only taking second lags. In accordance with Roodman's (2008) notes on the problem of too many instruments, the instrument matrix in the system GMM used here is collapsed. This goes some way toward reducing the instrument count, but not to desired levels. Little consensus exists on the ideal relationship between number of instruments and the size of the sample, other than the idea that instruments should be minimal. In data such as these, however, the larger problems remain unit effects and endogeneity. Therefore, the proliferation of instruments to deal with these issues is worth the cost of overfit.

Table A.2
GMM Results for models 1–3 in table 4.1, with and without outliers

Independent Variable	1. All Industries	2. All Industries	3. All Industries	4. All Industries	5. All Industries	6. All Industries
R&D spending, all industries$_{t-1}$	0.557*** (0.072)	0.543*** (0.089)	0.553*** (0.070)	0.486*** (0.098)	0.437*** (0.088)	0.438*** (0.100)
GDP per capita (logged)	0.781* (0.461)			0.099 (0.238)		
Human capital (interpolated)		0.525* (0.294)			0.602** (0.262)	
Internet users per 100 people (infrastructure)			–0.009 (0.010)			–0.001 (0.005)
Population (logged)	0.380* (0.224)	0.557*** (0.161)	–0.002 (0.123)	0.386*** (0.129)	0.640*** (0.144)	0.371*** (0.094)
GDP growth	–0.036 (0.024)	–0.002 (0.014)	–0.03 (0.021)	–0.007 (0.014)	0.005 (0.015)	–0.008 (0.014)
Number bilateral investment treaties	0.019** (0.009)	0.001 (0.005)	0.032*** (0.010)	0.008 (0.005)	0.002 (0.005)	0.010** (0.005)
Bilateral investment treaty with US (dummy)	–0.402 (0.619)	0.226 (0.245)	–1.449*** (0.542)	–0.108 (0.306)	0.254 (0.228)	–0.259 (0.255)
Trade	0.002 (0.003)	0.006** (0.002)	0.003 (0.003)	0.007*** (0.002)	0.008*** (0.002)	0.008*** (0.002)
Capital account	0.199** (0.098)	–0.027 (0.043)	0.215** (0.094)	–0.016 (0.045)	–0.04 (0.040)	–0.011 (0.045)
US FDI	0.000 (0.006)	0.003 (0.002)	–0.006 (0.005)	0.002 (0.003)	0.003 (0.002)	0.001 (0.002)

Table A.2 (continued)

Independent Variable	1. All Industries	2. All Industries	3. All Industries	4. All Industries	5. All Industries	6. All Industries
US trade	0.022 (0.014)	0.011 (0.009)	0.009 (0.011)	0.005 (0.007)	0.011 (0.008)	0.003 (0.005)
Democracy length	0.057*** (0.012)	0.012*** (0.004)	0.049*** (0.010)	0.011** (0.004)	0.016*** (0.004)	0.010*** (0.004)
Control of corruption index	0.218 (0.133)	0.137* (0.076)	0.229* (0.128)	0.172** (0.071)	0.228*** (0.073)	0.195*** (0.072)
Constant	–15.339* (8.133)	–13.087*** (4.170)	–1.166 (2.335)	–8.511** (4.257)	–15.230*** (3.722)	–7.369*** (1.818)
N	205	174	213	195	165	195
Countries	29	25	30	28	24	28
Wald chi-square	1029.06	707.61	1055.41	881.32	763.45	885.65
Outliers	Yes	Yes	Yes	No	No	No

Notes: Dependent variable in all models is US firm R&D spending as a percentage of value added. BEA data, 1999–2008. Entries are unstandardized coefficient estimates with standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. One-step system GMM, with orthogonal deviations. GDP per capita, human capital, internet users, the number of BITs, US FDI, and US trade are all treated as potentially endogenous regressors (GMM). All other variables are treated as standard independent variables. Outliers were identified by calculating Cook's D for panel data, using the conventional cutoff of $4/N$.

Table A.3
Diagnostic tests for GMM models

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Instrument count	52	52	52	52	52	52
Arellano‿Bond test for AR(2) in first differences	z4.58 0.000	z0.89 0.372	z4.69 0.000	z1.07 0.286	z0.64 0.521	z0.95 0.340
Sargan test for overidentifying restrictions	$chi^2(39)$ 136.91 0.000	$chi^2(39)$ 62.07 0.011	$chi^2(39)$ 143.09 0.000	$chi^2(34)$ 67.67 0.003	$chi^2(34)$ 68.96 0.002	$chi^2(39)$ 61.62 0.012

Zero-Inflated Negative Binomial Regression

Patent data, when organized through time in discrete and noncumulative instances, suggest count models. As patent counts are discrete and nonnegative dependent variables, their determinants can easily be accommodated in count models. However, there are a variety of count models to choose from, each with underlying distributional assumptions (Long 1997; Greene 2000). According to the standard Poisson event count model, there is an assumption that the conditional variance of the count distribution is equal to the expected value, which means that the incidence rate is constant in each country. However, in the data provided by the NBER patent data project, US firms register foreign-generated patents in the United States at different rates depending on the origin country and year. This stands to reason, as American firms display more patent activity in some countries than others, even accounting for size and economic development. In the patent count data, the variance (690.97) greatly exceeds the mean (6.58), which indicates that the data violate Poisson assumptions. This was also confirmed with a histogram of the data. A test for overdispersion revealed that there were significantly more large values and zero values than would be predicted by a Poisson process (see below). More concretely, overdispersion refers to a situation where the conditional variance of the event count exceeds the conditional expected value.

The preponderance of zero values in the limited patent count data is understandable – in most years American firms did not register patents in the United States from innovations generated abroad in many of these developing countries. However, it is also difficult to know what factors determine this heterogeneity, and even more difficult to model. Rather than fitting a complicated model, zero-inflated negative binomial models propose a two-step process for determining the incidence of an outcome and its frequency in a given time period. ZINB models combine a logit distribution with a negative binomial distribution (Long 1997). In the logit equation, the probability of any patent at all is a function of a set of predictors (in this case, GDP per capita). In the negative binomial equation, the expected number of patents is predicted taking into account various predictors and introducing a gamma-distributed error term ψ_i into the conditional mean of the standard Poisson distribution:

$$\Pr(Y_i = 0 | x_i, z_i) = \psi_i + (1 - \psi_i) f(x_i \beta)$$

$$\Pr(Y_i > 0 | x_i, z_i) = (1 - \psi_i) f(x_i \beta)$$

In the first (binary) model, presented in the bottom half of table 4.3, GDP per capita is the only independent variable that determines whether or not patenting takes place, as it is the strongest predictor in the unconstrained logit model (not reported). This translates into a process whereby the development of a country affects the likelihood of patenting taking place, and other predictors influence the patent count (the negative binomial part of the model). A Vuong test (reported below) indicated that the ZINB model fits the data better than a negative binomial alone, and an additional test confirmed the superiority of the negative binomial to a straightforward Poisson model for the count portion. Likelihood ratio tests on the alpha parameter revealed that unobserved heterogeneity within countries (a result of idiosyncratic factors) did indeed result in overdispersion, which again reinforces the need for a negative binomial.

In interpreting the results of the ZINB in table 4.3, it is important to point out that the coefficient for the logit (GDP per capita) equation in the lower half of the table indicates the probability of zero patents, as indicated in the equation above. Therefore, negative logit coefficients *increase* the probability of patenting taking place, and positive coefficients decrease the probability. The log odds of being an excessive zero would decrease by 1.234 for every unit increase in the log of GPD per capita. In other words, the richer the country, the less likely it is that the zero would be due to not patenting at all. As countries become more developed, it is more likely that patents will happen. Finally, in the ZINB model I employ robust standard errors for the negative binomial portion. The robust standard errors adjust for heterogeneity in the model.

Table A.4
Diagnostic tests for zero-inflated negative binomial model, table 4.3

Overall LR test for model	$chi^2(4)$ 68.15 0.000
Vuong test of ZINB vs. negative binomial	z1.61 0.054
LR test for alpha = 0 (overdispersion)	$chi^2(1)$ 2420.44 0.000

Notes: ZINB model in table 4.3 is estimated with robust standard errors. Diagnostic tests are for model with unconstrained standard errors.

Table A.5
Correlation matrix for independent variables in tables 4.1–4.3

	GDP per Capita	Human Capital	Internet Users per 100	Pop.	GDP Growth	Number of BITs	BIT with US	Trade	Capital Account	US FDI	US Trade	Democracy Length	Control of Corruption Index
GDP per capita (logged)	1												
Human capital (interpolated)	0.841	1											
Internet users per 100 people (infrastructure)	0.707	0.664	1										
Population (logged)	–0.072	–0.141	–0.144	1									
GDP growth	–0.031	–0.098	–0.096	0.075	1								
Number Bilateral investment treaties	0.046	0.318	0.25	0.277	0.075	1							
Bilateral investment treaty with US	–0.097	–0.008	–0.083	–0.161	–0.087	0.385	1						
Trade	0.292	0.287	0.235	–0.382	0.134	–0.085	–0.121	1					
Capital account	0.487	0.393	0.384	–0.595	–0.052	–0.103	0.04	0.417	1				
US FDI	0.103	0.127	0.079	–0.295	–0.036	–0.148	–0.043	0.335	0.272	1			
US trade	–0.202	–0.256	–0.073	–0.355	0.004	–0.44	–0.065	0.292	0.029	0.117	1		
Democracy length	–0.2	–0.264	–0.052	–0.094	–0.043	–0.141	–0.088	–0.235	–0.124	–0.056	0.156	1	
Control of corruption index	0.534	0.579	0.667	–0.196	–0.147	0.045	–0.009	0.188	0.22	0.104	0.081	0.132	1

Table A.6
Descriptive statistics for tables 4.4 and 4.5

Firm-Level Variables	Country-Level Variables and Sources	Observations	Mean	SD	Min	Max
Dependent Variables						
Local R&D spending (binary)		1085/3037				
Developed a major new product line in past three years (binary)		1739/3551				
Upgraded an existing product line in past three years (binary)		2601/4162				
Introduced new technology in past three years (binary)		1725/4139				
Independent Variables						
Foreign ownership (%)		3037	74.297	28.505	10	100
Size of firm (hundreds of employees)		3037	4.314	10.195	0.000	194.533
Percentage of sales sold domestically		2484	54.347	42.638	0.000	100
Percentage of domestic sales to parent company or affiliated subsidiaries		1469	7.423	22.519	0.000	100

Table A.6 (continued)

Firm-Level Variables	Country-Level Variables and Sources	Observations	Mean	SD	Min	Max
	Democracy (binary), Cheibub et al. (2010)	1834/3037				
	Population (natural log), WDI	3037	17.905	1.976	13.519	20.977
	GDP growth (previous year), WDI	3037	6.135	2.394	–1.005	12.1
	Trade openness [(IMP+EXP)/GDP]*100, WDI	3037	79.842	34.731	27.062	201.451
	GDP per capita in constant US$ (log), WDI	3037	7.360	0.990	4.869	9.533
	Manufacturing, value added as percentage of GDP, WDI	2485	23.191	8.362	2.832	34.449
	Manufactured exports as percentage of total exports, UN Comtrade database	2516	64.694	25.899	5.546	93.720
	Services, value added as percentage of GDP, WDI	459	57.376	11.162	33.809	75.940

Notes: All firm-level variables from World Bank surveys, 2002–2005. Country surveys included in models: Albania, Algeria, Armenia, Azerbaijan, Bangladesh, Belarus, Benin, Bosnia-Herzegovina, Brazil, Bulgaria, Cambodia, Chile, China, Costa Rica, Croatia, Czech Republic, Ecuador, Egypt, El Salvador, Eritrea, Estonia, Ethiopia, Georgia, Greece, Guatemala, Guyana, Honduras, Hungary, India, Indonesia, Kazakhstan, Kenya, Kosovo, Kyrgyzstan, Latvia, Lithuania, Macedonia, Madagascar, Malawi, Mali, Moldova, Montenegro, Morocco, Nicaragua, Oman, Pakistan, Peru, Philippines, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Slovenia, South Africa, South Korea, Sri Lanka, Syria, Tajikistan, Tanzania, Thailand, Turkey, Uganda, Ukraine, Uzbekistan, Vietnam, Zambia.

Table A.7
Post-estimation diagnostics for table 4.4

	Manufacturing Firms Only	Manufacturing Firms Only	Service Firms only	Market-Seeking, Manufacturing Firms	Efficiency-Seeking, Manufacturing Firms
Residual intraclass correlation	0.224 (0.048)	0.229 (0.046)	0.359 (0.120)	0.226 (0.046)	0.204 (0.051)
LR test vs. logit model without random intercepts	170.21 0.000	184.48 0.000	24.38 0.000	166.77 0.000	91.96 0.000

Note: Dependent variable in all columns is the firm-level presence or absence of R&D spending (binary).

Table A.8
Post-estimation diagnostics for table 4.5

Has your company undertaken any of the following initiatives in the last three years?	DV: Developed a major new product line	DV: Upgraded an existing product line	DV: Introduced new technology that has substantially changed the way that the main product is produced
Residual intraclass correlation	0.060 (0.014)	0.113 (0.023)	0.054 (0.013)
LR test vs. logit model without random intercepts	115.89 0.000	200.44 0.000	125.82 0.000

Appendix B

Table B.1
Additional descriptive statistics for tables 5.2–5.4

Firm-Level Variables	Country-Level Variables and Sources	Observations	Mean	SD	Min	Max
Dependent Variables						
R&D spending as a percentage of sales		442	1.050	1.140	0.000	4.985
Independent Variables						
Consistent and predictable governance		442	3.310	1.315	1	6
Education of workforce (% with some university education)		442	26.578	24.660	0	100
	WGI government effectiveness	1667	0.214	0.567	–1.107	1.183
	WGI regulatory quality	2048	0.254	0.590	–1.080	1.420
	WGI control of corruption	1845	–0.113	0.464	–0.990	1.060
	Corruption Perceptions Index	1858	3.602	0.950	2.200	6.5
	ICRG control of corruption	1724	2.227	0.679	1.500	4
	ICRG bureaucratic quality	1825	2.243	0.536	1.000	3
	Logistics performance index, WDI	1654	2.746	0.461	1.780	3.440
	Intellectual property index, Park (2008)	1648	3.447	0.698	1.660	4.480
	Years of schooling, Lee and Lee (2016)	1602	8.372	1.828	4.353	12.813
	Human capital, population aged 15–64, Lee and Lee (2016)	1609	4.870	0.626	3.061	6.175

Notes: All firm-level variables from World Bank surveys, 2002–2005. Models contain additional covariates described in other appendix tables.

Table B.2
Post-estimation diagnostics for table 5.2

	WGI Government Effectiveness	WGI Regulatory Quality	WGI Control of Corruption	Corruption Perceptions Index	ICRG Control of Corruption	ICRG Bureaucratic Quality	Logistics Performance Index	Intellectual Property Index
Residual intraclass correlation	0.156 (0.042)	0.193 (0.046)	0.145 (0.041)	0.180 (0.049)	0.109 (0.041)	0.168 (0.046)	0.147 (0.042)	0.079 (0.033)
LR test vs. logit model without random intercepts	106.23 0.000	143.64 0.000	86.42 0.000	88.98 0.000	34.07 0.000	107.34 0.000	83.56 0.000	28.77 0.000

Table B.3
Post-estimation diagnostics for table 5.3

	Education	Human Capital	Manufacturing Firms Only	Service Firms Only
Residual intraclass correlation	0.057 (0.026)	0.065 (0.028)	0.131 (0.043)	0.010 (0.087)
LR test vs. logit model without random intercepts	20.95 0.000	23.48 0.000	65.04 0.000	0.01 0.451

Table B.4
Post-estimation diagnostics for table 5.4

Multilevel (xtmixed)	R&D intensity, measured as percentage of sales
Residual intraclass correlation	0.187 (0.071)
LR test vs. linear model without random intercepts	18.81 0.000

Appendix C

Table C.1
Determinants of forms of R&D, Ireland 2008 CIS

	Expenditure on In-House R&D	Expenditure on External R&D	Expenditure on Acquisition of Machinery, Equipment, and Software	Expenditure on Acquisition of Other External Knowledge
Foreign-owned (dummy)	14.128** (6.801)	.329*** (.123)	3.444 (2.135)	0.882 (0.538)
Turnover (thousands of euros, logged)	–12.231* (6.393)	–0.026 (0.023)	–1.863*** (0.667)	–0.381 (0.263)
100s of employees	3.056* (1.636)	–0.002 (0.011)	.494** (0.198)	0.094 (0.071)
Constant	113.045* (58.832)	0.300 (0.218)	17.576*** (6.144)	3.511 (2.425)
Observations	1423	1396	1401	1384
R-squared	.072	.064	.068	.074

Notes: Sector dummy variables based on NACE two-digit classifications omitted from table. Robust standard errors. Dependent variable in all cases is scaled as a percentage of turnover. ***$p < .01$, **$p < .05$, *$p < .1$.

References

Acemoglu, Daron, and James A. Robinson. 2013. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. New York: Crown Publishers.

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2002. Reversal of Fortune: Geography and Institutions in the Making of the Modern World Income Distribution. *The Quarterly Journal of Economics* 117 (4): 1231–1294.

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2003. An African Success Story: Botswana. In *In Search of Prosperity: Analytic Narratives on Economic Growth*, ed. Dani Rodrik, 80–119. Princeton, NJ: Princeton University Press.

Agarwal, Sanjeev. 1994. Socio-Cultural Distance and the Choice of Joint Ventures: A Contingency Perspective. *Journal of International Marketing* 2 (2): 63–80.

Agarwal, Sanjeev, and Sridhar N. Ramaswami. 1992. Choice of Foreign Market Entry Mode: Impact of Ownership, Location and Internalization Factors. *Journal of International Business Studies* 23 (1): 1–27.

Aitken, Brian J., and Ann E. Harrison. 1999. Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela. *American Economic Review* 89 (3): 605–618.

Aitken, Brian, Gordon H. Hanson, and Ann E. Harrison. 1997. Spillovers, Foreign Investment, and Export Behavior. *Journal of International Economics* 43 (1): 103–132.

Almeida, Rita, and Ana Margarida Fernandes. 2008. Openness and Technological Innovations in Developing Countries: Evidence from Firm-Level Surveys. *The Journal of Development Studies* 44 (5): 701–727.

Alt, James E., and Michael Gilligan. 1994. The Political Economy of Trading States: Factor Specificity, Collective Action Problems and Domestic Political Institutions. *Journal of Political Philosophy* 2 (2): 165–192.

Álvarez, Isabel, and Raquel Marín. 2010. Entry Modes and National Systems of Innovation. *Journal of International Management* 16 (4): 340–353.

Ambos, Björn. 2005. Foreign Direct Investment in Industrial Research and Development: A Study of German MNCs. *Research Policy* 34 (4): 395–410.

Ambos, Björn, and Tina C. Ambos. 2007. Outside the Triad: An Examination of International R&D Investments within Peripheral Economies. In *Multinationals on the Periphery*, ed. Gabriel R.G. Benito and Rajneesh Narula, 188–205. Basingstoke: Palgrave Macmillan UK.

Amsden, Alice H. 1989. *Asia's Next Giant: South Korea and Late Industrialization*. Oxford: Oxford University Press.

Amsden, Alice H. 1994. Why Isn't the Whole World Experimenting with the East Asian Model to Develop? Review of the East Asian Miracle. *World Development* 22 (4): 627–633.

Amsden, Alice H. 2001. *The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies*. Oxford: Oxford University Press.

Amsden, Alice H., and Wan-wen Chu. 2003. *Beyond Late Development: Taiwan's Upgrading Policies*. Cambridge, MA: MIT Press.

Arellano, Manuel, and Stephen Bond. 1991. Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies* 58: 277–297.

Arellano, Manuel, and Olympia Bover. 1995. Another Look at the Instrumental Variable Estimation of Error-Components Models. *Journal of Econometrics* 68: 29–51.

Arndt, Christiane, and Charles Oman. 2006. Uses and Abuses of Governance Indicators. *OECD Development Centre Series*. Paris: Organization for Economic Cooperation and Development.

Arora, Ashish, Alfonso Gambardella, and Salvatore Torrisi. 2001. In the Footsteps of Silicon Valley? Indian and Irish Software in the International Division of Labour. In *Workshop on the Indian Software Industry in a Global Context, Indian Institute of Management, Ahmedabad*. http://www-siepr.stanford.edu/papers/pdf/00-41.pdf.

Asiedu, Elizabeth. 2002. On the Determinants of Foreign Direct Investment to Developing Countries: Is Africa Different? *World Development* 30 (1): 107–119.

Asiedu, Elizabeth, and Hadi Salehi Esfahani. 2001. Ownership Structure in Foreign Direct Investment Projects. *Review of Economics and Statistics* 83 (4): 647–662.

Asiedu, Elizabeth, and Donald Lien. 2004. Capital Controls and Foreign Direct Investment. *World Development* 32 (3): 479–490.

Baran, Paul A. 1957. *Political Economy of Growth*. New York: Monthly Review Press.

Barnet, Richard J., and Ronald E. Müller. 1974. *Global Reach: Power of the Multinational Corporation*. 1st British ed. London: Jonathan Cape.

Barro, Robert J., and Jong-Wha Lee. 2001. International Data on Educational Attainment: Updates and Implications. *Oxford Economic Papers* 53 (3): 541–563.

Barry, Frank. 2007. Foreign Direct Investment and Institutional Co-Evolution in Ireland. *Scandinavian Economic History Review* 55 (3): 262–288.

Barry, Frank, and Adele Bergin. 2010. Ireland's Inward FDI over the Recession and Beyond. Institute for International Integration Studies Working Paper 321.

Barry, Frank, and Adele Bergin. 2013. Offshoring, Inward Investment and Export Performance in Ireland. In *The Oxford Handbook of Offshoring and Global Employment*, ed. Ashok Bardhan, Dwight M. Jaffee, and Cynthia A. Kroll, 311–334. New York: Oxford University Press.

Barry, Frank, and Clare O'Mahony. 2005. Making Sense of the Data on Ireland's Inward FDI. *Journal of the Statistical and Social Inquiry Society of Ireland* 34: 28–65.

Bartlett, Christopher A., and Sumantra Ghoshal. 1989. *Managing across Borders: The Transnational Solution*. Brighton, MA: Harvard Business School Press.

Beck, Nathaniel, and Jonathan N. Katz. 1995. What to Do (and Not to Do) with Time-Series Cross-Section Data. *American Political Science Review* 89 (3): 634–647.

Behrman, Jack N. 1971. US International Business and Governments. *The International Executive* 13 (3): 1–3.

Behrman, Jack N., and William A. Fischer. 1980. *Overseas R&D Activities of Transnational Companies*. Oelgeschlager: Gunn & Hain.

Benoliel, Daniel. 2015. The Impact of Institutions on Patent Propensity across Countries. *Boston University International Law Journal* 33(1): 129–169.

Blit, Joel. 2016. FDI and Indigenous Innovation: Foreign R&D Subsidiaries as a Medium for the Geographic Diffusion of Knowledge. University of Waterloo Working Paper. Available at https://uwaterloo.ca/economics/people-profiles/joel-blit.

Blomström, Magnus, and Ari Kokko. 1998. Multinational Corporations and Spillovers. *Journal of Economic Surveys* 12(3): 247–277.

Blomström, Magnus, Ari Kokko, and Mario Zejan. 2000. *Foreign Direct Investment: Firm and Host Country Strategies*. New York: Palgrave.

Branstetter, Lee, Ray Fisman, C. Fritz Foley, and Kamal Saggi. 2011. Does Intellectual Property Rights Reform Spur Industrial Development? *Journal of International Economics* 83 (1): 27–36.

Branstetter, Lee G., Raymond Fisman, and C. Fritz Foley. 2006. Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from US Firm-Level Panel Data. *The Quarterly Journal of Economics* 121 (1): 321–349.

Breathnach, Proinnsias. 1998. Exploring the "Celtic Tiger" Phenomenon: Causes and Consequences of Ireland's Economic Miracle. *European Urban and Regional Studies* 5 (4): 305–316.

Breznitz, Dan. 2007. *Innovation and the State: Political Choice and Strategies for Growth in Israel, Taiwan, and Ireland*. New Haven, CT: Yale University Press.

Bright, Jake. 2016. In Africa, Watson's Sister Lucy Is Growing up with the Help of IBM's Research Team. *TechCrunch*. http://social.techcrunch.com/2016/03/16/in-africa-watsons-sister-lucy-is-growing-up-with-the-help-of-ibms-research-team/.

Brouthers, Keith D. 2002. Institutional, Cultural and Transaction Cost Influences on Entry Mode Choice and Performance. *Journal of International Business Studies* 33 (2): 203–221.

Brunetti, Aymo, and Beatrice Weder. 1998. Investment and Institutional Uncertainty: A Comparative Study of Different Uncertainty Measures. *Weltwirtschaftliches Archiv* 134 (3): 513–33.

Brunetti, Aymo, Gregory Kisunko, and Beatrice Weder. 1998. Credibility of Rules and Economic Growth: Evidence from a Worldwide Survey of the Private Sector. *The World Bank Economic Review* 12 (3): 353–384.

Bruton, Henry J. 1998. A Reconsideration of Import Substitution. *Journal of Economic Literature* 36 (2): 903–36.

Buckley, Peter J., and Mark Casson. 1976. *Future of the Multinational Enterprise*. New York: Springer.

Busse, Matthias. 2004. Transnational Corporations and Repression of Political Rights and Civil Liberties: An Empirical Analysis. *Kyklos* 57 (1): 45–65.

Busse, Matthias, and Carsten Hefeker. 2007. Political Risk, Institutions and Foreign Direct Investment. *European Journal of Political Economy* 23 (2): 397–415.

Büthe, Tim, and Helen V. Milner. 2008. The Politics of Foreign Direct Investment into Developing Countries: Increasing FDI through International Trade Agreements? *American Journal of Political Science* 52 (4): 741–762.

Cantwell, John. 1992. The Effects of Integration on the Structure of Multinational Corporation Activity in the EC. In *Multinationals in the New Europe and Global Trade*, ed. Michael W. Klein and Paul J. J. Welfens, 193–233. Heidelberg: Springer.

Cantwell, John. 1995. Multinational Corporations and Innovatory Activities: Towards a New Evolutionary Approach. In *Technological Innovation, Multinational Corporations and International Competitiveness*, ed. Jose Molero, 21–58. New York: Routledge.

Cantwell, John, and Ram Mudambi. 2005. MNE Competence-Creating Subsidiary Mandates. *Strategic Management Journal* 26: 1109–1128.

Cardoso, Fernando Henrique, and Faletto Enzo. 1978. *Dependency and Development in Latin America*. Berkeley: University of California Press.

Carlsson, Bo. 2006. Internationalization of Innovation Systems: A Survey of the Literature. *Research Policy* 35 (1): 56–67.

Cassiolato, Jose E., Graziela Zucoloto, Dinesh Abrol, and Xielin Liu. 2014. *Transnational Corporations and Local Innovation: Brics National Systems of Innovation*. London: Taylor & Francis Group.

Casson, Mark, and Satwinder Singh. 1993. Corporate Research and Development Strategies: The Influence of Firm, Industry, and Country Factors on the Decentralization of R&D. *R&D Management* 23: 91–107.

Castellacci, Fulvio. 2008. Technological Paradigms, Regimes, and Trajectories: Manufacturing and Service Industries in a New Taxonomy of Sectoral Patterns of Innovation. *Research Policy* 37: 978–994.

Caves, Richard E. 1971. International Corporations: The Industrial Economics of Foreign Investment. *Economica* 38 (149): 1–27.

Caves, Richard E. 1996. *Multinational Enterprise and Economic Analysis*. Cambridge: Cambridge University Press

Chakrabarti, Avik. 2001. The Determinants of Foreign Direct Investments: Sensitivity Analyses of Cross-Country Regressions. *Kyklos* 54 (1): 89–114.

Cheibub, José Antonio, Jennifer Gandhi, and James Raymond Vreeland. 2010. Democracy and Dictatorship Revisited. *Public Choice* 143 (1–2): 67–101.

Chen, Yun-Chung. 2008. Why Do Multinational Corporations Locate Their Advanced R&D Centres in Beijing? *The Journal of Development Studies* 44 (5): 622–44.

Chinn, Menzie D., and Hiro Ito. 2008. A New Measure of Financial Openness. *Journal of Comparative Policy Analysis* 10 (3): 309–322.

Coe, David, and Elhanan Helpman. 1995. International R&D Spillovers. *European Economic Review* 39(5): 859–887.

Cohen, Wesley M. 2010. Fifty Years of Empirical Studies of Innovative Activity and Performance. In *Handbook of the Economics of Innovation*, ed. Bronwyn H. Hall and Nathan Rosenberg, vol. 1: 129–213. Amsterdam: North-Holland.

Cooper, Charles, and Noel Whelan. 1973. *Science, Technology, and Industry in Ireland*. Dublin: Stationery Office.

Dachs, Bernhard. 2014. Internationalisation of R&D: A Brief Survey of the Literature. In *The Internationalisation of R&D*, ed. B. Sachs, R. Stehrer, and G. Zahradnik, 5–26. Cheltenham, UK: Edward Elgar.

Dachs, Bernhard, and Bernd Ebersberger. 2006. Knowledge Flows between Multinational Enterprises and National Innovation Systems: The Case of Austria. In *Multinationals, Clusters and Innovation*, ed. A. Tavares and A. Teixeira, 13–26. Basingstoke: Palgrave Macmillan UK.

Damijan, Jože P., Mark Knell, Boris Majcen, and Matija Rojec. 2003. The Role of FDI, R&D Accumulation and Trade in Transferring Technology to Transition Countries: Evidence from Firm Panel Data for Eight Transition Countries. *Economic Systems* 27 (2): 189–204.

Damijan, Jože P., Andreja Jaklič, and Matija Rojec. 2006. Do External Knowledge Spillovers Induce Firms' Innovations? Evidence from Slovenia. In *Multinationals, Clusters and Innovation*, ed. A. Tavares and A. Teixeira, 27–47. Basingstoke: Palgrave Macmillan UK.

Davidson, William H., and Donald G. McFetridge. 1985. Key Characteristics in the Choice of International Technology Transfer Mode. *Journal of International Business Studies* 16 (2): 5–21.

Desai, Mihir A., C. Fritz Foley, and James R. Hines Jr. 2006. Capital Controls, Liberalizations, and Foreign Direct Investment. *The Review of Financial Studies* 19 (4): 1433–1464.

Dikova, Desislava, and Arjen Van Witteloostuijn. 2007. Foreign Direct Investment Mode Choice: Entry and Establishment Modes in Transition Economies. *Journal of International Business Studies* 38 (6): 1013–1033.

Dinopoulos, Elias, and Paul Segerstrom. 2010. Intellectual Property Rights, Multinational Firms and Economic Growth. *Journal of Development Economics* 92 (1): 13–27.

Djankov, Simeon, and Bernard Hoekman. 2000. Foreign Investment and Productivity Growth in Czech Enterprises. *The World Bank Economic Review* 14 (1): 49–64.

Doh, Jonathan, Gary Jones, Ram Mudambi, and Hildy Teegen. 2005. Foreign Research and Development and Host Country Environment: An Empirical Examination of US International R&D. *Management International Review* 45(2): 121–154.

Doran, Justin, and Eoin O'Leary. 2011. External Interaction, Innovation and Productivity: An Application of the Innovation Value Chain to Ireland. *Spatial Economic Analysis* 6 (2): 199–222.

Dos Santos, Theotonio. 1970. *Dependencia Económica y Cambio Revolucionario en América Latina*. Caracas: Editorial Nueva Izquierda.

Drukker, David M. 2003. Testing for Serial Correlation in Linear Panel-Data Models. *Stata Journal* 3 (2): 168–177.

Dunning, John H. 1988. The Eclectic Paradigm of International Production: A Restatement and Some Possible Extensions. *Journal of International Business Studies* 19 (1): 1–31.

Dunning, John H. 1993. *The Theory of Transnational Corporations*. Vol. 1. New York: Routledge.

Dunning, John H. 2005. Institutional Reform, Foreign Direct Investment, and European Transition Economies. In *International Business and Government Relations in the 21st Century*, ed. Robert Grosse, 49–78. New York: Cambridge University Press.

Dunning, John H., and Sarianna M. Lundan. 2008. Institutions and the OLI Paradigm of the Multinational Enterprise. *Asia Pacific Journal of Management* 25 (4): 573–593.

Dunning, John H., and Rajneesh Narula. 1996. The Investment Development Path Revisited: Some Emerging Issues. In *Foreign Direct Investment and Governments: Catalysts for Economic Restructuring*, ed. John Dunning and Rajneesh Narula, 1–40. New York: Routledge.

Easterly, William, and Ross Levine. 2003. Tropics, Germs, and Crops: How Endowments Influence Economic Development. *Journal of Monetary Economics* 50 (1): 3–39.

ECLAC. 2000. *Foreign Investment in Latin America and the Caribbean 2000*. New York: United Nations Publications.

Eden, Lorraine, Stefanie Lenway, and Douglas Schuler. 2005. From the Obsolescing Bargain to the Political Bargaining Model. In *International Business and Government Relations in the 21st Century*, ed. Robert Grosse, 251–272. New York: Cambridge University Press.

Edquist, Charles. 1997. *Systems of Innovation: Technologies, Institutions, and Organizations*. Abington, UK: Pinter.

Egan, Patrick J.W. 2012. Is Worker Repression Risky? Foreign Direct Investment, Labour Rights and Assessments of Risk in Developing Countries. *Review of International Political Economy* 19 (3): 415–447.

Elkins, Zachary, Andrew T. Guzman, and Beth A. Simmons. 2006. Competing for Capital: The Diffusion of Bilateral Investment Treaties, 1960–2000. *International Organization* 60 (4): 811–846.

Evans, Peter B. 1979. *Dependent Development: The Alliance of Multinational, State, and Local Capital in Brazil*. Princeton, NJ: Princeton University Press.

Evans, Peter B. 1995. *Embedded Autonomy: States and Industrial Transformation*. Princeton, NJ: Princeton University Press.

Evans, Peter B., Dietrich Rueschemeyer, and Theda Skocpol. 1985. *Bringing the State Back In*. New York: Cambridge University Press.

Fagerberg, Jan. 2005. Innovation: A Guide to the Literature. In *The Oxford Handbook of Innovation*, ed. Jan Fagerberg, David Mowery, and Richard R. Nelson, 1–27. Oxford, UK: Oxford University Press.

Fanning, Connell, and Ciaran Murphy. 2002. Nurturing Indigenous Entrepreneurship in Ireland: The Case of the IT Software Sector. In *The Irish Economy in Transition: Successes, Problems, and Prospects*, ed. Vincent G. Munley, Robert J. Thornton, J. Richard Aronson, 51–84. Bingley, UK: Emerald Group Publishing.

Fink, Philipp. 2004. *Purchased Development: The Irish Republic's Export Oriented Development Strategy*. Berlin: Lit.

Fitzgibbon, Michael. 2011. Fifty Years of Irish Industrial and Science Policies, 1960–2010: A Critical Analysis. *Administration* 59 (3): 101–141.

Florida, Richard. 1997. The Globalization of R&D: Results of a Survey of Foreign-Affiliated R&D Laboratories in the USA. *Research Policy* 26: 85–103.

Frankel, Jeffrey A. 2010. The Natural Resource Curse: A Survey. National Bureau of Economic Research (NBER) Working Paper, no. 15836.

Fu, Xiaolan. 2008. Foreign Direct Investment, Absorptive Capacity and Regional Innovation Capabilities: Evidence from China. *Oxford Development Studies* 36 (1): 89–110.

Fu, Xiaolan, Carlo Pietrobelli, and Luc Soete. 2011. The Role of Foreign Technology and Indigenous Innovation in the Emerging Economies: Technological Change and Catching-Up. *World Development* 39 (7): 1204–1212.

Gastanaga, Victor M., Jeffrey B. Nugent, and Bistra Pashamova. 1998. Host Country Reforms and FDI Inflows: How Much Difference Do They Make? *World Development* 26 (7): 1299–1314.

Gatignon, Hubert, and Erin Anderson. 1988. The Multinational Corporation's Degree of Control over Foreign Subsidiaries: An Empirical Test of a Transaction Cost Explanation. *Journal of Law, Economics, & Organization* 4 (2): 305–336.

Gereffi, Gary, and Raphael Kaplinsky. 2001. *The Value of Value Chains: Spreading the Gains from Globalisation*. Vol. 32 (3). Brighton: Institute of Development Studies of the University of Sussex.

Gereffi, Gary, and B. L. Wyman. 1990. *Manufacturing Miracles*. Princeton, NJ: Princeton University Press.

Gereffi, Gary, John Humphrey, and Timothy Sturgeon. 2005. The Governance of Global Value Chains. *Review of International Political Economy* 12 (1): 78–104.

Gerring, John. 2004. What Is a Case Study and What Is It Good For? *American Political Science Review* 98 (2): 341–354.

Gerschenkron, Alexander. 1962. *Economic Backwardness in Historical Perspective: A Book of Essays*. Cambridge, MA: Belknap Press of Harvard University Press.

Giarratana, Marco, Alessandro Pagano, and Salvatore Torrisi. 2005. The Role of the Multinational Companies. In *From Underdogs to Tigers: The Rise and Growth of the Software Industry in Brazil, China, India, Ireland, and Israel*, ed. Ashish Arora and Alfonso Gambardella, 207–235. Oxford: Oxford University Press.

Ginarte, Juan, and Walter Park. 1997. Determinants of Patent Rights: A Cross-National Study. *Research Policy* 26: 283–301.

Giroud, Axèle. 2006. Is Government Support Really Worth It? Developing Local Supply Linkages in Malaysia. In *Multinationals, Clusters and Innovation*, ed. A. Tavares and A. Teixeira, 179–196. Basingstoke: Palgrave Macmillan UK.

Giuliani, Elisa, Carlo Pietrobelli, and Roberta Rabellotti. 2005. Upgrading in Global Value Chains: Lessons from Latin American Clusters. *World Development* 33 (4): 549–573.

Gleeson, Anne Marie, Frances Ruane, and Julie Sutherland. 2006. Promoting Industrial Clusters: Evidence from Ireland. In *Multinationals, Clusters and Innovation: Does Public Policy Matter?*, ed. Ana Teresa Tavares and Aurora Teixeira, 107–119. Basingstoke: Palgrave Macmillan UK.

Good, Kenneth. 1992. Interpreting the Exceptionality of Botswana. *The Journal of Modern African Studies* 30 (1): 69–95.

Görg, Holger. 2016. *Multinational Enterprises and Host Country Development*. Singapore: World Scientific.

Görg, Holger, and Frances Ruane. 2001. Multinational Companies and Linkages: Panel-Data Evidence for the Irish Electronics Sector. *International Journal of the Economics of Business* 8 (1): 1–18.

Görg, Holger, and Eric Strobl. 2003. Multinational Companies, Technology Spillovers and Plant Survival. *Scandinavian Journal of Economics* 105 (4): 581–595.

Grand Challenges. 2013. *The Economist*, November 7. http://www.economist.com/blogs/baobab/2013/11/ibm-africa.

Granstrand, Ove, Lars Håkanson, and Sören Sjölander, eds. 1992. *Technology Management and International Business: Internationalization of R & D and Technology*. Hoboken, NJ: Wiley.

Greene, William. 2000. *Econometric Analysis*. 4th ed. Upper Saddle River, NJ: Prentice-Hall.

Grosse, Robert. 2005. *International Business and Government Relations in the 21st Century*. New York: Cambridge University Press.

Grosse, Robert, and Jack N. Behrman. 1992. Theory in International Business. *Transnational Corporations* 1 (1): 93–126.

Guimon, Jose, and Sergey Filippov. 2012. Competing for High-Quality FDI: Management Challenges for Investment Promotion Agencies. *Institutions and Economies* 4 (2): 25–44.

Gunnigle, Patrick, and David McGuire. 2001. Why Ireland? A Qualitative Review of the Factors Influencing the Location of US Multinationals in Ireland with Particular Reference to the Impact of Labour Issues. *Economic and Social Review* 32 (1): 43–68.

Haddad, Mona, and Ann Harrison. 1993. Are There Positive Spillovers from Direct Foreign Investment?: Evidence from Panel Data for Morocco. *Journal of Development Economics* 42 (1): 51–74.

Haggard, Stephan. 1989. The Political Economy of Foreign Direct Investment in Latin America. *Latin American Research Review* 24 (1): 184–208.

Haggard, Stephan. 1990. *Pathways from the Periphery: The Politics of Growth in the Newly Industrializing Countries*. Ithaca, NY: Cornell University Press.

Hajzler, Christopher. 2014. Resource-Based FDI and Expropriation in Developing Economies. *Journal of International Economics* 92 (1): 124–146.

Håkanson, Lars, and Robert Nobel. 1993. Foreign Research and Development in Swedish Multinationals. *Research Policy* 22 (5): 373–396.

Hall, Bronwyn H. 2002. The Financing of Research and Development. *Oxford Review of Economic Policy* 18 (1): 35–51.

Hall, Bronwyn H. 2010. The Internationalization of R&D. UNU-Merit Working Paper, no. 2011-049.

Hallam, David. 2011. International Investment in Developing Country Agriculture—Issues and Challenges. *Food Security* 3 (1): 91–98.

Hallward-Driemeier, Mary. 2003. Do Bilateral Investment Treaties Attract Foreign Direct Investment? Only a Bit and They Could Bite. World Bank Policy Research Working Paper, no. 3121.

Harding, Torfinn, and Beata S. Javorcik. 2011. Roll Out the Red Carpet and They Will Come: Investment Promotion and FDI Inflows. *The Economic Journal* 121 (557): 1445–1476.

Hausmann, Ricardo, and Dani Rodrik. 2003. Economic Development as Self-Discovery. *Journal of Development Economics*, 14th Inter-American Seminar on Economics, 72 (2): 603–633.

He, Qichun, Meng Sun, and Heng-Fu Zou. 2013. Financial Deregulation, Absorptive Capability, Technology Diffusion and Growth: Evidence from Chinese Panel Data. *Journal of Applied Economics* 16 (2): 275–302.

Henisz, Witold J. 2000. The Institutional Environment for Economic Growth. *Economics & Politics* 12 (1): 1–31.

Hennart, Jean-Francois, and Jorma Larimo. 1998. The Impact of Culture on the Strategy of Multinational Enterprises: Does National Origin Affect Ownership Decisions? *Journal of International Business Studies* 29 (3): 515–538.

Hill, Charles WL, Peter Hwang, and W. Chan Kim. 1990. An Eclectic Theory of the Choice of International Entry Mode. *Strategic Management Journal* 11 (2): 117–128.

Hiratuka, C. 2009. Islands of Possibility: MNCs and Economic Development in Brazil. In *Rethinking Foreign Investment for Sustainable Development: Lessons from Latin America*, ed. Kevin Gallagher and Daniel Chudnovsky, 33–50. New York: Anthem.

Holtz-Eakin, Douglas, Whitney Newey, and Harvey Rosen. 1988. Estimating Vector Autoregressions with Panel Data. *Econometrica* 56: 1371–95.

Hudson, John, and Alexandru Minea. 2013. Innovation, Intellectual Property Rights, and Economic Development: A Unified Empirical Investigation. *World Development* 46: 66–78.

Hymer, Stephen. 1960. On Multinational Corporations and Foreign Direct Investment. In *The Theory of Transnational Corporations*, ed. John Dunning. London: Routledge for the United Nations.

Hymer, Stephen. 1970. The Efficiency (Contradictions) of Multinational Corporations. *The American Economic Review* 60 (2): 441–448.

Hymer, Stephen. 1972. The Internationalization of Capital. *Journal of Economic Issues* 6 (1): 91–111.

Hymer, Stephen. 1976. *The International Operations of National Firms: A Study of Foreign Direct Investment*. Cambridge, MA: MIT Press.

Jacobsen, John Kurt. 1994. *Chasing Progress in the Irish Republic: Ideology, Democracy and Dependent Development*. New York: Cambridge University Press.

Jaspersen, Frederick Z., Anthony H. Aylward, and A. David Knox. 2000. The Effects of Risk on Private Investment: Africa Compared with Other Developing Areas. In

Investment and Risk in Africa, ed. Paul Collier and Catherine Pattillo, 71–95. Basingstoke: Palgrave Macmillan UK.

Javorcik, Beata Smarzynska. 2004. Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages. *American Economic Review* 94 (3): 605–627.

Javorcik, Beata Smarzynska, and Shang-Jin Wei. 2000. Corruption and Composition of Foreign Direct Investment: Firm-Level Evidence. National Bureau of Economic Research (NBER) Working Paper, no. 7969.

Jenkins, Barbara. 1986. Reexamining the "Obsolescing Bargain": A Study of Canada's National Energy Program. *International Organization* 40 (1): 139–165.

Jensen, Nathan M. 2003. Democratic Governance and Multinational Corporations: Political Regimes and Inflows of Foreign Direct Investment. *International Organization* 57 (3): 587–616.

Jensen, Nathan M. 2006. *Nation-States and the Multinational Corporation: A Political Economy of Foreign Direct Investment*. Princeton, NJ: Princeton University Press.

Jensen, Nathan M., Quan Li, and Aminur Rahman. 2010. Understanding Corruption and Firm Responses in Cross-National Firm-Level Surveys. *Journal of International Business Studies* 41 (9): 1481–1504.

Johnson, Chalmers A. 1982. *MITI and the Japanese Miracle: The Growth of Industrial Policy, 1925–1975*. 1st ed. Palo Alto, CA: Stanford University Press.

Jun, K. W., and H. Singh. 1996. The Determinants of Foreign Direct Investment: New Empirical Evidence. UNCTAD. *Transnational Corporations* 5 (2): 67–106.

Kalan, Jonathan. 2013. The Technology Modernising Kenya's Matatus—BBC News. http://www.bbc.com/news/business-24426676.

Kaplinsky, Raphael, and Mike Morris. 2001. *A Handbook for Value Chain Research*. Vol. 113. Ottawa: International Development Research Centre (IDRC).

Kaufmann, Daniel, Aart Kray, and Massimo Mastruzzi. 2007. Growth and Governance: A Reply. *Journal of Politics* 69(2): 555–562.

Kaufmann, Daniel, Aart Kray, and Massimo Mastruzzi. 2009. Governance Matters VIII: Aggregate and Individual Governance Indicators, 1996–2008. World Bank Policy Research Working Paper, no. 4978.

Kaufmann, Daniel, Aart Kray, and Massimo Mastruzzi. 2011. The Worldwide Governance Indicators: Methodology and Analytical Issues. *Hague Journal on the Rule of Law* 3 (2): 220–246.

Kenyon, Thomas, and Megumi Naoi. 2010. Policy Uncertainty in Hybrid Regimes: Evidence from Firm-Level Surveys. *Comparative Political Studies* 43 (4): 486–510.

Kerner, Andrew. 2009. Why Should I Believe You? The Costs and Consequences of Bilateral Investment Treaties. *International Studies Quarterly* 53 (1): 73–102.

Kimura, Yui. 1989. Firm-Specific Strategic Advantages and Foreign Direct Investment Behavior of Firms: The Case of Japanese Semiconductor Firms. *Journal of International Business Studies* 20 (2): 296–314.

Kindleberger, Charles P. 1969. *American Business Abroad: Six Lectures on Direct Investment*. New Haven, CT: Yale University Press.

Kingstone, Peter R. 2003. Privatizing Telebrás: Brazilian Political Institutions and Policy Performance. *Comparative Politics* 36 (1): 21–40.

Kirby, Peadar. 2002. *The Celtic Tiger in Distress: Growth with Inequality in Ireland*. New York: Springer.

Kirby, Peadar, and Mary Murphy. 2011. *Towards a Second Republic: Irish Politics and the Celtic Tiger*. London: Pluto Press.

Kobrin, Stephen J. 1976. The Environmental Determinants of Foreign Direct Manufacturing Investment: An Ex Post Empirical Analysis. *Journal of International Business Studies* 7 (2): 29–42.

Kobrin, Stephen J. 1987. Testing the Bargaining Hypothesis in the Manufacturing Sector in Developing Countries. *International Organization* 41 (4): 609–638.

Kogut, Bruce, and Harbir Singh. 1988. The Effect of National Culture on the Choice of Entry Mode. *Journal of International Business Studies* 19 (3): 411–432.

Kogut, Bruce, Gordon Walker, and Jaideep Anand. 2002. Agency and Institutions: National Divergences in Diversification Behavior. *Organization Science* 13 (2): 162–178.

Kosacoff, Bernardo, Andrés López, and Mara Pedrazzoli. 2008. *Trade, Investment and Fragmentation of the Global Market: Is Latin America Lagging Behind?* Vol. 39. New York: United Nations Publications.

Krugman, Paul. 1997. Good News from Ireland: A Geographical Perspective. In *International Perspectives on the Irish Economy*, ed. Alan W. Grey, 38–53. Dublin: Indecon.

Kuemmerle, Walter. 1999. The Drivers of Foreign Direct Investment into Research and Development: An Empirical Investigation. *Journal of International Business Studies* 30 (1): 1–24.

Kumar, Nagesh. 1994. Determinants of Export Orientation of Foreign Production by US Multinationals: An Inter-Country Analysis. *Journal of International Business Studies* 25 (1): 141–156.

Kumar, Nagesh. 2002. *Globalization and the Quality of Foreign Direct Investment*. Oxford: Oxford University Press.

Kurtz, Marcus, and Andrew Schrank. 2007. Growth and Governance: Models, Measures, and Mechanisms. *Journal of Politics* 69(2): 538–554.

Lall, Sanjaya. 1979. The International Allocation of Research Activity by US Multinationals. *Oxford Bulletin of Economics and Statistics* 41 (4): 313–331.

Lall, Sanjaya. 2003. Foreign Direct Investment, Technology Development and Competitiveness: Issues and Evidence. In *Competitiveness, FDI and Technological Activity in East Asia*, ed. Sanjaya Lall and Shujiro Urata, 12–56. Northampton, MA: Edward Elgar.

Lall, Sanjaya. 2004. *Reinventing Industrial Strategy: The Role of Government Policy in Building Industrial Competitiveness*. New York: United Nations Publications.

Langbein, Laura, and Stephen Knack. 2010. The Worldwide Governance Indicators: Six, One, or None? *The Journal of Development Studies* 46 (2): 350–370.

Lashinsky, Adam. 2014. This Is Why IBM Is Interested in Africa. http://fortune.com/2014/06/09/this-is-why-ibm-is-interested-in-africa/.

Lee, Jong-Wha, and Hanol Lee. 2016. Human Capital in the Long Run. *Journal of Development Economics* 122: 147–169.

Li, Guan-Cheng, Ronald Lai, Alexander D'Amour, David Doolin, Ye Sun, Vetle Torvik, Amy Yu, and Lee Fleming. 2014. Disambiguation and Co-authorship Networks of the US Patent Inventor Database (1975–2010). *Research Policy* 43: 941–955.

Li, Quan, and Adam Resnick. 2003. Reversal of Fortunes: Democratic Institutions and Foreign Direct Investment Inflows to Developing Countries. *International Organization* 57 (1): 175–211.

Licht, Georg, and Dietmar Moch. 1999. Innovation and Information Technology in Services. *The Canadian Journal of Economics* 32(2): 363–383.

Long, J. Scott. 1997. *Regression Models for Categorical and Limited Dependent Variables*. London, UK: Sage.

Low, Patrick, and Arvind Subramanian. 1995. TRIMs in the Uruguay Round: An Unfinished Business? *World Bank Discussion Papers*, 413–434.

Lundvall, Bengt-Ake. 1992. *National Systems of Innovation: An Analytical Framework*. London: Pinter.

MacSharry, Ray, Padraic A. White, and Joseph J. O'Malley. 2000. *The Making of the Celtic Tiger: The Inside Story of Ireland's Boom Economy*. Cork: Mercier Press.

March, James G., and Johan P. Olsen. 1984. The New Institutionalism: Organizational Factors in Political Life. *The American Political Science Review* 78 (3): 734–749.

Markusen, James R., and Anthony J. Venables. 1999. Foreign Direct Investment as a Catalyst for Industrial Development. *European Economic Review* 43 (2): 335–356.

Martincus, Christian Volpe, and Jerónimo Carballo. 2008. Is Export Promotion Effective in Developing Countries? Firm-Level Evidence on the Intensive and the Extensive Margins of Exports. *Journal of International Economics* 76 (1): 89–106.

Meyer, Klaus E. 2001. Institutions, Transaction Costs, and Entry Mode Choice in Eastern Europe. *Journal of International Business Studies* 32 (2): 357–367.

Meyer, Klaus E., and Hung Vo Nguyen. 2005. Foreign Investment Strategies and Subnational Institutions in Emerging Markets: Evidence from Vietnam. *Journal of Management Studies* 42 (1): 63–93.

Meyer, Klaus E., Saul Estrin, Sumon Kumar Bhaumik, and Mike W. Peng. 2009. Institutions, Resources, and Entry Strategies in Emerging Economies. *Strategic Management Journal* 30 (1): 61–80.

Miles, Ian. 2005. Innovation in Services. In *The Oxford Handbook of Innovation*, ed. Jan Fagerberg, David Mowery, and Richard R. Nelson, 433–458. Oxford, UK: Oxford University Press.

Milner, Helen V. 1989. *Resisting Protectionism: Global Industries and the Politics of International Trade*. Princeton, NJ: Princeton University Press.

Milner, Helen V. 2014. Introduction: The Global Economy, FDI, and the Regime for Investment. *World Politics* 66 (1): 1–11.

Minor, Michael S. 1994. The Demise of Expropriation as an Instrument of LDC Policy, 1980–1992. *Journal of International Business Studies* 25 (1): 177–188.

Montiel, Peter, and Carmen M. Reinhart. 1999. Do Capital Controls and Macroeconomic Policies Influence the Volume and Composition of Capital Flows? Evidence from the 1990s. *Journal of International Money and Finance* 18 (4): 619–635.

Motohashi, Kazuyuki. 2015. Measuring Multinationals' R&D Activities in China on the Basis of a Patent Database: Comparing European, Japanese, and US Firms. *China and the World Economy* 23(6): 1–21.

Moran, Theodore. 1975. *Multinational Corporations and the Politics of Dependence: Copper in Chile*. Princeton, NJ: Princeton University Press.

Moran, Theodore. 2014. Foreign Investment and Supply Chains in Emerging Markets: Recurring Problems and Demonstrated Solutions. *SSRN Scholarly Paper*, ID 2534095. Rochester, NY: Social Science Research Network.

Morisset, Jacques. 2000. *Foreign Direct Investment in Africa: Policies also Matter*. Vol. 2481. Washington, DC: World Bank Publications.

Mortimore, Michael. 2000. Corporate Strategies for FDI in the Context of Latin America's New Economic Model. *World Development* 28 (9): 1611–1626.

Munck, Gerardo L. 2003. Measures of Democracy, Governance and Rule of Law: An Overview of Cross-National Data Sets. School of International Relations at the University of Southern California Working Paper.

Murphy, Antoin, 1998. *The Celtic Tiger—The Great Misnomer: Economic Growth and the Multinationals in Ireland in the 1990's*. Dublin: MMI Stockbrokers.

Mutti, John H. 2003. *Foreign Direct Investment and Tax Competition*. Washington, DC: Peterson Institute for International Economics.

Narula, Rajneesh. 2003. *Globalization and Technology: Interdependence, Innovation Systems and Industrial Policy*. New York: Wiley.

Narula, Rajneesh, and John H. Dunning. 2000. Industrial Development, Globalization and Multinational Enterprises: New Realities for Developing Countries. *Oxford Development Studies* 28 (2): 141–167.

Narula, Rajneesh, and John H. Dunning. 2010. Multinational Enterprises, Development and Globalization: Some Clarifications and a Research Agenda. *Oxford Development Studies* 38 (3): 263–287.

Nelson, Richard R. 1993. *National Innovation Systems: A Comparative Analysis*. Oxford: Oxford University Press.

Nelson, Richard R. 2005. *Technology, Institutions, and Economic Growth*. Cambridge, MA: Harvard University Press.

Nelson, Richard R., and Sidney G. Winter. 1985. *An Evolutionary Theory of Economic Change*. Cambridge, MA: Belknap Press.

Nelson, Roy C. 2007. Transnational Strategic Networks and Policymaking in Chile: CORFO's High Technology Investment Promotion Program. *Latin American Politics and Society* 49 (2): 149–181.

Nelson, Roy C. 2009. *Harnessing Globalization: The Promotion of Nontraditional Foreign Direct Investment in Latin America*. University Park: Pennsylvania State University Press.

Neumayer, Eric, and Laura Spess. 2005. Do Bilateral Investment Treaties Increase Foreign Direct Investment to Developing Countries? *World Development* 33 (10): 1567–1585.

Niosi, Jorge. 1999. The Internationalization of Industrial R&D: From Technology Transfer to the Learning Organization. *Research Policy* 28: 107–117.

Noorbakhsh, Farhad, Alberto Paloni, and Ali Youssef. 2001. Human Capital and FDI Inflows to Developing Countries: New Empirical Evidence. *World Development* 29 (9): 1593–1610.

North, Douglass C. 1987. Institutions, Transaction Costs and Economic Growth. *Economic Inquiry* 25 (3): 419–428.

North, Douglass C. 1990. *Institutions, Institutional Change and Economic Performance*. New York: Cambridge University Press.

OECD. 2010. *OECD Economic Globalisation Indicators 2010*. Paris: Organization for Economic Cooperation and Development.

Oetzel, Jennifer M., Richard A. Bettis, and Marc Zenner. 2001. Country Risk Measures: How Risky Are They? *Journal of World Business* 36 (2): 128–145.

O'Hearn, Denis. 1998. *Inside the Celtic Tiger: The Irish Economy and the Asian Model*. London: Pluto Press.

O'Hearn, Denis. 2001. *The Atlantic Economy: Britain, the US and Ireland*. Manchester: Manchester University Press.

Olopade, Dayo. 2014. The End of the "Developing World." *New York Times*, February 28. https://www.nytimes.com/2014/03/01/opinion/sunday/forget-developing-fat-nations-must-go-lean.html.

O'Malley, E., Nola Hewitt-Dundas, and Stephen Roper. 2008. High Growth and Innovation with Low R&D: Ireland. In *Small Country Innovation Systems: Globalization, Change and Policy in Asia and Europe*, ed. C. Edquist and L. Hommen, 156–193. Cheltenham: Edward Elgar.

Oneal, John R. 1994. The Affinity of Foreign Investors for Authoritarian Regimes. *Political Research Quarterly* 47 (3): 565–588.

Ó Riain, Seán. 2004. *The Politics of High Tech Growth: Developmental Network States in the Global Economy*. Cambridge: Cambridge University Press.

Ó Riain, Seán. 2014. *The Rise and Fall of Ireland's Celtic Tiger: Liberalism, Boom and Bust*. Cambridge: Cambridge University Press.

Ornston, Darius. 2012. *When Small States Make Big Leaps: Institutional Innovation and High-Tech Competition in Western Europe*. Ithaca, NY: Cornell University Press.

Oxley, Joanne E. 1999. Institutional Environment and the Mechanisms of Governance: The Impact of Intellectual Property Protection on the Structure of Inter-firm Alliances. *Journal of Economic Behavior & Organization* 38 (3): 283–309.

Pandya, Sonal S. 2013. *Trading Spaces: Foreign Direct Investment Regulation, 1970–2000*. New York: Cambridge University Press.

Park, Walter. 2008. International Patent Protection: 1960–2005. *Research Policy* 37: 761–766.

Pauly, Louis W., and Simon Reich. 1997. National Structures and Multinational Corporate Behavior: Enduring Differences in the Age of Globalization. *International Organization* 51 (1): 1–30.

Paus, Eva. 2012. The Rise and Fall of the Celtic Tiger: When Deal-Making Trumps Developmentalism. *Studies in Comparative International Development* 47 (2): 161–184.

Paus, Eva. 2015. *Foreign Investment, Development, and Globalization: Can Costa Rica Become Ireland?* New York: Palgrave Macmillan.

Pavitt, Keith. 1982. R&D, Patenting, and Innovative Activities: A Statistical Exploration. *Research Policy* 11: 33–51.

Pavitt, Keith. 1984. Sectoral Patterns of Technical Change: Towards a Taxonomy and a Theory. *Research Policy* 13: 343–373.

Pearce, Robert D. 1989. *The Internationalisation of Research and Development by Multinational Enterprises*. New York: St. Martin's Press.

Pearce, Robert D. 1999. Decentralised R&D and Strategic Competitiveness: Globalised Approaches to Generation and Use of Technology in Multinational Enterprises (MNEs). *Research Policy* 28: 157–178.

Pearce, Robert D., and Marina Papanastassiou. 2009. *The Strategic Development of Multinationals: Subsidiaries and Innovation*. 1st ed. Basingstoke: Palgrave Macmillan UK.

Pearce, Robert D., and Satwinder Singh. 1992. *Globalizing Research and Development*. New York: St. Martin's Press.

Peng, Mike W., and Andrew Delios. 2006. What Determines the Scope of the Firm over Time and around the World? An Asia Pacific Perspective. *Asia Pacific Journal of Management* 23 (4): 385–405.

Peng, Mike W., Seung-Hyun Lee, and Denis Y.L. Wang. 2005. What Determines the Scope of the Firm over Time? A Focus on Institutional Relatedness. *Academy of Management Review* 30 (3): 622–633.

Ramamurti, Ravi. 2005. Global Regulatory Convergence: The Case of Intellectual Property Rights. In *International Business and Government Relations in the 21st Century*, ed. Robert Grosse, 341–360. New York: Cambridge University Press.

Ramamurti, Ravi, and Jitendra V. Singh, eds. 2009. *Emerging Multinationals in Emerging Markets*. 2nd ed. Cambridge: Cambridge University Press.

Ramondo, Natalia, Veronica Rappoport, and Kim Ruhl. 2013. Horizontal versus Vertical Foreign Direct Investment: Revisiting Evidence from US Multinationals. London School of Economics Working Paper.

Reddy, Prasada. 2000. *The Globalization of Corporate R&D: Implications for Innovation Systems in Host Countries*. 1st ed. New York: Routledge.

Reuber, Grant L. 1973. *Private Foreign Investment in Development*. Oxford: Clarendon Press.

Riedel, James. 1975. The Nature and Determinants of Export-Oriented Direct Foreign Investment in a Developing Country: A Case Study of Taiwan. *Review of World Economics* 111 (3): 505–528.

Robock, Stefan. 2005. How Will Third World Countries Welcome Foreign Direct Investment in the Twenty-First Century? In *International Business and Government Relations in the 21st Century*, ed. Robert Grosse, 381–394. New York: Cambridge University Press.

Rodriguez-Clare, Andres. 1996. Multinationals, Linkages, and Economic Development. *The American Economic Review* 86 (4): 852–873.

Rodriguez-Clare, Andres. 2001. Costa Rica's Development Strategy Based on Human Capital and Technology: How It Got There, the Impact of Intel, and Lessons for Other Countries. *Journal of Human Development* 2 (2): 311–324.

Rodrik, Dani. 2006. Goodbye Washington Consensus, Hello Washington Confusion? A Review of the World Bank's Economic Growth in the 1990s: Learning from a Decade of Reform. *Journal of Economic Literature* 44 (4): 973–987.

Rodrik, Dani, Arvind Subramanian, and Francesco Trebbi. 2004. Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development. *Journal of Economic Growth* 9 (2): 131–165.

Ronstadt, Robert. 1977. *Research and Development Abroad by U.S. Multinationals*. Westport, CT: Praeger Publishers.

Roodman, David. 2006. How to Do Xtabond2: An Introduction to Difference and System GMM in Stata. Center for Global Development Working Paper 103, Washington, DC.

Roodman, David. 2008. A Note on the Theme of Too Many Instruments. Center for Global Development Working Paper 125, Washington, DC.

Ruane, Frances, and Ali Uğur. 2005. Labour Productivity and Foreign Direct Investment in Irish Manufacturing Industry: A Decomposition Analysis. *Economic and Social Review* 36 (1): 19–43.

Rueschemeyer, Dietrich. 2003. Can One or a Few Cases Yield Theoretical Gains? In *Comparative Historical Analysis in the Social Sciences*, ed. James Mahoney and Dietrich Rueschemeyer, 305–336. Cambridge: Cambridge University Press.

Rugman, Alan M., and Jonathan P. Doh. 2008. *Multinationals and Development*. New Haven, CT: Yale University Press.

Rugman, Alan M., and Alain Verbeke. 2001. Subsidiary-Specific Advantages in Multinational Enterprises. *Strategic Management Journal* 22 (3): 237–250.

Rugraff, Eric, and Michael Hansen, eds. 2011. *Multinational Corporations and Local Firms in Emerging Economies*. Amsterdam, Netherlands: Amsterdam University Press.

Sachs, Jeffrey D., and Andrew M. Warner. 2001. The Curse of Natural Resources. *European Economic Review* 45 (4): 827–838.

Sands, Anita. 2005. The Irish Software Industry. In *From Underdogs to Tigers: The Rise and Growth of the Software Industry in Brazil, China, India, Ireland, and Israel*, ed. Ashish Arora and Alfonso Gambardella, 41–71. Oxford: Oxford University Press.

Scheve, Kenneth F., and Matthew Jon Slaughter. 2001. *Globalization and the Perceptions of American Workers*. Washington, DC: Peterson Institute for International Economics.

Schmiele, Anja. 2013. Intellectual Property Infringements due to R&D Abroad? A Comparative Analysis between Firms with International and Domestic Innovation Activities. *Research Policy* 42 (8): 1482–1495.

Schneider, Friedrich, and Bruno S. Frey. 1985. Economic and Political Determinants of Foreign Direct Investment. *World Development* 13 (2): 161–175.

Schrank, Andrew, and Marcus J. Kurtz. 2005. Credit Where Credit Is Due: Open Economy Industrial Policy and Export Diversification in Latin America and the Caribbean. *Politics & Society* 33 (4): 671–702.

Siedschlag, Iulia, Xi Shang, and Brian Cahill. 2010. The Effects of the Internationalisation of Firms on Innovation and Productivity. The Economic and Social Research Institute (ESRI) Working Paper, no. 363.

Simmons, Beth A. 2014. Bargaining over BITs, Arbitrating Awards: The Regime for Protection and Promotion of International Investment. *World Politics* 66 (1): 12–46.

Slangen, Arjen, and Rob Van Tulder. 2009. Cultural Distance, Political Risk, or Governance Quality? Towards a More Accurate Conceptualization and Measurement of External Uncertainty in Foreign Entry Mode Research. *International Business Review* 18 (3): 276–291.

Spar, Debora L. 1998. *Attracting High Technology Investment: Intel's Costa Rican Plant*. Washington, DC: World Bank Publications.

Steenbergen, Marco R., and Bradford S. Jones. 2002. Modeling Multilevel Data Structures. *American Journal of Political Science* 46 (1): 218–237.

Sterne, John. 2004. *Adventures in Code: The Story of the Irish Software Industry*. Dublin: Liffey Press.

Sturgeon, Timothy J. 2001. How Do We Define Value Chains and Production Networks? *IDS Bulletin* 32 (3): 9–18.

Sturgeon, Timothy J., Johannes Van Biesebroeck, and Gary Gereffi. 2008. Value Chains, Networks and Clusters: Reframing the Global Automotive Industry. *Journal of Economic Geography* 8(3): 297–321.

Sweet, Cassandra Mehlig, and Dalibor Sacha Eterovic Maggio. 2015. Do Stronger Intellectual Property Rights Increase Innovation? *World Development* 66: 665–677.

Tavares, A., and A. Teixeira. 2006. *Multinationals, Clusters and Innovation: Does Public Policy Matter?* Basingstoke: Palgrave Macmillan UK.

Terpstra, Vern. 1977. International Product Policy: The Role of Foreign R&D. *Columbia Journal of World Business* 12 (4): 24–32.

Tobin, Jennifer L., and Susan Rose-Ackerman. 2011. When BITs Have Some Bite: The Political-Economic Environment for Bilateral Investment Treaties. *The Review of International Organizations* 6 (1): 1–32.

Tsai, Pan-Long. 1994. Determinants of Foreign Direct Investment and Its Impact on Economic Growth. *Journal of Economic Development* 19 (1): 137–163.

UNCTAD. 2004. *World Investment Report: The Shift toward Services*. New York: United Nations Publications.

UNCTAD. 2005. *World Investment Report: Transnational Corporations and the Internationalization of R&D*. New York: United Nations Publications.

UNCTAD. 2009. *World Investment Report: Transnational Corporations, Agricultural Production, and Development*. New York: United Nations Publications.

UNCTAD. 2015. *World Investment Report: Reforming International Investment Governance*. New York: United Nations Publications.

Valenzuela, J. Samuel, and Arturo Valenzuela. 1978. Modernization and Dependency: Alternative Perspectives in the Study of Latin American Underdevelopment. *Comparative Politics* 10 (4): 535–557.

Vernon, Raymond. 1966. International Investment and International Trade in the Product Cycle. *The Quarterly Journal of Economics* 80 (2): 190–207.

Vernon, Raymond. 1971. *Sovereignty at Bay: The Multinational Spread of U.S. Enterprises*. New York: Basic Books.

Vernon, Raymond. 1979. The Product Cycle Hypothesis in a New International Environment. *Oxford Bulletin of Economics and Statistics* 41 (4): 255–267.

Vogt, Heidi. 2013. IBM Launches Research Lab in Kenya. *Wall Street Journal*, November 7. http://www.wsj.com/articles/SB10001424052702304672404579183941572320218.

Von Braun, Joachim, Ruth Suseela Meinzen-Dick, and others. 2009. *"Land Grabbing" by Foreign Investors in Developing Countries: Risks and Opportunities*. International Food Policy Research Institute Policy Brief, no. 13. Washington, DC: International Food Policy Research Institute.

Von Tunzelmann, Nick, and Virginia Acha. 2005. Innovation in "Low Tech" Industries. In *The Oxford Handbook of Innovation*, ed. Jan Fagerberg and David Mowery, 407–432. Oxford, UK: Oxford University Press.

Von Zedtwitz, Maximilian, and Oliver Gassmann. 2002. Market versus Technology Drive in R&D Internationalization: Four Different Patterns of Managing Research and Development. *Research Policy* 31 (4): 569–588.

Wade, Robert. 1990. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. Princeton, NJ: Princeton University Press.

Wei, Shang-Jin. 2000. How Taxing Is Corruption on International Investors? *Review of Economics and Statistics* 82 (1): 1–11.

Wells, Louis. 1983. *Third World Multinationals: The Rise of Foreign Investments from Developing Countries*. 2nd ed. Cambridge, MA: MIT Press.

Wells, Louis. 1998. Multinationals and the Developing Countries. *Journal of International Business Studies* 29 (1): 101–114.

Wheeler, David, and Ashoka Mody. 1992. International Investment Location Decisions: The Case of US Firms. *Journal of International Economics* 33 (1): 57–76.

Williamson, John. 1990. What Washington Means by Policy Reform. In *Latin American Adjustment: How Much Has Happened*, ed. John Williamson, 7–20. Washington, DC: Peterson Institute for International Economics.

Williamson, Oliver E. 1981. The Modern Corporation: Origins, Evolution, Attributes. *Journal of Economic Literature* 19 (4): 1537–1568.

Williamson, Oliver E. 2000. Economic Institutions and Development: A View from the Bottom. In *A New Institutional Approach to Economic Development*, ed. Satu Kahkonen and Mancur Olson, 92–118. New York: Oxford University Press.

Williamson, Peter J., Ravi Ramamurti, Afonso Fleury, and Maria Tereza Leme Fleury, eds. 2013. *The Competitive Advantage of Emerging Market Multinationals*. Cambridge: Cambridge University Press.

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.

The World Turned Upside Down. 2010. *The Economist*, April 15. http://www.economist.com/node/15879369.

Yackee, Jason Webb. 2008. Bilateral Investment Treaties, Credible Commitment, and the Rule of (International) Law: Do BITs Promote Foreign Direct Investment? *Law & Society Review* 42 (4): 805–832.

Yew, Lee Kuan. 2000. *From Third World to First: The Singapore Story—1965–2000*. 1st ed. New York: Harper.

Index

Note: Page entries referring to figures are indicated with "*f*"; tables are indicated with "*t*."