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INNOVATION AND INCLUSION IN LATIN AMERICA

Strategies to Avoid the Middle Income Trap

Edited by Alejandro Foxley
and Barbara Stallings

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Alejandro Foxley • Barbara Stallings
Editors

Innovation and Inclusion in Latin America

Strategies to Avoid the Middle-Income Trap

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Editors
Alejandro Foxley
CIEPLAN
Santiago, Chile

Barbara Stallings
Watson Institute of International &
Public Affairs
Brown University
Providence, Rhode Island, USA

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Acknowledgments

This book is the principal product of a collaborative project undertaken during 2013–2014 by American University's Center for Latin American and Latino Studies (CLALS) in collaboration with the Corporation for Latin American Studies (Corporación de Estudios para Latinoamérica, CIEPLAN), with funding provided by the Office of Strategic Planning and Development Effectiveness of the Inter-American Development Bank (IDB). The collaboration between CLALS and CIEPLAN has been intellectually fruitful and has resulted in a volume that we believe will be useful to a diverse array of stakeholders, in both academic and practitioner circles, who seek to better understand opportunities and challenges for the development agenda in Latin America and the Caribbean as the region endeavors to move beyond middle-income status and join the ranks of advanced economies. A Spanish-language version of this volume, titled *Economías latinoamericanas: Cómo avanzar más allá del ingreso medio*, was published by CIEPLAN in December 2014, though substantial revisions have been made in this current version.

Project research was directed jointly by Barbara Stallings, a CLALS-affiliated researcher on the faculty at Brown University, and Alejandro Foxley, the president of CIEPLAN. Stallings and Foxley, with support from staff at both American University (AU) and CIEPLAN, recruited a number of leading researchers to carry out studies on particular themes. Some of those experts were based at AU, others at CIEPLAN, and we supplemented that core team with economists and sociologists drawn from additional institutions from throughout the Americas and Asia. We worked with contributors intensively over the course of the yearlong ini-

tiative to hone their draft papers so as to better integrate them with one another and constitute a synthetic rather than disparate collection of essays on Latin America's emerging economic challenges and the lessons to be derived through comparisons both within and beyond the region.

An initial step was to draw on preliminary results of the research that we commissioned in 2013, as well as an extensive review of available literature and an iterative process of consultations with experts and policy makers, to prepare an overview paper presenting critical challenges for Latin American development and potential approaches to addressing them during the coming years. Alejandro Foxley took the lead in elaborating successive drafts of that study, which were presented in numerous IDB-convened events, particularly a series of consultations convened by IDB President Luis Alberto Moreno, who has been an unwavering supporter of our efforts. The final version of Foxley's study is presented as the second chapter of this book.

AU and CIEPLAN researchers coordinated our efforts closely, but there was a clear division of labor: CIEPLAN focused its efforts largely on South America, while AU addressed dynamics in Mexico and the relevance of East Asian experiences for strategies aimed at combining growth and inclusion in Latin America. Initial drafts of papers were discussed at CIEPLAN in Santiago, Chile in January 2014, and advanced drafts were reviewed in a workshop that we held at AU in Washington, DC in late May 2014. During our participation in IDB-sponsored meetings, we tried to hone in as much as possible on the policy implications of our inquiries, and we hope that this is evident in the book. Toward this end, feedback from readers drawn from the ranks of senior staff at the IDB assisted us in making decisions about final revisions to the papers. Conversations with our interlocutors at the IDB as well as our own interactions over the course of the project have also helped us to identify directions for future collaborations between AU and CIEPLAN, plans for which are advancing productively. We hope that these may also offer opportunities to partner with researchers in East Asia who have delved into the factors that enabled countries in the region to traverse paths that many Latin American countries aspire to emulate, adjusting to the particular historical, political, and economic societal characteristics of their societies.

A core mission of both the Center at AU and CIEPLAN is to conduct state of the art research on economic growth and distribution and to disseminate the findings of such investigations as widely as possible. We are especially grateful to President Moreno and to the IDB staff who have

facilitated our efforts to do so through this specific project, and special thanks is due to Veronica Zavala and Maria Camila Uribe, who have been particularly crucial supporters of our work. While they are not responsible for any oversights or omissions in this study, we are cognizant of the role that they and their colleagues have played in helping us to cover a broad range of critical issues. We also express our gratitude to Sara Doskow, Chris Robinson, and their colleagues at Palgrave Macmillan, who have played a key role in helping us disseminate our research findings and have provided efficient and timely assistance throughout the manuscript preparation process.

We believe, based on the reception of our work during a number of IDB-sponsored events, that the products of our effort provided a valuable external input into the strategic planning exercise that the IDB was undertaking during 2013–2014 and that are expected to shape its agenda during the coming years. It has been a privilege for both CLALS and CIEPLAN to have contributed to such an important process. We look forward to future opportunities to pursue common research agendas in order to shed light on the pressing analytic and policy issues that confront observers determined to impact understanding of how Latin American economies can learn from success cases across the region, as well as from valuable experiences that have unfolded in other parts of the world. As we await those opportunities, our hope is that this book will provide a modest contribution to debates about where the region finds itself in 2016 and how it needs to innovate in order to move forward. We hope as well that our contribution will advance scholarly inquiries into the factors that will determine whether Latin America proceeds along a path conducive to escaping the middle-income trap, which condemns societies to insufficient growth and inadequate social inclusion, toward a future that combines prosperity with enhanced welfare for the majority of the inhabitants of the region.

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List of Contributors

Robert A. Blecker is Professor of Economics and an affiliated faculty member at the Center for Latin American Studies at American University in Washington, DC.

Frederic C. Deyo is Professor of Sociology at the State University of New York (Binghamton).

Alejandro Foxley is the president and co-founder of the Corporation for Latin American Studies (CIEPLAN), a think tank based in Santiago, Chile.

Joaquín Gana is a researcher at the Corporation for Latin American Studies (CIEPLAN) in Santiago, Chile.

Osvaldo Larrañaga is a poverty reduction officer at the United Nations Development Program's office in Santiago, Chile.

Keun Lee is Professor of Economics at Seoul National University in South Korea.

Patricio Meller is Professor of Industrial Engineering at the University of Chile and a senior fellow at the Corporation for Latin American Studies (CIEPLAN) in Santiago, Chile.

Gonzalo Rivas is the president of the National Innovation Council for Competitiveness (CNIC) in Santiago, Chile.

María Eugenia Rodríguez is a researcher in the area of poverty reduction and inequality at the United Nations Development Program's office in Santiago, Chile.

Barbara Stallings is the William R. Rhodes Research Professor at the Watson Institute for International and Public Affairs at Brown University in Rhode Island and a research fellow at American University's Center for Latin American and Latino Studies.

CHAPTER 1

Innovation, Inclusion, and Institutions: East Asian Lessons for Latin America?

Barbara Stallings

Introduction

Latin American countries have made substantial progress with respect to some socioeconomic indicators in recent decades. Indeed, many countries in the region now enjoy middle-income status within the international context. This progress was accelerated by the "commodity super-cycle" during the ten years from around 2003 to 2012, as China's demand for commodities led to price and volume increases for many Latin American exporters of those products. Now the region faces two kinds of challenges. On the one hand, the commodity cycle is over for the foreseeable future, so another kind of strategy must be sought to maintain high growth rates. On the other hand, the commodity boom did not resolve all of Latin America's socioeconomic problems and may even have exacerbated some of them. Thus, the gap increased between nations, regions, and social groups that benefitted and those that did not. Moreover, productivity failed to rise in line with international trends.

One way of thinking about the situation that faces Latin America in the coming decades focuses on the so-called middle-income trap. As a number of scholars and policy makers have pointed out, the middle-income trap results when advanced developing countries are squeezed between low-wage and high-productivity competitors.[1] To combat the

B. Stallings (✉)
Watson Institute, Brown University, Providence, Rhode Island, USA

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middle-income trap, this book argues that Latin America must strive to achieve two main goals—greater innovation to increase productivity and greater inclusion to incorporate more of the population into the benefits of economic growth. We define innovation as "the application of new ideas to the products, processes, or other aspects of the activities of a firm that lead to increased 'value'" (Greenhalgh and Rogers 2010: 4). Inclusion is enabling the majority of the population to share in the benefits of economic growth and social services.

Innovation is relevant because it is an important way to raise productivity and incorporate more advanced technology into the productive sectors, leading to higher, sustained rates of investment and growth. Latin American countries have lagged behind the industrial countries as well as the emerging economies of East Asia with respect to research and development (R&D). A much lower share of gross domestic productivity (GDP) is devoted to these activities in Latin America, and skilled workers in scientific and technological fields have not been produced in adequate numbers. While there are small pockets of excellence, these are not widespread. An important policy question is whether there are lessons that Latin America can learn from countries that have been successful in stimulating innovation.

Inclusion is a separate, but related, goal for Latin America in the twenty-first century. No growth strategy can be successful if it leaves the majority of the population behind and inequality increases. Of course, there are many ways in which inclusion can be pursued. In our case, we focus on those aspects that are complementary to the innovation process. Thus, the two topics that will be central are education, including the training of skilled workers for employment in the high-technology industries, and the formation of links between large, advanced firms and small and medium-sized enterprises (SME) that act as sub-contractors. Again, the question is whether Latin America can learn from countries that have been successful in promoting inclusion.

The topics of innovation and inclusion are intimately interrelated as will be seen throughout the book. There are several ways in which the two are connected. One is through a normative argument: It is morally unacceptable that a small part of the population profits from innovation and growth at the expense of the majority. Another argument is political: If the fruits of greater productivity are not widely shared, the result may well be political instability, which will make it more difficult to attract the investment needed to stoke future growth. While we agree with both of these arguments, we concentrate on a third one. Innovation cannot

occur without the necessary skills among the population. Creating those skills can simultaneously increase well-being if quality education is widely spread. In other words, education and training are drivers of both innovation and inclusion, and together they can help to overcome the middle-income trap.

To move forward with greater innovation and inclusion, of course, several contextual factors must be taken into account, such as greater institutional capacity, prudent macroeconomic management, and sensible interrelationships with the increasingly global economy. We are particularly concerned about the role of institutions. Indeed, many social scientists have argued in recent years that institutions are the key factor in determining the success of developing countries in achieving faster and more inclusive growth. Unfortunately, however, there is serious discrepancy in terms of how institutions are defined. We will look for a definition that is useful for our purposes, think about how institutions relate to innovation and inclusion, and again ask what lessons Latin America can learn from others about how to strengthen institutions.

How should regional leaders develop policies to meet the innovation and inclusion challenges? First, they could look at experiences within Latin America itself. Second, they could look outside the region. In the book, we do both. A number of chapters look at both successes and failures within Latin America in terms of innovation and inclusion. In addition, we look toward other regions and, in particular, East Asia, which has lived the most dramatic socioeconomic transformation of recent years.[2] It is fairly clear that successful countries in Latin America could have lessons to offer to their neighbors. It is less obvious that they could learn from countries that are both geographically distant and have quite different histories and cultures. Nonetheless, for three decades now, scholars and policy makers in Latin America have been asking about the East Asian experience and wondering what, if anything, Latin America could learn from it. While beginning in the mid-1980s, this interest picked up substantially after the publication of *The East Asian Miracle* (World Bank 1993). That volume studied in detail the history of eight East Asian economies—Japan, South Korea, Taiwan, Hong Kong, Singapore, Thailand, Malaysia, and Indonesia—in terms of growth, productivity, income distribution, and the policies that made their success possible. These included prudent macroeconomic management, high savings and investment rates, development of human capital, and—controversially—various kinds of government intervention (interest rate repression, directed credit, selective industrial policies, and promotion of exports).[3]

The strongest argument in favor of the idea that Latin America could learn from these "miracle" economies is that the two largest Latin American countries—Brazil and Mexico—were frequently grouped together with South Korea and Taiwan in the 1970s and 1980s as the "newly industrializing economies" (NIEs).[4] All four enjoyed high growth rates and experienced rapid industrialization in the 1970s. While they seemed to be on similar trajectories, the 1980s debt crisis in Latin America led to a bifurcation of paths whereby Korea and Taiwan went onto even greater success, while Brazil and Mexico suffered a "lost decade" of growth from which they and other countries in the region have never completely recovered. It was this divergence of performance that led to Latin America's interest in East Asia.[5]

In trying to understand possible lessons from both inside and outside the region, we have organized our discussion into three sections and eight chapters. The first section provides an introduction to the volume. It consists of two chapters (Chaps. 1 and 2), by Stallings and Foxley, which lay out the challenges Latin America faces in terms of innovation, inclusion, and institutions in the context of experiences of other regions. In the case of Stallings, the focus is on East Asia; Foxley ranges more broadly to include a number of European countries. The second section of the book turns to the topic of innovation. Chapters 3–5 by Lee, Meller and Gana, and Rivas offer suggestions of how Latin America can learn from East Asia and from the region itself with respect to innovation policies and institutions for innovation. Finally, the third section analyzes issues related to inclusion. In Chapters 6–8, Deyo, Blecker, and Larrañaga and Rodríguez discuss lessons from East Asia and from Latin America. Blecker's chapter focuses especially on the Mexican case within the region. A number of the chapters also discuss the interrelationship between innovation and inclusion.

Innovation in East Asia and Latin America

Drawing on the definition referred to above, we argue that by making things work better, innovation within an economy can increase productivity and thus output with the potential of making everyone better off. For this reason, countries in Latin America and elsewhere view greater innovation as an important goal. The main question is how to increase innovation. Another important question is who benefits from the increase in productivity. Do owners appropriate the entire increase, or is it shared

with labor? By most measures, Latin America lags behind in innovation. One possibility is that lessons can be learned from countries that have been more successful in this area. In particular, we are interested here in differences between Latin America and East Asia, since some East Asian countries have been particularly successful in recent years.[6]

This section compares a group of emerging market economies in Latin America with counterparts in East Asia. While there is some variation across indicators, the general pattern is quite consistent: The Latin American region lags far behind East Asia. Among emerging markets in East Asia, the most successful group includes South Korea, Taiwan, and Singapore followed by China and Malaysia. In the case of Latin America, we find that the most successful countries with respect to innovation are Brazil, Chile, Costa Rica, and Mexico, but they rarely match their Asian counterparts.

Innovation Inputs

A first set of indicators with respect to innovation involves inputs—forming human capital and engaging in R&D. Table 1.1 compares East Asian and Latin American countries in terms of university first degrees as well as PhDs; in both cases, we distinguish between total numbers of degrees and the share in science and engineering, where the latter is the most relevant for innovation in the production system. University education in science and engineering provides a reservoir of people who can assume important roles with respect to innovation in business or policy-making, while PhDs provide more technical expertise to advances in new applications.

Table 1.1 shows that East Asia leads Latin America significantly on three of the four indicators. It had 50% more first degrees per million population in 2010, and twice as many were in science and engineering. With respect to PhDs, the difference in number of degrees was much greater, although Latin America actually led in the share specialized in science and engineering. The table also shows the changes during the first decade of the twenty-first century. Both regions doubled the number of first degrees awarded, but with respect to science and engineering, Latin America's share fell while East Asia's remained the same. The number of Latin American PhDs increased more than East Asia's, but it was from a very low starting point. In both cases, the share of PhDs in science and engineering declined. As a reflection of these differences, the share of firms identifying an inadequately trained workforce as a major

Table 1.1 Higher education in science and engineering in East Asia and Latin America, 2000 and 2010

Region/country	*First degrees (per mn population)*		*Share in science and engineering (%)*[a]		*PhDs (per mn population)*		*Share in science and engineering (%)*[a]	
	2000	*2010*	*2000*	*2010*	*2000*	*2010*	*2000*	*2010*
East Asia[b]	2,337	4,735	38.1	38.9	68	84	53.9	46.9
China	450	1,936	53.2	43.6	10	37	57.9	59.3
Indonesia	690	na	26.7	na	na	na	na	na
Korea	4,463	6,238	40.6	35.6	131	213	44.9	36.1
Malaysia	449[c]	4,162	24.4	35.1	na	27	na	48.7
Philippines	na	3,756	na	na	na	19	na	na
Singapore	1,400	2,441	67.5	44.6	na	na	na	na
Taiwan	5,106	9,877	36.5	35.6	64	161	58.9	63.3
Thailand	1,915	na	17.8	na	na	45	na	27.0
Latin America[b]	1,284	3,102	23.4	18.9	11	26	62.5	57.0
Argentina	1,027	2,768	23.2	16.7	11[d]	23	89.2	56.1
Brazil	1,406	4,359	20.6	10.8	20[d]	55	52.1	43.6
Chile	1,485	3,980	26.1	18.2	4[d]	25	87.7	70.2
Colombia	1,358	3,477	23.4	21.7	na	4	na	61.4
Costa Rica	1,126	na	18.5	na	na	na	na	na
Mexico	1,302	3,164	28.6	26.6	10	35	20.8	33.9
Uruguay	na	2,028	na	19.3	na	12	na	76.9
Venezuela	na	1,935	na	na	na	na	na	na

Sources: NSF (2004, 2014) for the number of degrees and those in science and engineering; World Bank, World Development indicators (online) for population

[a]Excludes social and behavioral sciences (except Colombia in 2000 for first degrees and Chile in 2000 for PhDs)
[b]Unweighted averages
[c]Figure is for 1990
[d]Figures are for 1996

constraint on their operation is far higher in Latin America (35.9% in 2010) compared to East Asia and the Pacific (21.5%; OECD 2015: 22).

Another typical indicator of innovation inputs is the share of GDP that is spent on R&D. Table 1.2 presents this indicator for the decade of the 2000s. Data are available for a slightly larger set of countries for each region. The same pattern appears whereby East Asian countries, on average, spend substantially more than their Latin American counterparts.

Table 1.2 Research and development as share of GDP in East Asia and Latin America, 2000–2010 (%)

Country/region	*2000*	*2005*	*2010*
East Asia[a]	1.1	1.5	1.7
China	0.9	1.3	1.8
Indonesia	0.1	na	0.1
Korea	2.3	2.8	3.7
Malaysia	0.5	na	1.1
Philippines	na	0.1	0.1
Singapore	1.9	2.2	2.1
Taiwan	2.0	2.4	2.9
Thailand	0.3	0.2	na
Latin America[a]	0.4	0.5	0.5
Argentina	0.4	0.5	0.6
Brazil	1.0	1.0	1.2
Chile	na	na	0.4
Colombia	0.1	0.1	0.2
Costa Rica	0.4	na	0.5
Mexico	0.4	0.4	0.5
Peru	0.1	na	na
Uruguay	0.2	na	0.4

Source: World Bank, World Development Indicators (online)

[a]Unweighted averages

In general, East Asia spent more than three times as much as Latin America on R&D activities (1.7% of GDP in the former in 2010 compared to 0.5% in the latter). Both regions improved over time, but East Asia more so.

In addition to discussing the two regions, it is important to examine the situation of individual countries or groups of countries. Korea and Taiwan stand out in Table 1.1 for the number of first degrees as well as PhDs that are awarded per million population, but it is mainly with respect to PhDs that the two countries really separate themselves from their regional neighbors and from Latin America. (Unfortunately, data on PhDs are not available for Singapore.) This is not surprising since the per capita GDP of Korea and Taiwan is far higher than that of the others—except Singapore—and a strong relationship is generally reported in the literature between per capita GDP and education.[7] In Latin America, the highest number of first degrees is awarded by Brazil and Chile, but many fewer than Korea and Taiwan. The same is found with respect to PhDs in Latin America. In this case, Brazil and Mexico stand out, but again both

are far behind Korea and Taiwan. Despite the fact that the numbers have been growing faster in Latin America, the gap remains large.

With respect to concentration in science and engineering, it is not the countries with the largest number of degrees where a concentration in science is found. In Asia, the two countries with the smallest number of undergraduate degrees per million population—China and Singapore—produced the highest share of scientists and engineers. The same was true in Latin America. While Brazil and Chile had the largest number of degrees, it was Mexico and Colombia that produced the highest share of scientific specialists. Among PhDs, as mentioned, Latin America exceeds East Asia in the share of PhDs in science and engineering, but part of this unexpected outcome is due to the lack of data for Singapore. Latin American countries—especially Chile, Colombia, and Uruguay—produce a large share of scientists and engineers, although they graduate a very small number of doctoral students overall.

Data on R&D expenditure mirror the education picture in East Asia. That is, Korea and Taiwan lead the league tables with Singapore just behind. While all Asian countries increased the share of GDP allotted to R&D in the 2000s, the biggest increases were found in China and Malaysia. In Latin America, the improvement was much less marked, and only Brazil stood out—but far behind the leading economies of East Asia. It should be pointed out that not all East Asian countries are leaders in either education or R&D. The region has laggards (especially Indonesia and the Philippines), which have even less impressive records than those found in Latin America. Although not shown in the table for lack of data, the poorest countries in East Asia—the so-called CLMV countries or Cambodia, Laos, Myanmar, and Vietnam—are similar to Indonesia and the Philippines or even lower on innovation indicators.

Innovation Outputs

Given that the East Asian region outperformed Latin America on inputs relating to innovation, we would expect that the same would be the case with innovation outputs. Table 1.3 confirms this expectation through examination of five indicators. The first is labor productivity (gross value added per worker), as calculated by the World Bank. The second is patent applications filed per million population. These are worldwide applications filed through the Patent Cooperation Treaty process or a national patent office; the World Intellectual Property Office (WIPO) collects the data.

Table 1.3 Indicators of innovation performance in East Asia and Latin America, circa 2010

Country/region	*Labor productivity (2005 dollars)*	*Patent apps filed (per mn pop)*			*Innovation index*	*Knowledge-intensive share of GDP (%)*	*High-technology share of manufactured exports (%)*
		Residents	*Non-residents*	*Total*			
East Asia[a]	24,443	488	434	922	4.42	23.0	30.8
China	6,145	320	85	405	4.05	20.4	25.8
Indonesia	6,273	2	22	24	3.96	13.4	8.3
Korea	39,749	2,816	834	3,650	4.96	28.9	25.7
Malaysia	16,556	40	197	237	4.70	18.5	43.4
Philippines	4,612	2	33	35	3.60	19.0	46.4
Singapore	69,405	220	1,820	2,040	5.27	37.2	45.2
Taiwan	45,719	na	na	na	5.08	31.8	na
Thailand	7,083	14	45	59	3.72	14.4	20.7
Latin America[a]	15,399	8	106	114	3.57	20.8	10.9
Argentina	17,954	20	120	140	3.35	22.4	8.0
Brazil	15,252	11	104	115	3.97	22.0	9.7
Chile	23,977	20	146	166	3.87	23.6	4.6
Colombia	13,223	4	39	43	3.58	20.8	4.3
Costa Rica	13,136	3	140	143	4.04	26.1	40.8
Mexico	20,837	9	112	121	3.79	21.3	16.5
Peru	8,211	1	39	40	3.31	15.3	6.2
Uruguay	12,684	6	202	208	3.46	na	5.8
Venezuela	13,319	1	55	56	2.78	15.1	2.5

Sources: World Bank (2013) for productivity; World Bank, World Development Indicators (online) for patents and high-technology exports, WEF (2012) for innovation index, NSF (2012) for knowledge-intensive share of GDP

[a]Unweighted averages except labor productivity

Patent applications are divided according to resident and non-resident applicants. The third indicator is the innovation index created by the World Economic Forum (WEF) through its Executive Opinion Survey. In other words, this variable is a perception index based on the opinions of approximately 14,000 business people representing around 100 per country. The fourth indicator is knowledge-intensive production as a share of GDP, calculated by the US National Science Foundation (NSF), where the numerator is defined as knowledge-intensive services and high-technology manufacturing.[8] The fifth is high-technology exports as a share of total manufacturing exports, which also comes from World Bank data.[9]

As seen in Table 1.3, East Asia—as expected—outperformed Latin America on all five indicators of innovation outputs. By far the largest difference between the two regions concerned patents, which some experts argue are the best measure of innovative capacity (e.g., Lee 2013). People in East Asian countries are many times more likely to apply for international patents than their Latin American counterparts. Moreover, it is significant that a majority of East Asian patent applicants were residents of their respective countries, while non-residents (presumably international investors) filed the overwhelming majority of Latin American applications. There was also a substantial difference in terms of labor productivity between the two regions and the share of high-technology exports. With respect to the innovation index and knowledge-intensive share of GDP, East Asian scores were higher, but the difference was not extremely large.

Not surprisingly, Korea, Taiwan, and Singapore formed the most outstanding group with respect to innovation outcomes as they did with inputs. These three countries led the productivity league table, and people in Korea and Singapore filed far more patent applications than other Asian countries. While it is likely that Taiwan would also be in this group, no data are available because Taiwan in not a member of the Patent Cooperation Treaty and so cannot file in the same process. Again, these three countries score highest on the innovation index and have the largest share of knowledge-intensive goods. China and Malaysia constitute an intermediate group on these indicators, trailed by Indonesia and the Philippines.

With respect to Latin America, an interesting shift is found in Table 1.3: Tiny Costa Rica ranks high in patents and highest in the region on the innovation index and knowledge-intensive goods. This performance undoubtedly is due to the presence in the country of a number of high-technology multinational corporations (MNCs), which are very important given the small size of the economy. They did not, however, manage

to raise productivity very much. Chile ranks highly on four of the five indicators, which would be predicted from its ranking on inputs. Other countries do well on some indicators—Mexico on productivity and high-tech exports, Uruguay on patents, and Costa Rica on the other two—but no clear patterns of excellence emerge. Peru and Venezuela tend to be at the low end of the innovation output indicators.

Inclusion in East Asia and Latin America

As mentioned earlier, we are particularly interested in inclusion as it relates to innovation and productivity, but it is useful to provide some general background on the distribution of income in East Asia and Latin America before turning to look at education and the role of SMEs. Table 1.4 there-

Table 1.4 Inequality and poverty indicators for East Asia and Latin America, circa 2010

Region/country	*Inequality measures*		*Poverty ratio*	
	Gini index	*20/20 ratio*	*$2 per day*	*$5 per day*
East Asia[a]	40.3	8.2	31.0	62.0
China	42.1	10.1	27.2	67.8
Indonesia	38.1	6.3	43.3	87.4
Korea	31.3	4.7	na	na
Malaysia	46.2	11.3	2.3	25.3
Philippines	43.0	8.3	41.5	82.8
Singapore	48.1	9.7	na	na
Taiwan	34.2	na	na	na
Thailand	39.4	6.9	40.5	46.8
Latin America[a]	49.8	14.2	7.0	29.4
Argentina	44.5	11.2	1.9	9.9
Brazil	54.7	20.2	10.8	36.0
Chile	52.1	13.4	2.7	19.1
Colombia	55.9	20.1	15.8	49.0
Costa Rica	50.7	14.3	6.0	27.4
Mexico	47.2	10.8	4.5	33.2
Peru	48.1	13.5	12.7	42.8
Uruguay	45.3	10.4	1.2	18.0
Venezuela	na	na	na	na

Source: World Bank, World Development Indicators (online)

[a]Unweighted averages

fore presents data on two measures of inequality (the Gini index and the 20/20 ratio) and two measures of poverty (the headcount ratio for $2 per day and $5 per day).[10] While missing data for Asia are problematic, a pattern emerges whereby East Asia suffers less from inequality but has higher poverty ratios. Looking at individual countries, all Latin American countries exceed the East Asian average for inequality, and there is little overlap between the two distributions. With respect to the poverty indicators, it is clear that the East Asian averages would come down if data were available for Korea, Singapore, and Taiwan, but the poorest Asian countries in our sample stand out as substantially worse off than their Latin American counterparts.

With this dichotomy as background, we want to examine some indicators of access to education in the two regions. Here we are no longer interested in scientific characteristics nor PhD level education, which are important for innovation. Rather, we want to know the extent to which primary, secondary, and tertiary education are available on a broad scale. Without at least secondary education, there is little chance for people to gain access to well-paying jobs.[11] Table 1.5 provides data on average years of education of the population and those who completed secondary education as well as those who have some tertiary education. All are reported for the population 15 years and older.

Table 1.5 suggests that there is not much difference between the two regions on this set of variables. In all cases, the East Asian averages are above those of Latin America. East Asian countries averaged 9.5 years of education in 2010, while Latin Americans attained an average of 8.7 years. Both improved during the decade 2000–2010, with East Asia increasing its lead somewhat. The shares of people who had completed secondary or had some tertiary education were 48.5% and 40.1%, respectively, in 2010. On a country basis, once again Korea and Taiwan excelled in East Asia, while Chile scored highest in Latin America. As can be seen, Brazil, long noted for problems in its education system, lagged behind most countries in the region.[12]

If quantitative indicators are fairly similar, the same is not true with respect to the quality of education, where large differences appear to exist. Drawing on the WEF Executive Survey, we find that all the East Asian countries we have been following (except Thailand) are in the top half of the rankings, while all Latin American countries (except Costa Rica) are in the bottom half (WEF 2012). While the survey is a subjective measure, subject to all the difficulties that this type of data source entails, it reinforces the consensus view that quality of education is a particular

Table 1.5 Education indicators in East Asia and Latin America, 2000 and 2010

Region/country	*Average years of education*		*Highest education level (15 years+) (%), 2010*		
	2000	*2010*	*Completed secondary*	*Some tertiary*	*Total*
East Asia[a]	8.1	9.5	27.7	20.8	48.5
China	6.9	7.5	46.5	8.1	54.6
Indonesia	5.1	7.6	10.5	3.4	13.9
Korea	11.1	12.1	36.3	42.5	78.8
Malaysia	9.1	10.4	37.9	16.1	54.0
Philippines	7.9	8.4	21.0	29.0	50.0
Singapore	9.2	10.8	22.3	18.3	40.6
Taiwan	9.6	11.1	32.5	38.2	70.7
Thailand	5.7	8.0	14.5	10.9	25.4
Latin America[a]	7.8	8.7	24.1	16.0	40.1
Argentina	8.7	9.5	29.6	12.3	41.9
Brazil	6.5	7.9	26.3	7.6	33.9
Chile	9.1	9.8	31.2	27.6	58.8
Colombia	6.9	9.0	35.1	8.9	44.0
Costa Rica	7.7	8.0	22.7	17.3	40.0
Mexico	7.7	8.8	21.8	16.5	38.3
Peru	8.9	8.9	26.6	21.4	48.0
Uruguay	8.1	8.2	19.3	9.3	28.6
Venezuela	6.7	8.4	4.4	23.1	27.5

Source: Barro and Lee (2014)

[a]Unweighted averages

problem in Latin America. Other types of quantitative (e.g., Programme for International Student Assessment [PISA] scores) and qualitative data back up this concern.[13] In addition to problems with the overall quality of education, inequalities among schools in Latin America with respect to quality further increase the difficulty of achieving the goal of inclusion (see Chap. 8).

The other issue regarding inclusion in which we are interested is the role of SMEs. In particular, we want to know something about the characteristics of these firms. Are they mainly very small units with minimal access to capital or skills, acting mainly as a social safety net, or are they well plugged into the economic structure and a source of upward mobility for those who work in them? It is extremely difficult to find comparative, cross-national indicators for this very important

topic. Table 1.6 provides information on SMEs that is collected by the International Finance Corporation (IFC), including micro firms (referred to as MSMEs). The table includes definitions, number of MSMEs, share among micro, small, and medium-sized firms, and the share of employment generated by MSMEs. There are no data on share of MSMEs among the total number of firms.

Unfortunately, it is very hard to draw useful conclusions from the table—except that there is no uniform definition of MSMEs, which makes analysis of other data problematic. The definitional differences are partly related to country size (e.g., China defines small firms as less than 300 employees, while Costa Rica and Uruguay define them as less than 5 or 6), but that is not always the case (e.g., Argentina also has a low cutoff for small firms). In both regions, micro enterprises (less than 5 or less than 10 workers) constitute the vast majority of the MSME category. While these units may occasionally be quite modern (especially in the service area), typical micro firms have little capital, few skills, low productivity, and very low remunerations. Frequently they operate as part of the informal economy in their respective countries.[14]

At the other end of the SME spectrum are a small number of medium-sized firms—generally with 50 to 100–200 workers—which can be quite viable. They may be stand-alone firms or part of production networks. The most complex cases are so-called small firms (generally with 10–50 workers), which are likely to need the most support to improve their economic potential. This support can come from other businesses, financial institutions, governments, or non-governmental organizations (NGOs).

Several recent papers on entrepreneurship in Latin America help to understand the nature of the problems faced there, especially by SMEs (e.g., Kantis 2011; Lederman et al. 2014). An earlier Inter-American Development Bank (IDB) study (Kantis et al. 2002), which specifically compares the situation of SMEs in East Asia and Latin America, is also useful. It studied the process of establishing (usually small) firms in the two regions and concluded that East Asia has substantial advantages. "In East Asia, the contributions of [new] entrepreneurs to social mobility, economic growth, and the creation of new knowledge-based sub-sectors is significantly higher" (p. 27). Small East Asian firms are more likely to be export oriented, use sub-contracting, and be involved in knowledge-intensive activities. One of the reasons for their greater success, according to the study, is their better access to finance external to the firm from banks, venture capital, or the public sector.

Table 1.6 Micro, small, and medium-sized firms (MSMEs) in East Asia and Latin America (latest year)

Region/ country	*Definitions (number of workers)*			*Number of MSMEs*	*Share of MSMEs (%)*			*Share of employment (%)*
	Micro	*Small*	*Medium*		*Micro*	*Small*	*Medium*	
East Asia								
China	None	<300	300–2000	10,231,000	0.0	90.0	10.0	80.0
Indonesia[a]	na	na	na	22,655,831	98.9	1.0	0.1	48.6
Korea	<10	10–49	50–300	548,267	96.7	3.3	3.3	48.1
Malaysia	<5	5–30	51–150	780,469	79.3	18.4	2.3	56.4
Philippines	<10	10–99	100–199	1,481,617	92.3	7.4	0.4	9.9
Singapore	<600	<600	<600	160,000	100	100	100	60.0
Taiwan	na	na	na	na	na	na	na	na
Thailand	None	<50	51–200	2,264,525	0	99.6	0.4	23.9
Latin America								
Argentina	<5	5–24	25–96	460,686	72.3	22.2	5.5	15.2
Brazil	<10	10–49	50–249	3,907,820	89.4	9.3	1.3	25.3
Chile	<10	10–49	50–199	725,383	80.8	16.7	2.5	60.8
Colombia	≤10	11–50	51–200	1,339,619	96.2	3.3	0.5	23.1
Costa Rica	≤5	6–30	31–100	55,214	71.0	24.5	4.5	19.9
Mexico	≤10	11–50	51–250	3,725,049	95.2	4.0	0.8	33.8
Peru	≤10	11–50	51–200	685,662	97.3	2.2	0.5	60.0
Uruguay	<5	5–19	20–99	119,959	85.1	12.1	2.8	30.2
Venezuela	None	1–50	51–100	71,079	0.0	96.8	3.2	na

Source: IFC (online)

[a]Definitions of firm size are based in monetary value of assets and turnovers, not number of workers.

Institutions in East Asia and Latin America

A growing number of social scientists argue that institutions are among the most important determinants of economic development, and several claim to have found evidence that institutions trump all other factors. Much of the contemporary literature on institutions and growth dates back to North's work on US economic history (North and Thomas 1973; North 1990), but the current focus is on the developing world. Economic analyses of the relationship are now abundant. Acemoglu, Johnson, and Robinson are leaders in this field, and they are also among the strongest advocates for the primacy of institutions as a causal factor. In their review of the literature on institutions and growth, they argue the following: "Although cultural and geographical factors may also matter for economic performance, differences in economic institutions are the major source of cross-country differences in economic growth and prosperity" (Acemoglu et al. 2005: 389). Rodrik, Subramanian, and Trebbi are other advocates for institutions. Indeed, one of their papers (2002) is called "Institutions Rule: Institutions as the Fundamental Cause of Long-Run Growth."

The most prominent recent statement about institutions is potentially of direct relevance to the topics of innovation and inclusion. Acemoglu and Robinson's book, *Why Nations Fail*, claims that economic and political institutions—which can be either inclusive or extractive—interact to determine both innovation and inclusion. "Inclusive economic institutions … pave the way for two other engines of prosperity: technology and education. Sustained economic growth is almost always accompanied by technological improvements that enable people (labor), land, and existing capital (buildings, existing machines, and so on) to become more productive" (Acemoglu and Robinson 2012: 77). They go on to say, "Intimately linked to technology are the education, skills, competencies, and know-how of the work force, acquired at school, at home, and on the job. We are so much more productive than a century ago not just because of better technology embodied in machines but also because of greater know-how that workers possess" (p. 78). While education, as I argued above, is related to both innovation and inclusion, Acemoglu and Robinson tie the latter directly to the character of political institutions, including democracy.

A major problem for research on institutions is differences with respect to definition. Most economists, such as those cited above, see institutions in fairly abstract terms—norms, values, and the rules of the game

that guide societies. This notion is manifested in the rule of law, property rights, transparency, and so on. For sociologists and political scientists, by contrast, institutions are generally viewed in more concrete terms, as organizations that make decisions and implement them. For this group, examples of institutions would be state bureaucracies, courts, banks, labor unions, business associations, and NGOs. My view is that we can combine the two. Economists' institutions form the context in which innovation and inclusion can be promoted, while sociologists' institutions are those groups that actually carry out the policies that bring about (or do not) innovation and inclusion.

To compare the first type of institutions in East Asia and Latin America, we rely on a well-known (but often criticized) set of indicators developed by the World Bank.[15] Table 1.7 presents data on four of

Table 1.7 Institutional indicators for East Asia and Latin America, 2005 and 2010[a]

Region/country	*2005 Rating*	*2005 Ranking*	*2010 Rating*	*2010 Ranking*
East Asia[b]	0.25	7.9	0.22	8.6
China	−0.43	12.0	−0.37	10.0
Indonesia	−0.90	16.0	−0.61	15.0
Korea	0.76	4.0	0.73	5.0
Malaysia	0.63	6.0	0.48	7.0
Philippines	−0.56	13.0	−0.76	16.0
Singapore	1.77	1.0	1.82	1.0
Taiwan	0.86	3.0	0.94	3.0
Thailand	−0.11	8.0	−0.44	12.0
Latin America[b]	−0.11	9.3	−0.07	9.3
Argentina	−0.28	9.0	−0.33	9.0
Brazil	−0.25	8.0	−0.01	8.0
Chile	1.20	2.0	1.19	2.0
Colombia	−0.75	6.0	−0.58	6.0
Costa Rica	0.44	14.0	0.54	14.0
Mexico	−0.26	11.0	−0.39	11.0
Peru	−0.67	13.0	−0.51	13.0
Uruguay	0.69	4.0	0.85	4.0
Venezuela	−1.08	17.0	−1.30	17.0

Source: World Bank, Worldwide Governance Indicators (online)

[a]Numbers are averages of four indicators: control of corruption, government effectiveness, political stability, and rule of law

[b]Unweighted averages

the six indicators collected by the Bank—rule of law, political stability, government effectiveness, and control of corruption for the years 2005 and 2010. In Table 1.7, higher ratings are better, but lower rankings are better. For both years, the East Asian countries have positive average regional scores on the ratings, while the Latin American countries have negative averages. Over the period, Latin American countries improved somewhat (their scores are slightly less negative in 2010), while East Asia moved slightly in the opposite direction.

The country scores are approximately what we would expect from the earlier discussion. Singapore's scores suggest that it has the strongest institutions, followed by Taiwan and Korea in East Asia. But Chile's score fits within this group. Indeed, the table suggests that its institutions are stronger than those of Korea or Taiwan. Uruguay, Malaysia, and Costa Rica also have positive ratings. All other countries in both regions have negative scores with the Philippines and Venezuela bringing up the rear in the two regions.

Clearly, there is a strong correlation between the indicators of institutional quality and those for innovation and inclusion. One of the problems that has been discussed in the literature concerns cause and effect with respect to the two sets of variables. Do institutions lead or follow economic success? World Bank economists have strongly argued that it is institutions that bring about positive economic outcomes.[16] Others see a reciprocal relationship, while a smaller group believes that institutions follow economic success.[17] The causal relationship is an issue of concern to policy makers in the two regions, but at a minimum, we can say that strong institutions are likely to be helpful for promoting development.

In terms of institutions of the more concrete type, I confine myself here to briefly discussing two that I consider especially important. They are government agencies for promoting economic development, including innovation and inclusion, and financial institutions that provide resources for development.

A great deal of literature on East Asia in the 1970s and 1980s focused on the so-called developmental state as the force behind the rapid growth and increased technological sophistication in that region. The four characteristics mentioned by Chalmers Johnson (1982), who is generally credited with coining the term in his analysis of Japan's Ministry of International Trade and Industry (MITI, now METI), include a small, elite state bureaucracy selected on a merit basis; autonomy of action for this bureaucracy; market-conforming intervention by the state in the

economy; and a key agency such as MITI, which devised, implemented, and enforced growth strategies.[18]

In comparative studies that got underway in the 1980s and 1990s, Latin America was criticized for not having a similar strategic outlook, nor agencies with personnel selected on a meritocratic basis to take a leading role. Indeed, a different term altogether—"dependent development"—became a counterpoint in Latin America to East Asia's developmental state.[19] A key factor was the crucial role played by foreign capital in Latin America, which was not a significant actor in East Asia (Stallings 1990). Although there were small centers of excellence in Latin America, they were not coordinated at a national level, and they tended not to be continued on a long-run basis. After the debt crisis in Latin America in the 1980s, development strategy turned even further from the developmental state approach, as governments began to assume a much smaller role in the economies in favor of the private sector (Stallings and Peres 2000). While various public–private sector joint ventures have been proposed, they have usually not been very successful.[20]

With respect to finance, it is well known that East Asia has substantially more finance available than does Latin America, especially in the form of bank credit. Bank credit as a share of GDP is more than twice as high in the former compared to the latter.[21] This does not get us to the issue of access to finance, however, especially for small and medium-sized firms. Using the World Bank's Enterprise Survey (World Bank, online), we can obtain data on the share of firms that identify access to finance as a major constraint according to size of firm. Uniform categories of firm size include small (5–19 workers), medium (20–99), and large (more than 100). Micro firms (less than 5 workers) are not included since they are highly unlikely to even be candidates for finance from the formal financial sector.

Table 1.8 shows data for the available countries (there are no data for Singapore or Taiwan), which indicate that finance is a much more serious constraint in Latin America for all sizes of firms. In 2010, 14% of East Asian firms identified finance as a major constraint compared with 29% in Latin America. In the regional averages, small and medium-sized firms appeared to be equally in need of credit. Nonetheless, in several countries medium-sized firms were more likely than their smaller counterparts to need credit, since small firms may rely more on informal sources, including family members, for finance. An even larger difference exists between large firms in the two regions. Less than 9% of large firms in East Asia see

Table 1.8 Finance as major constraint for firms in East Asia and Latin America, circa 2010

Region/country	*All firms*	*Small*	*Medium*	*Large*
East Asia[a]	14.0	15.8	15.2	8.6
China	2.9	2.2	4.0	2.9
Indonesia	14.3	14.8	12.4	5.7
Korea	12.1	14.1	9.6	7.8
Malaysia	14.9	13.4	21.3	8.1
Philippines	13.4	15.3	13.4	5.9
Singapore	na	na	na	na
Taiwan	na	na	na	na
Thailand	26.4	34.9	30.4	21.3
Latin America[a]	29.2	29.1	28.3	22.5
Argentina	43.4	48.9	40.3	25.8
Brazil	55.5	50.6	55.7	61.6
Chile	17.6	10.0	24.6	16.3
Colombia	41.4	51.6	15.7	11.6
Costa Rica	41.8	39.7	45.0	41.1
Mexico	29.6	26.9	38.7	25.1
Peru	8.5	6.7	14.5	4.5
Uruguay	16.0	16.8	14.2	13.2
Venezuela	9.2	10.6	5.7	3.0

Source: World Bank, Enterprise Survey (online)

[a]Unweighted averages

finance as a significant problem, but 22 % in Latin America do so. A partial explanation may be that public sector banks remain more common in East Asia than in Latin America; they generally are charged with helping SMEs and providing long-term finance for investment and innovation (Stallings and Studart 2006).

These trends in finance are important for both innovation and inclusion. Firms wanting to innovate are in need of finance, which could come from the banking sector, venture capital, or informal sources. At the same time, if SMEs are going to prosper and provide better opportunities for owners and workers alike, they need finance to invest as well as working capital to support everyday functions. It is not surprising that SMEs have more difficulty than large firms in obtaining finance; this is the case across the world. But the fact that finance appears to be more of a constraint in Latin America than in East Asia provides another area in which the two regions diverge, and where it is possible that East Asia has some lessons to offer its Latin American counterparts.

Policy Lessons for Latin America

In the following chapters, a number of policy suggestions are made that might be useful for policy makers in Latin America. I emphasize those from East Asia and Mexico, but also mention some lessons from other Latin American countries.

Five important conclusions emerge with respect to innovation. First, Keun Lee (Chap. 3), one of the leading experts on catch-up in Asia, argues that innovation should be thought of in the context of different phases of development. That is, poorer countries should be mainly concerned with stimulating growth in any way possible, including commodity exports. Only later, when they have raised per capita income and increased the availability of public goods (e.g., education and infrastructure), should they concern themselves with innovation as a major goal for the economy. If innovation becomes a major goal too early, it can siphon off resources needed to promote growth and increase inequalities, thus undermining attempts at development. To avoid the middle-income trap, however, wealthier developing countries must engage in innovation.

Second, both Lee and Patricio Meller and Joaquín Gana (Chap. 4) stress that countries need to learn how to innovate. This process is not obvious, and the existing literature on growth is not very helpful since innovation is frequently modeled as a "black box." Nonetheless, there are some suggestions as to how innovation can come about; in particular, governments and firms need to take an active approach to technology supplied through the import of capital goods and FDI. "Reverse engineering"—studying the way that machinery works—is the essence of the active approach that Meller and Gana call for in contrast to the passive approach that they say characterizes Latin America. University research can also be useful in principle, but its role is undermined by the fact that basic science is more prestigious than applying research findings to practical problems.

Third, a related issue is how to interest businesses in pursuing innovation, since it can involve considerable risk. Many Latin American businesspeople do not see much payoff in innovation and prefer to continue with their usual production processes. Thus, government incentives may be necessary to induce innovation, as they have been in East Asia. Gonzalo Rivas (Chap. 5) discusses the use of financial incentives in Latin America, such as technology funds, tax incentives, guarantees, and funding from public sector banks. With respect to public sector banks, the largest and best known is the Brazilian Development Bank (BNDES), which has lessons—both positive and negative—for other Latin American countries.

East Asia also has a number of public sector banks that would be useful to study. Nonetheless, Rivas points out that private firms have been hesitant to take up many of the financial incentives in Latin America. He attributes this to bureaucratic obstacles to their use and to lack of coordination among public and private actors.

Fourth, one of the main prerequisites for innovation in Latin America and elsewhere is supportive institutions. Two different kinds of institutions are discussed in the book. On the one hand, national innovation systems, which bring together business, government, and universities, are essential not only to understand the challenges facing the region but also to provide possible solutions to problems. According to Rivas, in many Latin American countries where attempts have been made to use national innovation systems for coordination of innovation, implementation, and follow-through have largely been absent. On the other hand, MNCs can also be key players in stimulating innovation in developing countries, as Meller and Gana explain. The fact that non-residents are the main actors filing for patents in Latin America suggests that MNCs are engaging in R&D, but there may not be much spillover to local firms without government incentives. Joint ventures can be useful up to a point, but Lee argues that MNCs eventually come to see successful local firms as a threat and so refuse to collaborate further. At that point, local firms—together with the rest of the national innovation system—have to be ready to set out on their own.

Fifth, since innovation generally takes place at the firm or sector level, strategies and policies are needed to translate these innovations into growth at the macro level and especially inclusive growth. The Mexican case is particularly illuminating with respect to this issue. While there are a number of highly successful and sophisticated firms in Mexico, both locally and foreign owned, this has not translated into sustained growth as happened in East Asia. The lack of spillovers, and of backward and forward linkages, is one set of explanations for the divorce between micro and macro levels in terms of innovation and growth. Governments thus need strategies, working in partnership with private firms, to create synergies between successful, innovative firms and the rest of the economy. Otherwise innovation may exacerbate inequalities among firms, sectors, and regions (Blecker, Chap. 7).

The other major topic covered in the book is inclusion as well as the relationship between innovation and inclusion. Here I mention four of the book's conclusions. First, Frederic Deyo (Chap. 6) points to the tremendous

importance of education and training in East Asian countries as a source of both greater productivity and inclusion. Governments through policy and resources have stressed quality education for all, but they build on the fact that families place a very high value on education and are willing to sacrifice a great deal to give their children a strong educational background. In addition to the traditional, academically oriented education system, vocational education is important in East Asia. Of course, vocational education also exists in Latin America, but its massive scale makes East Asia stand out in this respect. According to Deyo, at the beginning of the 2000s, from 40 to 60% of upper secondary education in China, Korea, and Taiwan consisted of vocational education, compared to only 14% in Mexico. The share has fallen in Asian countries, while Mexico's has increased, but it remains much higher (except for the case of Korea). While the private sector finances a good deal of vocational education in Asia, governments have encouraged it through laws. For example, Korea's law on vocational training, copied from Singapore, requires firms to provide in-house training or pay a fine that supports government-organized vocational education. China's law declares that all citizens have "the right to vocational education," and the government encourages municipalities to provide facilities especially for migrants.

Second, while education is expected to be a source of greater equality of distribution as returns to education fall with greater supply, education can result in increased inequality. This is especially the case when there is a large differential between the quality of public and private education as frequently happens in Latin America. Also, while East Asian countries typically concentrated on government-supported primary education in a first stage of development, and then progressed to secondary education while leaving most tertiary education to be financed by families, Latin America has subsidized middle-class students in public universities (Chap. 8). Deyo notes that particular disparities are evident in both regions with respect to women, rural residents, and contingent workers. Government affirmative action policies may be required to provide opportunities for these groups of workers.

Third, with respect to jobs, Deyo reports a perhaps counterintuitive conclusion based on the East Asian cases. As economies grew as a result of innovation processes, the absolute number of jobs tended to decline in the most sophisticated sectors. Higher-quality, better-paid jobs were created, but there were fewer of them. Thus, he says, it is necessary to maintain (lower-skilled) labor-intensive sectors at the same time that higher-skilled

jobs are created to fill the gap between supply and demand for employment. If this is not done, political instability can result if "over educated" youth are not able to find the kinds of jobs that they expect. Blecker reports a similar situation in Mexico.

Fourth, SMEs can play an important role with respect to inclusion if ways can be found to expand their scale and provide a better livelihood for owners and workers alike. As Blecker points out for Mexico, and it is generally true throughout the developing world, these firms on their own tend to have low levels of productivity and low wages in comparison with larger firms. One way that is often advocated for improving their situation is to join production networks. While we do not have much information on the extent to which they have done so, Deyo sounds a cautionary note on the process. Participation in production networks, he points out, can occur at various levels. Participation at a low level may not be much better for firms and workers than operating on a stand-alone basis unless there is a possibility to rise up to points in the networks where higher value is added and greater rewards are received. Once again, public–private partnerships are necessary to get the most out of production networks.[22]

Conclusions

Several messages on the challenges facing Latin America emerge from the data presented in this chapter. Especially with respect to innovation, East Asia on average is far ahead of Latin America. This divergence is seen in the number of scientists and engineers produced by the university systems, the share of national output devoted to R&D, labor productivity, patent applications, and the role of knowledge-intensive activities in the economy. With respect to inclusion, the comparison is not as clear, partly because of difficulties with information, but it is likely that East Asia has advantages here too. Overall inequality is certainly greater in Latin America, although poverty may be lower. Access to secondary and tertiary education is more widespread in East Asia, and educational quality appears to be substantially higher in East Asia as well. Also it has been argued that SMEs in East Asia have advantages over small and medium-sized firms in Latin America, especially in terms of access to finance.

One of the main questions of interest is whether Latin America can learn from East Asia in general and—equally important—which individual countries might provide useful lessons. Currently, there is somewhat of an obsession with China among Latin American scholars and policy makers.

Part of this obsession arises from fear about growing Chinese economic and political power as well as a desire to gain access to its markets and investment, but there is also interest in whether China can provide a "model" to further Latin American development. It may well be that China does have lessons to offer, but the data in this chapter suggest other countries may be of even greater interest. They include Korea, Taiwan, Singapore, and perhaps Malaysia. As mentioned earlier, in the 1970s, Korea, Taiwan, Brazil, and Mexico were frequently considered as a group of NIEs, so the distance that now exists is of recent vintage.

In addition, however, we also want to know what Latin American countries can learn from their own region. The topics of innovation, inclusion, and institutions are not new ones to the region. On the contrary, many countries have made attempts to deal with them in one way or another, as Foxley points out in Chap. 2. We have organized the book to include Mexico as a potential source of lessons for its neighbors in the rest of the region. Given that there is less difference in terms of historical trajectory, economic structure, and cultural inheritance within the region than between Latin America and East Asia, lessons from Mexico might be easier to incorporate. While Mexico does not stand out in all of the data that have been presented, it does well on several indicators—scientific education, labor productivity, and the volume of exports in general and high-technology manufacturing exports in particular. Mexico is also one of the few Latin American countries that have succeeded in entering international value chains with its production and exports. In this case, those value chains originate mainly in the United States rather than Asia, but in some instances, this process has brought spectacular success to some parts of the Mexican economy. The problem is finding ways to make this success spill over to the rest of the society. In addition to Mexico, other selected countries in Latin America have important lessons to offer their neighbors, as can be seen in other chapters. Brazil and Chile, for example, are discussed as exemplars with respect to institutions that can promote inclusive growth.

I conclude with a few words about institutions. While I believe it is true that strong institutions are an important factor in promoting innovation and inclusion, improving institutions themselves is no easy task. It seems useful to incorporate both the more abstract definition of institutions and the more concrete version; they are complements, not substitutes. Moreover, some Latin American countries—especially Chile, but also Costa Rica and Uruguay—have done well by various measures in

strengthening institutions, although they remain behind many East Asian countries with respect to innovation and inclusion. Thus, we need to think more carefully about the role of institutions and exactly what they can contribute to the agenda of inclusive growth. Only then does it make sense to look for lessons with respect to institutional development.

In summary, a consensus exists today that Latin American countries need to improve their performance on both innovation and inclusion. Some ideas on how to do so can come from the region itself and from other parts of the world. In this book, East Asia is of particular interest because of its success on both dimensions. If lessons can be extracted, they may help to provide higher growth and greater well-being for the population of Latin America. This means that they will also help to overcome the middle-income trap. We hope this book makes a modest contribution to this goal.

Notes

1. On the middle-income trap, among others, see Foxley and Sossdorf (2011), Kharas and Kohli (2011), Agenor and Canuto (2012), Paus (2012), Eichengreen et al. (2013), Im and Rosenblatt (2013).
2. A complementary analysis, which focuses on a comparison between Latin America and OECD countries, is OECD (2015).
3. The book was controversial because of disagreement over the relative emphasis on economic fundamentals versus government intervention. A number of rebuttals have been published. See, for example, Amsden (1994), Fishlow et al. (1994), and Stiglitz and Yusuf (2001).
4. The term "newly industrializing countries" (NICs) was initially used. The term NICs has generally been abandoned, however, with the rise of China and the acquiescence of most nations to China's insistence that Taiwan is not a country, but merely a province of China. A spillover of this political–legal situation is that most international databases do not include Taiwan, which makes comparative analysis difficult. Several chapters, including this one, suffer from this problem, as will be seen.
5. Even during the 1970s, there were important differences in the development strategies of the two regions; see Gereffi and Wyman (1990).
6. A number of publications on technological change, innovation, and productivity in Latin America have appeared in the last few years, testifying to the importance attached to these topics. Several compare Latin America and East Asia. See, for example, ECLAC (2008), Crespi and Zuniga (2010), Pagés (2010), IDB (2011), Crespi et al. (2014), and Lederman et al. (2014).

7. The relationship referred to here is between levels of income and education, which is not controversial. More controversial is the link between income and increase in schooling. Some evidence suggests that the relationship is not significant or even negative; explanations center on measurement error, endogeneity, and quality of education. There is also variation between findings at the micro and macro levels. For a useful review, see Krueger and Lindahl (2001).
8. Knowledge-intensive services are education, health, and business, financial, and communications services. High-technology manufacturing includes aerospace, communications and semi-conductors, computers and office machinery, pharmaceuticals, and scientific instruments. The OECD has taken the lead in establishing categories of products and organizing data collection.
9. High-technology exports are the same categories included in high-technology manufacturing in note 8.
10. The Gini index is one of the most common measures of inequality, where 0 represents perfect equality and 100, perfect inequality. The 20/20 ratio measures the relationship between the income shares of the richest and poorest 20% of the population. The head count ratios are the shares of the population that live below $2 or $5 per day, standardized at 2005 international prices.
11. For a United Nations Educational, Scientific, and Cultural Organization (UNESCO) study on types of secondary education and the relationship to the labor market in developing countries, see Holsinger (2000).
12. For recent analysis of problems within the Brazilian education system, see Brock and Schwartzman (2004), Kosack (2012: Chap. 6), and Sandoval (2012). An older book that is still relevant is Birdsall and Sabot (1996).
13. PISA is a worldwide study by the OECD in member and non-member nations of 15-year-old school pupils' scholastic performance on mathematics, science, and reading. Eight Latin American countries participate: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, and Uruguay. Students from those countries typically rank in the bottom third of the 65 nations that take part. For analysis of the state of education in Latin America, see Ganimian and Solano Rocha (2011), Hanushek and Woessmann (2012), and Fiszbein (2014).
14. There is a vast literature on SMEs and micro firms. The work of the IFC has been pioneering in its comparative and quantitative nature. See, for example, Kushnir et al. (2010). For a useful literature review on SMEs in developing countries, which addresses the relationship with growth, job creation, and income generation, see Kingombe et al. (2010).
15. These are the so-called Worldwide Governance Indicators, developed by Daniel Kaufmann and colleagues at the World Bank (http://info.worldbank.org/governance/wgi/index.aspx#home). There are six indicators; in

addition to the four mentioned in the text, they also include regulatory quality and voice and accountability. The indicators, which have been published by the World Bank since 1996, are made up of hundreds of sub-indicators taken from many other studies. The methodology used is explained in Kaufmann et al. (2010). The main critiques are that the measures are based on perceptions rather than actions, adverse selection is involved, and biases are included for and against various policy alternatives that have little to do with governance per se. See, for example, Kurtz and Schrank (2007).

16. See, for example, Kaufmann et al. (2009) as well as their response to Kurtz and Schrank (2007).
17. Kurtz and Schrank (2007) argue that growth brings about an improvement in governance. Ang (2014), in a case study on China, insists that the two "co-evolve."
18. In addition to Johnson, others who made significant contributions to this literature include Amsden (1989), Wade (1990), and Woo Cumings (1999). Stubbs (2009) wrote a recent review that asks, "What happened to the East Asian developmental state?"
19. Dependent development originated from Peter Evans' (1979) book by that name.
20. On public–private partnerships, see Devlin and Moguillansky (2009). It is interesting that the IDB, which had been a leader in advocating the withdrawal of the state, has recently decided this process has gone too far. See its latest "flagship" publication (Crespi, Fernández-Arias, and Stein 2014).
21. A comparison of Latin American and East Asian financial systems is found in Stallings with Studart (2006).
22. Both the IDB and the UN Economic Commission for Latin America and the Caribbean (ECLAC) have been working on the topic of production networks or "value chains" as they are also called. The IDB's work is discussed in Blyde (2014). ECLAC has published two recent books on the topic of value chains (ECLAC 2014; Hernández et al. 2014). An earlier paper that looked at East Asian investments in Latin America from a value chain perspective is Kwak (2012).

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CHAPTER 2

Inclusive Development: Escaping the Middle-Income Trap

Alejandro Foxley

Introduction

Latin America is once again facing familiar challenges: How to sustain high growth rates when the global economy has decelerated and commodity prices have fallen, and at the same time prioritize social inclusion as a requisite for long-term sustainability of the development process. If these goals are not achieved, Latin America runs the risk of falling into the so-called middle-income trap. It is a fact that, by late 2012, 20 countries already had crossed the threshold—US$10,000 per capita measured in PPP (purchasing power parity)—into the ranks of middle-income nations. In four of them (Antigua and Barbuda, Argentina, Chile, and Trinidad and Tobago), the figure was close to US$20,000. Another 11 economies struggling to join the club range from Haiti to countries like Jamaica and the Dominican Republic, which will have crossed the US$10,000 threshold by 2015.

The middle-income trap is characterized by three related conditions: (1) a slowdown in growth due to an inability to achieve continuous improvements in competitiveness and productivity; (2) excessive inequality and lack of social protection; and (3) the inability of the institutional system to provide stability, transparency, and good governance (Foxley 2012).

A. Foxley (✉)
Corporation for Latin American Studies (CIEPLAN), Santiago, Chile

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Many authors have studied the middle-income trap and its implications for policy. Lin and Treichel (2012) highlight the role of industrial policy and continuous structural upgrading; Eichengreen et al. (2013) put forth the drivers of growth slowdowns on different points of middle-income level, showing there are multiple modes of the trap. Paus (2014) provides an excellent review of the existing literature and builds on the structural view to provide evidence on the significant gaps in capabilities at social and firm levels. To avoid the trap requires a long-term development strategy shared by the public and private sectors and by political and social stakeholders. It must cover four large policy areas: the need for higher economic productivity; the challenge to integrate production systems to generate synergies among the countries of the region; the need to tackle poverty and address the vulnerabilities of a new middle class; and the need to improve the quality of institutions. The strategy should leave room for legitimate differences but its foundations must be maintained over time so that the institutional system can adapt to new realities and anticipate new challenges and problems.

To point out possible avenues toward these objectives, this chapter examines recent experience in the region as well as the experience of countries in other parts of the world that belonged to the middle-income group a few decades ago but were able to avoid the middle-income trap and today are firmly established as developed nations. Lessons from East Asia, Ireland, Finland, Australia, and New Zealand will be highlighted, as well as those of countries in Latin America and the Caribbean that have made significant progress in the four areas to be examined in depth—productivity and innovation, productive integration, social inclusion, and quality of institutions.

The Productivity and Innovation Challenge

One of the main challenges for Latin America and Caribbean economies in the coming decade will be to maintain growth, which will depend on their capacity to become more competitive in comparison to other emerging economies, particularly those in East Asia. In the future, demand driven by the US and European economies will be sharply curtailed. With no favorable "tailwinds" pushing them forward, the Latin American and Caribbean economies will have to rely more on domestic savings, investments, and increases in productivity, as well as on access to new, more dynamic markets in Asia. But the region comes up very short in savings, investment and, increased productivity compared to the East Asian economies. As a recent Inter-American Development Bank (IDB) report

indicates, its domestic savings rate has hovered around 18% of GDP over the last two decades, compared with more than 30% in East Asia and as high as 45% in some countries (IDB 2013).

There is also a wide gap in investment rates. In East Asia, fixed capital investment averages about 30% of GDP, while the average for Latin America and the Caribbean fluctuates around 22%. Nor is the productivity balance favorable for the region, when compared with other emerging economies. In the last 50 years, East Asian productivity has grown by more than 2% per year, while in Latin America and the Caribbean the yearly growth rate was just 0.3% (De la Torre 2012). This factor alone explains why countries like South Korea and other Asian nations are developed today, while Latin America and the Caribbean continue to struggle with the complexities of slow growth or the "middle-income trap."

Advances in productivity must be made simultaneously at the macroeconomic and microeconomic levels. At the macroeconomic level, higher domestic savings and investment will have a positive impact on productivity by providing domestic resources for investments to eliminate infrastructure bottlenecks and enhance the quality of the workforce and technological innovation. At the microeconomic level, the main challenge is to increase the productivity of small and medium enterprises (SMEs), often significantly below that of large enterprises in the same sector. Recent studies by the Organisation for Economic Co-operation and Development (OECD) and Economic Commission for Latin America and the Caribbean (ECLAC) found that the productivity of large Latin American enterprises is six times higher than that of SMEs. In the advanced economies, it is only between 1.3 and 2.4 times higher (OECD/ECLAC 2013). These studies suggest what might constitute an action agenda for governments and international agencies seeking to narrow those gaps in Latin American and Caribbean economies.

On that agenda would be strengthening the role of public financial institutions that provide long-term credit and guarantees for private bank loans to SMEs and facilitating technical assistance to SMEs to encourage their integration into supply chains, including export-oriented chains. A pro-SME policy should also help local governments act as catalysts for alliances among SMEs to facilitate their exchange of knowledge and skills and, thus, increase productivity. Policies of this kind would help export-oriented SMEs become internationally competitive. Other policies would aim to eliminate obstacles to growth for SMEs led by women. A recent study (Bardasi et al. 2011) documented that women-led SMEs in Latin America and the Caribbean tend to be smaller, less efficient, and have

lower growth rates over time. Although initial evidence indicates that the gaps in productivity and growth rates are not due to differentiated access to credit, a recent study in Jamaica, Barbados, and Trinidad and Tobago (Piras et al. 2013) showed that, under more precise definitions, women-led enterprises are more likely to face financial constraints.

As for productivity increases in specific sectors, the region must learn from the most successful experiences, particularly those in East Asia, which highlight three priority areas: strengthening institutions that promote technological innovation in specific sectors; making intelligent, strategic use of sovereign wealth funds in countries primarily devoted to exporting natural resources; and promoting a knowledge economy.

Technological innovation is a key factor for avoiding the middle-income trap. A recent study lists 36 countries with formally approved national innovation strategies and 24 with established national innovation agencies (Atkinson and Ezell 2012). Just two Latin American countries—Brazil and Uruguay—appear on this list. A number of other countries in the region have set up innovation commissions and designed national plans to make innovation a priority. In practice, however, many of these plans remain on paper. Why such meager results?

As Rivas points out in his contribution to this volume and elsewhere (2013), one barrier is the business community itself and its lack of interest in making innovation a priority. Innovation in the most successful countries arises from the creative interaction of companies, scientists, and research centers, with public agencies responsible for promoting it. But in Latin America and the Caribbean, the scientific community seems cloistered behind laboratory walls, while universities busy themselves lobbying for funds for scientific/academic purposes and are uninterested in the practical dimension of research as it applies to production. In turn, government bureaucracies are fragmented and public agencies only recently have begun to channel the efforts required from various stakeholders to promote innovation. The key role that public institutions such as the National Science Foundation, the National Institutes of Health, and the Defense Advanced Research Projects Agency have played in the technological leap forward in the United States in recent decades is worth noting, as are the success stories of Finland, Korea, Singapore, Australia, New Zealand, and others.

In Europe's experience, the prevailing mode for funding innovation is public financing in the form of subsidies or tax exemptions for companies that carry out activities with high potential (Atkinson and Ezell 2012).

Between 10 and 50% of European companies receive public funds for innovation. Fiscal subsidies can be very large: In France as much as 60% of a company's R&D investment. In Latin America and the Caribbean, just 8% of companies have been eligible for government subsidies for innovation.

Another mechanism used by successful countries is to attract foreign investment in technological areas of strategic interest (see Chap. 4). These policies are implemented with public funds as counterparts to the investments made in the country by foreign companies. Countries as ideologically diverse as Korea, Singapore, Israel, China, and Vietnam have followed this policy. Examples abound. In 2003, Singapore established a biomedical research center around which dozens of technologically advanced companies have set up. The center has attracted some 7000 top-ranked PhDs in bioscience from around the world. Another institute, called Fusionopolis, has installed 6000 scientists in biomaterials, clean technologies, and digital communications. In both cases, Singapore provided capital for the centers and multinational companies set up around them.

At the other end of the political and ideological spectrum, China and Vietnam have made similar efforts to attract leading multinationals in priority areas for their countries. The Chinese government provides capital, subsidies, and tax incentives to attract foreign high-technology companies. Vietnam offers four-year tax exemptions followed by a tax reduction of 50% to attract companies like Intel, which has invested US$10 billion in a plant and technology research center in Ho Chi Minh City (Atkinson and Ezell 2012).

In the case of Latin America, mention is often made of the Costa Rican government's success in attracting Intel, which made a large investment in a microchip production plant. What is less known is that Intel has had only a limited impact on Costa Rican firms that might have become its suppliers of inputs, parts, and components (Rivas 2013). This poses a further challenge for Latin American and Caribbean governments interested in promoting innovation: How to create links with local suppliers to allow them to learn from the new technologies, improve their products, and integrate into value chains with foreign companies installed in their countries (Pietrobelli and Rabellotti 2006).

More advanced countries can offer success stories worth examining and learning from (World Bank 2010). One is the National Linkage Promotion Program in Ireland, where executives of transnational companies operating in Ireland participated in discussions with local entrepreneurs and

government financial support encouraged the selection of subcontractors to join the supply chain of the parent company. Additional financing promoted alliance-building between small and medium-sized suppliers of inputs. In Denmark, similar monetary incentives were provided when at least three SMEs agreed to cooperate as part of an input supply chain. The program, called Grants for Network Creation, is complemented in subsequent stages with public venture capital to allow small companies that supply inputs to increase their scale of production. Great Britain has a similar and successful initiative, the Accelerate Programme. Determining whether and how these experiences could be usefully implemented in Latin America and the Caribbean is a task for the coming decade.

Some Latin American and Caribbean countries have created competitive technological funds for companies at the national, regional, or sector levels. Brazil's 14 sector funds provide long-term financing for innovative projects in priority areas. In other countries, funds exist but are not very widely used by the private sector. International best practices suggest technology innovation funds should be integrated into a continuous financing matrix that starts with access to seed capital from public money or private "angel investors," followed by venture capital and finally the formal long-term financing system. The goal of technological innovation, therefore, challenges the Latin American and Caribbean economies to design an institutional framework with identifiable roles for government and private parties, based on financing requirements in the different stages of developing a new company.

Lastly, due to insufficient market size in many Latin American and Caribbean countries, Rivas (2013) suggests creating a critical mass of demand for technology by combining producers in areas such as mining or agribusiness in nearby countries (such as Peru and Chile) while coordinating an integrated network of companies and technology research centers. Regional development agencies could provide concessional funding for coordinating such networks. This is another challenge that should be considered a priority over the next ten years.

Some Latin American and Caribbean countries have used sovereign wealth funds to deposit savings abroad as protection against future external economic shocks. About two-thirds of sovereign wealth funds worldwide have been established by countries with abundant national resources, such as oil, copper, and other commodities. The remaining third have been created by economies, like Singapore, with a long tradition of fiscal surpluses. (Elson 2008; Yi-Chong and Bihgat 2010). For countries rich in natural resources, the sovereign wealth funds are useful instruments to escape the

"resource curse" (Humphreys et al. 2007). In Chile, for example, some of those savings have financed countercyclical fiscal and social policy and future pension obligations. Not yet considered in Latin America and the Caribbean is using at least a fraction of a sovereign wealth fund's savings to co-finance projects that represent leaps forward in productivity in strategic areas, which would strengthen the process of diversifying production and exports (Griffith-Jones and Ocampo 2008).

In other parts of the world, sovereign wealth funds are used successfully as strategic capital to attract multinationals that are technology leaders in certain areas. These companies set up and invest in special zones, which generate a strategic development hub that is eventually joined by other multinationals and innovative local companies (Santiso 2008, 2011; Bolton et al. 2012). For example, the United Arab Emirates have used part of their funds to partner with Indian companies specializing in information technologies and the aerospace industry. The Abu Dhabi Fund encourages cutting-edge foreign investments in an industrial park developing new renewable-energy technologies. Singapore's sovereign wealth fund contributes to international companies and research and development (R&D) centers in areas as diverse as biomedicine, telecommunications, water treatment, and nonconventional energy. Six of every ten multinationals in Singapore have been established with significant capital contributions from its sovereign wealth fund. The sovereign wealth funds of Qatar and Malaysia are put to similar uses. The latter invests more than US$30 billion in international companies in areas such as automobiles, telecommunications, and health services for the entire East Asian region. To some extent, all of these countries have attempted to emulate the outstanding success of Silicon Valley.

In what areas could Latin American and Caribbean countries invest part of their sovereign wealth funds to untie the knots that prevent more significant productivity increases in strategic areas? The first and most obvious is to co-invest in the integration of supply chains for more efficient, larger-scale production of inputs for mining and agricultural sectors, including engineering services, energy, capital goods, and parts and components. Agriculture has the advantage of being more labor intensive than other industries, such as mining. In fact, Latin America and the Caribbean have an abundance of all the resources needed to develop a modern, highly competitive, export-oriented agriculture sector: water, sun, land, and a farming culture capable of modernization. In fact, integrating the agri-food sector with high-technology industries would enable a great leap toward what some have called a "new green revolution." Several Latin American economies are already showing significant progress in this direction.

Processing and adding value to their natural resources is, therefore, an obvious field for development, particularly if, as pointed out in the white paper "Australia in the Asian Century," two billion people will join the middle class in the Asian economies between now and 2030. Clearly, this will be the source of very fast-growing demand for agro products and other more diverse, higher quality consumer goods, offering an important niche for Latin American products. It will also lead to a rapid expansion of demand for construction materials, on account of the necessary growth in housing investment in urban areas and the need for better public utilities and financial and other services to improve the quality of life in Asian cities. Latin America and the Caribbean could meet part of this new and more varied demand if the region speeds up its transition to a more diverse and competitive structure for exportable products and services. Sovereign wealth funds can help drive this process through investments that attract world leaders in these areas, and accelerate the incorporation of best practices from more advanced economies.

Sovereign wealth funds also can make a significant contribution by investing, together with other countries, in regional public goods (Asian Development Bank 2008) such as air and ground transport, bi-oceanic highways, and co-investments to attract companies that would jointly market their products. Intraregional connectivity in telecommunications, electric grids, and regional energy companies are also priorities. The progress made in some sectors in Central America and Mexico offers a good starting point, and concessional funds and technical assistance from regional development banks, including experts from countries that have had the greatest success, would advance the process (Perry 2013).

Productivity improvement in the region also depends on the quality of education and the region's increased capacity to transfer knowledge and ideas. Latin American companies have difficulty finding adequately qualified workers for the more sophisticated tasks needed to compete with the best producers in other regions, including the East Asian countries (Birdsall et al. 2013; Larrañaga and Rodríguez 2013). One indicator of the poor quality of education in the region is the 2012 Programme for International Student Assessment (PISA), which tests 15-year-old pupils in language, science, and mathematics. Of 65 countries that participated, Latin American countries were clustered in the lowest quarter, below other middle-income countries like Turkey, Hungary, and Estonia. A similar deficit prevails in higher education. World rankings of institutions of higher learning show that in 2011 just nine Latin American and

Caribbean universities ranked among the 500 best (Academic Ranking of World Universities 2012; Malamud 2012). A significant improvement in quality normally would take many years. How can the transfer of knowledge and ideas from advanced countries to Latin America and the Caribbean be accelerated?

One possible response is to step up the intensity of exchanges with top rated centers and universities in the more developed countries. The most successful experiences in large-scale human resource exchange programs with global centers of excellence require, as Rodríguez (2013) argues, speed, size, and focus on priority areas. China, Korea, and India offer instructive examples. As for speed and size, China sent more than 700,000 students to study abroad between 1978 and 2003. In 2011 alone, there were 130,000 Chinese scholarship students in developed countries. The figures for Korea are similar, despite its smaller size and population. In 2011, 126,000 Korean students were studying abroad. In Latin America, President Dilma Rousseff of Brazil has launched Science without Borders, whose objective is to grant 75,000 public scholarships over four years to Brazilian students to study in the world's best universities in priority areas such as engineering, biological sciences, biomedicine, computer science, and renewable energy. Brazil's private sector has been urged to finance an additional 25,000 grants.

If successful, this program could become an initiative worth emulating by other countries in the region. However, it would require overcoming fears of a brain drain to emphasize instead the huge advantages for countries that want to stand on the frontiers of "brain flow" and knowledge (Rodríguez 2013). Such programs should include postgraduate grants and internships for professionals, ranging from middle managers in companies to teaching and education staff. Building alliances between technology R&D centers in Latin America and the Caribbean and their peers in advanced countries would be a complementary initiative, with high potential returns in closing gaps in technological innovation with more advanced economies.

Regional Integration as an Instrument to Increase Productivity and Innovation

Productivity growth and technological innovation can be significantly stimulated by refocusing and deepening regional integration in Latin America. Refocusing would imply reversing the current trend of a top-down approach

of governments that subscribe to numerous treaties that are ambitious in terms of objectives but very limited in their implementation. Alternatively, a new approach that would induce higher productivity and more technological innovation would consist of a bottom-up focus: integrating productive structures across countries that open up jointly to compete in the global economy. Can the Latin American countries move more rapidly in this direction? A growing consensus exists that the answer lies in gradual integration into global value chains (World Economic Forum 2012).

The example usually cited is the way East Asian economies interacted with Japan in the 1980s (see Chap. 1). The establishment of integrated supply chains linked the companies of those countries. In 1990, about 55% of South Korea's trade in East Asia was already industry-to-industry, mainly with Japanese firms. For other East Asian countries, intra-zonal trade, with Japan as the hub, ranged from 25 to 70% (Agosin 2012; De la Torre 2012). Japan played a key role by subcontracting the production of inputs and light manufacturing to companies in other East Asian countries. These links intensified in the 1980s, to include medium-sized and small companies, taking advantage of lower labor costs.

China's emergence as the most important trading partner for several Latin American countries is relevant here (Roett and Paz 2008; ECLAC 2010; IDB 2010; Fornes and Butt-Philips 2012; Rosales and Kuwayama 2012). Could China play a role in the Latin American economies similar to the one Japan played in spurring the integration of supply chains in East Asia, which came to be known as Factory Asia?

Current figures cause concern. The structure of trade of Latin American economies with China is heavily skewed. In Brazil, for example, just 5% of exports to China are manufactured goods; 95% are natural resources. On the other hand, virtually 98% of China's exports to Brazil are manufactured goods. And according to recently published figures, 45% of Brazilian companies report they are losing market share in Brazil, the United States, Argentina, and Chile, to Chinese producers (Da Motta and Ríos 2012).

To compete with China and other Asian middle-income countries, the Latin American region needs to raise productivity and reduce the costs of producing for exports. National efforts to improve the quality of human resources are just a starting point. Boosting productivity also means promoting effective integration at the production level. Intraregional trade is still very low. A study of countries in MERCOSUR, the Central American Common Market, the Andean region, Mexico, and

Chile shows that intraregional trade ranges between 15% and 20% of total trade, while the equivalent figure for Europe is 65% and for Asia about 50% (Foxley 2010).

If integration from the production base is the key for competing with products from China, Korea, and other emerging economies in the global market, what approach should be promoted in Latin America and the Caribbean above and beyond the frameworks that already exist? A limited set of public policies could be selected to promote "bottom-up" integration:

- Agreements that aim to gradually eliminate intraregional tariffs.
- Trade facilitation rules similar to those of the world's most open economies.
- Rules of origin to promote investments among the companies of the region, particularly in sectors with deficits in supply, such as energy, transportation, bi-oceanic highways, ports, and airports.
- Agreements that enable a massive exchange of engineers, technicians, and students to accelerate the creation of an integrated pool of high-quality human resources.
- Special incentives to attract the best international companies to invest and transfer cutting-edge technologies to the region. Japan, Korea, Singapore, and, recently, China and Vietnam, have successfully attracted such companies from Europe and North America, helping them speed up their diversification of production and exports.

Bottom-up integration would be facilitated if countries like Brazil and Mexico were to take on an explicit leadership role in this task. The advantage of such a role for Brazil is especially evident now, given that its economy faces two main risks: a marked slowdown in growth in recent years; and deindustrialization as a consequence of competition from Chinese products in international markets. Mexico, for its part, could strengthen a move toward production integration throughout Latin America and the Caribbean, building on its North American Free Trade Agreement (NAFTA) experience and its proven ability to attract foreign investment from multinational companies that are leaders in technology development (see Chap. 7).

For this approach to productive integration to succeed, both countries would have to open their markets to the rest of the region, without quotas

or managed trade. This would allow Brazilian and Mexican investments to openly take the lead in the integration of regional companies in Latin America, forming conglomerates capable of competing with the best in Asia. Meanwhile, the Pacific Alliance could integrate value chains with joint investments and active coordination to successfully compete in the enormous Asia Pacific markets.

A strong productive integration framework in Latin America and the Caribbean, strategically defining areas for cooperation and competition, would position the region to promote a more balanced economic relationship with the Asian economies, particularly China.

The Challenge of Inclusion and Social Protection

Social policies cannot be considered in isolation from the challenge of sustaining high growth rates over time. As mentioned earlier, the main restriction on rapid growth is the very modest increase in productivity in the Latin American economies over the last 50 years. When social policies for the future are discussed, they are not usually connected to the challenge of increasing productivity. But Levy and Schady (2013) argue that poorly designed social policy can hold back productivity and therefore lower the future growth rate of Latin American economies. Conversely, well-designed social policies can help boost productivity, enhancing potential economic growth and hence the general well-being of society.

Social policy must address two critical challenges: the need to continue reducing poverty, at least at the same pace as in the last decade, and the need to recognize that those who rise out of poverty join an increasingly large and empowered middle class that demands more and better social services and guarantees that they will not fall back into the poverty trap. The risk, which is becoming a reality in some countries, is that the emerging middle class comes to believe that current social policies cannot respond suitably and promptly to their new demands.

The pending challenges for social policy in Latin America and the Caribbean include continuing to reduce poverty through a focus on education, and extending social protection to the vulnerable middle class.

The quality of education is the best predictor of upward social mobility. It is also the Achilles heel of Latin American and Caribbean social policies. The main shortcoming lies in the coverage and quality of early childhood education. Although preschool coverage of children between the ages of three and five is generally about 70%, infant and nursery (up to age two)

coverage is considerably lower. In Chile it is 9.8%, in Mexico 5.8%, while average coverage in the OECD countries is 28% (OECD Family Database 2011). And coverage is significantly lower in rural areas, particularly in areas where indigenous populations are concentrated. Early childhood education requires heavy investments in nutrition programs, psychosocial stimulation, and all those public and private activities that increase the capacity of children from the poorest families to learn and subsequently integrate into their educational and social milieus.

Most Latin American countries have made significant efforts to increase their spending on education, resulting in higher coverage of primary and secondary education. However, this has not necessarily been accompanied by improvements in the quality of education. A major drawback is the low level of teacher training. The indicators are dramatic. By different measures, the performance of 90% of Ecuador's teachers is unsatisfactory. In Chile, the percentage is 33%. Half of Peru's math teachers are unable to perform basic arithmetical operations (Levy and Schady 2013). But governments shy from the political cost of implementing a system of rewards and sanctions to induce teachers to improve their performance. National teachers' unions are powerful, usually with ties to major political parties, and can not only paralyze the system with strikes but also impose serious political costs on the government in power.

What is needed is a mix of positive incentives and higher standards for teachers, a "new deal" that includes wage increases, performance bonuses, training in new teaching methods and educational content, and intensive exchange programs in the best international training institutions, through internships financed with public funds. A special effort should be made to raise the quality of post-secondary institutions that train future teachers. The idea is not just to increase funding to improve their equipment, but to create incentives to draw high school graduates with good grades to teachers colleges. Finland provides valuable lessons about how a small country can transform its teacher training schools to the point where they are among the best in the world. Their improved reputation helps attract the best high school graduates and lifts the status and prestige of teachers (Sahlberg 2007). International cooperation can help disseminate such best practices, finance large-scale international teacher exchanges, and upgrade the infrastructure of schools that educate the children of lower-income families.

Cash transfers to the poorest families linked to school attendance by their children and regular health checkups has been a key element in

attempts throughout the region to move from a welfare-based policy to investments in people that allow them to climb the "ladder of opportunity." There are two caveats, however. First, the transfers can become addictive, encouraging beneficiaries to remain in the informal sector and dependent on public assistance. Second, if the transfers are not linked to substantial improvements in the quality of education and maternal and child health services, the ability to learn and stay healthy over time will not necessarily improve. The challenge is to gradually shift the emphasis from transfers of income for the family to the active promotion of family capabilities and opportunities. The target groups of this new policy should be children and, particularly, female heads of households (Cecchini and Madariaga 2011).

The average rate of women's participation in the region's labor market remains considerably lower than that of men (49.8% vs. 71.4%), although the International Labour Organization (ILO) reports the gap to be shrinking year by year. In spite of the economic recovery following the international financial crisis, women's unemployment rates in the region remained, on average, 1.4 times higher than those of men (7.7% for women compared to 5.6% for men) (ILO 2012). This means the region still has a long way to go in incorporating women into the working world, which has a major impact on poverty and inequality figures.

High levels of informality in the labor markets, very small and fragile companies, and frequent job turnover mean women face major challenges in accessing formal, productive jobs. Those conditions also limit opportunities for work training and investment in workers' skills. Informal enterprises and quality of jobs are, thus, core obstacles for improving labor force productivity. In addition, the ubiquity of informality reduces the effectiveness of social security systems to protect families against adverse shocks, which translates into severe vulnerability of the emerging middle classes. Expanding childcare and preschool education financed with public funds increases the likelihood that low-income women can find stable jobs, but it is not enough. Job training programs offered by governments or companies need to be restructured to become more accessible to women.

A similar challenge affects many young people, who often lack the knowledge and skills required by the market because they left school too soon or did not receive a quality education. Usually they also lack networks of contacts with employers offering good jobs. In Latin America and the Caribbean, the unemployment rate for 15- to 24-year-olds is around 15%, roughly three times the rate for adults. One of every four

young people between the ages of 14 and 25 neither studies nor works, according to figures from the ILO. These figures get worse lower down the socioeconomic scale (IDB 2013), causing disenchantment and lack of trust among many young people, both in institutions and in their own opportunities for the future.

Research shows that training programs in the region targeted to women and young people can be effective (Ibarrarán and Rosas 2009). Social policies in the next decade should give top priority to in-depth reengineering of existing job training programs. In general, training programs operate with limited resources and little accountability in terms of quality. When tax exemptions are granted for training employees, companies are not particularly interested in the content of the training programs or the results obtained. Often, training is used as one more mechanism to reduce a company's taxes (Chilean Ministry of Labor 2011).

An effective training system should be the result of continual interaction between the government and companies (see Chap. 6). Employers have a key role to play in identifying the needs of different industries in the job market. Governments should be responsible for operation of the system as a whole, prioritizing specific sectors. Training programs should be subject to quality control so that their services translate into higher productivity and wages. And, criteria must be established for certification of the skills acquired by persons completing the programs (Puentes and Urzúa 2010). In countries with the most successful training programs, such as Germany, the job training system is continually designed and redesigned through a public–private dialogue by sector of activity.

The main shortfalls in social protection for the poorest populations are in unemployment insurance and social security, including access to health care and pensions. At the end of the last decade, unemployment insurance coverage in the region was quite low. In Brazil, just 6.5% of the unemployed received benefits; in Argentina, the figure was 12.4%, and in Chile, 19.5% (Velásquez 2010). In contrast, coverage is 67% in the Nordic countries (Stovicek and Turrini 2012). Pension coverage for those over 65 varies widely in Latin America and the Caribbean. In countries such as Argentina and Chile, it exceeds 60%, while in Guatemala, El Salvador, and Paraguay, it is under 15% (Rofman and Oliveri 2012). Increasing both types of coverage to universal levels for the poorest populations is an urgent task. In addition, quality of life among these sectors needs to be improved. That includes protection from crime, lowering the cost and improving the quality of urban public

transportation, and seriously attacking the environmental pollution that affects the poor with particular severity.

The working poor are often employed in the informal sector of the economy. The firms where they work have low productivity and, consequently, pay very low wages (Levy and Schady 2013). To generate higher and more stable income for these workers, it is essential to introduce incentives for informal companies to enter the formal economy. Replacing social security contributions with universal coverage financed out of general taxes, as proposed by Levy and Schady (2013), could be particularly relevant in countries whose labor market is sharply divided between a formal sector, where the employers' payroll tax covers the social security of their employees, and an informal sector, where employers do not pay the tax. This is an area where international agencies can make a significant contribution to clarifying options and financing some of the cost for a successful transition to a formal labor system.

Social protection and inclusion in the current decade in Latin America should also consider the massive emergence of a new vulnerable middle class. It is a fact that 46% of people in Latin America and the Caribbean living below the poverty line in 1995 had overcome that barrier by 2010 (World Bank 2013). Today they are part of the middle class, although their incomes are still too low to allow them to feel secure with their new status. Despite progress in terms of income, the new middle class in the region is still closer to the poor than to higher-income earners (Birdsall 2012; Birdsall et al. 2013). They are vulnerable to the risk of falling back into poverty because they tend to have unstable incomes and jobs (Birdsall 2012). Backsliding can have a variety of causes: serious illness of a family member, accidents leading to disability, death of the head of the household, unemployment, being victims of a natural disaster, or growing old with no social security coverage. The top priority for public policy in this sector should be to consolidate the position of these new members of the middle class through access to more stable income and basic security against unexpected events or retirement without an adequate pension.

Data from Honduras, the Dominican Republic, Peru, Mexico, Colombia, Costa Rica, Brazil, and Chile show that the new middle classes are employed in significant numbers by SMEs (Birdsall 2012). Since the productivity gap between large companies and SMEs is significantly wider in Latin America and the Caribbean than in the advanced economies, people belonging to the vulnerable middle class working for SMEs earn wages

that are close to the poverty line. Therefore, policies to spur increases in productivity in SMEs will have a positive impact on the wages and income of the vulnerable middle class, reducing their likelihood of falling back below the poverty line.

The main obstacle to consolidating the new middle class is the poor quality of education, which acts as a ceiling on its aspirations and opportunities. Chapter 8 breaks down the PISA results for Latin America by social stratum, showing that a significant percentage of students in the emerging or vulnerable middle class do not understand what they read. In Chile, 35% are below a satisfactory level, in Brazil 49%, and in Peru 62%. In other words, these middle-class students do not reach the minimum reading level required to participate effectively and productively in society. To raise the quality of education for these students, governments need to spend more on targeted efforts to improve public education. The existing gap between educational resources—computers, libraries, audiovisual equipment, and so on—available in private and public schools is substantial (although it arises more from a large deficit of these resources in the latter than to an excess of them in the former). In Argentina, private schools have 40% more resources than public ones, in Brazil the figure is 140%, in Chile 73%, and in Colombia 160%.

Leveling the playing field for vulnerable groups, therefore, entails a heavy emphasis on improving public education. Unfortunately, emerging groups are generally heading in the opposite direction, hoping to escape the low-quality public education trap by sending their children to private schools. But they run the real risk of not being able to pay for their children to complete those schools and end up over-indebted and with high economic uncertainty (Larrañaga 2013).

The problem for the vulnerable middle class can worsen when their children reach higher education. The trend in the region is clear: Between 1995 and 2010, the number of university students tripled, accounting for about 40% of youths between the ages of 20 and 24. Coverage is 50% for young people from the consolidated middle class, but just 25% for those from the emerging middle class. The main aspiration of that sector is to gain access to higher education for their children. Most new enrollments are in private institutions, with nine out of every ten new openings in the private sector in Peru and Chile, and eight out of every ten in Brazil (Larrañaga 2013).

The most vulnerable point in this process of expanding higher education is the mismatch between cost and quality. Tuition fees are very high

and are rising. Quality, particularly in the new private universities, is low and does not ensure that graduates will find jobs that reflect the cost of education and their expectations. Parents often pile up debts they cannot pay, forcing their children to drop out before they can complete their degrees. Children who do finish may be unable to find work. Frustration caused by unfulfilled expectations and aspirations leads to social protests that begin to destabilize the political system. Coordinating timely institutional responses to these problems is a major challenge for the region. A college loan system, with financing contingent on future professional income or on the current income of the student's family, is one needed measure. Others include a substantial increase in scholarships for young people from the vulnerable middle class as well as "equal opportunity grants" giving preference to students with initial disadvantages, such as having attended a poorer quality public high school, or having insufficient language skills or parents with a low educational level.

The economic reforms launched in Latin America and the Caribbean in the 1980s, in addition to opening up their economies to the rest of the world, also privatized, although to varying extents, the delivery of social services in areas such as education, health care, transportation, telecommunications, and utilities (water, electricity, etc.). This is the Latin American version of what Esping-Andersen (2002) calls the development of a "private welfare market." These market reforms were also an invitation to the new middle classes to substantially increase their consumption of goods, including goods that confer social status and have symbolic value, such as vehicles, second homes, travel, and durable goods of all kinds. One result was that people went deeply into debt and often found themselves unable to pay for services in markets that are insufficiently competitive or inadequately regulated and frequently operate as monopolies or oligopolies. Over-indebted consumers often see themselves as victims of abuse by powerful monopolies and demand that the government more actively regulate costs and improve the quality of services they perceive as deficient.

Reassuring the new middle class will therefore require governments to better regulate and/or increase competition in privatized services, including the financial or quasi-financial sectors. While there is no simple response to this problem, it is an area where experience from developed countries can provide lessons on how to stimulate competition in and better regulate markets for financial and privatized public services.

Improving the Quality of Institutions

Institutional instability has been a chronic feature of Latin America and the Caribbean in the past, one the region has fortunately started leaving behind over the last two decades. Democracy and the rule of law are becoming more fully consolidated. Backsliding occurs, but in the end, positive headway has been made. But democracy by itself offers no guarantee of good decisions, nor of decisions that are fully shared by a stable majority of the population. The dynamics of democracy sometimes create polarization and a widening of disagreement rather than consensus. A disturbing pattern in the region is the relative inability of governments to undertake complex reforms. Even in the region's most advanced countries, growing political and/or bureaucratic difficulties and ideological restrictions stand in the way of more effective public policies. Bad institutions may push many Latin American countries into a "middle-income trap" (see Chap. 1).

Every country faces different kinds of bottlenecks on the road to development. Some countries have serious energy problems; in others, deficits in physical infrastructure hinder regional and sub-regional productive integration. Extremely competitive elections often cloud long-term vision, while the inability to reform government bureaucracy ends up suffocating the productive system. The institutional dilemma is not a minor one. The question is how democratic institutions can be strengthened to create mechanisms that enable the design of development strategies shared across all sectors. A glance at comparative experience can be instructive.

Countries like Ireland in the 1980s and Finland in the early 1990s reached a convergence of visions as a reaction to acute economic crises. In South Korea and Australia, long-term strategic vision was triggered not by financial crises or shocks but by governments anticipating global trends and addressing them through a continuous dialogue between public and private stakeholders.

In the early 1980s, Ireland responded to a crisis of high inflation and weak economic growth, leading to increased emigration and unsustainable debt, by seeking a national consensus around "Social Partnership Agreements," dialogues involving government agencies and private stakeholders, including business and unions. Subsequently, universities and study centers joined the discussions to contribute new ideas and a vision

of the future. Strike and wage moderation were among the important outcomes. The Agreements were renewed and updated every three years by the executive and legislative branches as guides for public policy decisions. The most recent agreement, signed in 2006, was to remain in effect until 2016, although its application was interrupted by the massive crisis of 2008.

In Finland, the trigger was the collapse of the Soviet Union in the early 1990s. Finland's foreign trade and productive structure were highly dependent on the Soviet market. The collapse of that market pushed the Finnish government to create avenues for political and technical dialogue that led to a strategic U-turn toward economic integration with European markets. The Finnish parliament established a permanent Committee for the Future, which promotes long-term consensus on the country's development strategy.

In both cases, these agreements sought to manage a harsh macroeconomic adjustment through control of inflation, moderation in wage increases, fiscal deficit reduction, and an improvement in the balance of payments. Political leaders in both countries were perceptive enough to see the crisis as an opportunity to set up a permanent dialogue to reach longer-term policy consensuses.

In 1992, South Korea launched the "HAN Initiative" (Chung 2012) to create an institutional mechanism for making a strategic leap toward new areas of productive and technological development. Working in a public–private committee structure, government and private agencies analyzed the most likely technological changes in the global economy. The government allocated significant public funding to areas identified as strategic, including semiconductors, digital television, the automotive industry, and biological and agrochemical products. The public sector set aside US$1.6 billion a year solely for research and development of information technologies. In addition, the government implemented a series of interagency agreements, whose execution and results were assessed by the public–private committee. The HAN Initiative and a number of other programs arising from close public–private cooperation have spurred the country's recent sustained economic growth. These programs do not replace private initiative but rather encourage the public sector to seek guidance from the private sector about which areas should receive stimulus.

In Australia, the experience of seeking consensus in strategic areas of public policy dates back to the early twentieth century and intensified with

the economic crisis of 1982. The most enduring instrument has been the "Royal Commissions," which bring together key stakeholders to agree on reforms in strategic areas such as education, social security, and others (New Zealand has a similar approach). More recently, Australia sought to anticipate future trends with a 2012 white paper entitled "Australia in the Asian Century" (Australian Government 2012). The result of broad consultations, through the Productivity Commission and other public–private bodies, this document projected trends that will drive the global economy over the next two decades. Australia had already set out to become an integral part of so-called Australasia, or "Southern Asia," when the British Commonwealth collapsed in the 1980s. That decision contributed to uninterrupted economic growth for the last 20 years. The white paper sought to strengthen the pillars of that growth: heavy investment in education and training, continuous adaptability of the workforce, government stimulus for technological innovation targeted to five core strategic areas, and a strong drive for trade and partnerships with a variety of Asian companies and institutions.

Latin America and the Caribbean have had serious difficulties undertaking these sorts of initiatives. The few attempts have been limited in scope. Often, the economies of Latin America and the Caribbean have swung back and forth between two visions: an almost unrestricted free market driving growth; and state-led growth in the context of a more closed, protected economy. To overcome these polarized visions, countries in the region need to create institutions capable of building consensus among public and private stakeholders around a shared long-term strategic vision that boosts the competitiveness and growth of their economies. This could be a very effective way to avoid falling into the "middle-income trap" in Latin America.

Conclusions

The middle-income trap is characterized by three related conditions: (1) a slowdown in growth due to an inability to achieve continuous improvements in competitiveness and productivity, (2) excessive inequality and lack of social protection, and (3) the inability of the institutional system to provide stability, transparency, and good governance (Foxley 2012). Latin American and Caribbean economies will require significant changes and reforms to overcome these new problems and future challenges.

In order to tackle the productivity and innovation challenge, it is required to advance simultaneously at the macroeconomic and microeconomic levels. At the macroeconomic level, this implies higher domestic saving and investment. At the microeconomic level, this means reducing the productivity gap between small-medium enterprises and large ones. In this sense, technological innovation is key and important issues must be addressed: low R&D expenditure, the lack of interest of the business community in making innovation a priority, the relatively weak role of financial public institutions in promoting innovation, the need for foreign direct investment in strategic areas, and insufficient exchanges with top-rated centers and universities in the more developed countries. Sovereign wealth funds could play a financial role.

On a complementary level, a strong productive integration framework in Latin America and the Caribbean, strategically defining areas for cooperation and competition, would position the region to promote a more balanced economic relationship with Asian economies and especially China, the most important trading partner for several countries.

In terms of inclusion and social protection, a new consensus is required for three critical areas (Birdsall et al. 2013):

- An expansion of social protection that includes the emerging middle class. This requires the gradual integration of the ways in which workers in the formal and informal sectors are protected, including low-income groups.
- The fight against poverty must continue, shifting from an approach centered on transfers and subsidies to a crosscutting policy of investments in human capital and more equal opportunities for lower-income groups.
- The sustainability of this new approach will once again depend on the capacity of the region's countries to expand the tax base. Attempts to move in this direction have often failed in the past.

Last but not least, the quality of institutions has a major role to play in order to overcome the challenges of the middle-income trap. Polarized visions could delay development or generate stagnation for Latin American countries. Public–private consensus is a very important condition in order to make institutions more robust. Even if the future is uncertain, a shared long-term vision provides a guideline for tackling current and eventual challenges.

Whether political leaders achieve these new consensus will determine if Latin American and Caribbean economies fall back into the middle-income trap, or avoid it and, within a reasonably short time, become advanced economies and stable democracies.

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CHAPTER 3

Industrial Upgrading and Innovation Capability for Inclusive Growth: Lessons from East Asia

Keun Lee

Introduction

Generating and sustaining economic growth can be a precondition for "better and more" distribution and, consequently, inclusive growth. If growth can be sustained not only for a single decade but also for two or more decades, such growth will surely lead to increased equity because it will push wage rates to higher levels. For example, in South Korea and Taiwan in the 1970s and 1980s, sustained growth increased wage rates, reduced poverty, and eventually led to lower inequality (Bai 1982; Lee 2010). China seems to be showing similar signs as sustained growth has caused a labor shortage and increased wage rates in the coastal regions (Jin and Lee 2013). Bhagwati and Panagariya (2013) also observed that, since the 1990s, growth has tended to create more jobs and tax revenues in India that, in turn, pay for social welfare expenditures.

But why is some growth not inclusive? One answer is that many periods of growth in the Global South tend to be short-lived. Studies by Jones and Olken (2005), as well as Hausman et al. (2005), demonstrated that many

K. Lee (✉)
Economics/Seoul National University, Seoul, South Korea

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developing countries experienced growth spurts during a short period of time (usually less than a decade), but were unable to sustain such development in the long term. Another answer is that many periods of growth have few backward and forward linkages or spillovers, as is the case with mining or natural resource-based growth. The latter leads to countries that have not only relatively high growth rates but also high inequality, such as Nigeria or Namibia. In comparison, manufacturing, especially when done by locally owned companies, tends to have stronger domestic linkages and spillovers. Low educational attainment can be a source of weak spillover and high inequality. Cornia (2014) attributes falling inequality in Latin America since the 2000s to the decrease in educational inequality and the rise in demand for unskilled labor that followed the adoption of competitive exchange rates.

Another essential factor for maintaining growth over a longer period of time is innovation based on a better-educated workforce. Without the innovation necessary to upgrade products and sectors, growth that is based on lower costs (i.e., wages) in labor-intensive products tends to be unsustainable because, when successful, it boosts wage rates to the point where they are higher than those of competing countries (Lee and Mathews 2012). This is a classic example of the "middle-income trap": A situation in which middle-income countries face a slowdown of growth because they become caught between low-wage manufacturers and high-wage innovators. On the one hand, their wage rates are too high to compete with low-wage exporters; on the other hand, their level of technological capability is too low to compete with advanced countries (Yusuf and Nabeshima 2009; World Bank 2010, 2012; Lin 2012; Paus 2012).

Korea and Taiwan have been an exception to this problem, as they have been able to upgrade in two different ways: via intra-sector upgrading (moving into higher-value segments within the same sector) and inter-sector upgrading (entering into new industries that have higher value-added) (Lee and Mathews 2012; Lee 2013). China is also showing some signs of similar upgrading (Lee et al. 2011). According to Lee (2013), these two kinds of upgrading can also be considered as intra-sector and inter-sector diversification, in which resource-based growth is acceptable at first, but must be replaced by upgrading to make it sustainable through stronger backward and forward linkages. This is where innovation and science, technology, and industry (STI) policies can help.

Nonetheless, switching from low-end, labor-intensive production to high-end, knowledge-intensive production is a big jump and one that that is not easy to make. There are several explanations in the literature for the failure to make this change. The best known is neoclassical "market failure." In this approach, the reasons behind lagging innovation are sought outside the firm, such as in the capital market or risk market, and governments' corrective action is recommended. Policy recommendations tend to be research and development (R&D) subsidies (Greenwald and Stiglitz 2014). A second explanation is Neo-Schumpeterian "system failure" (Metcalfe 2005). Here the recommendation is for government efforts at coordination. In both of these approaches, firms are assumed to already be capable of conducting R&D and the problem is one of inability to produce the optimal amount.

A third approach, which is advocated in this chapter, involves "capability failure." In most developing countries, private firms are not able to conduct in-house R&D. They consider it an uncertain endeavor with uncertain returns. Thus, the problem is not about having more or less R&D, but rather "zero" R&D. In fact, the R&D/GDP ratio often stagnates among middle-income countries because they are not doing enough R&D (Lee 2013). This is a serious problem because middle-income countries are the very ones that need to pay more attention to innovation, adding more weight to the argument that a failure to innovate is the root of the middle-income trap (Lee and Kim 2009). To move beyond this stage, effective forms of government intervention are needed, not simply to provide R&D funds but also to cultivate R&D capability itself.

The rest of the chapter is organized as follows. The second section discusses the linkages between economic growth and equity through examples that compare the situation in East Asia with that of Latin America. The third section explains why simple, low-end production of goods is insufficient to sustain economic growth, and why middle-income countries should upgrade into higher-end segments or sectors. The fourth section elaborates on the three rationales for government activism and highlights capability failure as the most important justification for this activism within the context of developing countries. The fifth section discusses several ways to overcome capability failure by providing opportunities for technological learning for latecomer firms. The last section outlines criteria for specialization and "leapfrogging." The chapter closes with some brief concluding remarks.

Sustained Growth as the Basis for Inclusive Growth: The Asian Experience

The literature on the relationship between economic growth and income inequality is copious and diverse. A strand of scholarship that follows the pioneering work of Kuznets (1955) has concentrated on the causal effect of economic growth on income distribution. According to this line of study, conventional wisdom (the so-called Kuznets curve) states that income inequality and per capita GDP are related in the form of an inverted-U. That is, income inequality increases over time while a country develops, but when a certain income level is attained, income inequality begins to decrease. Following Kuznets' insight, a number of studies using data from developed and developing countries have found evidence in support of this theory (Adelman and Morris 1973; Chenery and Syrquin 1975; Lindert and Williamson 1985). Although doubts have been raised about the inverted-U hypothesis in recent literature, especially with regard to developing countries (Oshima 1991; Ravallian 1995; Deininger and Squire 1998; Riskin 2007), Korea and Taiwan have followed the prediction and achieved so-called equalizing growth.

Given that both countries' economies used to be based on agriculture, rural surplus labor was an important condition that determined inequality in the past. The "turning point" concept proposed by Lewis (1954) predicts that the income gap between the urban and rural sectors will continue until the modern urban sector absorbs surplus labor in the traditional sector and, consequently, this turning point will narrow the gap. This conjecture has been confirmed in Korea (Bai 1982; Lee 2010). Before its take-off in the mid-1960s, Korea had rural surplus labor. Inequality in Korea worsened initially because of the gap between those who stayed in rural areas and those who migrated to urban areas for higher-paid jobs. By the mid-1970s, however, once fast growth in urban areas had fully absorbed migrant workers from rural areas, Korea reached the Lewis turning point: Labor shortages began to emerge, and inequality started to decline as wage rates rose. The Gini coefficient for Korea increased from 0.32 in 1961 to 0.40 in 1972, but steadily decreased to 0.32 in 1997, the year of the Asian financial crisis (WIDER database: www.wider.unu.edu).

In China, three decades of sustained growth have helped several hundred million people to rise out of poverty, thus reducing the poverty rate from a quarter to less than 5 % of the population. However, these decades of growth have also seen a rise in inequality, especially urban–rural inequality.

In this sense, China faces a dualistic problem similar to what Korea had in the past. The urban–rural income gap in China is primarily caused by the considerable amount of agricultural surplus labor, as confirmed by econometric analysis by Jin and Lee (2013) using province panel data. Thus, slow and controlled urbanization and the resulting slow reduction in rural surplus labor have widened the urban–rural income gap and increased overall income inequality.

Whether China has passed the Lewis turning point and moved from a period of unlimited supply to an era of labor shortage has been the subject of heated debate (Cai 2010; Yao and Zhang 2010; Zhao 2010; Zhang et al. 2011; Das and N'Diaye 2013). Jin (2013) estimated the amount of surplus labor in each province and in the three major regions of China and found that the eastern region already showed a shortage of labor or a lack of surplus labor, whereas surplus labor remained in the central and western regions. In other words, the fast-growing coastal areas have experienced lower inequality than the slow-growing inland areas, due to the different rate of surplus labor absorption and the sustained demand for workers.

Recently, Jin and Lee (2013) have found that, during the earlier reform period, urban–rural income inequality in China was aggravated by economic growth, but the impact of economic growth on urban–rural income inequality has become insignificant or even negative in recent times, when controlling for openness, higher education, or technology variables. This result is consistent with the original insights of the Kuznets hypothesis. With wage rates increasing every year by more than 25% in coastal regions of China, firms are turning to innovation to move into higher-end segments of value chains and sectors (Lee et al. 2011), with an overall R&D/GDP ratio of 2%. Jin et al. (2008) also found that the engine behind China's growth has moved away from foreign direct investment (FDI), denationalization, and exports and toward innovation and exports.

The experience of Asian countries suggests the following pattern can lead to a successful transformation toward sustained growth: An initial takeoff based on cost advantages → an increase in wage rates and control of further inequality → increased expenditures on education and innovation → entrance into higher-value segments and sectors → sustained growth over a longer period of time, accompanied by decreased inequality. In this sense, the source of problems in countries that have fallen into the middle-income trap is a failure to promote sufficient education and innovation and, consequently, to move into higher-value activities. The

contrast between East Asia and Latin America with respect to this process is clear, as discussed below.

Korea, like other developing countries in the 1960s and 1970s, faced external imbalances with persistent trade deficits during the first two decades of industrialization. Since the mid-1970s, however, the government has emphasized technological development by conducting publicly funded and conducted R&D. These results were then made available to private firms, which initiated private R&D. This private R&D was further encouraged through tax incentives and the initiation of public–private joint R&D for bigger and riskier projects in the 1980s. In the mid-1980s, Korea's R&D/GDP ratio surpassed 1%. In the 1990s, the share of the private sector in total R&D expenditure surpassed 50%, and eventually reached 80%.

In contrast, during this same period, most Latin American countries failed to increase their R&D expenditure; their R&D/GDP ratios were around 0.5% in the early or mid-1980s (see Table 3.1). In 2000, none of them surpassed the 1% mark in their R&D/GDP ratios, whereas Korea's ratio exceeded 2% in the early 1990s, with private R&D accounting for more than 80% of the total. Recently, the same thing happened in China. China has been strongly pushing for more R&D expenditure. It finally reached the 1% ratio in 2000, earlier than most of the Latin American middle-income countries, and recently rose to around 2%.

In higher education, through government actions, the number of college students rose substantially in the mid-1980s in Korea.[1] Over a period of five years, the enrollment ratio in tertiary education more than doubled to reach 34.1% in 1985, higher than that the average level of developed countries (Lee 2006). Table 3.1 also shows that Korea and Taiwan tend to show much higher ratios of tertiary school enrollment than Brazil, Mexico, and Chile, even though all of these countries are comparable in secondary school enrollment. In terms of the tertiary school enrollment ratio, China had a 3.4% ratio in 1990, much lower than that of the nine middle-income countries' average of 13.5% in 1980 (Lee 2006). However, China is rapidly catching up. Its remarkable progress has to do with the higher education revolution in the late 1990s and the steady increase in the number of students entering college (20% every year) since 1998 (Lee et al. 2011).

Such a combination of intensified R&D expenditure and investment in higher education laid the basis for knowledge-driven growth, as demonstrated by the rise in US patents filed by Koreans. In the early 1980s, the number of US patent applications by Koreans was within the range of

Table 3.1 Education and innovation indicators in East Asia and Latin America, 1965–2000

Country	*Secondary school enrollment (gross, %)*			*Tertiary school enrollment (gross, %)*			*R&D/GDP ratio (%)*		
	1965	*1980*	*2000*	*1965*	*1980*	*2000*	*1965*	*1980*	*2000*
Korea	17.5	78.1	94.2	3.6	8.9	77.6	0.5	0.6	2.7
Taiwan	15.1	68.4	92.2	4.3	10.9	38.7	na	0.7	2.1
Malaysia	9.4	47.7	69.3	1.5	1.4	27.0	na	0.1	0.5
China	na	45.9	68.3	na	na	na	na	0.7	1.0
Argentina	13.1	56.2	96.7	3.7	6.1	52.1	0.2	0.5	0.4
Brazil	8.8	33.5	105.3	1.8	5.0	16.5	0.3	0.6	1.0
Chile	22.0	52.5	85.5	2.8	7.2	37.5	na	0.4	0.5
Mexico	5.3	48.6	73.5	1.9	4.9	20.5	0.1	0.6	0.4

Source: Adapted from Lee and Kim (2009: Table 1)

Notes: In some cases, GNP was used rather than GDP for R&D ratio and nearest available year to ones specified

other developing countries, including Latin American countries (Lee and Kim 2009: Table 3.1). Throughout the 1980s and 1990s, this number increased sharply to more than ten times the average of middle-income countries in Latin America, which showed little or no increase in patent applications during the same period. Finally, the same source indicates that in 2000, Korea and Taiwan filed more than 5000 US patent applications; the other middle-income countries filed less than 500 applications. This often-unnoticed achievement finally succeeded in producing the first trade surplus in modern Korean history, a surplus that occurred briefly in the late 1980s and in a more stable manner from the mid-1990s onward, laying the basis for the upgrading of Korea's exports from low-end to higher-end goods so that it could afford the rising wage rates.[2] During this time, Korea was able to overcome the persistent trap of external imbalances (the stop–go cycle) and the need for devaluations.

Limits to Low-Cost Growth Models and the Need for "Double Upgrading"

In the early days of their takeoff, Asian firms faced at least two important competitive disadvantages: their isolation from the major international sources of innovation and their distance from advanced markets

and the user–producer links essential to innovation. Original equipment manufacturing (OEM) became one of the chief institutional mechanisms used to overcome these entry barriers and to enable technological learning (Hobday 2000). OEM is a form of subcontracting in which finished products are made to the precise specifications of a particular buyer, which then markets the products under its own brand name and through its own distribution channels. In Taiwan and Korea, OEM accounted for a significant share of electronics exports during the 1970s, 1980s, and even the 1990s.

While latecomer firms readily achieve an early stage of development through producing products designed by others (the OEM model), they face uncertain long-term prospects as potential technology suppliers refuse to sell designs or licenses or switch production orders to other lower-wage sites or countries (Lee 2005). The fundamental reason for the unfolding of an "OEM crisis" has to do with the rising wage rates that follow successful production and the difficulty that firms have paying higher wages when they upgrade into higher value-added segments. Upgrading requires acquisition of design capabilities. In the Korean case, firms found products to imitate, but no designs were forthcoming from existing producers since they were reluctant to transfer design technology to potential rivals. In Taiwan, the crisis was so intense that foreign vendors switched their OEM orders to firms in other lower-wage economies like Malaysia. The Taiwanese firms then realized that they had to upgrade their design capability if they wanted to keep their customers. Specifically, they had to design an "imitative" product by themselves and start to sell this product under their own brand name.

Design capability is not easily acquired either by continuing as a subcontractor or through networking with local producers. The case of Acer in Taiwan shows how difficult it is to move out of the OEM phase and into "own brand manufacturing," or OBM (Hobday 2000; Khan 2002; Mathews 2002). Acer was the most representative high-tech start-up to emerge in Taiwan in the late 1970s and the early 1980s. Initially, Acer relied on product innovation and OEM with experience gained by individuals who had worked overseas in the United States. The firm started with just 11 engineers in 1976 and achieved total sales of 1.4 billion US dollars in 1993. Acer led the Taiwanese computer industry in the 1980s with a 60% market share in Taiwan. Later, it began to distribute directly to customers abroad in order to challenge other brand leaders and move beyond OEM. Nonetheless, it has had to retreat from OBM back to OEM

or ODM (own design manufacturing) after heavy losses between 1990 and 1993.[3] Since the early 1990s, Acer has been stuck in ODM, in which a large percentage of its sales are made to IBM and others. Only very recently has the firm reportedly been trying to return to an OBM-based strategy.

The Korean and Taiwanese cases show that upgrading in the same industry and successive entry into promising new industries occurred over the course of industrial development. My proposition is that, unless both of these kinds of upgrading are pursued, the chances for successful and sustained catch-up are slim. There are two issues involved here: one from the perspective of the latecomer and the other from that of the front-runner, or incumbent, firm.

First, from the latecomer perspective, success with the OEM strategy tends to trigger a consequent rise in wage rates, and cheaper labor sites in "next-tier-down" countries can emerge to replace a country's position in the global value chains. This condition forces firms to move up to higher value-added activities in the same industries. Second, innovators in the leading countries tend to generate new higher value-added industries. As innovations arise, established industries mature and may degrade into lower value-added activities, forcing firms to enter newly emerging industries and higher valued-added activities.

The need for these two kinds of upgrading stems partly from the typical international industrial life cycles (e.g., new industries have tended to be created by the developed world) and partly from the fact that, in the past, latecomer countries and firms tended to inherit these industries after they had already become mature and their products had been standardized (Vernon 1966; Suarez and Utterback 1995). Given this life cycle, an important feature of successful catch-up has been the ability to enter at an earlier (higher value-added) stage of cycles as time goes on, which is possible only with enhanced absorptive capabilities. Otherwise, a company may be doomed to remain stuck in lower-wage activities or industries, with few chances for long-term success.

In East Asia, examples of upgrading in the same industries are numerous. For example, semiconductor firms in Korea and Taiwan started with integrated circuit (IC) packaging or testing (low value-added activities), then moved to IC fabrication and eventually to IC design (highest valued-added) (Mathews 2004, 2006). Likewise, in Taiwan and Korea, there are many cases of successive entry into higher value-added activities. For instance, the Tatung company in Taiwan has made successive entries into new activities since the 1960s, starting with black-and-white TVs in 1964,

color TVs in 1969, VCRs and PCs in the mid-1980s, hard-disk drives in the mid-1980s, TV chips/application-specific integrated circuits (ASICs) in the late 1980s, and workstation clones in 1989 (Khan 2002). The Samsung group in Korea is well known for its successive entrance into new industries during its 60-year history. Samsung started with involvement in light manufacturing industries, such as textiles, but then entered consumer electronics, followed by semiconductors, telecommunications equipment, and flat-panel displays.

The question that naturally arises from these success stories is how to make double upgrading happen. Upgrading and structural transformation do not occur automatically even if a country is open to trade and FDI. Rather, they always involve deliberate learning and risk-taking by companies and public actors, combined with the exogenously open windows of opportunity. The market mechanism serves not as a triggering factor but as a facilitating factor that stimulates risk-taking and rewards successful actors.

For example, Taiwan's successful entries into higher value-added industry segments would have taken longer had there been no public–private R&D cooperation, the first successful example of which was the consortium to develop laptop computers (Mathews 2002). However, it should be noted that there were several failed attempts prior to this achievement. Such public–private joint effort does not guarantee immediate success, but is the only way out of the old specialization in low-end goods sectors and, hence, out of the middle-income trap. In Korean history, the first case of a successful public–private R&D consortium was the development of digital telephone switches. This marked the beginning of the country's emergence as a leader in telecommunication and IT devices, given that this success was the source of learning and confidence that, in turn, led to further public–private cooperation in the production of memory chips, mobile phones, and digital TVs. Following this success, a series of public–private R&D collaborations began to enter new industries.

Market Failure, System Failure, and Capability Failure[4]

The new structural economics of Lin (2012), as well as the initiatives put forward by Cimoli et al. (2009), argue for a proactive role for the state in the presence of market failure.[5] Governments are advised to promote infant industries as well as to facilitate industrial upgrading and

diversification, which are justified by identifying issues of information and coordination failure, as well as external conditions that can be regarded as instances of broadly defined market failure. According to Greenwald and Stiglitz (2014), market failure stems from the fact that knowledge is a public good, and thus industrial policy is necessary due to possible underinvestment in learning when there are flaws in the capital and risk markets, as well as market failure associated with imperfectly competitive industries and a spillover in learning. From this perspective, the actual amount of R&D is often less than the optimal amount that would prevail without the presence of market failure, and government subsidies to support R&D are advisable given the externality involved in the production of knowledge.

Another view on the role of government is the system failure view of Neo-Schumpeterian economics, specifically the concept of the national innovation system of Nelson (1993) and Lundvall (1992). One noteworthy proponent is Metcalfe (2005), who argues that the process of innovation depends on the emergence and success of innovation systems connecting the various actors (components) engaged in the process, wherein innovation systems consist of firms, universities, public research laboratories, and government and financial institutions. He argues that effective interaction among actors in the innovation systems does not exist naturally, but instead has to be constructed and purposefully instituted. In particular, some scholars (Bergek et al. 2008; Dodgson et al. 2011) observe that system failure often exists where missing or weak connections (and synergies) among actors tend to lead the system to lower performance.[6] In this situation, the main function of the government is not to promote individual innovation events, but to set the framework conditions in which innovation systems can better self-organize across a range of economic activities.

We need to re-assess these views to determine whether they constitute effective and applicable government roles in developing countries. For instance, their common but unstated assumption is that the firms and other economic actors are already capable of production and innovation and that the government must simply try to increase the extent of their activities or promote interaction among them. The stark reality in developing countries, however, is that economic actors, especially firms, have extremely weak capability levels. In a number of developing countries, private firms are unable to pursue and conduct in-house R&D, which they consider to be an uncertain endeavor with uncertain returns. Thus, the problem is not one of less or more R&D, but of "zero" R&D. This is a serious condition because middle-income countries are the ones that should start pay-

ing more attention to innovation efforts. This information clearly suggests that such inattention is the root of the middle-income trap.

In contrast to the concept of market failure or system failure, this chapter emphasizes capability failure and suggests specific ways to raise the capabilities of firms in developing countries, including some roles that could be played by the public sector. In developing countries where firms have a low R&D capability, a safer way of doing business is to buy or borrow external technologies or production facilities, as well as to specialize in less technical methods or assembly manufacturing. To move beyond such states, an effective government role must include not only the provision of R&D funds but also efforts to cultivate R&D capability itself. More effective and alternative forms of intervention may include the transfer of R&D outcomes performed by public research institutes and public–private R&D consortia, which have been successful in Korea and Taiwan (OECD 1996; Lee and Lim 2001; Mathews 2002; Lee et al. 2005).

Such direct intervention is important since learning failure occurs not only because knowledge is a public good but also because of a lack of opportunity for effective learning due to historically inherited conditions or policy failure. Seen from this angle, industrial policy is not about choosing winners, but about choosing good students and matching them with good teachers or bringing them to good schools. Good schools may take the form of licensing-based learning or public–private R&D projects, in which direct, cooperative learning takes place. By contrast, banks that merely supply R&D finance might not serve as good schools. Continuing with this analogy, the market failure view can be expressed as, "I will pay for your school so that you may take more classes," whereas the system failure is equivalent to, "Go to school and make more friends." These views do not pay enough attention to factors such as the initial aptitude of students, what is taught to them in schools, who the teachers are, and how they teach their students. In the capability view, these aspects are crucial to a successful industrial policy. Thus, the capability failure view essentially believes in the importance of raising the level of capabilities of the firms (students) and the various learning methods to be provided over the dynamic course of learning, not only in elementary schools but also in secondary and tertiary institutions. In sum, both tuition fees (R&D money) and good friends (linkages to other components in the system) are needed in schools, but the critical factors are the students themselves, a good curriculum, a knowledgeable teacher, and an effective teaching method. Table 3.2 summarizes these arguments.

Table 3.2 Three types of failure

	Market failure	*System failure*	*Capability failure*
Focus	Market institutions	Interaction among actors	Actors (firms)
Source	Knowledge as public good	Cognition failure from tacitness of knowledge	Historically given no learning opportunity
Example of problem	Sub-optimal R&D	Lower R&D effects	No R&D
Solutions	R&D subsidies	Reduce cognitive distance among actors	Access to knowledge and help in learning
School analogy	Tuition support	Making more friends	Targeting student learning
Relevance	Developing and advanced countries	Developing and advanced countries	More specific to developing countries

Source: Lee (2014)

Ways to Cultivate Technological Capability: The East Asian Experience

An essential requirement for upgrading and receiving the learning needed in a firm is to establish and initiate its own in-house R&D center. Independent R&D efforts are required because foreign firms become increasingly reluctant to grant technology licenses to rising latecomer firms, especially when the latter attempt to enter the skill-intensive markets dominated by the advanced countries. Thus, investment in R&D is required not only for the further absorption of advanced technology but also for the development of the latecomers' own technological capabilities. Developing in-house R&D capabilities is also critical because initial success in this area leads to an increase in local wage rates, resulting in lower competitiveness compared to other economies offering cheaper costs or wages (Lee and Mathews 2012). Innovation is necessary to offset these disadvantages.

With the establishment of in-house R&D labs, firms may explore the more diverse channels of learning and access to foreign knowledge that arise from licensing. Arranging access to foreign knowledge and trying new modes of learning is critical because isolated in-house R&D efforts are often insufficient to build indigenous R&D capabilities. Alternative modes of learning are diverse, including co-development contracts with foreign R&D specialist firms and/or public R&D institutes, gaining

mastery of the existing literature, setting up overseas R&D outposts, and initiating international mergers and acquisitions (M&As). For example, since the early 1990s, a small number of Korean firms began to establish overseas R&D posts, mainly to obtain access to foreign technology, which used to be difficult to acquire through licensing. These overseas posts also served as windows on recent trends in technological development (OECD 1996). In the following pages, several alternatives will be introduced; these may be useful for Latin American countries to consider.

Forming and Participating in a Public–Private Research and Development Consortium

Forming and participating in a public–private R&D consortium can be an effective school for private firms when their capability is low. Given their low R&D capabilities, the private firms cannot take the lead in the consortium, in which public research agencies play the key R&D roles and teach and transfer the outcomes to participating private firms. We can find many examples of this process from Korea, Taiwan, and other latecomers.

A noteworthy example would be the government-led R&D consortia in the telecommunications equipment industry, specifically the accompanying local development of telephone switches. This led to the successful localization of telephone switches in the 1980s and 1990s in several latecomer countries, including China, Korea, India, and Brazil (Lee et al. 2012). Most of the developing countries had serious telephone service bottlenecks in the 1970s and 1980s; they had neither their own telecommunications equipment manufacturing industries nor their own R&D programs. As a result, they imported expensive equipment and related technologies, and local technicians merely installed foreign switching systems into the countries' domestic telephone networks. With industrial and commercial bases developing rapidly—along with population growth—a number of countries decided to build their own manufacturing capabilities.

Starting with Brazil in the 1970s, followed by Korea and India in the mid-1980s, and trailed by China toward the late 1980s, all of these countries crafted state-led systems of innovation in the telecommunications equipment industry, with a government research institute at the core. The research institute developed more or less "indigenous" digital telephone switches, which were then licensed to public and private domestic enterprises. In these four countries, a common pattern in the indigenous development of digital switches was the tripartite R&D consortium among the

government research institutes in charge of R&D functions, state-owned enterprises or the ministry in charge of financing and coordination, and private companies in charge of manufacturing at the initial or later stages. However, the subsequent waves of industry privatization and market liberalization in Brazil and India, as compared to the consistent infant industry protection in Korea and China, differentiated the trajectory of the industries in these four countries (Lee et al. 2012). At one extreme, the indigenous manufacturers of China and Korea took over from the importers and multinational corporations (MNCs). Their enhanced capabilities in wired telecommunication, which had accumulated over the preceding decades, led to the growth of indigenous capabilities in wireless telecommunication as well. At the other extreme, Brazil and India have increasingly become net importers of telecom equipment, and their industries are now dominated by MNC affiliates.

As noted by Lee and Mathews (2012), examples from Taiwan include the production of calculators and laptop PCs. In the case of calculators, the acquisition of more fundamental design capability and a basic design platform was made possible with the help of government entities, such as the Industrial Technology Research Institute. Another example is the public–private R&D consortium that developed laptop PCs from 1990 to 1991 (Mathews 2002). This consortium developed a common mechanical architecture for a prototype that could easily translate into a series of mass-produced standardized components. The consortium represented an industry watershed, and even after several failed attempts, it succeeded in establishing new "fast follower" industries in Taiwan.

Co-Development Contracts with Foreign Research and Development Specialist Agencies or Firms

A good example of this mode (co-development) is the case of Hyundai Motors of Korea. The main business of the Hyundai group used to be construction, a long-cycle, technology-based sector. Hyundai entered the business of automobiles in the early 1970s as an assembly maker for Ford, the US car manufacturer. Such a story is common in developing countries. However, Hyundai Motors and Korea's current status as a stronghold of the automobile business would not have been possible without the company's brave decision to cut its ties with Ford and sell its own brand of automobiles equipped with its own engines. Hyundai then became a joint venture (JV) with the Japanese carmaker, Mitsubishi, wherein the Japanese

company provided engines and other key components, whereas Hyundai merely assembled them. In that partnership, Hyundai was a licensed producer but not an OEM producer, as it used its own brand in the local and export markets. When Hyundai wanted to develop its own engines, Mitsubishi (which held 20% of the equity) refused to teach its partner how to design and produce these engines on its own. Most developing country business people would have given up at that point, but Hyundai's founding chairman, Chung Ju-yung, did not. He decided to spend an enormous amount of money on R&D, with efforts focused on engine development. In addition, Hyundai sought and gained access to the external knowledge of specialized R&D firms, such as Ricardo in England. The process was not easy: Not only did Ricardo have to provide an engine design, but the two companies essentially co-developed a completely new design. In fact, the partners had to try more than 1000 prototypes until they finally succeeded seven years after the project was launched in 1984 (Lee and Lim 2001).

Promoting Indigenous Firms by Learning from Multinational Corporations

Realizing the attractiveness of China's market size and the bargaining power associated with it, the Chinese government has actively approached multinational suppliers to engage in technology transfer and JVs, adopting a strategy of "trading the (domestic) market for (foreign) technology" (Mu and Lee 2005). Although this strategy has not been entirely successful, there are cases where it has worked and contributed to technological catch-up, an excellent example of which is the telecommunications equipment industry. China took advantage of its large market size to pressure its foreign partner to transfer core technology to the local partner. Shanghai Bell and other JV establishments fostered the diffusion of technological know-how about digital telephone switches across the country. Thus, indigenous manufacturers emerged and began to compete directly with JVs in the mid-1990s, initially in rural markets and subsequently in urban markets.

This process is called "parallel learning" (Eun et al. 2006). Although a similar diffusion of knowledge also occurred in Southeast Asian countries, China was more successful in turning diffusion into the promotion of indigenous companies. In this sector, China achieved a stage-skipping catch-up. As China had limited experience in developing and producing

electromechanical switches, it skipped the development and production of analog electronic switches and jumped directly to digital automatic switch production. Similar phenomena have taken place in other sectors. Chinese authorities regard a JV as a channel through which learning about technology can take place. Thus, even after its entry to the World Trade Organization, the Chinese government has made no commitment to lift the restriction on the maximum foreign share (usually limited to 50%) in JVs in key industries, including automobiles, telecommunications, and banking. This continuing restriction on foreign shares is in sharp contrast to the market opening exemplified by the present lowering of tariffs to about 10% or less on average, which is lower than the average in most developing countries.

Promotion of Academy-Run Enterprises in Forward Engineering

China has successfully reared a number of national champion firms in high-technology sectors by exploiting their own scientific knowledge base as exemplified by Lenovo, Founder, Tsinghua Tongfang, and Dongruan. These firms have all been established by and affiliated with academic institutions. These academy-run enterprises are widespread in China. Although their share in the national economy is still minimal, their importance in key high-tech regions, such as Beijing and Shanghai, is substantial. The direct involvement of academic institutions in industrial business is called "forward engineering" (Lu 2000; Eun et al. 2006), in contrast to "reverse engineering."

In the reverse engineering strategy, latecomer firms acquire technological principles by conducting autopsies on final (typically imported) products. Reverse engineering is a *bottom-up* mode, whereas forward engineering is a *top-down* mode of technological development, in which the creators (academic institutions), who already possess scientific knowledge, further process nascent knowledge until it can be applied to commercial uses. Forward engineering is an inherently Chinese approach that differentiates China from other East Asian countries. Taiwan and Korea have rarely exploited their academic institutions for technological development, with academia mainly supplying engineers to local firms. But Chinese universities and research institutes, such as those under the banner of the Chinese Academy of Sciences, have played an active role in commercializing new technologies using the results of their research projects.

Acquisition of Foreign Technologies and Brands Through Mergers and Acquisitions

Until the 1990s, Chinese outward foreign direct investments were highly regulated compared with those of other major source countries for FDI. A significant shift in policy was made at the Chinese Communist Party's 16th Congress in 2002, when the Premier announced a new strategy for encouraging Chinese companies to "Go Global" by investing overseas. The policy change seemed to reflect a desire on the part of the Chinese government to acquire foreign technologies and brands, as can be seen from many M&As targeting foreign companies in the manufacturing sector. This strategy serves the objective of saving time for catch-up considering the amount of time and effort that it takes to build original brands and technologies. A well-known case is Lenovo's purchase of the PC division of IBM in 2004 and TCL's acquisition of the European company Schneider for electricity technology. The move by BOE, a Chinese cathode ray tube maker, to acquire parts of the Korean company Hynix had more to do with the technology than the brand. Similar cases of targeting foreign technologies include Geely's acquisition of Volvo, D'rong's acquisition of German passenger airplane maker Fairchild-Dornier, and Shanghai Automobile's acquisition of Korean automaker SsangYong.

Criteria for Sectorial Specialization and "Leapfrogging"

Besides building innovation capabilities, a thorny issue for developing countries is how to choose the right sectors or businesses. This is because capability building does not take place in a vacuum but in specific areas of business and sectors. The nature and criterion of sectorial specialization has been a classic issue in economics, in particular for unbalanced growth theories. The established answer for low-income groups is specialization based on initial endowments, such as labor and natural resources or comparative advantages associated with resource endowments (Lin 2012). These industries usually produce low value-added or low-end goods in the global division of labor, which means that they essentially resemble trade-based specialization.

A more intriguing issue is how to identify a criterion of specialization that can be applied to the group of middle-income countries, which strive to upgrade their industrial structures from lower to higher value-added.

Value-added per worker or labor productivity might be a criterion, but it is too general and there are too many sectors with similar levels of labor productivity for it to function well. Lin's (2012) structural economics points out the need for dynamic comparative advantage, suggesting that latecomers should target the industries with latent comparative advantage or mature industries from the countries slightly ahead of them. Nevertheless, though this is a good practical guideline, either a more theoretically grounded criterion or a more specific, differentiating criterion is still needed for middle-income countries attempting to mobilize new tools of technology policy.

For example, suppose that a country is ready to form a private–public R&D consortium to develop certain technologies or products. In this case, one challenging issue is identifying which technologies or products to target. Greenwald and Stiglitz (2014) have also raised the question of specialization, suggesting that an economy should choose a sector with the greatest learning possibility and capacity; they do not provide further specifications. Other scholars, such as Hausmann et al. (2007), argued that developing countries should diversify their exports into more sophisticated products, which should open the way for sustained growth. These scholars developed a measure of the sophistication of tradable products using income level as the weighting factor, but this definition made the measure somewhat tautological. That is, the measure suggests that if a country wants to be rich, it has to move its production into goods currently being produced by richer countries. In other words, the gradual nature of diversification begs the question: In which sector should diversification first begin? Another criterion that has been suggested by other scholars is technological opportunity, as measured by the growth rate of patents per field. This opportunity variable has been used in the literature as an indicator of "good" technological specialization, yet Meliciani (2002) failed to confirm any significant relationship between such specialization and economic growth. Lee (2013: Ch. 4) also confirmed the absence of a significant relationship between the variable of technological opportunity and technological catch-up in the cases of Korea and Taiwan. From a latecomer's perspective, specialization in high-opportunity sectors is desirable, but involves a greater risk because such sectors are more crowded with already-established companies.

As an alternative to these measures, this chapter suggests using the cycle time of technology as a criterion for the specialization of middle-income countries. Conceptually, the cycle time of technologies refers to the speed by which technologies change or become obsolete over time, causing new

technologies to emerge more often. A long cycle time indicates greater importance of old knowledge, hence the greater need for latecomers to study such knowledge, as in the case of medicine, pharmaceuticals, and machineries. When knowledge in the field changes quickly (i.e., has a short cycle time), as is typical with IT products, the disadvantages for the latecomer might be less substantial. Thus, it is advantageous for qualified latecomers to target and specialize in these sectors.

Technologies based on short cycle time possess two key properties, namely, the sector has less reliance on existing technologies as well as offers a greater opportunity for the continued emergence of new technologies. New opportunities, which indicate more growth prospects and less reliance on existing technologies, may lead to faster local implanting of knowledge-creation mechanisms. Additionally, this criterion satisfies the condition of viable profitability and competitiveness because it involves lower entry barriers and the possibility of higher profitability due to fewer collisions with advanced countries' technologies, lower royalty payments, and even first- or fast-mover advantages or product differentiation.

The validity of this argument about the criterion for specialization has been verified by extensive econometric analysis conducted by Lee (2013) at the firm, sector, and country levels. He shows that Korea and Taiwan were similar to other typical developing countries specializing in low-end, long-cycle sectors (such as apparel), but increasingly turned to shorter-cycle technology-based sectors (such as IT) from the mid-1980s onwards in order to seek their own niche away from the incumbent high-income countries. Table 3.3 shows that there are no overlaps at all between the top seven (or even top ten) technological fields, where the largest number of US patents are filed by G5 countries, and those of Korea and Taiwan, indicating the completely different specialization of these two groups. In contrast, there were several overlaps between the G5 and other middle-income countries. In the 2000s, these two catching-up economies tried to enter industries similar to those of the advanced countries, including more hard-science-based sectors, such as bio and medical products. This long journey, or "detour" as Lee calls it, is described in Fig. 3.1.

Typical research in this area, such as the diversification thesis, tends to focus on how quickly a developing country's economic activity can become similar to that of a rich country. For instance, scholars have pointed out that the industrial structure of advanced economies is highly diversified and thus recommend that developing countries should also try to diversify. However, these studies do not explain how latecomers can

Table 3.3 Top seven US patent classes by different country groups, 1980–1995

Group	*Class*	*Class name*	*Number of patents*
G-5 countries[a]			
1.	514	Drug, bio-affecting and body-treating compositions	10,349
2.	428	Stock material or miscellaneous articles	3,883
3.	73	Measuring and testing	3,789
4.	123	Internal-combustion engines	3,479
5.	424	Drug, bio-affecting and body-treating compositions	3,389
6.	210	Liquid purification or separation	2,853
7.	435	Chemistry: molecular biology and microbiology	2,852
Middle-Income			
1.	514	Drug, bio-affecting and body-treating compositions	120
2.	424	Drug, bio-affecting and body-treating compositions	76
3.	435	Chemistry: molecular biology and microbiology	54
4.	75	Metallurgical composition, metal mixtures	52
5.	65	Glass manufacturing	44
6.	604	Surgery	44
7.	210	Liquid purification or separation	40
Korea/Taiwan			
1.	438	Semiconductor device manufacturing process	1,189
2.	348	Televisions	712
3.	439	Electrical connectors	408
4.	257	Active solid-state devices (transistors, solid-state diodes)	374
5.	362	Illumination	374
6.	280	Land vehicles	355
7.	365	Static information storage and retrieval	346

Source: Adaptation from Lee (2013: Table 3–7); data from NBER patent data
[a]Canada, France, Germany, Italy, and UK

maintain competitiveness and succeed against the incumbents in the same industries. Furthermore, they do not describe how to diversify or what direction should be taken first. In contrast, this chapter suggests that latecomers should avoid the immediate emulation of rich countries, as well as direct market competition with them. Instead, they should look for their own niches in short-cycle sectors, where they can be more competitive.

Lastly, the rationality of all middle-income countries specializing in the same short-cycle technologies is questionable. Such an approach is analogous to the adding-up problem, which refers to the risks involved in the labor-intensive specialization practiced by all low-income countries.

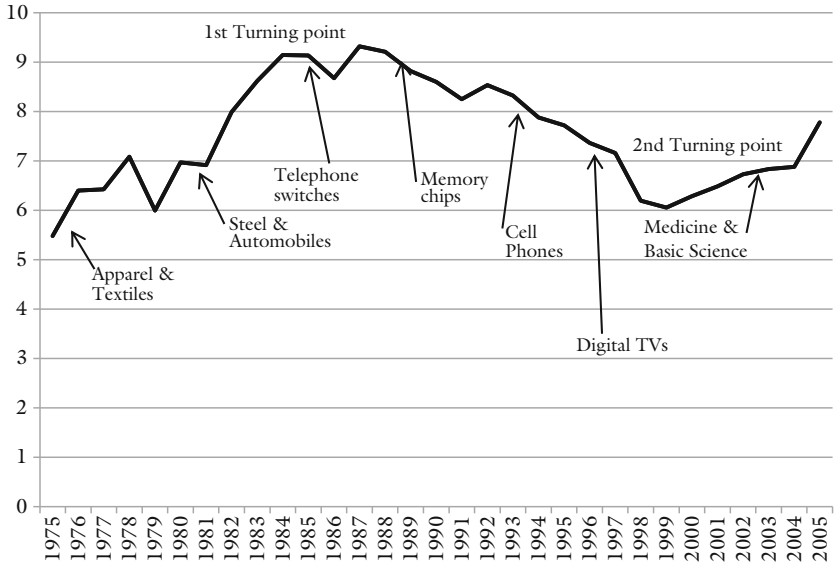

Fig. 3.1 Korea's entry into shorter cycle technology sectors and the resulting diversification. Notes: The numbers in the vertical axis are the cycle time of technologies measured by the mean backward citation lags of the Korean-held US patents. For instance, a cycle time of "9" means that patents in the field are no longer cited or useful after an average of 9 years. The names of sectors are positioned along the average cycle time of Korea near the year when Korea entered those sectors, ranging from low-end, long-cycle sectors (apparel), medium-cycle sectors (steel and autos), short-cycle sectors (most IT goods), and finally high-end, long-cycle sectors (bio and medicine). The first turning point indicates the point (in the mid-1980s) during which Korea started to turn decisively into shorter-cycle technologies, and the second turning point indicates that, since the 2000s, Korean industries are maturing or becoming more similar to those of advanced countries and that they are trying to enter into more hard-science-based (long-cycle) sectors. For a detailed explanation, see Lee (2013: Chaps. 1, 6, and 9)

A specialization based on factor endowments is relatively fixed, with few opportunities for change, but specializing in short-cycle technologies does not entail a fixed list of technologies. Instead, the implication in sectors with short-cycle technologies is that new technologies always emerge to replace existing ones. In other words, the criterion for technological specialization

is less about the cycle length itself, and more about the technological sectors that rely less on existing technologies and offer greater opportunities with newly emerging technologies. Continuous technological emergence suggests the availability to new entrants of fresh windows of opportunity that are not confined to the old, dominant technologies. This concept is the exact opposite of the product life cycle concept of Vernon (1966), in which latecomers merely inherit old or mature industries (or segments thereof) from the incumbent economies.

Until now, this chapter has often used Korean and Taiwanese firms and industries as examples of successful catch-up, leaving us with an intriguing question: Did policy makers in these countries consider the criterion of cycle time as they planned their economic development? While the answer to this question is negative, they were always asking themselves, "What's next?" They looked keenly at which industries and businesses were likely to emerge in the immediate future and thought carefully about how to enter into emerging ones. New or emerging industries or businesses are often the ones with short-cycle technologies because they rely less on existing technologies. Therefore, without specifically planning to do so, the policy makers were always pursing short-cycle industries.

According to Lin's (2012) framework, if policy makers choose to target an industry that is new to a latecomer country but mature in the forerunning countries, the industry must offer a latent comparative advantage. After a certain amount of technological capability is built up in the latecomer economy, it can then target another industry that is new to both the latecomer and advanced economies. This is an effort at leapfrogging, and China is already doing this in various industries. Its efforts to this end are exemplified in particular by its solar and wind power initiatives. Korea also succeeded in leapfrogging in the 1990s into mobile phones and digital TV, for which they used to be a latecomer without solid experience and knowledge (Lee 2013: Ch. 7). In general, a leapfrogging strategy has a higher chance of success when it is conducted during shifts in technological paradigms or generations (Perez and Soete 1988), and such shifts happen with higher frequency in short-cycle technology sectors.

For this reason, a policy idea for Latin America is to utilize resource-based development as a starting point for these countries to leapfrog into emerging technologies that combine renewable energies, nanotechnology, bioelectronics, and new materials. Experts on innovation in Latin America, such as Perez (2008), have also described resource-based development as offering only a short window of opportunity, but such development can

also serve as the basis for a self-funded developmental leap, possibly into new emerging industries. Perez makes the following analogy between East Asia and Latin America: East Asian tigers acquired their initial capability in the fabrication industries of the 1960s and 1970s, and they used this capability to place themselves in an advantageous position within the emerging paradigms of information and communications technology (ICT) industries of the 1990s. Latin American economies can similarly use their current resource exports as both a platform for and source of funding with which to begin to enhance their capabilities in preparation for entering the next technological revolution.

Concluding Remarks

This chapter has argued that sustaining growth over a long period of time is one of the key conditions for inclusive growth. Sustained growth can lead to more jobs, wage rate increases, and also greater equality, especially when it entails sufficient backward and forward linkages and remains primarily locally owned. A desirable process of successful transformation for inclusive growth would be as follows: Initial takeoff based on cost advantages → an increase in wage rates and control of further inequality → increased expenditures on education and innovation → entrance into higher-value segments and sectors → sustained growth over longer periods of time, accompanied by decreased inequality.

To sustain growth and to move beyond the middle-income trap, or to avoid the adding-up problem, a country has to accomplish double upgrading, moving into higher-end segments in current industries and also shifting toward new, higher-end industries, which require enhanced effort for learning and innovation capabilities. To overcome capability failure, a country's private sector must be provided an opportunity for learning, including access to foreign knowledge.

This chapter has discussed several ways to cultivate the technological capabilities of the private sector of developing countries in general and Latin America in particular. They include public–private joint R&D, co-development with foreign R&D entities, promotion of indigenous firms' learning from international firms, promotion of academia-run enterprises, international M&As, and the establishment of overseas R&D outposts. These channels are more diverse than just public laboratories, and a key aspect is that these learning initiatives should be locally owned and grounded, mobilizing whatever knowledge resources are available within

a territory, while at the same time arranging access to foreign knowledge without which they are doomed to fail. For instance, Hyundai's engine development did not involve public labs, but rather collaboration with a UK-based R&D company. Fixed-line telephone switch development in the 1980s in Korea was an outcome of public–private joint R&D, but with licensing arrangements for some foreign technology. A Korean consortium developed the world's first code division multiple access (CDMA)-based mobile phones, but used technology provided by the US-based Qualcomm Co.

This chapter also suggests that, for a developing country to go beyond the middle-income stage, it should specialize in short-cycle technology-based sectors and even leapfrog into emerging technologies and sectors. This strategy makes sense because in sectors with shorter technology cycle times, new technologies emerge frequently and existing ones become obsolete quickly. Thus, the latecomers do not have to master existing technologies dominated by the incumbent. As a caveat, the double-edged nature of short-cycle or frequently changing technologies should be noted: They can serve either as windows of opportunity or as additional barriers to entry.

Although Korea and Taiwan have successfully caught up in short-cycle sectors, other developing countries, such as those in Latin America, have not experienced success in these sectors. This circumstance may have to do with the notion of truncated learning (Lall 2000), in which frequent technological changes interfere with effective learning, and acquired knowledge becomes obsolete or useless with the advent of new technologies. In other words, typically, developing countries feel safe or comfortable staying with low-end, long-cycle technology-based sectors (such as apparel or footwear) because they do not have to worry about disruptive technological change that might make their past learning or skills obsolete. Such a perspective explains why latecomers should build a certain level of innovative capabilities through the diverse learning modes discussed above, before attempting to leapfrog. It makes sense for low-income countries to specialize in low-end, stable, long-cycle sectors, but a middle-income country aiming high should start taking some risks. Entering and leapfrogging into emerging technologies requires the successful accumulation of capabilities in the preceding stages. Several Latin American countries seem to have already accumulated a certain level of capabilities in some sectors required for upgrading or leapfrogging. Although these activities involve significant risk, they are the only way toward high-income status.

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Notes

1. The exact reason behind this jump in college enrollment is unclear, as is whether the government explicitly saw this as an opportunity for generating a knowledge-based economy and industrial upgrading. Nonetheless, it is in sharp contrast to the policy initiatives in the 1960s and 1970s, when the government promoted many vocational high schools to boost human capital for low- or middle-end manufacturing.
2. An additional exogenous factor was the rapid appreciation of the Japanese yen, which helped to increase the price competitiveness of Korean goods that were in competition with Japanese goods.
3. The ODM firms carry out a majority of the product design, while allowing their customers' firms to carry out the marketing functions.
4. This section relies on Lee (2014).
5. This nature of market failure is similar to the concept of appropriation failure discussed in Sabel et al. (2012: Ch. 1).
6. A neoclassical counterpart to this concept of system failure would be coordination failure, discussed in Sabel et al. (2012: Ch. 1).

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CHAPTER 4

Perspectives on Latin American Technological Innovation

Patricio Meller and Joaquín Gana

Introduction

In the global economy of the twenty-first century, technological innovation is fundamental for emerging countries to achieve three interrelated goals: to increase economic growth, to raise international competitiveness, and to generate a path toward convergence with developed economies. Yet Latin America's capability for technological innovation remains stubbornly low. This chapter analyzes why Latin American productive enterprises spend relatively little on research and development (R&D), and considers whether the region can develop an innovative and Schumpeterian entrepreneurial capacity.

Innovation and modern technology constitute a central factor in economic growth: Their contribution surpasses 50 %. This modern technology is generated mainly by multinational corporations (MNCs) of developed countries. From this it can be inferred that countries that lag behind in their level of development (i.e., emergent countries) have a great advantage: They do not need to invest resources to produce modern technology. Instead, it can be acquired from developed countries in different ways, and this generates the convergence process ("catching up") between emerging and developed countries (Gerchenkron 1962).

P. Meller (✉)
Industrial Engineering, University of Chile, Santiago, Chile

J. Gana
Corporation for Latin American Studies (CIEPLAN), Santiago, Chile

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This convergence phenomenon should be intensified in a global world. In effect, thanks to globalization and to globalization-oriented policies, there is practically free mobility in everything: free trade (of goods and services), free investments flows (foreign direct investment), free capital mobility (financial), immediate diffusion of knowledge (via the Internet), and complete access to modern technology. This has suggested the hypothesis that "the world is flat" (Friedman 2005), and that the influence of geographic distance is dramatically reduced.

Yet the empirical evidence calls into question the extent of convergence. We will examine what has happened in a period of 50 years (1950–2000) with the existing gap of per capita gross domestic product (GDP) of several emergent countries in relation to the per capita GDP of the United States (which will be used as a benchmark). The "underdevelopment gap" of the emergent country will be calculated as the relationship between two components: per capita GDP of the emergent country divided by that of the United States in 1950 and the same figures for the year 2000. The convergence hypothesis suggests that the gap should diminish. The actual results obtained show the following (see Meller and Gana 2014): (1) For most Asian countries, the convergence hypothesis is valid: Their per capita GDP in 2000 is closer to that of the United States than it was in 1950; (2) In most Latin American countries, the opposite occurred: The per capita GDP becomes increasingly distant from that of the United States.[1] Instead of convergence, there is divergence. What is the reason for such a different performance between Asian and Latin American countries? What are the factors that contribute to generate convergence in Asian countries?

The implicit assumption regarding the advantage of backwardness in emergent countries relative to the incorporation of modern technology is not generally valid (Mathews 2006). The entrance of modern technology in an emergent country does not automatically generate convergence with the development level of developed countries. Empirically, one observes that the reception of modern technology in emergent countries generates a certain technological progress, but at the same time there has also been an acceleration of the technological innovation process overall. Not all countries have the same capability to adapt to the current innovation pace.

The "flat world" hypothesis is thus overblown. As in Alice's Wonderland, it is necessary to make progress at the same speed as the average country to remain in the same place. Asian countries are advancing steadily, while Latin American countries are moving at a snail's pace and are thus lagging behind. What lessons can Latin American countries learn from Asia?

What can a Latin American country do to generate a convergent path with developed countries?

Mechanisms for Technological Transfer

There are different mechanisms associated with the promotion of technological transfer. The two main ones are trade (import of goods, machinery, capital goods, and services) and foreign direct investment (FDI).[2] Capital goods and machinery embody modern technology and incorporate R&D, which developed countries carry out to improve manufacturing products. For technological transfer to happen, emergent countries have to open up to the exterior by eliminating import barriers. In effect, imports of machinery and capital goods are an important source for the acquisition of modern technology. But this is only the first phase of the technological transference process.

The quantity of capital goods imports of a number of Latin American and Asian countries in a recent period, 1996–2011, shows the following (calculated from UNCOMTRADE):

1. In both absolute and relative terms, imports of capital goods are generally higher in Asian countries in comparison to their Latin American counterparts. In the first decade of the twenty-first century, the median value of capital goods imports for Asian countries fluctuated between 14 and 16% of GDP, whereas for Latin American countries, this median fluctuated between 4.5 and 5.5% of GDP. Therefore, Asian countries are relatively more inclined to introduce modern technology through this mechanism of capital goods imports. This would be associated with the higher investment coefficients observed in Asian countries.
2. In 2011, only four out of 15 Latin American countries displayed an import of capital goods greater than 10% of GDP: Costa Rica, Mexico, Panama, and Paraguay. In comparison, five out of eight Asian countries had capital goods imports that topped 10% of GDP. Some of them had very high percentages, such as Hong Kong (105% of GDP), Singapore (54% of GDP), and Malaysia (26% of GDP).[3]

Let us assume that we have two emergent countries: one in Latin America and one in Asia. Both countries import the same machinery in

quality and amount. The Latin American country considers imported machinery as a "black box with a plug"; the only production interest of local businesspeople is to plug in the machine. In the Asian country, by contrast, there is interest in understanding how the machine works. Thus, they dismantle "the black box" and reassemble it. This reverse engineering generates a technological learning process that is necessary to start gaining the know-how of modern technology production.

What difference does this relationship with modern technology produce in the two emergent countries? The Latin American country is a passive user. Business people there do not deem it necessary to incur the costs associated with learning modern technological know-how, as in a globally integrated world there is less cost and risk in permanently importing modern technology created by developed countries. In the Asian country, however, there is a motivation to understand modern technology in order to facilitate the process of adoption and technological adaptation. Furthermore, Asian business people have a long-term goal of producing improvements and innovations based on modern technology acquired from developed countries in order to eventually become exporters of modern technology themselves. In short, the Latin American country has a static vision of the future, which is simply a repetition of the present. The Asian country perceives the globalized world of the twenty-first century as characterized by a permanent and accelerated process of innovation. Future competitiveness requires business people to understand technology and generate technological innovations.

FDI performs a role similar to that of machinery imports in relation to the transfer of modern technology. International organizations (e.g., the International Monetary Fund, World Bank, and World Trade Organization) have argued that to stimulate development, emergent countries must implement an import liberalization process. They have also suggested that emergent countries should have a free access system for FDI without any kind of restrictions. In fact, in the 1990s, a great number of emergent countries competed with each other to attract FDI. Not only did this establish an environment of quite liberal policies, but it also provided important public subsidies (Görg and Greenaway 2003).[4] It should be noted that MNCs are the primary modern technology generators, so it seems logical that emergent countries' strategy should be oriented toward attracting MNCs (UNCTAD 2005).[5]

The implicit assumptions with regard to the benefits of FDI are: (1) For emergent countries, additional investment flows contribute to the cre-

ation of employment and growth; (2) FDI is an important mechanism of technological transfer and helps to spread modern technology in the host country, thus contributing to raising local productivity and exports; and (3) FDI increases the quality of emergent countries' capital stock because it employs the best practices of "how things are done" and incorporates modern management.[6]

In effect, MNCs are considered one of the main mechanisms for disseminating modern technology, with respect to both tangibles and intangibles. There are different ways to generate the diffusion of modern technology. One approach favors: (1) backward linkages with MNC providers; (2) forward linkages with consumers; and (3) horizontal connections between MNCs and local partners through joint ventures, licenses, and/or strategic association (Ciruelos and Wang 2005). Another approach emphasizes: (1) the demonstration effect of MNCs, or simply imitation by local companies; (2) MNC personnel who are attracted by local companies, or who leave to form their own companies; and (3) backward linkages with providers (i.e., "maquilas") (Hoeckman, Maskus, and Saggi 2004).

When comparing data on FDI in a group of Latin American and Asian countries, one sees the following: (1) In both regions, there was an important increase of FDI flows from 1990 to 2010. As a percentage of GDP, Latin America has experienced a larger relative increase of FDI incidence than Asia has. (2) If two Asian countries, Hong Kong and Singapore, are excluded, FDI was a larger share of GDP in a significant number of Latin American countries than in the Asian countries (UNCTAD 2005). In other words, FDI plays a relatively larger role in Latin American economies than in Asian ones. But what about the effect of the FDI?

Economic literature has concentrated on measuring the effects of FDI in the host country, and in particular the magnitude of the diffusion of modern technology. Once modern technology has been introduced in the emergent country, what are the mechanisms that induce the dissemination of the technology? As can be seen, this question is the same as in the case of modern technology imports. Empirical studies do not provide conclusive results. Some say that the "spillovers" from MNCs are very small or nonexistent.[7] There are even several studies that express doubts about whether FDI has positive effects on the diffusion and spread of modern technology.[8] Saggi (2002) asks, why would an MNC be interested in the diffusion of modern technology in the host country? Which objective function would it be maximizing? The rational behavior of an executive of an MNC would likely be oriented toward blocking imitation by local

companies. The advantages of MNCs are based on modern technology, management, and know-how; what incentives would an MNC have to erode this competitive advantage? In reality, this is the conduct of any business person, whether of an MNC or a local company.

If FDI does not generate "spillovers" in the host country, does this mean that MNCs have no positive impact on emergent countries? FDI performs the role of introducing modern technology in an emergent country, but who should be responsible for spreading modern technology? In the case of local companies that import modern technology, why is their very limited role in the dissemination of technology not questioned? In reality, it is the host country and the local companies that are responsible for the assimilation, adaptation, and diffusion of modern technology. If this is to happen, a capacity to absorb technology is required. This is associated with the existence of a minimum of human capital in the local country (UNCTAD 2005).

One can distinguish two types of emergent countries according to their attitudes toward FDI. One type is the totally passive emergent country, whose objective in working with MNCs is exclusively to accommodate their presence in the country. Here it would not be the responsibility of the MNC to worry about the diffusion process of modern technology. The other type is the more proactive emergent country that induces FDI to assume a dynamic role in the technological transfer process and in the diffusion of modern technology. This country encourages the constitution of joint ventures, granting licenses, and/or the use of local inputs in the production processes of MNCs.[9]

Returning to the former discussion of Latin American and Asian countries in which we considered their behavior with respect to MNCs, we would have a Latin American country acting passively when facing FDI under the assumption that in this way it will increase the probability of larger investments from MNCs in the future. On the other hand, the Asian country is more interested in learning the technological know-how of MNCs and implementing the proactive policies previously suggested. For the Asian country, the entrance of FDI is part of its technological policy (i.e., how it learns to produce modern technology). For the Asian country, the future is unpredictable and changing. What happens today may not be a good forecast of tomorrow.

In summary, confronted by both of the main mechanisms associated with technological transfer, Latin American countries have a doubly passive attitude: disdain toward modern technological imports ("what is the use of opening black boxes?") and indifference to the diffusion of MNC

technology. In contrast, Asian countries have a doubly proactive attitude: They apply reverse engineering to modern technological imports and implement specific policies to induce MNCs to generate transfer and the diffusion of modern technology.

The local existence of technological ability and entrepreneurial know-how is fundamental to generating the transfer and efficient adaptation of modern technology, and this allows the development of abilities and skills to carry out technological innovations. Which of the attitudes previously described is more prone to produce local technological capacity in an emergent country: the passivity of the Latin American country, or the proactivity of the Asian country? The answer is obvious, and the empirical evidence regarding convergence illustrates it.

Measurement of Latin American Technological Ability

In this section, we will examine several indicators traditionally employed to measure the technological ability of a country. Indicators such as R&D expenditures, human capital (number of scientists and engineers), and royalty payments reflect inputs that generate technological ability, while production generated by technological ability is measured through patents and scientific papers. By 2012, according to the World Bank (World Development Indicators, online), Latin America represented roughly 8.5% and 7.7% of world population and GDP, respectively. We will see that, concerning indicators related to technology, the relative Latin American incidence is less than 50% of their population and GDP shares.[10]

Research and Development Expenditures

R&D expenditure is considered the most representative variable of a country's level of technological capability. According to the National Science Foundation (2014), Latin America spent US$36.6 billion in 2011, which represents only 2.5% of world expenditures for R&D. The Asian region, which is much larger than Latin America, spent US$492.3 billion on R&D in 2011. This is 13.5 times what Latin America spent, a number greater than the existing gap between regions in population and GDP.[11] What is interesting is the large increase, both absolute and relative, of R&D expenditures observed in the Asian region. This region represented 24.2% of world R&D expenditures in 1996. Fifteen years later, it represented

34.3% (NSF 2014). This increase of ten percentage points illustrates the big competitive advantage attained by Asian countries.

Research and Development Expenditures

R&D expenditure as a percentage of GDP is the conventional indicator used for international comparisons of the effort and priority assigned by a country to the development of local technological capacity. Nevertheless, as we will see later, in the Latin American case, this indicator does not totally reflect the technological lag of the region.

Figures for R&D as a share of GDP for three country groups show the following (UNESCO online statistics):

1. Considering median values for 2011, Latin America is the region with the smallest R&D expenditures: 0.33% of GDP compared to 1.07% of GDP in Asia and 2.04% of GDP in the Organisation for Economic Co-operation and Development (OECD) countries.[12]
2. Observing the intertemporal evolution, one sees that R&D expenditures in Latin America vary from 0.30% to 0.33% over a period of 15 years (1996–2011), in contrast with the trends observed for Asia and the OECD, where there is an increase in R&D expenditures from 0.57% to 1.07% and from 1.63% to 2.04%, respectively.
3. R&D expenditures as a share of GDP in Asia in 1996 are 72% higher than those of Latin America in 2011. In other words, Latin America's 2011 expenditures for R&D have not even reached a level near that of Asia 15 years ago.

Contribution of the Private Sector to Research and Development Expenditures

By using total R&D expenditures as a share of GDP for international comparisons, we are implicitly assuming that the agents involved (companies, universities, and government) are similar in the different countries, but we will see that this is not the case. From the point of view of international competitiveness, it is interesting to examine what the productive sector (private and state companies) is spending on R&D. Unfortunately, the information available is incomplete.

In medium-size countries in Latin America (Argentina, Chile, Colombia, Peru, Uruguay), the productive sector contribution to R&D expenditure fluctuates between 30 and 35% of total R&D expenditure. In large countries (Brazil and Mexico), it fluctuates between 40 and 50%.

In Asian countries, the contribution of the productive sector to R&D generally exceeds 50%, and in some countries (China and South Korea), it reaches 75%. In most OECD countries, the productive sector contribution to total R&D generally fluctuates between 60 and 70% (UNESCO, online statistics). Given the total share of productive sector R&D, and since the percentages in Latin America are around half the values observed in Asia and the OECD, the figures traditionally used (total expenditures for R&D as a share of GDP) underestimate the differential between Latin America and the rest of the world.[13]

Considering private R&D as a share of total R&D also underestimates the Latin American lag. As mentioned previously, in a globally competitive world, all productive companies compete with each other "on an even playing field." So, what a company spends for R&D influences its efficiency; the more it spends for R&D per worker, the greater its competitiveness. Consequently, the best indicator to determine future competitiveness of a company will be the R&D expenditure per worker measured in US dollars per employee. In a "flat world," the competitiveness generated by R&D is not measured by the share of GDP but by employing monetary magnitudes in US dollars per worker.

In Latin America, in 2011, only Brazil spent more than US$100 per worker for R&D, followed by Mexico, which spent US$72 per worker. Most of the other Latin American countries have figures inferior to US$50 per worker. By contrast, in Asia, there are two countries, South Korea and Singapore, that spent over US$1300 per worker, while China, Hong Kong, and Malaysia spent over US$200 per worker. Similarly, there are several OECD countries (Germany, Denmark, Finland, Israel, Japan, Sweden, and the United States) that spent over US$1500 per worker.[14]

The central question suggested by these figures is the following: Why do Latin American productive companies invest relatively little in R&D? Considering that the degree of globalization will increase more and more, therefore generating a greater level of interdependence, how will Latin American companies be able to compete with Asian and European companies if the latter spend 30 times more for R&D per worker?

Licenses and Patents

Licenses

Licenses can be a substitute for FDI in the acquisition of modern technology, but MNCs can include clauses in the licenses that restrict alterations of

design for the local company. MNCs might prefer FDI in order to internalize transactional costs and to prevent losing control over technology. There is plenty of literature that examines the role of "national culture" or "degree of confidence" in the host country in relation to MNCs' preference for FDI over licenses. On the other hand, the host country may have a preference for licenses over the entrance of MNCs, since this could facilitate the acquisition of technological know-how embedded in modern technology, as is the case with South Korea (Lee 2013: Chap. 2). As previously seen, machinery imports could also be considered a substitute for FDI and licenses. In this case, local business people would have a less proactive attitude in the acquisition of technological know-how. Let us consider the amount spent on licenses as an indicator of a local business person's preferences when trying to acquire know-how embedded in modern technology. If we examine the amounts of payments for licenses (or royalties) in three geographical regions, we can conclude the following (World Bank, World Development Indicators, online):

1. In 2011, Latin America represented only 3.4% of world expenditures for licenses, while Asian countries represented 19.3%.
2. From 2006 to 2011, Latin America increased its expenditures for licenses by 51%.[15] In spite of this important increase, Latin American expenditures decreased relative to the global total. During the same period, Asia and the rest of the world increased their expenditures for licenses by 84% and 63%, respectively. This is the "Alice in Wonderland" effect regarding Latin America's relative backward trajectory.
3. The Latin American countries that stand out for paying over US$1000 for licenses are Brazil, Mexico, Chile, and Argentina.

Another indicator associated with licenses, which also gives an idea of the degree of control (or existence of adaptation and transfer) of modern technology, is the amount of royalties received by national companies. At the global level, Latin America received US$1.2 billion in royalties in 2011, which represented only 0.5% of total world payments. Asia received US$7.8 billion, which represented 3.1% of world payments (World Bank, World Development Indicators, online).

Patents

Most empirical studies consider patents a reflection of the technological change in a country, so they are supposed to be a good indicator of its degree of innovation ability (or control of modern technology). In this

section, we will present two indicators: total patenting and patents registered by country residents.

Figures of total patenting reveal Latin America's lack of importance in world patenting. In the twenty-first century, Latin America has had a total patenting level that fluctuated between 46,000 and 59,000 patents per year. This represents 2.4–3.5% of the overall global number. Asia had more than 750,000 patents in 2011, which represented 39% of world patenting. Just 15 years earlier, this region had less than 150,000 patents per year (World Bank, World Development Indicators, online). How did Asia manage to increase the number of annual patents at an average rate of 11.4% per year for 15 years?

The number of applications for patents by local residents presumably better reflects the country's own capacity for technological innovation. In this case, residents of Latin American countries received around 5000 patents a year in 2011, which is close to 0.5% of world patenting (by residents). Asia has an annual output of resident patenting which is 100 times larger. In 1996, Asia represented only 14% of resident world patenting. Fifteen years later, it represented 45% of the world total (World Bank, World Development Indicators, online). How did Asia increase its (resident) patent level from 93,000 annually to 567,000? Who is generating this enormous expansion in the number of patents? What is the incentives system that induces patenting? And what role do local universities play? All of these questions need to be answered for Latin America to increase its capacity for technological innovation.

Researchers in Private Research and Development and Scientific Papers

Private Research and Development

Assuming that the global competitiveness of companies depends mainly on R&D carried out internally, the pertinent variable would be the number of researchers involved in private R&D in a region (or country). In the first place, let us consider the total number of researchers dedicated to R&D. From this total, we will examine what percentage of them practice R&D in the private sector. In Asia and the OECD, the percentage of researchers dedicated to private sector R&D fluctuates around 45% of total researchers, while in Latin America, the equivalent percentage is generally less than 10%. In other words, contrary to what happens in Asia and the OECD, in Latin America, most of the researchers dedicated to R&D

(almost 90%) are not in productive companies (UNESCO, online statistics). Presumably, most Latin American researchers are in universities or in public agencies. What accounts for this particular distribution of Latin American researchers? Is there little demand for researchers from Latin American productive companies? Or is there a preference among Latin American researchers for primarily conducting academic research?

The effect of the pro-university bias of Latin American researchers, which consequently has negative effects on the competitiveness of productive companies, is indicated by the number of researchers involved in productive R&D expenditures per worker. In Latin America, the number of researchers involved in R&D per million workers is in the single digits, whereas in Asia and the OECD, the number of researchers involved in R&D per million workers is in the thousands. The gap between Latin America and Asia/OECD fluctuates between 20 and 30 times, which is consistent with the differentials related to expenditures for R&D in US dollars per worker.[16]

Scientific Publications

The observed bias of Latin American researchers for academic research in universities should have an effect on Latin American contributions to scientific papers in the world. The data indicates the following: (1) Latin America and Asia produced a similar percentage of the world's scientific papers in 1996: 2% and 3%, respectively. (2) In the following 15 years, Latin America increased its annual production of scientific papers by 127%, which elevated its percentage relative to the world from 2 to 3.3%. But, over the same period of time, Asia increased its annual production of scientific papers by 493%, accounting for 13.3% of global output.

The growth differential in scientific papers between these two regions is associated with the large differential of students that have completed their doctorates. For the effect of generating technological innovation, it is interesting to observe the following figures for PhDs in science and engineering who graduated in the United States from 1989 to 2009. To candidates from China, India, and South Korea, there were 57,705, 24,809, and 21,846 PhDs awarded, respectively. The only Latin American country for which there is equivalent information is Mexico, where only 3589 PhDs were awarded in science and engineering from US universities.

Summary of Results

The contrast in technological indicators between Latin America and Asia is overwhelming. Although Latin America has shown advances in absolute

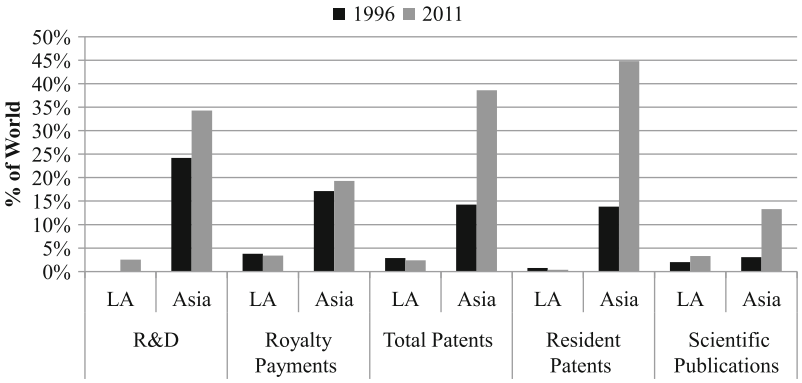

Fig. 4.1 Latin America and Asia relative technological indicators, 1996-2011. *Sources*: R&D from the National Science Foundation (2014). Other variables are from the World Bank (World Development Indicators, online). *Notes*: Asia includes Japan in R&D/Royalty Payments 1996 correspond to 2006/2011 Publications are 2009

terms in several of the indicators reviewed here, its position in relative terms has stagnated or worsened over time. In other words, the region has shown slower improvement than the rest of the world. In contrast, Asia has moved faster than the world average and staked out top positions in relative terms during the same period of time (see Fig. 4.1).

Technological Innovation in a Non-Flat World

The Role of Multinational Corporations of Developed Countries

MNCs of developed countries are the main generators of technological change at the global level. The indicators we considered in the previous section stress the importance of the private sector's share of R&D expenditures in OECD countries and, increasingly, in some Asian countries, such as South Korea and China. In this section, we will examine the importance of MNCs in technological change at the global level.

An empirical synthesis of the influence of developed countries' MNCs on world expenditures for R&D reveals the following (UNCTAD 2005): (1) The MNCs of developed countries are the dominant source of global expenditures for R&D, representing more than 50% of the total; (2)

Developed countries' MNCs represent more than 75% of private world expenditures for R&D; and (3) Many developed countries' MNCs spend more on R&D than do the majority of individual emergent countries as a whole. Relative to the two largest countries in Latin America (Brazil and Mexico), many of the 700 largest MNCs (e.g., Toyota, Roche, Microsoft) spend more for R&D than all of Mexico, and these three MNCs together spend more than all of Brazil. If the world were really homogeneous, with complete information available to all economic agents situated in any geographic site, it should be expected that technological innovation would be uniformly distributed throughout the world. Obviously, this is not the case, and this concentration of expenditures for R&D validates Latin America's interest in attracting FDI carried out by large MNCs. But, as we will see later, there is an important difference between the productive activity of an MNC in an emergent country and its expenditures on R&D.

Most MNCs that carry out R&D are located in developed countries. Only two countries, the United States (42.3%) and Japan (22%), are home to almost 65% of the MNCs that spend the most on R&D (UNCTAD 2005). In terms of industries, expenditures of the 700 MNCs that spend the most on R&D are found in the following sectors: information technology (21.7%), automobiles (18%), pharmaceutical and biotechnology (17.5%), and electronics and electrical products (10.4%). During the twentieth century, expenditures for R&D by MNCs constituted an activity that was rarely practiced outside of the home country. This is because of its strategic importance and because it requires advanced levels of knowledge, especially tacit. Eventually, MNCs started to carry out R&D away from their countries of origin, but the destination of these investments was mainly other developed countries. MNCs did invest in R&D in emergent countries, but this was oriented toward adapting products and processes to the local market. In the twenty-first century, the amount of R&D carried out by MNCs away from their home countries has been growing, and there has been an important change: Recipient countries are no longer just developed countries but also emergent countries. Formerly, the innovation dynamic consisted of MNCs generating new ideas at home and exporting them to emergent countries, especially in Asia. Today, R&D has become polycentric. On the one hand, MNCs are creating centers of R&D around the world, both in developed countries as in emergent countries.[17] On the other hand, MNCs have arisen in emergent countries that have their own centers of R&D.[18]

What are the factors that influence the location of MNCs' R&D activities in other countries? This analysis suggests the type of policies a country should adopt to attract R&D (Guimón 2009). Lee et al. (2011) state that there is a crucial difference between developed countries and emergent countries: The MNCs of developed countries locate their R&D in those developed countries where there is substantial local productive sector involvement in R&D, whereas MNCs locate their R&D in those emergent countries where there is substantial public investment for infrastructure to do R&D ("crowding-in").

The relative importance of MNC expenditures for R&D within an emergent country is very heterogeneous. There are countries like Ireland and Singapore where national expenditures for R&D are mainly carried out by MNCs (72.1% and 59.8%, respectively). Then there is a set of emergent countries, including Brazil and Mexico, where the expenditures of MNCs for R&D represent between one-half and one-third of national expenditures. Finally, countries like South Korea and Japan stand out for their low share of MNC involvement in national R&D expenditure (UNCTAD 2005).

Attraction of Multinational Corporations for Research and Development

The Latin American Evidence

Let us examine what happened in Latin America with the presence of MNC R&D centers during a recent ten-year period (2003–2013). In terms of projects and expenditures, the presence of R&D centers belonging to MNCs is highly concentrated. Table 4.1 shows that half of the projects were realized in Brazil, followed by Mexico and Chile. The situation is similar in terms of expenditures: Brazil accounted for two-thirds of total expenditures (in US dollars) for R&D, while Mexico and Chile together represented almost 20%. The same pattern appears when considering the ten largest investments: Brazil attracted eight while the other two went to Mexico and Puerto Rico. By geographical origin, practically half (47%) of the region's projects from 2003 to 2013 belonged to MNCs coming from the United States, followed by 11% from Germany. Further back were Spain, Great Britain, Switzerland, and Canada, with each accounting for close to 5% of total projects.

Table 4.1 MNC projects for R&D Centers in LA countries, 2003–2013

Countries	*Projects*		*Expenditures*	
	No. of projects	*Total (%)*	*US$ Mn*	*Total (%)*
Brazil	48	50	3,146	66
Mexico	17	18	450	9
Chile	10	10	405	9
Puerto Rico	5	5	224	5
Panama	4	4	117	2
Colombia	3	3	117	2
Peru	3	3	86	2
Costa Rica	3	3	68	1
Argentina	1	1	65	1
Uruguay	1	1	35	1
Total	95	100	4,713	100

Source: Fdimarkets.com, FDI intelligence Financial Times (2013)

Brazil

The influence of the host emergent country's policies depends on its promotion of R&D through investment promotion agencies and the strengthening of the national innovation system (UNCTAD 2005).[19] There is a broad range of available options for meeting these objectives: public R&D, technological infrastructure, human capital, financial and fiscal incentives for private R&D, intellectual property systems, formation of clusters around MNCs, achievement requisites, and post-investment service attention (Guimón 2013).[20]

What explains the great Brazilian success as compared to the rest of Latin America? Is it consistent with the factors and/or domestic policies suggested in the literature? Certainly, the Brazilian case has several of the aforementioned components, but its two main attractions are the following: It is the largest country in Latin America, with one-third of the region's GDP and population; and it presents the highest levels of expenditure for R&D (1% of GDP) in the region and in absolute terms. In line with the former and based on the 54 affiliates of the major MNCs that carry out R&D in Brazil, Galina et al. (2013) emphasize that the main attraction factors are linked to technology[21] and market size.[22] This helps to explain part of Brazil's relative success, but some researchers still question Brazil's performance.

Zanatta et al. (2008) compare Brazil with a set of successful countries, including direct competitors for R&D like China and India, and conclude that selectivity, coordination, and continuity of domestic policies help to create a favorable environment for this type of investment. Their main criticism of Brazil focuses on the lack of specific domestic policies to attract FDI, either general or R&D-intensive. The passive Brazilian attitude could be explained by the empirical fact that many centers dedicated to R&D have already entered the country. Since this is the case, why would Brazil need specific measures to attract them?

The Brazilian government has responded in part to this criticism in recent years. In 2012, the Science and Technology Department started TI Maior, a strategic plan of US$220 million over four years, in an effort to boost the software industry through several measures and incentives. Among the explicit goals was to attract MNC R&D centers that were awarded to Microsoft, Intel, EMC, and SAP. However, factors linked to the presence of MNC R&D in Brazil emphasize the size of the market and better technological capabilities in relation to the rest of Latin America, rather than a coordinated technological policy, as the reason for their appearance. This is consistent with the type of medium or low complexity R&D mainly carried out in Brazil, like the adaptation of products to new markets, among others. In short, the rest of Latin America would not be able to replicate the Brazilian experience because it lacks a similarly large market and high-quality human capital.

Costa Rica

Costa Rica provides a contrasting example to Brazil. This country managed to attract Intel in 1996, demonstrating that very small economies (3.5 million inhabitants) can also be successful in these initiatives. The arrival of Intel started a substantial transformation and productive diversification process, which was reflected in the composition of the export basket in the following years. While in 1995, technological goods exports were practically nonexistent, in 2011, they rose to US$12.4 billion, representing more than 50% of total exports (MIT Atlas of Economic Complexity, online). The primary long-term effect of Intel's arrival in Costa Rica was its demonstration that the country could be a friendly platform for FDI.[23] After the arrival of Intel, a number of MNCs followed, among them Hewlett Packard, IBM, Sykes, and Procter and Gamble, which generated a technological cluster. Other equally relevant effects include their contribution as exporters[24] and the provision of training in human capital.[25]

The arrival of Intel is due to characteristic factors typical of Costa Rica (i.e., its political and social stability), its bargaining strategy, and its specific concessions.[26] Regarding this last point, the key factor was the government's commitment to comply with the need for physical infrastructure and educational quality. Additionally, the government stipulated free commercial districts where profits were tax-free during the first eight years, and only 50% over the following four years.

In spite of its positive impact, in 2014, Intel announced the closure of its microprocessing factory in Costa Rica for reasons of efficiency. The factory will be relocated to Vietnam and Malaysia, countries with lower labor costs. Is this the end of the technology incorporation process for the Costa Rican economy? Probably not. An exogenous factor caused the departure of the most emblematic MNC in the country, but Costa Rica's technological policy that consistently favors FDI can help not only to maintain, but also to increase, the presence of other companies.[27] IBM plans to increase its investments in the country, which suggests that the space left by Intel can be an opportunity for other MNCs. It must be pointed out that Costa Rica's technological cluster is not oriented toward manufacturing but rather toward services (software and programming), giving it more flexibility in the future.

Ireland

The example par excellence of attracting FDI as a development motor, including firms intensive in R&D, is Ireland.[28] The Irish strategy consisted of promotion through low tax rates for companies and selectivity of investments coming from abroad. All of this was sustained by a national consensus about the positive effects of FDI. The objective was to convert Ireland, a small economy with few initial comparative advantages, into an export platform of services and more sophisticated goods to the European Union. This strategy has been positively evaluated.[29]

A relevant part of Ireland's success is due to the role played by the Industrial Development Agency, founded in 1949. In addition to attracting MNCs, it also operates a number of support instruments for when they arrive. This role has evolved according to the development stages of the country. At first, the challenge was to generate jobs, but later it changed to promoting Ireland's innovation and insertion into more sophisticated segments of international value chains.

In short, greater selectivity of investments is not a new policy, but rather has deepened since 1970, with a clear bias toward more complex goods such

as electronic and pharmaceutical articles, and biotechnology. Attracting Intel, Microsoft, and later Hewlett-Packard in the early 1990s turned out to be a pivotal moment, after which Ireland began to strengthen the electronics cluster, which was constantly supported by the government by way of forming human capital and other necessary inputs. Incentives evolved as the country developed: While fiscal exemptions were previously used for the installation period, at present cash grants are available exclusively for training in R&D. When comparing Ireland with Latin American countries, we observe that the former's budget for promotion and incentive efforts is 15 times larger than those of Latin American countries (Gligo 2007).

Buckley and Ruane (2006) provide a synthesis of the main lessons of the Irish case for emergent countries: (1) Recipient countries must never stop being proactive; (2) Recipient countries should adopt an MNC-centered approach; (3) Sector priorities require a selectivity of projects; (4) Selectivity of projects requires a cost–benefit analysis, strategic negotiations, and strong structures of governance to avoid corruption; (5) Incentives based on both fiscal and financial results should operate correctly; and (6) There are limits to potential local linkages due to the progressive creation of more global value chains.

Role of Intermediate Institutions in Technological Transfer

Multiple actors are linked to the technological transference and innovation process, all of whom have difficulties interacting with each other: universities and companies, business people and the state, big businesses and small and medium enterprises, providers, and so on. Intermediate institutions were created in developed countries to connect the different sectors. Brazil is among the three main exporters of orange juice, soya, and pork meat. Chile is one of the two main exporters of salmon and special varieties of fresh fruit. In both countries, intermediate institutions played an important role, focusing on adaptation and technological transfer: Brazil's EMBRAPA (Brazilian Corporation for Agricultural Research) and Fundación Chile (Andreoni and Chang 2014).[30] These institutions connect different actors to promote technological transfer and innovation, but both institutions also generate comparative dynamic advantages. Let us examine two concrete cases.

The "miracle of the Cerrado" is a great MNC success story. The Cerrado was a large zone of the Brazilian pampa where it was thought nothing could be produced. EMBRAPA's strategy to transform the Cerrado into

productive land had several stages (Andreoni and Chang 2014): (1) In the 1990s, the barrenness of the Cerrado was reduced by spraying limestone, while at the same time, EMBRAPA generated a bacterium that reduced the need for fertilizers for this very dry land; (2) EMBRAPA transformed the soya that was harvested in temperate climates to a soya that could be harvested in tropical climates through a genetic modification of the soya seed. This variety of Brazilian soya accelerates the productive cycle, allowing for two annual harvests. This is how Brazil became the top global soya producer in 2013, producing 88 million tons of soya (a high percentage in the "nonproductive Cerrado") and displacing the United States.

The main success of Fundación Chile is salmon production for export. Fundación Chile created a pilot company dedicated to salmon cultivation and looked for the best available technology in the world to solve the technological problems of foreign companies that had previously failed in Chile. Fundación Chile built a fresh water pisciculture operation in the south of Chile (Coyhaique), opened sea cultivations of roe, and started a "cages to feed salmon" program. After an experimental process, Fundación Chile managed to create an efficient productive company able to export salmon at a competitive price in the world market. Since Fundación Chile is a nonprofit (public/private) institution, it began a pedagogical program to spread the technology of salmon production among Chilean business people. Fundación Chile's pilot company was a showcase for local business people that verified the profitability of the business and taught the know-how of salmon production. At present, Chile is the second largest salmon producer in the world, with exports exceeding US$3 billion in 2013.

From these two cases, one can infer that EMBRAPA and Fundación Chile have been key factors in the creation of new export markets for Brazil and Chile. This implies that these institutions have generated dynamic comparative advantages. To this effect, EMBRAPA and Fundación Chile have carried out the following functions: (1) promoting technological transfer through the identification, adaptation, and development of productive techniques to geographic (natural) local conditions, which includes different and complex processes of experimentation (laboratories, etc.); (2) spreading, disseminating, and transferring technology and the resulting productive techniques to private domestic companies (Andreoni and Chang 2014).

The fact that both EMBRAPA and Fundación Chile are nonprofit institutions and that the public sector plays an important role solves the incentive problem resulting from failure to internalize the acquired tech-

nological know-how. On the contrary, EMBRAPA and Fundación Chile consider that a fundamental part of their work is to contribute to the expansion and diversification of the national export basket. To achieve this goal, the involvement of national private companies is fundamental.

Final Observations

Although Latin America showed advances in absolute terms in many of the technological indicators reviewed between 1996 and 2011, its global position in relative terms has remained the same or worsened. The region has improved more slowly than the rest of the world. In comparison, Asia has improved its position more quickly than the world average over the same period of time. In summary, Latin America maintains a relatively low technological position and has been at a standstill in the last 15 years, while Asia has shown notable technological improvement.

The central question related to this phenomenon is the following: Why do Latin American productive companies invest relatively little in R&D? One possible answer is linked to the shortage of Latin American Schumpeterian business people. The Latin American business person is a passive user of technology. He or she does not deem it necessary to incur the costs associated with learning modern technological know-how. In an integrated global world, there is less cost and risk associated with dedicating oneself to permanently importing modern technology designed by developed countries. On the other hand, the Asian business person is motivated to understand modern technology in order to make adopting technological processes easier. Besides, he or she has the long-term goal of improving and innovating modern technology, and eventually exporting it.

In terms of policy suggestions for generating technological transfer, disseminating modern technology at a local level, and increasing innovation, there is no single prescription. Given the existing delay, Latin American countries should apply a number of measures in different areas. On the public policy level, there must be a strengthening of the national innovation system and priority given to the promotion of and investment in R&D centered on productive activities. This implies investment for technological infrastructure and human capital. Additionally, countries should establish financial and fiscal incentives, such as tax exemptions, to stimulate private R&D, and strengthen intellectual property laws. Countries should also stimulate the formation of clusters around MNCs, which includes

strengthening the links between MNCs and other economic agents, and boosting the capabilities of national agents in order to increase their capacity to absorb technology.

The policy of attracting MNCs and foreign investments should become a central component of local technological policy, similar to that present in some Asian countries. In this sense, the local priority given to MNCs would center on maximizing the transfer of know-how from these companies instead of concentrating on maximizing tax revenues. To maximize technological transfer from MNCs, countries should encourage the constitution of joint ventures, promote the use of licenses, and establish human capital training programs in foreign investment agreements.

Latin American universities must review their engineering curricula and introduce courses related to the reverse engineering of an extensive range of modern technologies. In addition, they must get out of their academic bubble and increase their links with productive companies. Local rankings of Latin American universities should use the number of patents as the main indicator of achievement. In our opinion, the "conversion rate" of patents and articles published in top-ranked (ISI) international journals should be one to two (i.e., one patent equivalent to two ISI papers). The number of patents should also influence the promotion system in academic careers at least for faculty in science and engineering. Finally, emergent countries should always be proactive. This includes having a national development strategy with a specific role for MNCs.

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Notes

1. In this chapter, unless otherwise indicated, Latin American countries include Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Mexico, Panama, Paraguay, Peru, Trinidad and

Tobago, Uruguay, and Venezuela. Asia includes China, Hong Kong, India, Indonesia, Malaysia, Singapore, South Korea, and Thailand.

2. Other mechanisms suggested for technological transfer are the role of exports (Hausmann et al. 2007), the import of know-how, and migration (Hoeckman et al. 2004). Later on in the article, licenses and royalties as well as joint ventures will be examined.
3. Note that the very high values for Hong Kong and Singapore reflect their role as entrepôts, which handle a large volume of re-exports.
4. These public subsidies fluctuated between US$30,000 and US$150,000 for employment generated by FDI (Görg and Greenaway 2003).
5. In this chapter, FDI and MNC will be used as equivalent concepts.
6. See Saggi (2002), Görg and Greenaway (2003), and Hoeckman et al. (2004).
7. See references in Saggi (2002).
8. Görg and Greenaway (2003) go through several econometric studies and conclude that "there is no effect (statistic) of MNC on the productivity of local firms."
9. Saggi (2002) suggests in this regard that a "pure policy" (no restrictions) for FDI is not feasible in the real world.
10. It is relevant to point out that the data must be considered as estimates of the corresponding year and not as exact figures.
11. By 2010, Asia represents around one-fourth of the world GDP and had almost 60% of the population.
12. For the comparisons with the OECD, the OECD does not include Chile, South Korea, and Mexico, which are assigned to their respective geographic region. Asia includes South Korea, Hong Kong, and Singapore.
13. The differentials previously mentioned should be multiplied by two.
14. UNESCO (online statistics) for R&D and World Bank (World Development Indicators, online) for labor force.
15. The calculations were made with current US dollars; this was a period of low world inflation.
16. UNESCO (online statistics) for R&D, World Bank (World Development Indicators, online) for labor force.
17. The Microsoft laboratory in Beijing has developed very sophisticated software that permits computers to recognize handwriting.
18. "The world turned upside down" (*The Economist*, April 15, 2010). Huawei, the large Chinese telecommunications company, is already one of the companies that is at the forefront of world patenting.
19. This includes both strengthening links between MNCs and other agents and boosting the capacities of domestic agents in order to increase their absorption capacity.

20. Guimón (2013) provides a review of domestic policies used to attract R&D-intensive FDI in the case of emergent countries.
21. The main variable emphasized was availability of qualified human capital, followed very distantly by academic excellence and favorable incentives.
22. Proximity, size, growth, presence of the company's manufacturing unit, and strategic business interest.
23. World Bank (2006) provides a synthesis of Intel's effect on Costa Rica nine years after its arrival.
24. In 2012, they represented almost 20% of Costa Rican exports; in 2005–2012, they represented almost 6% of the GDP of the country.
25. See Monge-González and González-Alvarado (2007).
26. Spar (1998) provides a detailed study of the negotiation process with Intel.
27. Intel will keep its Center of Global Services in Costa Rica.
28. This country increased its income from US$10,855 (PPP) to US$34,157 (PPP) during the period 1970–2000 in what is known as the "Irish miracle."
29. In addition to the great per capita income increase, today more than half of the manufacturing jobs correspond to MNCs, and Ireland exports several products of great complexity such as medical drugs. Likewise, the contribution of MNCs as a proportion of expenditures for R&D is one of the highest of the world.
30. See also Recart and Kuznetzov (2005) and Alves (2010).

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CHAPTER 5

Policies and Institutions for Driving Innovation in Latin America

Gonzalo Rivas

Introduction

Most Latin American economies have a limited degree of innovation. Regardless of the indicator used, comparisons of the reality of the region to the more developed countries show substantial differences that have grown larger over time, rather than diminishing. Even more worrisome, however, are that the gaps vis-à-vis other emerging economies—especially in Asia—have widened as well.

The baseline proposition for this study is that there are no unsurmountable obstacles preventing Latin America and the Caribbean from moving forward on this front. A lack of natural resources is manifestly not a factor, as evidenced from such disparate experiences as those of the Scandinavian nations or Australia. Nor is cultural or historical legacy a factor, as shown by the cases of China, South Africa, or Ireland, which have achieved significant progress despite adverse starting conditions. A review of these and other experiences point instead to the quality of public policies and institutional arrangements as key elements of the success stories (Devlin and Moguillansky 2010).

Innovation entails creating market value by introducing novelty in products, processes, or organizational or business changes. Accordingly,

G. Rivas (✉)
Economist, National Innovation Council for Competitiveness (CNIC), Santiago, Chile

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corporations are innovation's core players. However, corporations do not operate in a vacuum. Their performance reflects their context, particularly with respect to available capabilities in the system and existing incentives. The State has a crucial role to play in creating a favorable framework for businesses to innovate, both through their actions in the traditional arena of science, technology, and innovation policies and through decision-making in other public policy realms that impact corporate behavior.

In a context of increasing awareness of the need to increase public support to foster innovation, the purpose of this study is to analyze the experience of countries in the region to identify what has worked, what has not, and what remains to be done in this field in order to gain the necessary insights for designing relevant and quality public policies.

To this end, the study is organized in three sections in addition to this Introduction. The first section reviews the region's experience with the design and implementation of innovation-promoting policies and instruments, considering the actions taken to develop capabilities and create incentives for higher levels of innovation among both existing and start-up businesses. The second section analyzes the institutional modalities that have guided public intervention, assessing their operation at the strategic, political, and implementation levels. Lastly, the third section introduces a set of policy recommendations derived from the preceding analysis.

Public Intervention in Support of Innovation in Latin America

The progression of innovation policies reflects the influence of successive paradigms that have sought to explain the innovation process. The years following World War II witnessed the emergence of the predominance of a vision of innovation as a practically linear outcome of scientific research, along a sequence where science produced knowledge, which through applied research then translated into technologies that were ultimately assimilated into businesses. This supply-favoring approach, which essentially aimed to strengthen scientific and technological capabilities, was the primary driver for intervention in the region from the 1950s through the early 1980s. Since the 1990s, the focus shifted toward a view of corporations as the fundamental innovation agent. At that point, causality was reversed and it was suggested that it is businesses that must lead the innovation process based on market opportunities or requirements.

The suitability of both approaches as sources of policy guidance has been challenged due to their linear (or sequential) take on innovation activity. In contrast to this view, a more comprehensive approach has been growing in which the level of dynamism achieved by innovation in a society comes as a result of both available capabilities and the depth of relationships established between the various players. There is complementarity between businesses and institutions in the process of innovation, and as the interactions between them increase so too does the knowledge gained by the contributing parties and the system's ability to develop further capabilities. This recent approach—more consistent with a systemic view of innovation—has become increasingly established as a guiding framework for public intervention in some countries in the region. Despite this trend, however, in the majority of cases, prevailing taxation policies still comprise a narrow and more linear approach showing an overlap of various types of interventions that are generally fragmented and lacking strategic orientation.

Policies for Developing Basic Innovation Capabilities

Recent years have seen increasing importance given to advanced training of human resources throughout the region. So, over the past couple of decades there has been a sustained increase in the number of university graduates, almost quadrupling over that time. This growth, however, reflects increases in the number of graduates in the field of social sciences while increases in the number of professionals trained in fields directly associated with the production and dissemination of technical advances, particularly in engineering and technology, have been much slower. The only countries in the region showing increasing rates of engineering and technology graduates between 1990 and 2010 are Colombia and Mexico, reaching levels of over 20%, which places them on par with OECD member countries (IDB 2011). While the number of graduates in these fields in Chile is still slightly above this level, this indicator dropped by close to 5% during this period. The ratio of engineers and technology professionals in the other countries is less than 10% of graduates (Fig. 5.1).

The number of graduating PhDs has also seen substantial growth, although from a very low baseline. In this case, however, the expansion is focused on a few countries and, in absolute terms, reflects increases in Brazil, which went from graduating 1410 PhDs in 1990 to 11,368 in 2009. Unlike the case of undergraduate degrees, PhD graduates show a

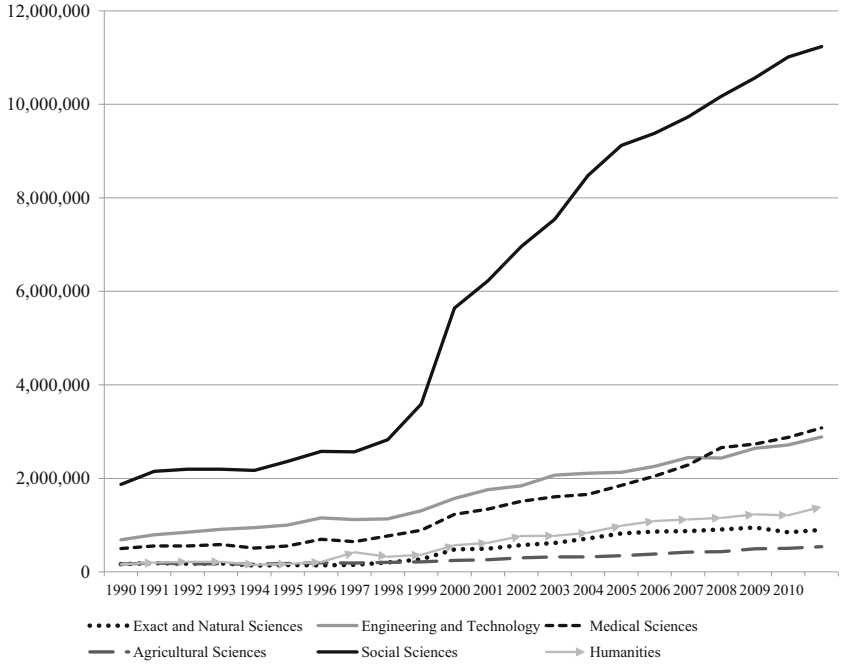

Fig. 5.1 Change in university graduates in Latin America and the Caribbean

much higher ratio in science and engineering fields. This is presumed to reflect the stronger sense of direction provided by the overseeing authority on postgraduate training through the selective granting of scholarships (Fig. 5.2).

Throughout most of the region, top-level education continues to rely on individual efforts and access to scholarships from international organizations. This tends to skew the research according to the interests of scientists themselves (curiosity-driven research), at the expense of that driven by a country's development priorities (mission-driven research), which negatively impacts the creation of critical masses in specialty fields.

Conversely, the experiences of countries that have advanced more in this area (Brazil, Chile, and Mexico) share a common feature of comprehensive action that combines increases in scholarships granted, programs for educating PhDs at the local level, funneling resources into the creation and strengthening of top-notch scientific–technological research centers,

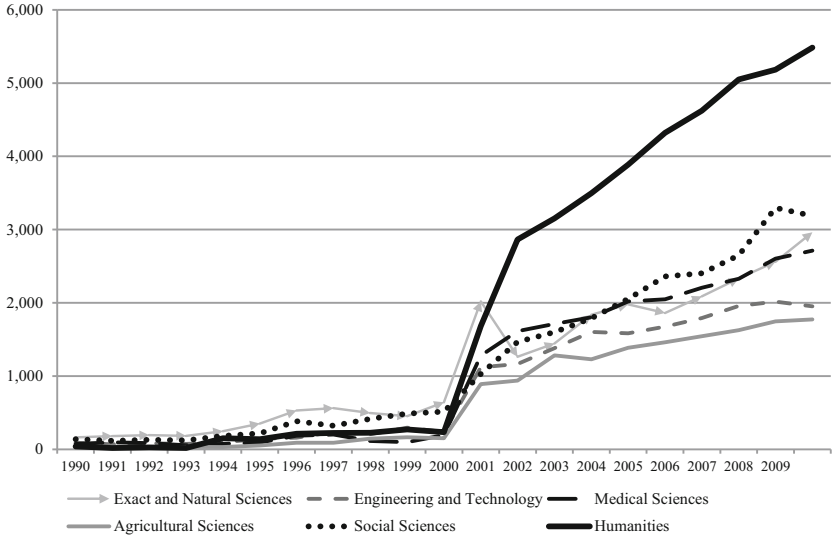

Fig. 5.2 Progression of PhDs in Latin America

and funding in support of young researchers, among others (Sanz 2007; Lemarchand 2010). The importance of taking such a comprehensive approach to promote capacity building should not be underestimated. For example, achieving a sustained increase in the number of PhDs is not possible by relying solely on out-of-country training, and if no investments are made in new research venues and facilities, trained professionals will not have anywhere to apply their acquired knowledge. The latter not only causes frustration among those who have gone through the trouble of educating themselves at such high levels but it also implies lower returns on efforts made and, ultimately, the likelihood of these professionals not returning to their countries.

Training of technical personnel is another area where there are serious limitations in the region. Innovation surveys actually show that the difficulty in finding top-notch technicians is one of the main reasons given by businesses to explain their struggle in innovation (IDB 2011). Paradoxically, research indicates that businesses do not particularly value technical training at hiring, preferring instead to assign a higher value to basic reading/writing skills and, especially, social-emotional skills like

commitment and responsibility (World Bank 2002; Bassi et al. 2012). This paradox may partially be explained by poor or inadequate training of graduates by technical institutions, which would lead firms to opt for hiring people and training them in-house. In this context, knowledge acquired in prior training could be seen by the business as an obstacle to the kind of learning their employees are supposed to acquire rather than as an asset.

Promoting Innovation among Businesses

Businesses sit squarely at the core of innovation, which is why extending and deepening the practice of innovation within the business universe is one of the top public policy objectives. The reasoning behind allocating public resources to private businesses is based on the need to offset the effects of market failures that undermine the ability for businesses to access funding for innovation development, as well as for the creation of benefits beyond those that may accrue to a business when it innovates. Additionally, it has been speculated that public support may help generate knowledge among businesses, thereby encouraging a shift in their behavior with regard to innovation (OECD 2006).

Technology Funds (TFs) are currently the most prevalent form of support for business innovation in Latin America and the Caribbean. TFs started gaining popularity in the early 1990s, to a large extent as a way to overcome the limitations of a supply-oriented intervention model that assigned an absolutely marginal role to business interests and needs. At their core, TFs operate by subsidizing funding for innovation projects that are selected based on their merits. TFs typically follow different paths to support initiatives generated directly by businesses themselves and those driven by technology entities (which may or may not be associated with businesses). The demand for originality or research and development (R&D) tends to be lower in the case of paths aimed at directly supporting businesses than in those aimed at technology entities. It should be underscored that, in the case of support for business projects, TFs always operate by requiring firms to partially cover project funding, which helps reduce the moral risk involved in resource transfers.

Some countries have also explored granting tax exemptions for R&D expenses. The cases of Brazil, Colombia, and Mexico are noteworthy in this area. By their nature, tax incentives tend to be more common among larger corporations (so that the value of the exemption becomes significant) and in efforts with a major research element (as they have large

expenses). Consequently, relatively large resource amounts are associated with relatively few users, as compared to mechanisms such as TFs.

Credit instruments and the use of guarantees are less extended throughout the region. The broadest and most effective use of credit facilities occurs in Brazil—by the Brazilian Development Bank (BNDES). These lines carry concessionary interest rates and provide long-term financing on amounts up to US$5 million. The allocation of these lines has been highly successful, totaling around US$1.3 billion in 2011.

TFs in countries with a stronger tradition of using them (Argentina, Brazil, and Chile) have been the object of econometric assessments to ascertain their impact on targeted businesses. Results show that TFs have had a positive and significant impact on business innovation behavior and performance. Specifically, rather than crowding out private projects, public input is shown to enhance it, with supported businesses tending to produce more innovations and establish deeper linkages with technology entities than unsupported ones (López 2009).

Despite their positive effects, the coverage of funding instruments in support of business innovation is still limited in the region. Chile held the lead in this regard at the close of the last decade, reporting 8% of targeted businesses, closely followed by Brazil, although considerably behind most OECD members. The relatively low use of support instruments by businesses does not necessarily reflect a scarcity of public funds intended for this purpose. The resources allocated for promoting business innovation in the national budgets of most countries in the region are actually not even spent (Fig. 5.3).

While TFs' degree of influence varies on a case-by-case basis, there are two factors that help explain this situation. First, in most countries the state lacks a legal or regulatory framework enabling it to effectively manage innovation-supporting instruments, and where it actually has one, it lacks the agencies with the technical capabilities required to manage them. Second—as is shown below—public policy has generally devoted little attention to the development and strengthening of linkages between the various players in the innovation system.

National Innovation System Linkages

From a demand standpoint, the use of innovation promotion instruments is limited by an insufficiency in and underdevelopment of mechanisms and institutions to help connect business needs and scientific-technological

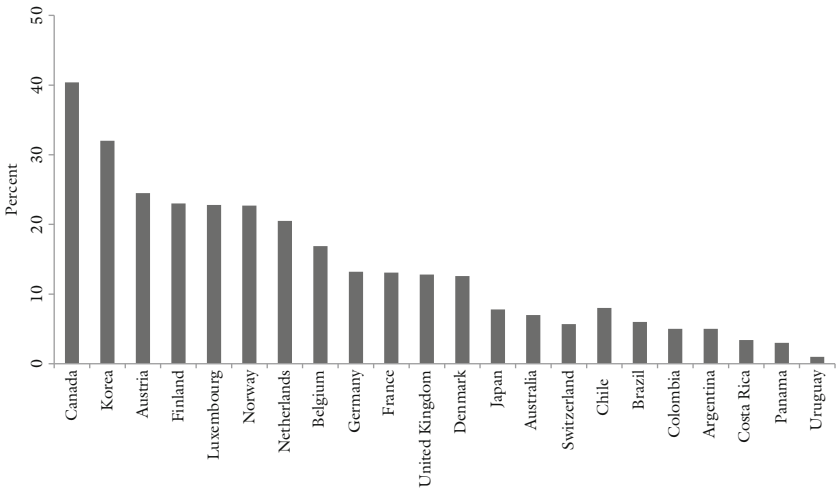

Fig. 5.3 Percent of firms that received public support to finance innovation activities. *Sources*: Innovation Surveys (Argentina: 1998–2001; Brazil: 2005; Chile: 2004–2005; Colombia: 2003–2004; Costa Rica: 2008; Panama: 2008; Uruguay: 2005–2006). Data for OECD countries are from OECD (2009). *Notes*: Indicators refer to the Manufacturing Industry. Indicators are weighted for OECD countries; data for LAC countries (excepting Brazil) are provided by researchers and are un-weighted

capabilities to available public resources. Companies do not necessarily have the capabilities needed to identify and build on innovation projects deemed eligible by the Funds. Countries that have succeeded in expanding the use of innovation instruments show the state playing an active role in encouraging businesses to identify innovation opportunities and to design and implement projects. These roles are performed by Chambers of Commerce, technological institutions, or the staff of the very entities tasked with managing the Funds. As the network of active institutions in this area grows denser, both the demand from businesses and the connections between them and specialized knowledge centers increase.

The experience of Costa Rican subsidiaries of advanced technology transnational corporations is a clear example of missed opportunities due to insufficient linkages among technological change agents. Ever since Intel decided to establish a semiconductor manufacturing facility in Costa Rica in 1998, the country has reaped the benefits of significant

direct investment inflows from technology companies in various segments. However, several analyses have revealed very weak linkages between transnational and local firms, which have caused very meager technological spillover effects. It is generally accepted that Costa Rica has been very successful in attracting investment, but it has failed to establish public policies that enable the country to capitalize on existing possibilities (Mata and Mata 2008; Monge et al. 2010; Ciravegna 2011). One of the issues highlighted by Monge et al. (2010) is the absolute lack of connection between efforts to attract investments and innovation support programs. Similar instances of missing linkages between successful investment attraction efforts by technology firms and innovation promotion instruments have been reported in Mexico (Paus and Gallagher 2006) and Chile (OECD 2003).

The case of technological institutions warrants special mention in this context. Several countries in the region established these kinds of entities, particularly in the 1960s and 1970s, in order to have available entities capable of performing the dual tasks of doing high-level applied research in fields deemed relevant to their national economies and transferring knowledge and technology to businesses. In many cases, these institutions contributed significantly to the development of their productive sectors. However, inadequate governmental attention to communication and information technologies (CIT) through the 1980s and 1990s led to a sharp deterioration in the capacity of technology institutes in the region (Bitrán and Gonzáles 2012). The combined effect of reduced resources and the need to outsource a substantial portion of their funding from the sale of services—but lacking the legal and corporate governance framework necessary to face existing challenges—a great many of these entities grew technologically obsolete, lost their most qualified human resources, and became increasingly irrelevant or focused on routine services (such as certifying, calibrating, and testing).

In a bid to draw additional capabilities into their innovation systems and know-how to more effectively respond to societal and production needs, some countries established centers that operate as local branches of prominent international research and/or technology transfer institutions. Thus, Germany's Max Planck Institute has a presence in Argentina, France's Pasteur Institute is operating in Uruguay, and Panama has created a logistics center jointly with Georgia Tech (United States). Chile's international bidding process to attract technology entities to various high-potential fields is noteworthy in this regard. As a result of this effort,

Australia's CSIRO, Germany's Fraunhoffer Institute, France's INRIA, and the Netherlands' Wageningen have set up shop in Chile. The working agreement calls for each of these institutions to receive US$20 million in funding, with a 20% offset over five years that can be covered by staff contributions.

Selectiveness in Innovation Support Policies

Innovation policies implemented in the region largely favor horizontal or neutral sector interventions, with subsidies to business demand as the main intervention-driving mechanism.

The predominance of this approach has been criticized on two grounds (Cimoli et al. 2005). First, the fact that the likelihood of obtaining resources hinges on the proactiveness of potential beneficiaries creates a bias for those with the most developed capabilities, which can lead to a deepening of the existing diversity in the productive structure. Second, it is argued that the interventions do not help create a critical mass of capabilities in any sector, which undermines the ability to drive a productive structure transformation process capable of creating a shift toward higher value-added activities.

The traditional objection to a more selective public policy approach is that the state cannot replace the market's resource allocation ability, so that a desire to support winning sectors may result in backing activities that ultimately fail to take off. While the relevant debate in the region has been rather ideologically charged, practice has shown that as countries move forward with their interventions, they also more precisely incorporate targeted efforts along the way. While ideological elements have played a role in either driving or hindering this process in specific cases, the most salient aspect seems to be the learning process created in the public sector. It could therefore be argued that innovation policies have followed an evolutionary path marked by interventions that grow increasingly complex as capabilities develop.

More selective interventions may adopt different targeting or discretion levels, making it easy to differentiate among the variations implemented throughout the region. A first type of selective interventions are those implemented within the TF framework by creating some priority sectors and/or targeted competitive processes. This is quite common in most of the countries that have TFs, as they try to prevent excessive resource dilution. The implementation of this type of selective approach, which tends

to coexist with windows available to projects from non-priority sectors, requires no special efforts from public agents.

A more complex intervention type seeks to establish research centers/business partnerships or agreements aimed at undertaking R&D activities deemed relevant for business competitiveness. In these cases, no specific project is funded, but a comprehensive research agenda is designed from dialogue between firms and various research institutions with the business side taking the lead. These are generally efforts with at least a four-year horizon involving major deployments of financial resources and research capabilities. The partners in these arrangements tend to be relatively large corporations.

Structuring a partnership is difficult work, as it entails not only forging agreements among the players that operate under dissimilar ways of thinking and seeking different goals but also identifying relevant research topics that simultaneously enable all participating business players to share in the created knowledge. However, the results can have major impacts. A relevant example is the case of the partnership of Chile's state-owned mining company CODELCO and Nippon Mining to undertake research in biotechnology applied to copper refining. To that end, a joint venture (Biosigma) was established in 2002, exclusively focused on generating derivative products from its R&D and already holding a number of patents.

The debate over the neutral or selective nature of public intervention in our continent has been highly tinged with ideological notions. Assessments of some of the targeted cases that have been implemented show some interesting results that could help place this discussion in a more pragmatic light.

An initial aspect to consider is that selective interventions demand substantially higher public sector capabilities than horizontal interventions. The biggest challenge facing the public sector in implementing horizontal instruments is designing them so that the incentives actually move the users in the intended direction. Selective action poses at least two additional challenges. On the one hand, the public player must possess a deep knowledge of the technological and commercial realities of the targeted sector, and the trends influencing its development. On the other hand, selective action involves the need to invest efforts to encourage different players to act on shared goals. Not only is it necessary to help identify collaborative spaces among businesses but also to successfully harmonize the actions of the business world with those of the research world.

A second aspect to consider is the scope of the selective approach. The approach taken by the countries that have advanced along this path suggests a higher degree of relevance of selective actions in capacity building and actions with a high content for the public good, including joint tasks. Selectiveness makes it possible to focus limited resources in certain areas in order to achieve a critical mass, which would otherwise be quite difficult to do given the high investment cost needed to develop leading capabilities in any given field. From this perspective, selectiveness is not contrary but rather complementary to a horizontal approach, as suggested by Brazil's innovation policy.

Lastly, it is important to stress that selectiveness should not be looked at as synonymous with arbitrariness. In the many experiences implemented so far in the region, there is no record of forcible resource allocation. Funded projects or programs were selected through merit assessment processes. Maintaining this standard is key to preventing resource misappropriation. It also requires maintaining an adequate system to follow-up and monitor the quality of funded efforts, which requires further development throughout the region, although major advances have been made in this regard as will be seen below.

New Players: Support for New Dynamic Enterprises

The pace of innovation in any given country does not depend solely on the behavior of existing businesses, but also on the entry of players introducing new ways of doing things. However, not all businesses are the same. As pointed out by the IDB (2011), there are many companies in Latin America; however, the majority are not productive. The reason is that many of these companies were established as a response by their creators to a lack of other opportunities for earning a living, and they do not necessarily have much potential for growing into dynamic sources of employment and well-paying jobs. From a growth perspective, the goal is to promote the creation of what are known as dynamic companies, which provide a high potential for short-term expansion due to their innovative nature. These kinds of businesses are decidedly scarce in the pool of start-ups created every year, but analyses show that they account for a very significant portion of the newly created stable jobs in the economy (Bos and Stam 2011).

Recognizing the key role played by start-ups in the productive transformation process explains why start-ups policies in most OECD member

countries have been shifting from support for small and medium-sized enterprises (SMEs) toward innovation as a growth factor (Dalshtrand and Stevenson 2007). The inherently innovative features of agile start-ups make accessing credit difficult for them early on which is why venture capital is considered the ideal funding source for these types of enterprises.

Interest in supporting dynamic start-ups in Latin America dates back to the second half of the 1990s and reflects the influence of the strong growth experienced by businesses in the nascent CIT sector, particularly in Silicon Valley and Israel. Acknowledgement of the role played by venture capital in both cases, as well as the importance of some public programs intended to help their development, drove several countries in the region to establish effective policies aimed at triggering the launch of the venture capital industry.

Early efforts focused on promoting the establishment of venture capital funds. A number of countries set up public funding facilities under favorable terms with a view to enticing private players to generate funds. Professionals were trained how to properly function in the industry and fund-managing firms with international expertise were encouraged as a way to transfer know-how. These actions aimed at promoting venture capital were accompanied in some countries (Brazil and Chile being the most salient cases) by a set of regulatory and taxation reforms intended to create a favorable environment for the development of these types of investment instruments.

To a large extent in response to results that were less promising than expected, this approach was increasingly expanded to give way to an approach that sought to serve start-ups based on their needs along their development phases. This is in line with a more systemic rationale that saw venture capital as one of the last links in the development life cycle of dynamic enterprises, and one that cannot advance without a nurturing source of good projects. This has resulted in initiatives that include, among others: support for business plan contests; incubator and pre-incubator promotion (particularly in universities); seed capital programs; support for the creation of angel investment networks; and even actions aimed at promoting entrepreneurship through the inclusion of special courses at varying levels of education.

Despite advances in policy design and implementation in this field, outcomes remain rather scant in the region. Even in the case of Chile, results are rather poor (Rivas 2014) despite the fact that this country has headed the Latin American Venture Capital Association (LAVCA)

ranking for regulatory environment conditions and venture capital development policies for many years (LAVCA 2011). Brazil and Mexico (particularly the Monterrey area) show the most encouraging outcomes. The reason here seems to not only reflect the size of these economies but above all the relatively higher level of progress of their technology-based businesses.

Consequently, promoting the creation of venture capital funds in most Latin American countries does not look especially promising, at least not as long as there is a lack of systematic innovation-producing capabilities. There will eventually be a few success stories, but their contribution to economic transformation processes will not be significant, though this is not to say they should abandon the promotion of innovative or high-potential businesses. The emphasis should be in targeting support in the early stages of such projects. Seed capital programs with public support can play a significant role, particularly if they engage private participants.

Institutionalism and Direction of Innovation Support

The conducted analysis shows that there have been a number of initiatives with positive results, not only regarding the strengthening of capabilities but also with respect to incentives for entrepreneurial innovation. However, these efforts are mostly of insufficient magnitude, weakly interconnected, and often short lived. Except for the case of Brazil, innovation does not currently appear to be a core element of growth and competitiveness policies, as reflected both in resource allocations to promote it and its position in the public policy agenda.

While innovation is ultimately the result of business action, the state must play an active role in building capabilities, generating incentives, and in many cases, providing the necessary resources needed for it to occur. However, in order to be effective in this regard, public policy must overcome at least three challenges. First, the systemic nature of innovation raises the challenge of linkages and governance of many different players who pursue objectives and actions that may vary greatly, depending on their scope of action, distance to markets, nature, and goals. Second, the relevant scope of interventions is considerably broad, ranging from regulatory to financial aspects, and in many cases includes very specific sector

considerations. Third, the changing nature of challenges and the relatively long lead times of projects add to the difficulty of fostering cohesive policy over time.

The complexity inherent in these challenges makes it imperative to establish an institutional framework conducive to a stronger financial effort aimed at promoting innovation and allowing various government agencies to coordinate decisions and maintain consistent policies. Some Latin American countries have recently seen progress on this front through a variety of institutional arrangements. In order to draw lessons from these experiences, three levels of analysis have been identified: strategic, political, and implementation. The relevant institutional framework required for these three levels will not deplete a country's institutional capability for innovation, but it will establish a baseline for effective public action to develop a system to its full complexity.

The Challenge of Building a Broad Agreement for Innovation

Successfully instituting innovation as an effective competitiveness factor requires time and sustained effort. However, persistent public action in this area is hindered by the very nature of the objective itself. Unlike areas such as health, education, or infrastructure, the outcomes of successful action in the field of innovation are not immediately visible to the public. Innovation is also not a goal with a clearly defined interest group behind it that could press for support. In most countries, the business community—arguably the clearest candidate for this role—first needs to be convinced or encouraged to take on the challenge of innovating. Therefore, with few exceptions, its members do not become active supporters of innovation policies. For its part, the scientific and academic community focuses on promoting science—which is undoubtedly essential—but it does not reflect the global challenge faced. Additionally, scientists are skeptical about speeches pushing innovation as a policy goal, concerned that this will reduce the resources allocated to scientific activity. A zero-sum game of sorts is thus played that divides the very players who should cooperate to promote a sector facing a multiplicity of development needs.

Several countries have set up commissions to prepare situation reports and corrective action proposals. A few have tried to make such commissions more enduring by establishing public–private councils that try to combine the views of business and academic circles and define strategic

priorities in support of public policy design. Nevertheless, most of these efforts wind up drafting a document that is then submitted to the government and the general public and ultimately either fails to translate into concrete action due to insufficient resources or ends up being diluted into an ineffectual piece of public action guidance, particularly when the administration behind the effort reaches the end of its term in office.

Beyond differences in approach, there is an increasingly widespread agreement in the region regarding the importance of promoting innovation to drive competitiveness. The challenge lies in translating this growing consideration into policies that are consistent over time, which in turn requires a minimum level of agreement on the role that the public sector can and should play.

The case of Chile's National Innovation and Competitiveness Council (Consejo Nacional de Innovación y Competitividad, CNIC) stands out among the efforts to vest innovation promotion with an increased ability to provide strategic direction. This agency was established in 2005 with a mandate to advise the Office of the President on innovation- and competitiveness-related policies encompassing the areas of science, human resource training, and technology development, transfer, and dissemination. This was triggered by the establishment of mandatory fees on all copper mining operations (known as the mining royalty, "*royalty minero*"), whose proceeds went to increased spending on innovation and competitiveness promotion. The intent was to create a highly independent entity endowed with a horizon longer than that of the incumbent administration, in order to make policies more stable and introduce impartiality safeguards in the use of resources.

The CNIC was organized with input from representatives of the public sector (ministers of the related ministries), as well as of the business sector, innovation- and competiveness-related academia, and the scientific R&D world, to assure comprehensive sector representation. Contrary to other experiences in the region, CNIC's design combined two features that gave it influence and assured it a lasting presence. First, it was tasked with advising Chile's government on allocating mining royalty proceeds through the Innovation and Competitiveness Fund (Fondo de Innovación y Competitividad, FIC). Second, it was staffed with 12 specialized professionals and was given resources for funding research and assessment projects. This enabled CNIC to monitor strategy progress, periodically update strategy, and in general act as lookout for new challenges to the system.

Despite these design strengths, CNIC's strategic guidelines failed to remain fully up to date when the new governing coalition took office in 2010. This seems to suggest a major lack of agreement on the country's relevant strategic options, and it further revealed that even a very good institutional design cannot make up for a lack of basic consensus on the characteristics necessary for official state interventions.

Chile's experience elicits a question about the need to translate some policy compromises into legal frameworks that make policies more stable. In Brazil, the passage of the Sector Funds Act actually reflected the search for a mechanism to assure the continuation of funding for innovation promotion in certain sectors (Pacheco 2005). In the Chilean case, Congress' inability to agree on a law establishing and regulating the FIC and the CNIC left royalty proceeds intended for innovation—as well as the very existence of the CNIC—subject to the discretion of the executive branch, which at any moment could produce a sudden, unexpected shift in the allocation of these resources and even making the disbanding of the CNIC a very real possibility. Although none of this has happened so far, it remains feasible. While this is not the same as stating that the establishment of law is the best way to promote innovation, the law itself can contribute to greater stability and certainty of societal agreements about innovation.

Drafting and Implementing Innovation Policies

Early efforts to create an authority to govern science, technology, and innovation policies in Latin America came about in the 1960s, with the establishment of scientific–technological councils. Several countries statutorily established these entities as the sector's governing bodies. This arrangement reflected a linear view of innovation, which bestowed the core responsibility for scientific and technological research upon these bodies and saw businesses simply as adopters of any new developments. As the understanding of innovation as a complex, systemic process gains currency and countries dedicate more efforts to this area, there is a move toward establishing governing bodies of higher political ranking, with expanded responsibility and broader purview. Additionally, operational duties have been gradually taken away from political leaders in favor of a specialization process in aspects such as regulatory design, priority setting, and intervention coordination and supervision.

Different countries have experimented with a range of ideas to enhance the political relevance of innovation. For instance, Argentina, Brazil, and Costa Rica have created science, technology, and innovation ministries. Chile has delegated management to its Ministry of Economy and has created an Inter-Ministry Council for Innovation. Uruguay has set up a cabinet-level innovation agency, though it has not appointed a responsible minister, while Panama's SENACYT Secretary attends cabinet-level meetings with the President of the country. At first glance, establishing a dedicated Innovation Ministry seems the obvious course of action for elevating the profile of innovation promotion. This sends a clear political signal about innovation's importance. Additionally, having a ministry responsible for guiding relevant public policy could enhance coordination within the system. The implication here is that these entities would be properly equipped with the tools required to perform their governing duties, although this is not necessarily the case.

The clearest example in this area is Costa Rica's Ministry of Science and Technology, which has no effective administrative or guardianship powers over the public resources allocated to promoting science, technology, and innovation activities in the country, nor does it have a staff of professionals who would enable it to exert some influence through specialized knowledge. As a result, its ability to influence the direction taken by the innovation system has been severely limited, as has its ability to promote a higher level of coordination in its operations.

The relevant authorities' competencies to manage the system are similar in Argentina, Brazil, and Chile. These competencies correlate with the ability to influence public resource allocation to the sector, as well as with the potential value added to the system by designing policies based on specialized management of information and knowledge. Also, the challenges that these countries face in coordinating public efforts are comparable; in no case can cabinet-level authorities tasked with promoting innovation take charge of all the policy spheres relevant to the task at hand. For instance, in all cases, policies pertaining to higher education and human resource training in general fall under the purview of the education ministries.

One way to promote better linkages among the various players has been the use of national science, technology, and innovation programs. The use of this tool is growing throughout the region, and in some cases is a legal obligation. These programs can contribute greatly to guiding government action, provided their design is undertaken early on

by incoming administrations; clear priorities are established; budgetary backing for proposals is available; objectives have verifiable indicators attached to them; and effective follow-up mechanisms are in place. There are some such good experiences in the region, even in countries with less of a tradition in this field, such as Panama.

From the design and implementation standpoint, innovation policies face three major challenges in the region: improving information capabilities for decision-making; expanding their sector reach; and integrating the public policy tools used.

Most countries lack mechanisms for producing and processing information intended to nurture innovation-related decision-making processes. In any case, it is encouraging that those countries that have assumed a deeper commitment in this regard have increasingly strengthened their technical capabilities as well as their production of decision-making inputs (OECD/ECLAC 2011). For instance, five countries—Argentina, Brazil, Chile, Colombia, and Uruguay—conduct regular surveys to measure innovation depth and practices among businesses. Additionally, there have been impact assessments made to measure the performance of public intervention instruments in all of these countries, although this has been established as a systematic practice only in Brazil and Chile. On the other hand, all of these countries have created or strengthened teams of specialized professionals tasked with supporting policy design. A prominent case in point is that of Brazil, which in addition to the Ministry's own professional staff, relies on input from the Center for Strategic Studies and Management in Science, Technology, and Innovation (CGEE), an independent entity affiliated to the Ministry that focuses on conducting innovation analyses.

Nevertheless, even taking into account these advances, both information production levels and the availability of analysis capabilities in more specific intervention areas continue to lag far behind prevailing levels of most OECD members, as evidenced by reviews of covered areas and the wealth of statistical material published in OECD journals.

As innovation has positioned itself as a key competitiveness factor, the more advanced OECD members have adopted a policy approach that includes an increasing number of public entities tasked to promote innovation (OECD 2007; OECD/World Bank 2009). This "whole-of-government" approach is consistent with a systemic view of innovation that acknowledges that innovation results from the interaction of a set of conditions connected to diverse public policy areas which must be adequately coordinated to produce desired outcomes.

This broader outlook of the relationship between public management and innovation is also reflected in an extension of the policy instruments used, particularly with definitions in statutory and regulatory arenas. A case in point is that of environmental regulations, where there is ample evidence that higher demand leads to increased innovation, particularly when accompanied by support programs targeted to businesses (Blind 2012). By establishing the Sector Funds and linking its industrial policy objectives and innovation, Brazil is the only country in Latin America and the Caribbean to have advanced to a more comprehensive approach to public policy in this field. In the other countries, a more limited view still prevails that focuses on developing scientific and technological capabilities and encouraging business demand.

Advances and Challenges in Implementation

Over the past few years, countries in the region have come to agree more and more on the importance of having specialized entities for designing and implementing innovation-supporting instruments and programs. This trend is a positive shift from previous approaches that prioritized implementation by ministries or, alternatively, handed program implementation over to domestic or foreign private entities—in a bid for transparency and operating flexibility.

By having specialized agencies in place, countries can rely on entities that operate with more flexibility than ministerial agencies and whose professional teams tend to be more stable than those working in ministries (Angelelli et al. 2006). The upswing of this type of agencies is normally associated with the recognition of the technical nature of the intended activities, which imparts its actions with a higher level of independence vis-à-vis the typical shifts occurring in the political arena, and makes possible merit-based hiring practices. In turn, such features make it likely that these agencies will become environments for learning and sustained improvement in intervention design.

There are two organizational models for the institutionalization of support for science, technology, and innovation efforts in the region. Some countries (e.g., Brazil and Chile) have set up separate entities for supporting scientific research development (including advanced human resources training) and for supporting business innovation, while others (e.g., Argentina) have placed these functions under a single entity. Colombia

and Uruguay have also taken substantial steps in recent years for strengthening their capabilities in this regard.

Countries with specialized entities have produced a broader range of interventions and have explored more complex efforts. To a great extent, this is a result of better instrument design capabilities, but also because these organizations are able to identify emerging needs in the system through their own operation. The risk, however, lies in coming up with an excessively wide range of instruments.

These organizations should seek mechanisms that allow them to delegate the operation of instruments for which acquired routines are already in place, so they can focus their efforts on more complex and higher-impact interventions. This opens up opportunities for establishing partnerships with other players in the system to act as the operators of these instruments—with relevant safeguards. Additionally, this is an opportunity to foster higher levels of geographic decentralization in promoting innovation, a task that is still pending in virtually every country.

Policy Recommendations

In a context of generalized under-development, Latin American countries demonstrate varying degrees of development in their innovation support systems, along with a variety of policy and institutional experiences. There are interesting success stories as well as failed attempts, but the most distinctive feature in the region's path is not related so much to the results of the efforts as to the scant volume and inconsistency of efforts. These two elements are mutually reinforcing: Without an increased commitment of public resources, these efforts are not sustainable over time and will fail to yield satisfactory results, but without persistent actions to build capabilities, a sudden increase in resources will not achieve results either.

A review of experiences shows that there are no shortcuts for achieving strong progress in this field. Rather, it is an evolutionary process combining capability development of the actors who carry out science, technology, and innovation activities with the accumulation of knowledge by those responsible for designing and implementing public policy. A set of useful elements to be factored in when designing and implementing interventions can be derived from this approach, particularly considering that virtually every country in the region, regardless of its developmental stage, is interested in turning innovation into a more relevant competitiveness factor.

Developing and Strengthening Institutions Is Key to Producing Knowledge and Providing Continuity to Efforts. Only those countries whose specialized public entities are well established and strong have successfully persisted in promoting CIT activities. Where these entities are missing, there is no possibility of accumulating knowledge and expertise in a field where public action operates on the basis of incentives that must be carefully designed in a framework of fluid interaction with the players. As accurately highlighted by Hausmann and Rodrik (2003), challenges in this type of setting vary from one case to the next and evolve over time, so that there are no recipes for the precise type of instrument to use. Effective public action in this area hinges more on assuring process quality than on an abstract definition of instruments to use. To be sure, it is not easy to create public entities that are capable of effectively and efficiently carrying out this task, nor is this something that can be achieved in the short term, but the trajectory of an increasing number of countries in the region shows that this is not only necessary but possible.

Taking (a Real) Systemic Approach to Policy. References to a national innovation system approach are now commonplace throughout the region, and furthermore, true to the prevailing formalist tradition, some countries have enacted laws for creating such systems. Policymaking often departs from this approach, however, which causes the deployment of efforts that are incoherent or based on extremely simplistic approaches to innovation. A typical example of this is the bizarre and outdated confrontation—still observable in many countries—between advocates of the preeminence of scientific and research development and advocates of absolutely privileging business demand. Though there is the possibility that corporate interests may be behind these positions, public policy should avoid these false dilemmas and instead follow an approach that encompasses the various aspects that combine to produce innovation. Inevitably, advances so achieved bring about new challenges in ancillary areas. So, for instance, incentivizing business innovation soon runs into an obstacle created by a lack of adequately trained personnel, which in turn are impossible to train when research capabilities are not developed.

In order to fully adopt this comprehensive approach, policy should be enriched through continuing dialogue and consultation among the various players in the system. This process should be sustained over time, rather than a sporadic exercise that fades into oblivion soon after its inception. Another key element in guiding policymaking is the

production of information and knowledge. Several countries already have well-established data-gathering and periodic surveying systems in place that provide them with more accurate baselines to inform the debate, although this is far from a widespread practice in the region. Even scarcer are efforts aimed at producing more knowledge at the sector level, an essential element in guiding policy in terms of the "discovery" of areas calling for interventions (Hausmann and Rodrik 2003). Assessing intervention impacts is also an emerging practice that needs to be consolidated. Strengthening these capabilities, both in the public sector and in academia, is undoubtedly a priority as most countries are still making blind decisions in this field.

A review of the paths followed by the most advanced countries in stimulating innovation shows that their advancement involves not only more resources but also increasing complexity in public action. This higher degree of complexity comes both from including more focused or selective interventions and from the need to strengthen the connections and links among system players, which in turn translates into the establishment of new entities—public or private—to carry out this function. This transition is not without challenges, however, and should not be underestimated.

Integrating Intelligent Selectiveness in Public Action. Exercising selectiveness in public action is a natural option in a context of limited resources. Paradoxically, this option could be even more compelling in natural resources-based economies, since they face challenges associated with their specific farming, climate, or water conditions, or with the development of new uses for resources that, for example, do not need to be included in the research agendas of other countries. Additionally, having natural advantages available in certain sectors opens up clear possibilities for promoting related activities, thereby easing the selection process. But, beyond discussing its merit, selective action requires developing or incorporating new capabilities among public policy makers, as well as defining certain criteria for guiding interventions, so as to prevent falling into volunteerism.

Investing in the Development of Linking Agents. A partial explanation for the difficulty of this development is that it requires funding entities to be tasked with this function, which is normally viewed with some reluctance, as it is considered an additional cost in resource allocation rather than as a source of added value. This reluctance is also based on the difficulties inherent in properly channeling the work of many public technology institutes, which in some cases have ceased to fulfill a relevant function

for some time. Sadly, this is an area heretofore lacking exemplary experiences suitable for outright replication, although it does require further attention.

Expanding the Scope of Innovation Policy. OECD member countries have been moving toward an innovation policy approach that encompasses all governmental spheres (whole government approach) for some time now. So far, innovation promotion in the region has tended to remain constrained to the realm of the organizations that traditionally operate in this field and to use tools that are primarily financial in nature. Reliance on statutes and regulations, or participation by more players, in public policy geared toward higher innovation levels has been scant. Only Brazil, with its Sector Funds, demonstrates a tighter connection between innovation policies and those advanced in other relevant public agenda areas. There has also been some application of regulatory measures in this area that take into account their effect on innovation (e.g., as with fuels).

Implementing a Proactive Policy of Linkages to Foreign Investment. While countries such as Costa Rica and Mexico, not to mention Brazil, have greatly benefitted from the influx of foreign companies, efforts to foster linkages and technological spillover effects into local businesses have been few or of mixed success. This marks a significant difference from the experience of both Southeast Asian nations and countries on the periphery of Europe, which have implemented policies explicitly aimed at boosting the transfer of knowledge and technology from multinational corporations that set up shop within their borders, and that today vigorously advertise themselves as sites for R&D centers.

Taking Advantage of Regional Integration. Lastly, it is worth highlighting the heretofore virtually unexplored potential of regional integration. Contrary to what is happening in Asia or Europe, intra-regional trade in Latin America is quite low. There are various explanations for this situation, which undoubtedly include the decades-long institutional and macroeconomic instability plaguing the region. Nevertheless, as stability slowly becomes part of the scene, new options will emerge that would be worth exploring. For instance, existing deposits in Chile and Peru make up the world's top copper-mining district, yet both countries occupy leading positions in several fruit-producing segments. This kind of dynamics generates a critical mass of technological demand that should guide the joint efforts of both the research and business communities in the countries involved. The path to follow, however, does not appear to be that of

agreements among leading sectors, but rather to support specific cooperation efforts both at the level of R&D projects and joint business ventures. The long-lasting experience of the European Union should be a source of lessons in this regard.

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CHAPTER 6

Productivity, Education, and the Economic Inclusion of Workers and Small Firms in East Asian Development

Frederic C. Deyo

Introduction

East Asia's much-heralded "economic miracle" has generated a vast literature on the role of manufactured exports in generating growth in economies lacking natural resources and agricultural potential. That growth, made sustainable by continuing technological advance, has brought favorable social outcomes as well, particularly in Japan, Korea, and Taiwan. These outcomes include comparatively low levels of income inequality, dramatic reductions in poverty, improved standards of living, and the emergence of dynamic small enterprises in key economic sectors.[1]

Focusing on two quite different exemplars of the East Asian miracle, South Korea (hereafter Korea) and China, this chapter seeks to assess the role of policies relating to education, worker training, and small enterprise development in linking technology-led manufacturing growth and social improvements, with an eye to policy lessons for other developing countries.

The chapter begins with an assessment of the social outcomes of East Asia's economic growth, focusing on the developmentally critical manufacturing sector. Confining attention to manufacturing facilitates

F.C. Deyo (✉)
Department of Sociology, State University of New York, Binghamton, NY, United States

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comparisons across countries with quite different national economic structures. I ask to what extent workers in the manufacturing sector and in small and medium enterprises (SMEs) have shared in the benefits of innovation-based technological upgrading and industrial advance in the rapidly growing export-oriented economies of Korea and China. I then ask how education and SME policies have influenced those social outcomes for workers and small firms. A variety of redistributive and social safety net programs (e.g., welfare programs, national health insurance, social security, and retirement systems) would seem to offer a natural starting point for a discussion of socioeconomic inclusion, particularly with respect to vulnerable groups and populations. Nonetheless, I confine my attention to policies and programs that most directly link technology advance with social betterment, thus variably promoting economic opportunity and mobility within, rather than outside or beyond, employment structures and production networks themselves.

While this chapter deals primarily with Korea and China, I include Mexico in several of the preliminary tables and discussion in order to offer a point of departure for the chapter on Mexico (Chap. 7). I also make brief reference to Taiwan and the Philippines, whose quite different experiences help contextualize and extend the policy lessons one might draw from Korea and China. The Taiwanese contribution relates to highly successful science-based industrial parks and domestic SME promotion, while the Philippine case illustrates the less positive social outcomes of reliance on foreign investor-dominated high-tech industrial exports without significant efforts to encourage research and development (R&D) localization, tertiary science and engineering studies, or local supplier networks.

Growth, Productivity Gains, and Economic Inclusion

Chapter 1 makes clear the broad social gains associated with East Asian development. I turn here to a more focused look at the links between economic growth, manufacturing productivity, and outcomes for workers. More specifically, I ask if workers have shared innovation-driven productivity gains through corresponding improvements in pay levels and occupational advance.

Table 6.1 presents available data on labor productivity and compensation levels for years after 1995 in four of the five countries mentioned

Table 6.1 Labor's share in manufacturing productivity gains

Country	*Value added per industrial worker*[a]			*Real manufacturing labor compensation*[b]		
	1995	*2010*	*Annual gain (%)*	*1999–2000*	*2008*	*Annual gain (%)*
Korea	38.8	91.8	9	1,476	2,758	10
China	3.1	10.8	17	650	1,674	20
Philippines	7.6	9.8	2	9,256	10,687	2
Mexico	13.4	27.5	7	71	80	1

Sources: World Bank, World Development Report, 2013 (for value added); ILO, ILO Laborsta (for labor compensation)

[a]Value added in 2005 US thousand dollars
[b]Direct pay plus benefits in national currency

above. The table suggests that worker compensation in manufacturing sectors has largely tracked rapid productivity gains in Korea and China.[2] By contrast, pay stagnation has reflected negligible productivity gains in the Philippines, while lagging Mexico's somewhat greater productivity gains. While Taiwan cannot be included in the table because of lack of information, other indicators suggest that Taiwanese workers have not done as well as their Korean counterparts although they have clearly shared in the gains of improved productivity (US Bureau of Labor Statistics 2013).

Other measures of labor's inclusion in the benefits of industrial expansion and technology upgrading include job creation, occupational mobility into higher skill jobs, increased responsibility and autonomy, employment security, and better conditions of work. From the standpoint of job creation, Table 6.2 shows that the percentage of manufacturing employment in total employment has in most cases remained flat or, as in Korea and Mexico, declined. Most notable is the case of Korea, where manufacturing's growing share of GDP has been accompanied by a sharp and continuing decline in manufacturing employment. As labor-intensive production in Korea has gradually been displaced by automation (especially robotization),[3] production outsourcing, and the rapid expansion of modern service/finance sectors, the employment of production workers has declined. By contrast, Chinese manufacturing employment has remained at high levels following an earlier surge in the 1980s and early 1990s.[4] From the standpoint of paid labor, Taiwan stands out as retaining large numbers of manufacturing production workers, a trend in part reflecting stable unit labor costs despite rising pay levels, as discussed below.

Table 6.2 Manufacturing output and employment

Country	*Manufacturing as share of GDP (%)*		*Manufacturing employment as share of total (%)*		
	1999	*2012*	*1999–2001*	*2007–2008*	*2011–2012*
Korea	28	31	26	22	17
China	32	32	30	29	28
Taiwan	24	24	28	28	27
Philippines	23	21	14	12	na
Mexico	20	17	24	19	na

Sources: World Bank, World Development Indicators, online (for manufacturing as share of GDP); ILO, ILO Laborista (for manufacturing employment as share of total employment)

A further question asks whether industrial advance has been associated with a workforce transition from traditional, labor-intensive "light" industries (especially in the dynamic export manufacturing sectors) to "higher-technology" industries. Table 6.3 provides data on employment shifts across low- and high-technology light industry and heavy industry sectors.

With the exception of China, all these countries have seen declines in the percentage of manufacturing workers employed in traditional light industries (e.g., textiles, clothing, footwear). Taiwan and Korea lead in high-tech employment, while Mexico lags well behind.[5] The Chinese data reflect continuing traditional light industry production alongside stagnation and a scaling back of state-enterprise heavy industry, increasingly displaced by export-oriented high-tech electronics, pharmaceuticals, and other industries. In many cases, these have been financed by foreign direct investment (FDI). Korea, by contrast, shows increased employment in such heavy industries as steel, motor vehicles, aircraft, ships, and other transportation equipment. Finally, increased high-tech employment in the Philippines largely reflects the developmental cul-de-sac of growth of semi-skilled electronics testing and assembly during the 2000s.

Inasmuch as technology-intensive industries tend to offer pay levels and work conditions generally superior to traditional ones, this transition should bring some gains to workers. Partial confirmation of such positive gains comes from comparative data on sub-industry pay levels for workers in these countries. Table 6.4 offers further confirmation for Korea of the positive relationship, in this case at the sub-industry level, between worker value-added and pay levels, with the exception of that country's

Table 6.3 Industrial distribution of manufacturing workers by selected ISIC categories (as share of total manufacturing employment)

Country	*Traditional light manufacturing*[a] *(%)*		*High-tech manufacturing*[b] *(%)*		*Heavy/chemical industries*[c] *(%)*	
	1990s	*2000s*	*1990s*	*2000s*	*1990s*	*2000s*
Korea[d]	22	15	12	21	27	33
China[e]	17	18	7	17	46	28
Taiwan[f]	20	17	25	25	21	19
Philippines[e]	29	21	7	17	8	11
Mexico[g]	27	23	10	11	19	20

Source: Deyo (2012: 76). Percentages do not total 100% due to the exclusion of several categories

[a]Textiles, wearing apparel, leather products and footwear, and plastic products
[b]Light industries with high R&D content: electrical machinery, electronics, communications equipment, professional and scientific instruments
[c]Basic and industrial chemicals, petroleum refining, basic metals (including iron and steel), non-electrical and general purpose machinery, vehicles and transport equipment
[d]Years are 1995 and 2008
[e]Years are 1990 and 2008
[f]Years are 1999 and 2002
[g]Years are 1999 and 2008

Table 6.4 Value added and compensation in selected industries

Sector	*Korea*[a]	*Korea*[b]	*Taiwan*[b]	*Mexico*[b]
	Value added per employee	*Hourly compensation*	*Hourly compensation*	*Hourly compensation*
Textiles	10.8	13.4	7.3	3.9
Apparel	7.6	16.0	na	2.9
Electronics	16.7	24.3	11.3	5.2
Machinery	17.6	18.2	na	6.6
Vehicles	47.5	25.7	10.0	7.8

Sources: UNIDO, International Yearbook of Industrial Statistics (for Korea value added); US Bureau of Labor Statistics, "International Labor Comparisons," August 2013 (for hourly compensation)

[a]Value added for 2007 in thousands of current US dollars
[b]Compensation for 2012 in current US dollars. Compensation costs combine direct pay, benefits and social insurance, and labor-related taxes incurred by the employer. The inclusion of the taxes, as well as the conversion to current US dollars, renders these figures problematic for this analysis

Table 6.5 Average wages in selected industries, China

Sector	*Average wages*[a]
Textiles	21,735
Apparel/footware	23,710
Computer equipment/electronics	36,156
Machinery	32,749
Vehicles	40,493

Source: People's Republic of China, National Bureau of Statistics, China Labor Statistics Yearbook

[a]Data are in Chinese yuan for 2010. Data were not converted into US dollars (as in Table 6.4) because of distortions created by managed Chinese exchange rates

highly automated/robotized vehicular manufacturing. More generally, compensation data for all these countries suggests the generally positive outcomes for workers of a structural transition to more technology-intensive industries. Data for China (in yuan) can be seen in Table 6.5.

Productivity gains, if shared with workers, link competitiveness and inclusion by holding down unit labor costs even as pay levels rise. This positive conjuncture, a hallmark of East Asian success, better characterizes the growth experience of Taiwan during the 2000s than it does that of Korea, whose more sluggish productivity gains alongside faster pay increases have resulted in growing unit labor costs and the emigration of manufacturing jobs to China and elsewhere. By contrast, a closer relationship between productivity and worker compensation in Taiwan has led to declining unit labor costs, the continued competitiveness of domestic manufacturing, and retention of manufacturing employment, despite rising pay levels.[6]

The Chinese experience has been more mixed, with wage gains increasing unit labor costs during 2007–2008, but failing to further increase those costs in 2009–2010 as productivity growth increased disproportionately (World Bank, *China Quarterly Update*, 2012). During the longer period 2004–2011, Chinese unit labor costs rose modestly from 0.19 to 0.22 (Fang and Yang 2013).

Our best evidence of positional upgrading comes from Korea, where the ILO reports an increase in the percentage of professional and technical manufacturing workers from 8 % in 1994 to 15 % in 2007 (ILOSTAT). Kapri (2013) further confirms these trends in his finding of an increase during 2002–2009 in the percentage of Korean workers who may be

classified as skilled, from 40 to 43%. Relatedly, ILO data show a continuing reduction in the percentage of machine operators and assemblers in total Korean manufacturing employment from 32% in 2009 to only 19% in 2012.[7] Indicative of Taiwan's transition from labor-intensive to skill- and technology-intensive industry is a marked increase in that country's index of human capital intensity in manufacturing from 35 in 2000 to 100 in 2011 (ROC, *Statistical Yearbook of the Republic of China*, 2012).

While these data support optimistic accounts of economic change in East Asia from the standpoint of overall national trends in employment and aggregate earnings, more critical accounts note continuing or growing employment disparities and segmentation within the working-class populations of these economies. These disparities are troublesome not only from the standpoint of worker inclusion in Asia's miracle economic growth, but point as well to significant costs in human capital development associated with the economic exclusion of large segments of the workforce from the benefits of technological advance. They thus point to continuing developmental challenges to economic policy in East Asia. Two examples of such segmentation, between regular and contingent workers in both Korea and China and between urban workers and migrant workers in China, illustrate the socioeconomic costs associated with such outcomes as well as the ways in which they may be addressed through policy.

Korea's transition to more technology-intensive manufacturing activities has been associated with a growing divide between "regular" workers in large companies and growing numbers of "contingent" or "non-regular" (contract) workers in both large and smaller companies. The decade of the 2000s saw a continuing shift from long-term, protected, and variably unionized employment to contingent employment, even among technical workers and university-trained engineers. During the 2001–2007 period, over half of all Korean workers were engaged in non-regular employment (Kim 2007).

The shift to contingent employment in Korea, beginning in the early 1990s, has been encouraged by structural changes associated with the growth of dynamic, technology-focused start-up SMEs; increased emphasis on flexible production systems and technologies among companies; and national legislation initially enacted in December 1996. It was further encouraged under the terms of the loan bailout negotiated with the IMF during the 1997 financial crisis, which enabled employers to rely increasingly on temporary workers at all skill levels. This transition to

contingent employment played an important role in Korea's enactment of the Employment Insurance System (EIS), which will be discussed later.

China shares some of these same problems with Korea, but highlights as well a further and highly problematic bifurcation: between urban resident workers and the masses of rural workers who migrate to urban centers for work.[8] Migrants have overwhelmingly taken up work in labor-intensive export factories, but they have been denied access to the social services and educational institutions available to local urban residents. Training opportunities and mobility into better-compensated and secure employment have largely been blocked for most of these workers. I return to this important exclusion below and to government efforts to address it.

Accounting for East Asia's Social Gains: The Role of Education and Training

In economic terms, education and training encourage innovation, technology learning, and increased productivity. Recent research suggests that education plays an especially important role in encouraging and supporting the structural transition to higher-technology industries and better paying jobs (Kapri 2013). At the same time, education and training offer social benefits through a pathway to well-paid employment and career mobility in more dynamic, skill- and technology-intensive sectors. In the context of a continuing loss of non-market-based sources of livelihood, a shrinking social wage in many developing countries, and a corresponding heightened dependence on wage employment, education assumes ever-greater importance. Absent a skilled and well-educated workforce, firms may pursue technological advance through automation, attracting foreign workers, international outsourcing, and other means that bypass and marginalize large portions of the local workforce, thus encouraging a downward socioeconomic spiral with unpredictable political consequences.

In China, Korea, and Taiwan, education and training priorities have historically been guided by a "productivist" agenda that subordinates social policy to the imperatives of economic growth (Holliday 2000; Deyo 2012). As market-oriented reform has gradually undercut more direct developmental interventions by government, this productivist approach has increasingly emphasized human capital formation to bolster technology learning and productivity. Singapore is broadly recognized as the first Asian country to systematically and effectively pursue this approach to development through the economic stimulus of a massive public housing

program; a Central Provident (pension) Fund whose investors could use their savings to purchase housing and whose investments helped finance ports, roads, and other city infrastructure; a 1979 boost in the minimum wage that helped push cheap labor-based production out of Singapore and that forced investors to shift to higher value-added activities; and a Skills Development Fund penalizing firms that failed to provide worker training. Singapore's emphasis on productivist social policy has subsequently influenced governments across the region, albeit in different ways depending on political pressures, economic opportunities and constraints, and other local circumstances. The following discussion assesses the role of education and training in bringing together economic and social agendas of development.

The World Economic Forum's (2013) *Global Competitiveness Report* provides a useful starting point, distinguishing among three types or stages of development relating to world market competitiveness: factor-driven, efficiency-driven, and innovation-driven. Factor-driven competitiveness relies on increased factor inputs like raw materials, capital, and work-ready labor. Efficiency-driven competitiveness is based on intensified exploitation of those factor inputs and the institutional capacity to ensure their rational allocation (in the case of workers, through labor markets) to the most productive and profitable activities. Innovation-driven competitiveness goes one step further, encompassing domestically originated R&D, product innovation and the creation of new market niches, and the instituting of new ways of organizing production.[9]

Following this typology, countries and industries in cost-focused, factor-driven sectors (e.g., traditional light manufacturing sectors) minimally require primary school qualifications ensuring basic literacy and numeracy among large numbers of low-skill workers. Efficiency-driven industries might require secondary school and two-year technical school qualifications, while innovation-driven sectors might, at least for highly skilled and technical/professional workers, rely more heavily on technical colleges and universities for both innovation and recruitment.

How well have our five countries done in achieving educational levels supportive of efficiency- and innovation-based competitiveness in high-technology industries? Data compiled by the World Bank and other UN agencies, shown in Table 6.6, suggest significant differences in educational funding and outcomes across these countries. Perhaps surprisingly, the table shows that while Mexico far surpasses Korea, Taiwan, and China in government educational funding as a percentage both of GDP and

of total government expenditure, Korea and Taiwan surpass Mexico in educational attainment at the secondary and tertiary levels. Table 6.6 also shows substantial gains in tertiary enrollments in Korea, China, Taiwan, and Mexico, although here Korea and Taiwan are far above the rest. China's significant improvement at the tertiary level lends support to an argument, discussed below, that tertiary education more than secondary or primary education,[10] provides a foundation for this country's notable capacity for innovation, which seems to have "leap-frogged" (Lee 2013: 133) the more gradual and evolutionary industrial transition, and strong reliance on technology learning through supplier relationships.

But what can we say more specifically about technical and vocational education, which is so important for technological advance? Chapter 1 presents data on science and engineering enrollments, indicating East Asia's lead in this important area. Table 6.7 extends that discussion by showing change over time at both secondary and tertiary levels. This table offers some expected results. China and Taiwan have more than twice the percent of upper secondary students in technology/vocational programs than Mexico, mainly in public rather than private institutions. Similarly, Mexico lags behind Taiwan, China, and less dramatically Korea, in its percentage of tertiary students in science and technology studies.

Table 6.6 Educational funding and outcomes

Country	*Govt expenditure on education as % of:*		*Secondary enrollment (%)*		*Tertiary enrollment (%)*		*Mean years of schooling*	
	GDP	*Govt expend*	*Net*[a]	*Gross*[a]	*Gross*[a]			
	2008–2010	*2007–2009*	*2009–2012*		*1999*	*2011–2012*	*1995*	*2010*
Korea	3.7	16	96	97	74	98	10.6	11.8
China	3.5	na	na	89	7	27	6.4	8.2
Taiwan	3.8	19	96	na	39	84	na	11.3
Philippines	2.9	17	61	85	29	28	7.9	9.0
Mexico	5.3	22	67	84	18	228	7.1	9.1

Sources: World Bank, World Development Indicators, online (for secondary enrollment, tertiary enrollment, and government expenditure on education as share of total expenditure); World Bank, World development Report, 2013 (for mean years of schooling); Deyo (2012) (for government expenditure on education as share of GDP). Data for Taiwan, where available, are from Taiwan Statistical Data Book

[a]Net enrollment includes only age-appropriate enrollees as a share of total age group; gross enrollment includes all enrollees regardless of age as a share of the appropriate age group

Table 6.7 Technical and vocational education statistics

Country	*Enrollment in technical/ vocational education as % of upper secondary*		*Private enrollment as % of upper secondary technical/vocational education*		*Tertiary grads in science and technology as % of total first degree grads*[a]		*PhDs in science and technology as % of all PhDs*[a]
	1999	*2011–2012*	*1999*	*2011–2012*	*1999*	*2011–2012*	*2008*
Korea	38	21	52	47	41	31	36
China	57	44	11 ('06)	19	na	44	60
Taiwan	58	48	na	na	53	45	59
Philippines	na	na	na	na	na	20	na
Mexico	14	20	22	15	23	27	31

Source: UNESCO, UIS Statistics in Brief and some national sources. Definitions vary somewhat by country

[a]Science and technology includes natural sciences, engineering, technology, and construction

But these data offer surprises as well, particularly from the standpoint of temporal trends. Upper secondary vocational enrollments have declined over the past decade in Korea, China, and Taiwan, while rising in Mexico, such that vocational enrollments in Korea and Mexico are now nearly the same. This pattern is repeated at the tertiary level, where the percentage of first-degree science and technology (S&T) graduates has declined in Korea and Taiwan, while rising in Mexico. And while PhDs in China and Taiwan are concentrated in S&T fields, those in Korea are more often in other fields of study. Further, only in Korea have private institutions played a major role in technical/vocational education. In seeking to explain some of these results, I turn now to a more focused discussion of educational trends, policies, and institutional changes in Korea and China.

The Korean Case

Korea's very high overall school enrollment rates, as well as this country's similarly high ranking on international standardized language and mathematics tests (Korean Statistical Information Service [KOSIS]), are due only in part to pro-education government policies. This fact helps to explain the seeming discrepancy between Korea's modest public educational funding compared to its impressive educational outcomes. In large

part, those outcomes reflect other social influences, including intense parental pressures and corporate hiring practices, which push students to complete tertiary degrees at whatever financial or psychological cost.

The important role of private institutions in Korean vocational education (Table 6.7) is further confirmed by other available statistics on private educational expenditures showing that nearly 70% of all Korean families spend substantial funds for supplemental or private instruction, including tutoring, supplementary evening classes, and private school enrollment. It is estimated that 13% spend more than 50,000 won per annum, and sizable numbers spend as much as half a million won per annum.[11] Other data show that Korean parents spend, on average, roughly 25% of total family income on education, while almost all parents invest heavily in supplemental educational activities.[12] Reliance on private, rather than public, educational expenditure is reflected as well in the rapid growth of private secondary and tertiary institutions. In 2005, roughly 75% of tertiary enrollments were in private colleges and universities, and in that same year private finance accounted for two-thirds of total national educational costs.

In response to growing concerns about student academic pressures, the government has sought to discourage late-night enrollment at *hagwons*, or cram schools, at which roughly 75% of high school students seek to gain an edge in the very competitive university entrance exams that greatly determine their educational and career futures. In 2008, a night-time curfew was placed on *hagwons*, as government has tried to dampen the "educational fever" that is in part blamed for large numbers of student suicides.[13]

Korea's strong tertiary educational outcomes also in part reflect a significant growth in the numbers of adult workers who return to college or technical school,[14] often on a part-time basis, in order to qualify for new or higher-level jobs, and often in response to worker training and development incentives offered by employers and government. Especially important in this regard are correspondence and online courses, technical schools, polytechnical institutions, and corporate human resource development and training programs. It is noteworthy that 35% of workers aged 45–54 participated in such continuing education/training programs in 2013, and that 41% of adult students sought new qualifications at the college/university level, thus explaining gross tertiary enrollment percentages greater than 100%.[15]

Korea's Basic Law for Vocational Training, enacted in 1976 and modeled after Singapore's Skills Development Fund, requires large firms to

provide in-house training for workers, failing which they must pay a training levy of at least 6% of their total wage bill to support vocational training in government-sponsored training schools (Asian Development Bank, *Key Indicators*, 2003).[16] This law also established the Korea Research Institute for Vocational Educational Training (KRIVET), which coordinates policy research and support relating to vocational education programs and human resource development. Pursuant to this law, the Ministry of Labor assumed operational control of all private vocational training, while the Ministry of Education assumed oversight over vocational education in schools, vocational institutes, polytechnic institutes, and universities.

Driven in part by an overwhelming student preference for higher prestige, non-technical advanced degrees alongside growing calls from business for more technically trained workers, the government has encouraged a shift to science and technology enrollments at tertiary levels. This effort, leveraged through tax incentives and government scholarships, has led to significant enrollment increases in two-year technical colleges and the establishment of new technical universities and colleges, mostly private. It must be noted, however, that despite this effort, tertiary S&T enrollments have not kept pace with enrollments in other programs (see Table 6.7). This decline may also mirror Korea's structural movement away from industry to modern service sectors.

In addition, the government has embraced and institutionalized a national program of computer literacy for high school students. The Korean Education, Research, and Information Service (KERIS) pursues an active program of Information and Communication Technology (ICT) research and dissemination of information to schools and other organizations, including efforts to support computer learning outside of schools themselves, since most computer use occurs outside school, at home and in net cafes. Korea's active involvement in ICT training and upgrading resulted in this country's impressive 2009 Program for International Student Assessment (PISA) first place world ranking in computer literacy.

It should be pointed out that Korea's strong reliance on private, rather than government, educational funding has tended to reduce both the governmental burden of industrial upgrading and, conversely, government leverage in manpower planning and development. In this context, much of Korea's success in areas of R&D and tertiary vocational and technological education is attributable only in part to direct government involvement. As important have been the efforts of large private corporations, where the lion's share of training and R&D activities occur.[17]

They themselves have often taken the initiative (assisted by government tax and other incentives) in establishing technical programs and colleges oriented to skill requirements. A prominent example is the Pohang University of Science and Technology, established by the Pohang Iron and Steel Corporation. This caveat regarding state support for technical education is not so much to diminish the role of government as to contextualize it and to note its general reliance on indirect means (e.g., tax incentives, low-interest loans, administrative guidance, and infrastructural support) rather than direct investment and operational involvement.

The Chinese Case

Government efforts to expand Chinese tertiary education are evident in the very rapid increases in tertiary enrollments in the 2000s, officially estimated at 10.5% per annum during 2001–2011 versus only 2.2% at the secondary and –2.4% at the primary levels, with large numbers of students entering programs in science and engineering (Asian Development Bank, *Key Indicators*, 2003, and http://www.adb.org/statistics, online). Indeed, very substantial increases in government spending on education in general, and on tertiary science and engineering-based tertiary education more specifically, suggest a future in which tertiary education may assume a lead role in Chinese economic growth. Massive tertiary educational expansion, especially in engineering and science, has been further reinforced by corresponding investments in government-sponsored R&D activities within state research and technical institutes (Deyo 2012; Lee 2013). By the mid-2000s, China's total spending on R&D as a percent of GDP was reported to rival that of the United States.[18]

It should be noted in this regard that the central government's investments in tertiary education, largely controlled and funded by national and provincial authorities, has not been matched by corresponding improvements at primary and secondary levels, funded by local and municipal governments, particularly in rural areas and small towns. Of particular concern, local governments, facing increasing budget constraints and growing debt, tend to underfund primary and secondary schools and to impose substantial fees on parents for uniforms and books, particularly after the ninth grade. This problem was further exacerbated in 1994 by a new requirement that localities remit an increased share of tax revenues to the central government.[19] Given that local governments are

largely responsible for social welfare and educational functions, the new requirement was especially burdensome.

This returns us to the matter of regional disparities and the plight of Chinese migrant workers. In rural areas, parents often must pay weekly fees to board their children in dormitories at distant, consolidated schools. By consequence, many rural families withdraw their children from school, a response contributing to large percentages of rural populations with less than a primary education (Zhang 2009). It is notable that per pupil educational expenditures in major cities like Shanghai are several multiples of expenditures in rural towns. Further, contributing to this geographical disparity are China's *hukou* residence restrictions under which masses of Chinese rural migrants, who intermittently stream into urban manufacturing centers, lack legal access to education and health programs available to permanent urban residents. As a consequence, their families and children often remain at home where they can attend school. Given wide disparities in quality of instruction and resources between urban and rural schools, as well as related problems created by extended family separation, rural poverty, and the low wages of migrant workers in cities, the educational prospects for children of migrants are dim. The gap is particularly important from the standpoint of continuing beyond the mandatory nine years of schooling and, by extension, competing for good jobs as adults. This disparity is reflected in their relatively low scores in national university entrance exams, key to university entry, and correspondingly low proportions of rural students in Chinese universities.[20] In response to this problem, experimental programs have offered migrants fuller access to social and educational services in selected urban centers, and NGOs have been supported in their efforts to provide social and educational services to migrant families and children. While these and other reforms have begun to afford increased rights of urban access to rural migrants (Deyo 2012), China's *hukou* residency rules remain a formidable obstacle to broadened access to education, and thus to a fuller inclusion of workers in the rewards of economic growth. The resultant widening the urban–rural divide during the late 1990s and early 2000s, in part explains China's worsening record of inequality (Zhuang 2014).[21]

Like Korea, China confronts the disincentives of increased contingent employment on firm-level training. As state-enterprise employment has declined and as rural workers have migrated on a temporary and seasonal basis to urban centers to find factory and poorly paid service work,[22] firms have employed increasing numbers of short-term and irregular workers.

In the case of state enterprises, this transition has been encouraged by state-enterprise managers seeking to respond to new cost pressures by releasing existing workers earning relatively good wages and benefits and replacing them with temporary workers. As a consequence of this change, more an indirect result of economic restructuring than of flexibility-promoting changes in employment law itself (as in Korea), employers are reticent to invest in training even as they have increasingly complained about shortages of skilled and technical workers. As noted earlier, escalating wage increases have forced public recognition that technology and educational upgrading would be necessary to bolster productivity and to restrain unit labor costs so as to accommodate higher wages and to encourage investment in higher value-added industries.[23]

The 1996 Law on Vocational Education, which committed to a new emphasis on vocational and technical education at secondary and tertiary levels, remains the foundation of China's turn to technology- and skill-focused instruction and comprises a primary response to problems of rural–urban migration, skill deficits, and accompanying social disorder. Of particular relevance, this law accords citizens "the right to receive vocational education"; encourages rural districts to adapt vocational education to agricultural and rural economic requirements; specifically encourages the inclusion of women in the new programs; initiates new systems of vocational and occupational credentialing and certification; empowers enterprises and various social groups to establish (state-certified) training institutions; incentivizes in-house and company training; and, in response to chronic problems of corruption, stipulates that "no organization or individual may embezzle or pocket a portion of funds for vocational education." While this law did not specify operational or budgetary implementation, it laid down a set of core principles that have broadly guided vocational education over succeeding years. Most efforts in this area were originally directed at secondary education, turning later to a greater emphasis on tertiary programs.

During much of the late 1990s and early 2000s, vocational education expenditures were largely confined to infrastructural investments in teaching facilities and materials. These investments were sizable, although they fell short of the Education Act's commitment of 20% of total educational expenditures, remaining below 10% through the mid-2000s (Potter 2011). Vocational teacher shortages were initially addressed by hiring often untrained, part-time, and temporary teachers. Local governments struggled to provide the required funding for those programs that were started, and student enrollments remained low.

By the mid-2000s, the cumulative economic and political costs of a relative neglect of vocational education prompted more substantial reforms and financial commitments. Most prominent was encouragement of training centers on the part of enterprises (which ran 220,000 such centers by 2006), trade unions, the Communist Youth League, the Women's Federation, and a variety of social organizations including foreign-assisted NGOs. In rural areas, adult literacy programs, farmers' colleges, and rural training programs for women were greatly expanded. And building on a model of local experimentation, several high-profile, centrally and provincially funded vocational education pilot projects were launched across the country. These new efforts resulted in a dramatic increase in the percentage of students enrolled in vocational (vs. standard) high schools, from 2% in the early 1980s to 15% in the late 1990s, 25% in 2000, and 50% in 2009 (Potter 2011).

In order to adequately fund this rapid expansion in vocational school education, financing often involved public–private partnerships with state enterprises, private companies, and even foreign investors. It is important to note that the social agenda of reducing social inequalities played an explicit and very important role in pushing China's expansion of secondary level vocational and adult education, in contrast to a narrower economic rationale that has guided tertiary policy initiatives.

A prominent skills enhancement program that has drawn these various elements of human capital policy into a coherent local effort is the Shanghai Highland of Talent Strategy initially launched in 1996 and subsequently expanded and strengthened in 2003 (Zhang 2009). This program sought to replace a shrinking state enterprise sector with higher value-added industries and services, to address significant skills deficits,[24] and to provide new employment to both migrant workers and laid-off state-enterprise workers. The program, whose key components were locally coordinated by the Municipal Labor Bureau, sought initially to attract skilled and technical workers from abroad and from other regions, but after 2003 to refocus on building and upgrading the skills of existing job holders, jobless workers, school leavers, and migrants, and to develop highly skilled workers in targeted areas as dictated by employment surveys and manpower projections. In response to the negative influence of migrant mobility and labor instability on the willingness of companies to provide training, Shanghai took a lead role in relaxing *hukou* rules that barred migrant worker access to social security and family benefits and, most importantly, to public education for their children. In addition, the program encouraged and provided a range of incentives for local

companies to invest in in-house, on-the-job training, and established a skills certification program to facilitate company hiring. By most accounts, the Shanghai Talent Strategy was highly successful, nearly doubling the percent of the Shanghai workforce that officially qualified as "skilled" between 1998 and 2005. In response to this success, the central government has encouraged other Chinese cities to replicate this program.

While this chapter does not deal with the important role of labor policy other than human capital investment in mediating the relationship between technological advance and worker inclusion, such policy plays a rather obvious role in encouraging employment structures within which workers and employers are incentivized to invest in vocational education and training and in establishing employment relations within which workers are empowered to push for training, adequate benefits, and an equitable sharing in profits derived from productivity gains. I confine myself here to two important examples of labor market policy that have functioned to address the earlier noted training disincentive created by the trend toward employment contingency and instability: Korea's 1996 EIS and China's 2008 Labor Contract Law.[25]

In Korea, job security and training opportunities traditionally went hand in hand, at least for regular workers in large companies. But as contingent employment has incrementally reduced the time horizon for expected returns to training and increased the risk that trained workers may be poached by other firms, an important institutional foundation (job security) of this country's industrial training system was threatened. In such a context, and given continuing complaints regarding the non-availability of skilled and technical workers, businesses have increasingly and successfully pushed for a greater government role in this area. It is in this context that the EIS and other training initiatives have been expanded.

The EIS, which covered more than 80% of all workers in 2005, seeks to stabilize and upgrade employment and to move unemployed workers back into gainful work, thus in part addressing the training deficit caused by the growth of contingent employment. Of particular importance is its emphasis on and support for vocational training, rather than just job placement, in helping workers to move from declining employment sectors to growing sectors. In 1999, in response to high levels of unemployment linked to the regional financial crisis, the EIS helped fund some 500 vocational training institutes and 200,000 workers, 41% of whom participated in in-plant training. (For a general discussion of the EIS, see Asian Development Bank Institute 2010.)

In the Chinese case, and in part in response to the economic and sociopolitical tensions associated with reliance on seasonal, low-skill migrant workers in economically important urban export zones, the 2008 Labor Contract Law sought to stabilize employment among the many workers, including migrants, who work informally on a casual basis and who lack employment contracts. This legislation, broadly implemented by 2010, heightens efforts to ensure that employers offer legally enforceable individual or collective contracts to all employees, including seasonal migrant workers, thus giving migrants, low-skilled workers, and others legal standing in challenging unfair labor practices, most famously including non-payment or delayed payment of earned wages, as well as other employer practices in contravention of employment law. This legislation has been accompanied by parallel efforts to force large employers, especially foreign companies like Walmart, to permit and even encourage the formation of (albeit "captive") unions under the umbrella of the state-linked union federation, the All-China Federation of Trade Unions (ACFTU). (On the Labor Contract Law, see People's Republic of China, National People's Congress, 2009.)

While continuing problems of enforcement and of biased labor–management arbitration at the local level remain impediments to effective implementation, these Chinese legislative initiatives have at least in principle had the effect of gradually formalizing large sectors of previously informal labor, and of giving employers a degree of predictability in their relations with employees, thus encouraging worker training and development.

Accounting for East Asia's Social Gains: The Role of Small and Medium Enterprises

As in the case of education and training, SME policies may be considered from the perspective of economic agendas of growth and technology advance, and of the profitability of SMEs themselves, both as entrepreneurial spin-offs from established firms and as suppliers of goods and services to larger and/or foreign companies.[26] But from the perspective of social agendas and policies, attention is directed more to the role of SMEs in bolstering the incomes and livelihood security of economically disadvantaged groups, including not only SME owners and their families, but those otherwise employed in SMEs as well.[27] Typically, this social perspective embraces small and micro-enterprises, rural populations, and informal sectors.

Another similarity with respect to education and training is that SME development comprises a domain of policy making and structural change wherein these economic and social agendas may potentially and most readily be reconciled. This follows in part from the possibilities SME development offers from the multiple standpoints of the growth of family business, entrepreneurial start-ups and spin-offs, job creation, and reductions in economic inequality. Confining attention to manufacturing, I focus here on technological upgrading, SME supply and technology linkages with large and/or foreign companies, and worker livelihood outcomes.

Some key contextual factors influencing the economic and social outcomes of SME development include the technology, competitiveness, and cost pressures characterizing the market niches in which small firms operate; the production strategies of larger domestic and international firms or investors occupying key nodes in production chains and thus the creation of high value links in those chains; governments' SME promotional or support policies directed at both formal and informal sector firms; locally available infrastructures (e.g., educational and technical institutions, finance, communications, transportation, energy)[28]; and economic and social incentives for small firms to take advantage of new market opportunities and technologies. A principal cause of economic stagnation in the Philippines' manufacturing sector is the deficit local SME's face in virtually all these areas, especially in FDI-based electronics and other export sectors. Conversely, it is here that the successes of Taiwan and, more recently, of Korea and China stand out.

The Korean Case

From the late 1960s to the early 1980s, Korean development efforts centered on building large domestic firms that would spearhead the country's drive to industrialize and export. By consequence, a small number of huge, family-owned conglomerates (*chaebol*) emerged, in most cases vertically integrated to own or control the many affiliate companies that were their suppliers and contractors in each of their several product markets. This trend accelerated in the 1970s as government support, protection, and finance were directed at rapid growth in heavy and chemical industries. In this context, most manufacturing SMEs remained subordinate parties to the strategies of larger corporations, typically subordinated in ways that precluded independent technological development or innovation.

This changed to some degree in the 1980s and 1990s, as the government sought to reduce the tight control of *chaebol* over exports and domestic markets, narrow the broad range of product markets in which they competed, and more generally rein in their growing political influence. This effort included moves to divest *chaebol* of controlling interest in many industries and affiliated companies, including suppliers.

Beginning in the 1990s, more general structural changes gave some impetus to Korean SME development. First, as standard production was increasingly relocated to other lower-cost countries, most prominently China,[29] technology-intensive and small batch specialty production became more common, thus encouraging a proliferation of small, technology-based companies and spin-offs from conglomerates and university research institutes. Second, liberalization of trade and foreign investment opened up new opportunities for smaller companies to undertake export production and, more importantly, to enter into the nascent supply chains of foreign-invested companies in Korea itself. In the context of a well-developed transport and energy infrastructure and high educational levels, Japanese, Taiwanese, and Western investors were as likely to seek out local suppliers as to try to assist their home suppliers to relocate to Korea. It should be noted, however, that most SME exports were indirect, as they continued to be channeled via subcontracting ties through large companies and *chaebol*.

By consequence of these and other influences, growing numbers of small, high-tech firms were established, and an increasing percentage of workers found employment in small firms, a trend that continued up until the 1997–1998 financial crisis, and then resumed following the rapid economic recovery in the early 2000s (Nugent and Yhee 2001; Kim 2007). Most notably, SME employment growth centered on small, rather than mid-sized, enterprises (i.e., those with fewer than 50 employees).

The fact that vigorous SME growth continued in recent years is somewhat surprising, given a number of growing structural constraints and, indeed, the overall decline in Korean manufacturing employment more generally. A key problem was the negative influence of *chaebol* outsourcing of labor-intensive production to lower-cost production sites in China, Southeast and South Asia, and elsewhere. *Chaebol* outsourcing had several unfortunate consequences for domestic SMEs. First, it reduced supplier opportunities in those labor-intensive activities that had traditionally sustained local SMEs (Nugent and Yhee 2001).[30] Second, it increased the competitive cost pressures facing small supplier firms, thus reducing their

capacity to invest in longer-term R&D activities as they struggled to compete on cost in maintaining their ongoing *chaebol* supply relations. Finally, it remains the case that government efforts to weaken the political and economic power of the *chaebol* were only marginally successful, as several of largest of these conglomerates continued in their old ways. To take a major example, Samsung, currently the leading world producer of cell phones, remains highly vertically integrated: from chips, display panels, and many other electronic parts, to assembly of its own smartphones and other devices. By consequence, Samsung's ownership structure still reaches deeply into a captive supply chain.[31]

Technological advance and increasing labor skills have become ever more important for the continued development of Korean SMEs, particularly small ones. Yet intense cost pressures, non-competitiveness vis-à-vis larger companies in attracting and retaining research and technical workers, high rates of labor turnover (resulting in a loss to competitors of investments in training), and disadvantaged access either to knowledge-sharing subcontract networks or venture capital undercut efforts in both areas. In some industries (e.g., automobile manufacturing) supply chains have provided an important source of technology learning for small companies. More generally, however, supply chains have functioned mainly to push small companies to reduce production costs, under threat of loss of contract renewal. Nugent and Yhee (2001), for example, found that the percentage of SMEs with significant R&D expenditures fell from an already low 11% in 1990 to only 8% at the outset of the crisis in 1997.

In this context, government efforts, particularly relating to technology development, have been very important. The growth of university research and science-based industrial parks has generated high-technology spin-offs as researchers have sought commercial applications of their own work. But other programs more specifically targeting SME technology upgrading played a greater role. As early as 1979, the Small and Medium Industry Promotion Corporation was established to provide technical assistance and training programs for SMEs. In the 1980s, a number of laws were passed to channel capital to small, high-tech start-ups and to offer direct technical assistance to SMEs. A proliferation of government-supported technology research centers and institutions, not specifically designated for SMEs but disproportionately utilized by smaller companies unable to undertake or fund such activities internally, offered further assistance. More recently, tax incentives already offered mainly to larger companies that set up research institutes, were extended in the 2000s to smaller companies that had not previously qualified.

Of particular importance are government-sponsored science-based industrial parks for creating networks of small and large companies near research institutions and universities. Perhaps most prominent is the Daedeok Innopolis (formerly Daedeok Science Park), originally established in 1973 and located in Daejeon. This park hosts numerous research and educational institutions and corporate research centers and features close relationships with neighboring research institutions and universities that produce large numbers of technical and engineering graduates (including at the PhD level), many of whom find work in nearby firms. This science zone is now a major research center in high-tech areas like telecommunications, biotechnology, and atomic energy. Collectively, the research institutes in this park support professional collaboration, job placement, professional networking, and joint R&D activities among locally established firms, many of which are quite small (Deyo 2012: Ch. 11).

The Chinese Case

A major impetus to industrial development in China came with the agricultural reforms of the 1980s. Communes were gradually displaced by family cultivation under the Household Responsibility System; many farm workers were now free to find new employment; and governments at multiple levels saw the need to create new employment opportunities for workers inhibited by *hukou* residence restrictions from migrating to large cities in search of work. In response, rules relating to self-employment and micro-enterprise were relaxed, thus permitting many unemployed workers to start their own small workshops and commercial establishments. A second policy response was to promote and assist in the establishment of Town and Village Enterprises (TVEs). These enterprises, which were mostly labor-intensive operations that produced for local and regional domestic markets, tended to be small[32] and inefficient. They did, however, achieve their intended goals: They grew rapidly, absorbed large numbers of unemployed rural workers,[33] and were critically important in launching China's manufacturing "miracle."[34]

A second impetus to the proliferation of small manufacturing enterprises came with the opening to foreign capital investment in the 1990s. The lion's share of early investment came from Hong Kong and Taiwan, and much of it funded small companies positioned to tap China's seemingly unlimited supply of cheap labor. As domestic firms began to imitate the successes of these small export firms, specialized industrial clusters

formed in China's eastern provinces (Deyo 2012). Only later did foreign investors, especially those from Japan, Korea, the United States, and Europe, come to partner with local investors, including local governments, in establishing the very large factories we now associate with major Chinese export industries. These firms in turn sought out local suppliers, although many of them were themselves foreign-invested companies from Taiwan and Hong Kong. These and other developments encouraged a proliferation of manufacturing SMEs, especially in eastern provinces, as seen in declining average firm size after the mid-1990s. Between 1998 and 2004, mean firm size fell from 345 to 221 workers (PRC, *China Statistical Yearbook*, 2005), thereafter continuing to drop to below 200 by the end of the decade (UNIDO 2011). While very large manufacturing and supplier firms have clearly played a key role in China's export successes (Appelbaum 2009), it was estimated that in 2010, SMEs accounted for 60% of GDP, for 80% of total employment, and for a sizable and growing share of total exports (Li 2012).[35]

SME growth was not initially accompanied by significant technology upgrading. Rather, the competitive edge of most of these enterprises remained tied to the recruitment of masses of cheap labor migrating to cities in search of seasonal employment. But by the late 1990s and early 2000s, it had become clear that China's cheap labor advantage would soon end (Harvie and Lee 2002). The flow of migrant labor slowed, skill scarcities become more troublesome, wages rose, and traditional and even high-tech export production began to disperse to other countries, including Mexico, whose gradual convergence with China in unit labor costs reinforced its long-standing advantage of close proximity and negotiated access to US markets (Chap. 7).

To a degree, as international contractors have begun to deepen and upgrade their local supply chains to take advantage of the growing numbers of technicians and engineers flowing from expanding secondary-level vocational education and from tertiary S&T degree programs, stagnation in standard production activities has been countered by industrial upgrading. By way of example, Apple Inc. has recently begun hiring hundreds of engineers and supply chain managers to work with Chinese contract companies in localizing product development and in adapting products to a growing Chinese middle-class market. Apple has been working with Taiwanese technology firms to create research teams in Taipei and Shanghai to develop components for iPhones and iPads as it plans for faster and more frequent product releases.[36] While Apple's R&D activities remain

highly stratified, with core activities still concentrated in Cupertino, CA, lower-tier supplier R&D activities are increasingly diffused beyond Taiwan to China itself.

From the standpoint of government promotion, science-based industrial zones near major cities like Beijing and Shenzhen have also been important for SME technology upgrading. A prime example may be found in Dezhou City, where small high-tech firms have formed an industrial agglomeration of internationally competitive solar industry producers.

If *chaebol* are the lead engines of R&D in Korea, public universities more often assume that role in China.[37] Lee (2013: Chaps. 3 and 8) describes China's unique emphasis on "forward engineering," based on university research-generated spin-off firms, rather than on "reverse engineering," as practiced by domestic companies as they imitate and learn from the technologies of large and foreign companies, often through supplier linkages. According to Lee, many of China's most successful high-tech companies have been established by and are affiliated with academic institutions. By contrast, Korean universities serve primarily to produce engineers for local firms.

While many of the companies that are nurtured by university research in China are quite large, they usually started out as small, high-tech spin-off firms as university researchers sought commercial and industrial applications for their academic work. Equally important, where government-sponsored high-tech zones or parks provide the context for university–firm collaboration, small start-up companies (whether or not they are university spin-off ventures) benefit greatly from their proximity to universities and to other firms, and thus to the networks of professional contacts, subcontract links, and government services that characterize such zones. Prominent among these is the Zhongguancun Haidian Science Park, wherein firms benefit from the research activities of nearby Peking and Tsinghua Universities, as well as from proximity to large numbers of research institutes and national laboratories for product development and technical recruitment. Importantly, this park attracts international IT firms like IBM, HP, Cisco, and Microsoft that commit (often with government prodding) to technology sharing, local training, and supply chain development. In addition, this park provides a range of tax rebates to subsidize company research, housing and community amenities for professional and technical workers, "business incubators" (many of which are government run) that help start-up businesses, and training facilities and programs that most directly benefit smaller firms.[38]

Despite these advantages, a major problem facing Chinese SMEs must be noted: access to credit and investment finance. While this issue is beyond the scope of this chapter, it is worth noting that financial system reform has addressed this matter with increasing urgency, particularly following the financial crises of the late 1990s and the late 2000s. Following the 1997–1998 crisis that took a particularly heavy toll among Chinese SMEs (Hilgers 2009; Li 2012), new legislation contained in a 2002 SME Promotion Law provided direct governmental SME funding, established a range of SME service facilities and offices, and encouraged increased SME loans by government banks, credit cooperatives, commercial banks, and local governments.[39] Under this law, preference was to be given to SMEs offering employee training, hiring unemployed persons, locating in impoverished areas, establishing joint ventures or supply relations with foreign companies, and introducing new technologies. Despite this and other efforts, SMEs remain highly vulnerable to economic downturns while at the same time relying heavily on high-interest informal sector and shadow banking loans. As a consequence, China's 2013–2014 economic contraction and tightened credit markets disproportionately hurt SMEs.[40]

A Note on Worker Outcomes

The majority of East Asian SMEs, even in the manufacturing sector, are primarily household businesses. They seek a modest, secure income for family members, several of whom (mainly daughters and wives) are typically engaged as unpaid household workers.[41] Most of these firms, many of which employ other workers on a casual basis, seek neither growth nor technological advance. Quite different are the small and medium-sized firms that have only recently begun to participate in the growing supply chains of large, international firms and that are often subject to multiple and often conflicting pressures: to cut costs, to improve quality, to become more flexible, to move up the technology ladder, and sometimes to conform to international labor standards in managing their own workforce. The varying emphasis on one or another of those demands by governments, downstream buyers, and final consumers defines the environment within which workers are employed and managed. While SMEs may sometimes seek to move to higher-value, technology-intensive, and innovative product niches, thus encouraging greater efforts to train, incentivize, and advance workers to higher levels of performance, cost-focused external

pressures may trump entrepreneurial aspirations. In this context, governmental educational, training, employment, and SME technology policies play a critical role.

Policy Lessons for Other Developing Countries?

If the East Asian experience, and that of Korea and China more specifically, presents a variety of developmental tensions that have both influenced and flowed from governmental policy, the larger picture of relative success in negotiating a balance between social and economic agendas should not be obscured. This chapter on the manufacturing sectors of these countries identifies policies and programs that have enhanced the inclusion of workers and small enterprises in the benefits of industrial advance. I conclude by asking if there are general policy lessons which may be learned from this experience.

- Improved levels of education and training, particularly in technical/vocational areas, support productivity gains while also enabling workers to find decent, higher paying work. But productivity gains comprise only a necessary, but not sufficient, condition for improved worker outcomes.
- Education and training enhance the linkage between productivity gains and worker outcomes by encouraging firms to adopt "deep-skill production strategies," which rely on larger numbers of skilled and technical workers in both parent and supplier firms, rather than adopting labor-displacing strategies that place greater reliance on automation, foreign contract workers, and/or international outsourcing. The contrast between Korea, where manufacturing employment has declined sharply, and Taiwan, where it has not, illustrates the importance of technical (vs. non-technical) education in this regard.
- The link between productivity and worker outcomes is further enhanced by employment policies that protect the contractual rights of workers (e.g., China's Contract Labor Law) and that encourage worker representation in enterprise decision-making and national tripartite policy deliberation (as in Korea).
- The outcomes of public investments in human capital formation are augmented through "social leveraging," whereby educational programs build on existing cultural, institutional, and economic features

to augment outcomes. The importance of cultural leveraging in Korea, and of institutional leveraging through implementation via firms, trade unions, and civil society groups in both Korea and China, show the possibilities for such an approach.

- Strong reliance on private educational choices, resources, and institutions brings both benefits (e.g., reduced fiscal pressures) and costs (e.g., loss of policy influence over important developmental outcomes, such as vocational education in the case of Korea). This suggests the need for targeted public incentives and oversight and of effective public–private partnerships in critical areas.
- Enterprise training, an important basis for improved productivity, is encouraged by labor market policies that help stabilize employment, thus enhancing employer gains from investment in training. In the context of increasing labor market flexibility and a corresponding destabilization of employment, other labor market policies may compensate by providing incentives for training (e.g., Korea's skills training levy and the EIS) or by enhancing the predictability of employment tenure (e.g., China's Contract Labor Law).
- The exclusion of major population groups from the benefits of development is economically costly and socially destabilizing. The inclusion of those groups in programs of human capital and SME development is important in mitigating those costs. China's Law on Vocational Education and 2002 SME Promotion Law target migrant and laid-off workers and impoverished rural areas, respectively, for special assistance.
- The inclusion of workers and small enterprises in the benefits of economic growth is enhanced through an explicit linkage (as opposed to parallel and separate consideration) of economic and social agendas in development policy. Both Korea's EIS and China's Labor Contract Law encourage training while also addressing worker needs for livelihood security and protection.
- Education and training, along with SME technology development, create a social infrastructure that attracts and holds technologically advanced foreign investment and that encourages the creation of dynamic, innovative domestic supply chains that emphasize quality and innovation as much as cost. Creation of such an infrastructure also offers leverage to governments, as in China, that seek to negotiate with foreign companies the terms of investment including training, supply chain development, and international technology sharing.

- China's reliance on decentralized experimental and pilot projects to test various approaches to vocational education and skill upgrading (e.g., the Shanghai Highland of Talent Strategy) suggests a cost-effective way to develop new, untried human capital and SME policies prior to large-scale implementation.
- East Asia's science-based industrial parks provide a developmentally critical infrastructure for the development of small but technologically advanced enterprises. In China, universities, technical colleges, and foreign companies play the lead role in fostering technology start-ups. In Korea, domestic firms play a more prominent role through supply chain development, especially in science-industry clusters.
- Finally, while Taiwan has not been a primary focus in this chapter, the development experience there highlights the importance of these policy principles for inclusionary growth. Taiwan's early and successful land reform, broad-based educational investments, initial emphasis on small business and supply chain OEM (original equipment manufacturing) development, and early creation of science-based industrial parks provided a head start in technological advance. Moreover, it also resulted in the emergence of a social infrastructure supportive of both inclusionary development and the continuance of advanced, employment-generating manufacturing at a time when other countries, especially Korea, have seen a flight of manufacturing employment to lower-cost locations.

Notes

1. For comparative data, see Chap. 1.
2. Most striking in this regard are results from a 2012 enterprise survey that found average monthly earnings of China's migrant workers, critical in light export industries, rose by 15% in real terms during 2010–2011. "Even as Wages Rise, China Exports Grow" (*The New York Times,* Jan. 10, 2014: B-1). This article also suggests that blue-collar factory workers have more generally seen nominal pay levels increasing by factors of five to ten since the early 2000s.
3. South Korea led Japan, Germany, the United States, and most other economically advanced countries in the use of industrial robots in 2012. See "The Build-Up: Good and Ready" (*The Economist,* March 29, 2014: 6–10).

4. See "Chinese Exports Still Grow, Despite Rapidly Increasing Labor Expenses" (*The New York Times,* January 10, 2014: B-1) and "China's Embrace of Foreign Cars" (*The New York Times,* April 9, 2014: B-1).
5. Unfortunately, the data for Taiwan, drawn from the ROC *Statistical Yearbook*, cover a very short period (1999–2002), thus rendering difficult an assessment of industrial trends over the longer run.
6. Between 1995 and 2012, Taiwan's index of unit labor costs (based on 2006 = 100) declined from 126 to 82.
7. The late 2000s world financial crisis played some role in this decline.
8. Nearly 30% of the rural workforce now works in cities ("A Dramatic Decline in Suicides: Back from the Edge," *The Economist,* June 28–July 4, 2014).
9. This corresponds to a "Neo-Schumpeterian" growth model, as discussed in Lee (2013: Ch. 2). Here one notes the important distinction between competition and competitiveness. The latter is often linked to the creation and occupation of new market niches within which there is little or no competition, at least in the short run before imitators begin to enter.
10. Official statistics reported in the *China Statistical Yearbook 2012* show that tertiary enrollments increased by an annual average of 10.5% over 2001–2011 versus only 2.2% for secondary, and –2.4% for primary enrollments.
11. KOSIT (online) *Korean Statistical Information Service*. In 2014 dollars, these amounts are about $50 and $500, respectively.
12. OECD ("Education at a Glance, 2013").
13. "The Other Arms Race: South Korea's Education Fever Needs Cooling" (*The Economist,* October 26–November 1, 2013: 11–12).
14. Enrollment figures presented here reflect gross, rather than net, enrollment.
15. KOSIT op. cit.
16. This section draws heavily on Deyo (2012).
17. It is estimated that roughly three-quarters of R&D is funded by corporations, not government, whose R&D investments center largely on research institutes rather than universities (Republic of Korea 2013).
18. "Chinese Spending for Research Outpaces the U.S." (*Wall Street Journal,* Sept. 29, 2006).
19. Some 60% of such revenues were to be remitted to the central government, leaving only 40% for local expenditures (World Bank 2009: 159).
20. "University Admissions: Not Educating the Masses" (*The Economist,* January 4–10, 2014: 33).
21. In 2000, urban per capita income was double that of rural areas, and over triple rural incomes in 2010 (PRC, *Labor Statistics Yearbook,* 2012).
22. It is estimated that roughly 250 million workers migrate annually to coastal cities to find low-skilled work in factories and the service sector ("China's Cities: The Great Transition," *The Economist*, March 22, 2014).

23. See "Chinese Exports Still Grow, Despite Rapidly Increasing Labor Expenses" (*The New York Times,* January 10, 2014: B-1).
24. The OECD report ("Education at a Glance, 2013") estimates that in 2003, 60 % of Shanghai's workforce was of low skill, and that only 10–20 % of local enterprise demand for high-skilled workers could be met.
25. I bypass the problematic issue of intentionality here in favor of an understanding of the function of these two examples of labor policy for enterprise training.
26. See Lee (2013) for discussion of the economic dimensions of SME policy and development. Technology development among mid-sized supplier firms is also discussed briefly in Deyo (2012: Chap. 11).
27. Since SMEs employ the majority of workers in most developing countries, discussion of economic outcomes for workers cannot reasonably ignore this important dimension of economic inclusion.
28. Despite the great importance of non-educational infrastructure, especially finance, most attention here is directed to educational and technical institutions, policies, and programs, at the level of both firms and government.
29. Indeed, many Korean SMEs began themselves to invest in other countries of the region.
30. SME exports centered on textile products and, increasingly, electronics products.
31. "Samsung: Uneasy in the Lead" (*The New York Times,* December 15, 2013: B-1).
32. They averaged 39 employees in 1980, 13 in 1990, 19 in 2000, and 21 in 2008 (People's Republic of China, *Labor Statistics Yearbook*, various issues).
33. Employment rose from 30 million TVE workers in 1980 to 128 million in 2000 and 155 million in 2008 (People's Republic of China, *Labor Statistics Yearbook,* various issues).
34. It should be noted, however, that many of them were engaged in services rather than manufacturing.
35. SME export data are not available, but may be estimated from data on exports by private enterprises, which are overwhelmingly SMEs. In 2012, private enterprises accounted for over 30 % of total exports, even disregarding indirect exports via supply chain relations with larger export firms (reported on Ministry of Commerce official website, 2014). One must be careful in using these figures in comparative work since Chinese firms with as many as 500 employees are classified as SMEs.
36. "Apple Boosts Hiring in Asia: Giant Expands Engineering Teams in Shanghai, Taipei to Work with Suppliers" (*The Wall Street Journal*, March 4, 2014, B-1).
37. Private universities are far more prominent in Korea than in China.

38. For an extensive, if selectively self-promoting, description of this park, see "Zhongguancun: Rethinking Innovation," a lengthy paid advertisement in *The Wall Street Journal* (October 24, 2013: A-12).
39. See the Ministry of Commerce website.
40. See the Ministry of Commerce website.
41. "Smaller Companies in China Pinched as Credit Dries Up" (*The New York Times*, April 16, 2014: B-1).
42. The ILO estimates that 88% of all persons classified as "contributing family members" in 2008 were women, roughly the same percentage as in 1990 and 2000 (ILO, *Laborsta*, online).

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CHAPTER 7

Integration, Productivity, and Inclusion in Mexico: A Macro Perspective

Robert A. Blecker

Introduction

Among the larger Latin American nations, Mexico stands out for attempting to escape the middle-income trap through a development strategy focused on economic integration. By joining the General Agreement on Tariffs and Trade (GATT, the predecessor to the World Trade Organization) in 1986, enacting the North American Free Trade Agreement (NAFTA) in 1994, and signing numerous other trade agreements since then, the Mexican government has transformed what was once a relatively closed economy into one of the world's most open and export-oriented ones. As a result of these trade policies together with a set of domestic reforms, Mexico has become one of the world's leading exporters of manufactured goods in general and of relatively advanced product categories in particular. Manufactures now account for about 80% of Mexican exports, and about three-quarters of these consist of machinery and equipment broadly defined—including large volumes of automotive and electronic products, and small but growing amounts of aerospace equipment, biotechnology products, and information technology. Mexican industries have become deeply integrated into global value (supply) chains, especially within North America and increasingly with East Asia and other world regions.

R.A. Blecker (✉)
Economics, American University, Washington, DC, United States

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Yet, paradoxically, Mexico's stunning success in exports has been accompanied by a relatively low average growth rate of gross domestic product (GDP) over the past few decades, and the country has shown no signs of convergence with the United States and other industrialized countries in per capita income or labor productivity since it liberalized its international trade and foreign investment in the late 1980s. At the aggregate level, Mexico does not rank highly in international comparisons on a variety of key indicators of technological progress, such as patenting activity, research and development (R&D) expenditures, or productivity growth. Moreover, the benefits of Mexico's export success do not appear to have been widely shared within the country, as the net employment gains in export industries have been disappointing and real wages in manufacturing have not increased significantly over the past two decades.

The incongruence between Mexico's export success and its lags in other indicators can be explained to some extent by the conceptual framework about technological innovation and economic catch-up proposed by Lee in his chapter in this book (see also Lee 2013). As Lee observes, what ultimately drives increases in real wages and living standards is a sustained high rate of economic growth, which eventually exhausts the pool of surplus labor in a developing economy. Once real wages begin to rise, firms then have incentives to engage in innovative activities, aimed at raising the productivity of labor on the one hand and shifting industrial production toward goods that emphasize high quality over low cost on the other. In order to launch this process, a developing country should first emphasize growth by pushing exports of whatever products it has a comparative advantage in, usually unskilled labor-intensive manufactures. In these early stages of industrial development, inequality typically worsens as wage rates are initially low but productivity starts increasing. Over time, however, as increased industrial employment eventually pulls up wages and industries shift into more capital-intensive and technologically advanced directions, average living standards increase and the benefits of industrial development become more widely shared—but only if rapid growth is sustained over a long period of time rather than being sporadic.

In the Mexican case, in spite of considerable success on the export front, the country has not had the kind of sustained rapid growth that is necessary to eliminate excess supplies of labor and raise real wages. Mexico's average GDP growth rate since it opened its economy in the late 1980s is less than 3% per year, compared with about 6% in the earlier epoch of import substitution industrialization policies, and notably less

than what has been seen in the emerging market nations such as Korea and China in which real wages have increased dramatically. Mexico's slow average growth initially resulted from a series of boom-bust cycles and periodic crises in the 1980s and 1990s, but more recently has been the outcome of macroeconomic stabilization policies that have been designed to avoid crises but have done so by effectively restraining the accumulation of capital and growth of output in the domestic economy (Moreno-Brid and Ros 2009; Ros 2013). In addition, the growth stimulus that Mexico received from exports in the early post-liberalization and post-NAFTA years (1987–1993 and 1994–2000, respectively) has been considerably dampened since 2001 (see Ibarra and Blecker 2015). As a result of slow average growth, real wages have not increased, incentives for innovation have been blunted, and the gains from export success have not been widely shared.

Nevertheless, Mexico's openness to trade and its participation in global and regional value chains have led to significant industrial upgrading and the beginnings of local innovative efforts in certain segments of the economy. The days when labor-intensive apparel sweatshops were typical of Mexico's maquiladora export industries are gone; apparel factories and other low-skilled activities have largely moved on to lower-wage nations. As Mexico's exports have become concentrated in various types of machinery and equipment of increasing technological sophistication, its export industries have undergone a notable upgrading, resulting in rising skill levels and educational requirements for the labor force and—to a much more limited extent—nascent R&D activity within a subset of firms.[1]

Before proceeding further, it is important to acknowledge that Mexico's geographic proximity to the United States makes it a unique case among the major Latin American countries. As a result of this proximity, Mexico's economic opening policies have resulted in a degree of economic integration with the United States that no other large Latin American nation would be likely to attain. Nevertheless, as shown by the comparative data presented in the chapters by Stallings (Chap. 1) and by Larrañaga and Rodríguez (Chap. 8), Mexico is not so different from the major South American nations in terms of many indicators of social and economic development or educational attainment. Therefore, while taking Mexico's unique characteristics into account, an analysis of the Mexican case can help to reveal both the benefits and the costs of a strategy for breaking out of the middle-income trap that is based heavily on trade liberalization and regional integration policies.

Trade and Integration

The growth of Mexico's manufactured exports since the country's economic opening in the late 1980s has been nothing short of stunning. Mexican manufactured exports grew (in real, inflation-adjusted terms) at an average annual rate of 14% in the first seven years of its trade liberalization policies (1987–1993) and an even faster 16% annual clip during the first seven years of NAFTA (1994–2000).[2] Manufactures accounted for less than one-third of total Mexican exports in the 1960s and early 1970s, but averaged more than 80% of total exports during the entire post-NAFTA period (1994–2012) (Ibarra and Blecker 2015).

As of 2012, the manufacturing share of Mexico's exports as reported by the World Bank was 74%, which placed Mexico in the first ranks of nations globally as a manufacturing exporter.[3] By this measure, Mexico was very close to the European Union (EU) and Turkey, only slightly behind Korea, and ahead of India and the United States—and far above the Latin American and Caribbean average or the larger South American countries. Indeed, Mexico's share of manufactures in total exports was higher than that of four out of the five BRICS (Brazil, Russia, India, China, and South Africa) countries (only China's share was higher, but China is a natural resource-scarce country that exports relatively few primary commodities). However, the impact of this success in exports of manufactures on the overall Mexican economy and the country's efforts to escape the middle-income trap has been attenuated by several factors.

First, the dynamism that the export sector exhibited in the early years of liberalization and NAFTA (late 1980s and 1990s) has been significantly diminished since the early 2000s. The average growth rate of real manufactured exports in 2001–2012 was only 3%, during a period of slower growth in Mexico's primary export market (the United States) and increased Chinese penetration of that market (Ibarra and Blecker 2015). A similar pattern of dynamic export gains in the early years of trade liberalization and NAFTA followed by a slowdown after 2001 is found in the data on bilateral Mexican–US trade (see Table 7.1). US real nonpetroleum imports from Mexico grew at a remarkable 25.2% average annual rate between 1993 and 2000.[4] At the same time, the share of Mexico in total US nonpetroleum imports increased from 6.7% in 1993 to 11.4% in 2000. During the 2000–2007 period, however, the average annual growth rate of US real nonpetroleum imports from Mexico slowed to

Table 7.1 Growth rates and shares of US nonpetroleum imports from Mexico, China, and other countries

	Percentage share in total US nonpetroleum imports				
	1987	1993	2000	2007	2013
Mexico	4.5	6.7	11.4	11.3	13.4
China	1.7	5.9	9.1	19.7	23.2
Other countries	93.8	87.4	79.5	69.0	63.5

	Average annual growth rate of real nonpetroleum imports (in percent per year)			
	1987–1993	1993–2000	2000–2007	2007–2013
All countries	5.2	14.6	5.8	1.5
Mexico	12.4	25.2	5.6	4.4
China	29.1	23.2	20.4	4.3
Other countries	4.0	12.8	3.3	0.1

Sources: US Bureau of Economic Analysis (BEA), International Transactions Accounts, Release of March 19, 2014 (Tables 2a and 2b), and National Income and Product Accounts, release of March 27, 2014 (Table 4.2.4), www.bea.gov; Petróleos Mexicanos (Pemex), *Anuario Estadístico* (various years), www.pemex.com; US Census Bureau, FT900: US International Trade in Goods and Services, December 2013, www.census.gov; and author's calculations

Notes: Percentages may not add to exactly 100.0 due to rounding. US petroleum imports from Mexico were taken from Pemex up to 2007 and Census for 2013, and were subtracted from total imports from Mexico to get nonpetroleum imports from Mexico (all US imports from China are nonpetroleum). Shares were calculated using nominal values; growth rates were calculated based on real imports where nominal imports in current dollars were deflated by the US chain-type price index for nonpetroleum imports. Data for 2013 are preliminary

only 5.6%, while the growth rate of such imports from China was almost four times higher at 20.4%.

As a result of these trends, the Mexican share of US nonpetroleum imports stagnated at around 11% between 2000 and 2007, while the Chinese share surpassed the Mexican share and reached almost 20% by the latter year (see Table 7.1). Mexico held its position in the US market better than most other nations during the early 2000s, as the doubling of China's share in the 2000–2007 period came mostly at the expense of other countries. Nevertheless, numerous studies using a variety of methodologies have concluded that significant amounts of potential Mexican exports were displaced by competing Chinese products in the US market, implying that the Mexican share would likely have grown notably larger in the absence of the extraordinary growth of Chinese exports to the United States during that period.[5]

The reduced dynamism of Mexican exports in 2000–2007 occurred—with suitable allowance for lagged effects—following a rise in the real (inflation-adjusted) value of the peso in the late 1990s and early 2000s (see Fig. 7.1). This currency appreciation was an important factor limiting Mexico's export gains in the early 2000s. Mexican exports performed relatively better during the most recent phase (2007–2013), largely because a depreciated peso (especially relative to the Chinese yuan, as shown in Fig. 7.1) combined with rising global fuel and transportation costs made Mexico once again a more competitive location for industrial production. During this period, overall US nonpetroleum imports grew slowly (only 1.5% per year) as a result of the Great Recession and the sluggish recovery thereafter, but imports from Mexico grew faster than this average rate and about the same as imports from China (4.4% for Mexico vs. 4.3% for China) and the Mexican share of the US market rose to 13.4% by 2013 (see Table 7.1).

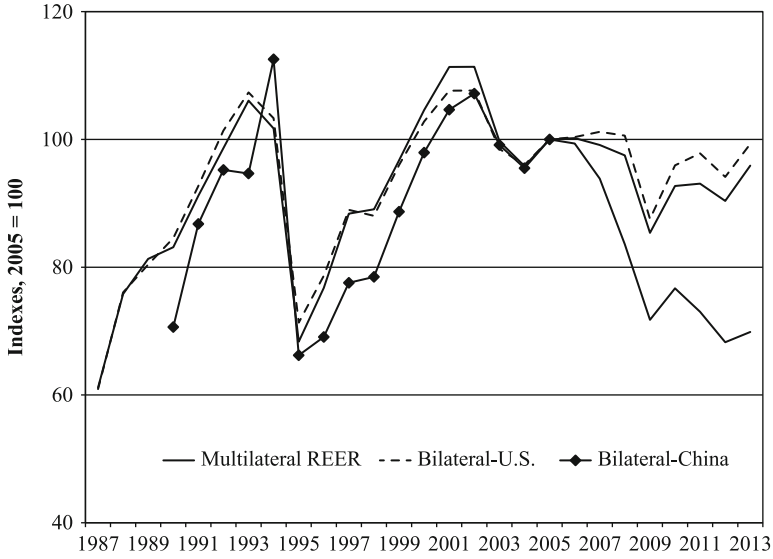

Fig. 7.1 Real value of the Mexican Peso, bilateral and multilateral indexes, 1987–2013. *Source*: International Monetary Fund, International Financial Statistics, online database, and author's calculations

A second factor limiting the gains from Mexico's export-led growth strategy is the shifting intensity of (and benefits from) the country's regional integration within North America. In the early years of trade liberalization and NAFTA, the Mexican economy became more tightly integrated with the US economy, but this tendency has been partially reversed since around 2000. On the export side, the US share of total Mexican exports rose from 69.2% in 1987 to 88.7% in 2000, but then diminished to 78.8% in 2013.[6] The reduction in this share after 2000 was partly a result of Mexico's efforts to diversify its export markets via other trade agreements, but also reflected the slowdown in US growth. On the import side, the diminished degree of regional integration is even more striking: The US share of total Mexican imports averaged about two-thirds to three-quarters during the late 1980s and 1990s, but fell to about one-half by 2007 and has remained at that level since then. In Mexico as well as the United States, much of the diminished intensity of intra-regional trade can be attributed to increased penetration of imports from China and other Asian countries. The Chinese share of Mexican imports increased nearly tenfold from 1.7% in 2000 to 16.1% in 2013, while the other Asian share rose from 10.0 to 15.2% over the same period.

Thus, the data reveal a striking shift in Mexico's pattern of international integration since around 2000. When Mexico opened up its economy and joined NAFTA, it initially developed a heavily regional pattern of trade within North America: Mexico imported mostly US-produced capital and intermediate goods, and exported assembled products manufactured with these inputs back to the US market. Since 2000, however, Mexico has exhibited more of a triangular pattern of trade, in which its imports come increasingly from East Asia while its exports are still sold primarily in the United States. Unfortunately for Mexico, it has not yet tapped into the greater dynamism of the Asian markets on the export side.

In spite of this geographic shift in its trade, the integration of Mexico's industrial sector with that of the United States has become notably stronger since NAFTA was formed. The correlation coefficient for the growth rates of the two countries' monthly indexes of industrial production (shown in Fig. 7.2) was only 0.23 for the period 1981–1993, prior to NAFTA, but rose to 0.59 in 1994–2013 after NAFTA, even including the years of the peso crisis and recovery (1994–1996).[7] If we focus on the years after NAFTA *and* the recovery from the peso crisis, this correlation increased further to 0.83 in 1997–2013.

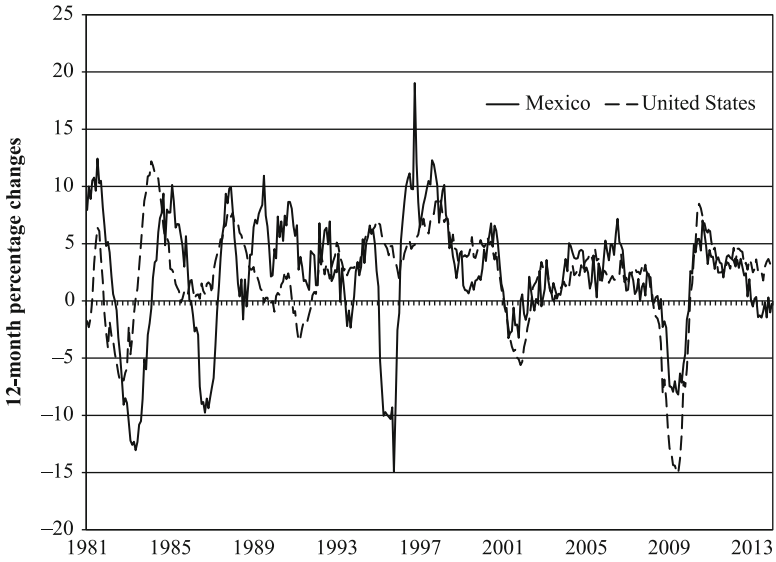

Fig. 7.2 Mexican and US indexes of industrial production, 12-month growth rates, monthly, January 1981 to December 2013. *Sources*: Federal Reserve Board of Governors, INEGI, and author's calculations

Deeper industrial integration with the United States proved to be a boon for Mexico in the late 1990s. In the period 1997–2000, after the recovery from the peso crisis, the two countries' average annual growth rates of industrial production were almost identical, at 5.3% for the United States and 5.4% for Mexico. However, during the 2001–2013 period, average annual industrial growth dropped to 0.7% per year in the United States and 1.2% in Mexico. Moreover, as Fig. 7.2 shows, this slowdown in industrial growth began even before the Great Recession of 2008–2009. Thus, the integration of Mexican industries into North American supply chains has turned out to be much less beneficial for Mexico since US industrial growth slowed down in the early twenty-first century.

Finally, the gains from Mexico's incorporation into international (regional or global) value chains have been limited by the high degree of reliance on imported inputs (parts and components) for the country's export production and the heavy concentration of the exports in a limited

number of sectors (Moreno-Brid et al. 2005; Dussel Peters and Gallagher 2013). Ibarra and Blecker (2015) estimate that the elasticity of Mexican imports of intermediate goods with respect to manufactured exports is about 0.6–0.7, implying that for every 10% increase in manufactured exports, imports of intermediate goods rise by about 6–7%. In regard to sectors, about three-quarters of Mexico's manufactured exports consist of transportation equipment (principally automobiles and auto parts, now joined by small amounts of aerospace products), computers and electronic products, and other machinery and equipment. However, most of the growth of exports in recent years has occurred in transportation equipment, which expanded by a remarkable 52% (in chained 2009 dollars) between 2007 and 2012, while exports in all other manufacturing sectors grew relatively little or even shrank.[8] The way that these trends in Mexico's international trade have limited the inclusiveness of the country's development model will be discussed below, but first we turn to an analysis of the trends in productivity and innovation.

Productivity and Innovation

In spite of Mexico's relative success on the export side, its productivity growth has continued to lag behind many other major emerging market nations. Figure 7.3 compares the annual average growth rates of real GDP per employed person, in constant 1990 purchasing power parity (PPP) dollars, for a sample of emerging market nations from Asia and Latin America for the period 1990–2012. Mexico's productivity growth rate of only 0.8% per year ranks near the bottom among this group of comparator countries. However, Mexico's low average growth rate of productivity for total GDP is partly a reflection of the shift of labor into services, in which productivity grows more slowly (or has been falling, depending on the time period examined),[9] especially because a large portion of Mexican services production is in the informal sector in which productivity is low and slow-growing.

In order to compare productivity growth rates for the trade-related parts of GDP, we also present data in Fig. 7.3 for the manufacturing sector.[10] As expected, Mexico's growth rate of labor productivity (real value added in constant pesos per employed worker) in manufacturing is higher than for overall GDP (2.1 vs. 0.8% per year). However, productivity growth is higher for manufacturing than for overall GDP in most of the countries shown, so Mexico remains toward the lower end of the sample.

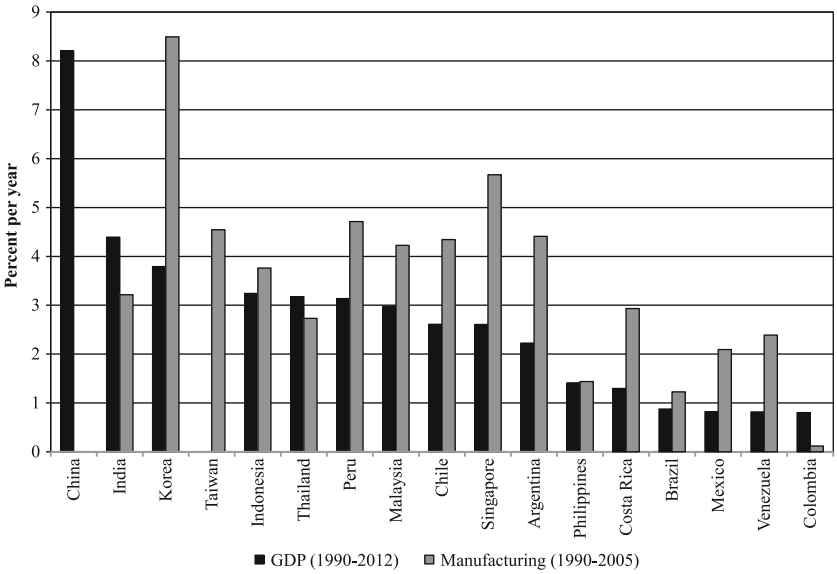

Fig. 7.3 Average annual growth rates of labor productivity: GDP and manufacturing value added per employed person in constant 1990 PPP dollars. *Sources*: GDP data from World Bank, World Development Indicators online database; manufacturing data from Groningen Growth and Development Centre 10-Sector Database, Timmer and de Vries (2007); and author's calculations. *Notes*: GDP per employed person is not available for Taiwan; manufacturing value added per employed person is not available for China. Manufacturing data for India are for 1990–2004 only

Among the 16 countries included in this database (which includes Taiwan but excludes China), Mexico is ahead of only three countries (the Philippines, Brazil, and Colombia) in manufacturing productivity growth and behind the other 12 covered (the highest of which, Korea, registers 8.5% annually).

Although Mexico's average productivity growth is thus quite disappointing, the growth rate of productivity for the whole economy masks considerable unevenness between different segments of the country's highly dualistic economy. According to an analysis of Mexican economic census data for the period 1999–2009 by Bolio et al. (2014),[11] real value added per occupied person (in constant 2003 pesos) grew at a 5.8% annual

rate in large firms (those with more than 500 employees), a 1.0% annual rate in medium-sized firms (11–500 employees), and a –6.5% annual rate (i.e., there was falling productivity) in small firms (10 or less employees). The last group of firms, most of which can probably be considered informal enterprises, accounted for 42% of total employment in this sample in 2009 (up from 39% in 1999), while large firms accounted for only 20% (the same as in 1999). Thus, as of 2009 the vast majority (80%) of the nonagricultural private labor force was working in firms that had either mediocre or negative productivity growth during the preceding decade. This accounts for why the overall average growth rate of productivity (0.8% for all firms covered in these economic censuses) is so low, but it also shows that there is a modern segment of the Mexican economy in which productivity growth is quite rapid.

Whereas Bolio et al. (2014) analyze labor productivity in all nonagricultural firms (and hence include services and other industries, such as transportation, mining, and utilities, in addition to manufacturing), an earlier study by López-Córdova and Moreira (2004) focused on total factor productivity (TFP) in the manufacturing sectors of Mexico and Brazil. For Mexico, this study found that "all firm-level gains (in TFP) occurred in traded industries, as productivity in firms in nontraded industries actually declined," and that the reallocation of resources toward traded goods production contributed significantly to aggregate TFP gains in manufacturing (López-Córdova and Moreira 2004: 589). The authors also found that "foreign firms were 13 percent more productive than their local counterparts in Mexico," after controlling for other industry characteristics (p. 598). López-Córdova and Moreira did not find that exporting per se or the use of imported inputs contributed significantly to productivity growth (in fact the latter had a negative effect on TFP growth for foreign firms). However, they concluded that exporting selects for the more productive firms (i.e., the more productive firms are the most successful in exporting, and hence grow faster than other firms), and that the resulting reallocation of resources toward such firms increases average productivity and the average TFP growth rate in manufacturing.

Turning to innovation, at the aggregate level Mexico's R&D expenditures are only about 0.5% of GDP, which puts the country well behind the leading emerging market nations such as Korea and China as well as the advanced industrialized countries, and Mexico also does not rank highly in patenting activity (see Chap. 1). At the micro level, there is evidence of a small but increasing amount of technological innovation being conducted

by firms inside Mexico (see Carrillo and Gomis 2014), but thus far this activity has had little impact on the aggregate statistics for either innovative activity or productivity growth. One important reason for this lack of an aggregate impact is the dualism discussed above: The vast majority of the smaller, low-productivity firms are incapable of innovating; mostly the larger ones and perhaps a few of the smaller or medium-sized ones have the potential to be able to innovate. However, even among the larger firms and multinational corporations (MNCs), the vast majority are not currently engaged in innovative activities. The survey of MNCs in Mexico discussed by Carrillo and Gomis (2014), which includes both foreign and domestically owned firms, shows that only 28% are conducting innovation in Mexico while 72% are not.[12] Trade liberalization and economic integration have induced Mexican producers to focus on upgrading their production facilities and product quality, but this upgrading has been accomplished primarily through the adoption of foreign technology rather than through domestic innovative efforts (Carrillo et al. 2012).

Another important factor limiting domestic innovative activity is that government policies designed to promote R&D in Mexico are both recent in time and still limited in scope and budget. According to Villavicencio (2012: 35, 43; author's translation), "Innovation policy as such in Mexico began only about a decade ago…It is only in the new millennium that policies began to promote innovation in firms, as well as to stimulate private investment in R&D and the cooperation of firms with academic institutions and public centers of research." As an example, Villavicencio documents how one new institution, the federal Fondo Sectorial de Innovación (created in 2002), has funded R&D activity in various sectors, but has failed to increase its efforts significantly over time as a result of both budget constraints and a limited pool of eligible proposals. Because of the limited extent of the innovative efforts to date as well as the long lags involved in achieving measurable gains in productivity from innovative activities, it is too soon to judge what kind of aggregate impact these activities may have in the long run.

To conclude, there is a significant segment of the Mexican economy that is modern and dynamic, with high and rising productivity; this segment consists mainly of the larger firms and perhaps a small portion of the small and medium-sized ones, and within manufacturing is primarily oriented toward exports and dominated by foreign MNCs. In this sense, Mexico's economic opening strategy and its increasing integration into regional and global value chains have been successful in creating industries

that are globally competitive and technologically progressive. However, this segment of the economy has not yet grown large enough to encompass more than one-fifth of the private, nonagricultural labor force, and only a subset of the modern segment of the economy is engaged in truly innovative activities. As a result, the average growth rates of productivity for the entire economy and for the manufacturing sector as a whole remain disappointingly low.

Inclusion: Employment, Wages, and Convergence

One of the main objectives of Mexico's trade liberalization and economic integration strategy was to boost employment and wages in the country's industrial sector. This set of objectives was famously enshrined in President Carlos Salinas' twin promises that NAFTA would enable Mexico to "export goods not people" and transform the country into a first world nation (which presumably would imply absolute, unconditional convergence in per capita income and real wages). Of course, the flow of migration to the United States did not diminish, and if anything probably accelerated in the first decade after NAFTA (Hanson 2006); it has slowed since then mainly as a result of increased US enforcement of immigration restrictions and slower growth in the US economy. In this section, we focus on the domestic outcomes in the Mexican labor market and income distribution (see Chap. 6, for comparisons of Mexico with East Asian countries).

Employment

Because manufactures account for the vast majority of Mexico's exports, we focus on manufacturing employment. Figure 7.4 pieces together the best available data for employment in the manufacturing sector of Mexico between 1988 and 2013. Total employment in Mexican manufacturing grew by about 900,000 jobs in the first five years of NAFTA (comparing the economic census figures for 1993 and 1998), and probably about one million in the first seven years.[13] Although that was impressive growth in employment at the time, the number of manufacturing jobs in Mexico shrank by about 500,000 after 1998, leaving a net increase from 1993 to 2013 of only about 400,000. Given that the Mexican labor force has increased by about 950,000 per year throughout the past two decades,[14] we can see that the long-term net increase in manufacturing employment since NAFTA has amounted to less than half of one year's increase in the

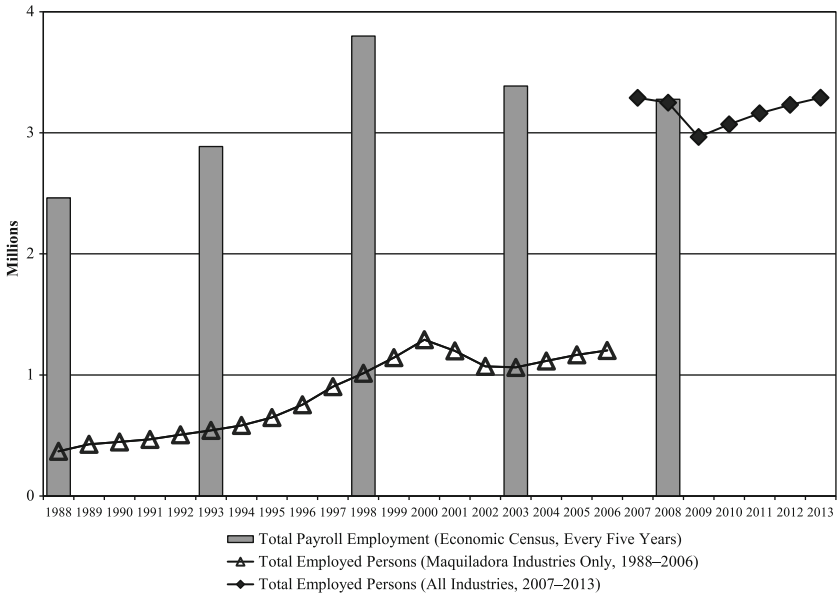

Fig. 7.4 Total employment in Mexican manufacturing, alternative measures, 1988–2013. *Sources*: INEGI, Encuesta Nacional de la Industrial Manufacturera (EMIM), Censos Económicos, and author's calculations. *Notes*: Data are shown for all periods for which each series is available: maquiladora data ended in 2006; the new, complete survey of all industries began in 2007; and the Economic Census is quinquennial (Census data for 2013 were not available at the time of this writing). Data for the maquiladoras (1988–2006) and for all industries (2007–2013) are annual averages of monthly data

size of the Mexican labor force, and hence has made only a small dent in the country's long-term employment needs.

In relation to the composition of manufacturing employment, it is important to note that the activities that account for the lion's share of Mexico's manufactured exports do not represent a majority of its manufacturing employment. As noted earlier, three sectors (transportation equipment, computers and electronic products, and other machinery and equipment) accounted for 76% of manufactured exports in 2012, but these sectors accounted for only 40% of manufacturing employment as of 2013.[15] Paradoxically, and in spite of Mexico's reputation for specializing in labor-intensive exports, the most successful export industries are

apparently *less* labor-intensive than the industries that produce mainly for the domestic market (see also Ruiz Nápoles 2004).

The disjuncture between exports and employment also reflects the industrial dualism discussed earlier. Bolio et al. (2014) identify the manufacturing sector with the largest amount of employment (food and beverages) as one characterized by a very large number of extremely small and low-productivity firms, most of which do not export. Indeed, the only manufacturing sector in which employment has increased since 2007 is transportation equipment; employment in all other sectors has either held steady or actually fallen, with the biggest decreases registered in textiles and apparel products and computers and electronic products—both of which are sectors subject to intense competitive pressures from lower-wage countries in Asia and Central America.

There are several reasons why the employment gains from manufacturing exports have been disappointing. First, although the gross value of Mexico's exports has increased dramatically, a large portion of the increase consists of products assembled from imported intermediate goods (parts and components), leading to relatively little value added and few backward linkages to other domestic industries. The maquiladora plants are the most extreme case, as imported intermediate inputs on average accounted for more than three-quarters of the gross value of their exports (and hence value added was less than one-quarter) throughout most of the period from 1990 to 2006 (the last year for which separate data for the maquiladoras were reported). But the maquiladoras produced more than half of Mexico's manufactured exports during those years and accounted for most of the employment growth shown in Fig. 7.4. As noted earlier, Ibarra and Blecker (2015) estimated that imports of intermediate goods have an elasticity of about 0.6–0.7 with respect to manufactured exports in Mexico. Since these estimates are for total manufactured exports and total intermediate imports (both maquiladora and non-maquiladora), they suggest a very high dependency of all manufactured exports on imported intermediate inputs and a correspondingly low proportion of value added.[16]

Second, although Mexico has achieved large bilateral surpluses in goods trade with the United States, reaching $112 billion in 2013, these bilateral surpluses are entirely offset by similarly large deficits with other countries (led by a $101 billion deficit with Asia, of which $55 billion was with China alone, plus a $25 billion deficit with Europe),[17] so that Mexico gets no net stimulus to aggregate demand from its trade overall. Moreover, on a multilateral basis Mexico has a significant trade deficit in manufactures,

offset mainly by a surplus in petroleum (Moreno-Brid 2013). In 2013, Mexico had a deficit of –$12.0 billion in manufactures, offset by surpluses of $8.7 billion for petroleum products and $2.3 billion for other primary commodities (agricultural and mineral, except petroleum).[18] Thus, contrary to the conventional view that Mexico is a natural resource-scarce country, it is actually a net exporter of natural resources and a net importer of manufactures (thus more like the major South American nations than may appear). In any event, Mexico's trade deficit in manufactures signifies a net transfer of industrial employment to other countries, especially the Asian nations that supply Mexico with increasing proportions of its imports.

Third, contrary to the conventional view that Mexico's comparative advantage lies in less skilled labor, the industries that have grown the most in the long term are ones that emphasize highly skilled labor. Mexico's export industries have experienced a significant quality upgrading since trade liberalization, NAFTA, and the peso crisis, leading to rising demand for more educated workers (see, among others, Esquivel and Rodríguez-López 2003; Verhoogen 2008). The export industries that are most intensive in less skilled labor, such as apparel, have largely left Mexico for lower-wage locales in Asia or Central America, while the most successful export industries, such as electronics and transportation equipment, require more education and training for their workers. This industrial upgrading and the associated increases in skill requirements contribute positively to the long-term development of the Mexican economy, including its capacity for innovation, but have nevertheless meant that the net increases in manufacturing employment associated with exports have been much more limited than were expected as a result of trade liberalization and NAFTA (similar to what Deyo observes in the employment trends in Korean manufacturing in his chapter).

Finally, Mexico's slower rate of industrial growth and its loss of US market share to China since 2001, discussed earlier, contributed to the absolute decline in manufacturing employment after that time. Even though Mexico's labor productivity in manufacturing has grown more slowly than that of many other countries, it has still grown faster than industrial output since the early 2000s (roughly 2 vs. 1%), resulting in a tendency for manufacturing employment to fall. Thus, it is no wonder that manufacturing employment in 2013 was still about a half million below its peak around 2000.

Wages and Inequality

One consequence of the upgrading of Mexico's industrial structure was a significant increase in the wage premium for more skilled workers in the early years after trade liberalization and NAFTA. The best measure of the skill premium that is available for the manufacturing sector (where the impact of trade is greatest) is the ratio of the salaries of nonproduction workers to wages of production workers (both measured on an hourly basis).[19] This ratio increased sharply from about 2:1 in 1987 (the year after Mexico joined GATT) to about 3:1 in 1996, and then diminished gradually to about 2.6:1 in 2013 (thus remaining substantially above its 1987 level). Similarly, Hanson (2004) found that wages increased relatively more for the more educated strata of the labor force in a comparison of broader population census data for 1990 and 2000.

The increase in wage inequality in the late 1980s and early 1990s was unexpected at the time, because most analysts expected *ex ante* that Mexico would specialize in industries that were intensive in less skilled labor. Since then, several explanations have been offered for the rising skill premium. Cragg and Epelbaum (1996) and Esquivel and Rodríguez-López (2003) argued that Mexico was experiencing skill-biased technological change that increased the relative demand for skilled labor. Revenga and Montenegro (1998) and Hanson and Harrison (1999) found that Mexico's tariff reductions after it joined GATT and NAFTA were greatest for products that were more intensive in less-skilled labor. Their findings suggested that trade liberalization reduced the rents that unskilled workers had been able to obtain previously in highly protected industries.

Feenstra and Hanson (1997) developed a model of US–Mexican offshoring in which US industries outsource the least skill-intensive operations in their supply chains to Mexico, but those operations are relatively high skill-intensive compared to the pre-existing industrial activities in Mexico. Such offshoring results in a rise in the average degree of skill intensity in both countries, leading to a rise in relative demand for more skilled labor and increasing wage inequality in both. According to Verhoogen (2008), the peso depreciation of 1994–1995 added an additional shock that induced further "quality upgrading" in Mexican industries. Essentially, the depreciation led to more rapid expansion of the more efficient and higher quality firms in export sectors, which in turn led to greater wage increases within these firms compared to other firms and relatively greater

wage increases for white-collar workers compared with blue-collar workers, and hence contributed to a rise in within-industry wage inequality.

In contrast, the more gradual decline in the skilled wage premium since 1997 appears to be largely unrelated to Mexico's international trade. Esquivel et al. (2010) and Lustig et al. (2013) show that this decline can be attributed mainly to an increase in the relative supply of more educated workers, which more than offset the rising relative demand so that the rate of return to higher education diminished in the early 2000s. Nevertheless, wage inequality still increased in the long run, as the post-1997 decline in the skill premium was much less than the previous increase. This implies that the wage gains from trade liberalization and export growth have still been skewed toward the more highly educated and relatively better-off workers. For those workers who have the requisite education and training, the gains have helped to propel them into the rising Mexican middle class. But for the larger numbers of workers who lack the requisite skills, trade liberalization has failed to bring the promised benefits—and has left many of them seeking other solutions such as emigration or employment in low-productivity informal activities.

In addition to rising wage inequality between more and less skilled (or educated) workers, Mexico also experienced a widening of other social gaps in the years following its trade liberalization. Several studies have found that wage gaps between different regions of the country increased, with workers in the northern and border regions (where export industries and foreign direct investment are concentrated) doing relatively better than those in the central and southern regions (Hanson 2004; Borras and López-Córdova 2007; Chiquiar 2008). The latter two studies also provide an important qualification to the finding of increased wage inequality: They find that the increase in the skilled wage premium was relatively smaller in the northern and border states than in the rest of the country. This finding could be a result of low-skilled workers losing the most from globalization in the regions of the country that had less participation in exports and more exposure to the negative side of globalization (e.g., cheap imports of basic foods and other consumer goods displacing local production). Also, Borras and López-Córdova (2007) found that less skilled women workers did relatively better in the northern and border states than workers in the rest of the country as a result of globalization forces. Altogether, this evidence suggests that the benefits of export activity and globalization were very uneven and highly concentrated in certain regions and groups, while other regions and groups either did not share in the gains or felt the brunt

of the losses (e.g., the losses to Mexican farmers caused by subsidized and dumped imports of US corn, according to Wise 2010).

Regardless of the shifts in relative wages between different groups of workers since trade liberalization, overall average real wages in Mexican manufacturing have stagnated since those policies were adopted. As shown in Fig. 7.5, real compensation per hour fluctuated cyclically in the aftermath of the debt crisis in the 1980s, then fell after the peso crisis of 1994–1995, and eventually (by around 2003) recovered from the latter. However, as of 2013 real hourly compensation had barely recovered to its previous peak level of 1994, when NAFTA went into effect, and still remained below its historical peak level of 1981. Hanson (2004: 515) noted that the real wage fell for both genders in his comparison of data from the 1990 and 2000 population censuses: "When deflated by Mexico's consumer price index (CPI), the average hourly wage in 1990 dollars declined for males from $1.33 to $1.11 and for females from $1.24 to $1.13." Thus, *all of the changes in relative wages for different categories of workers discussed here*

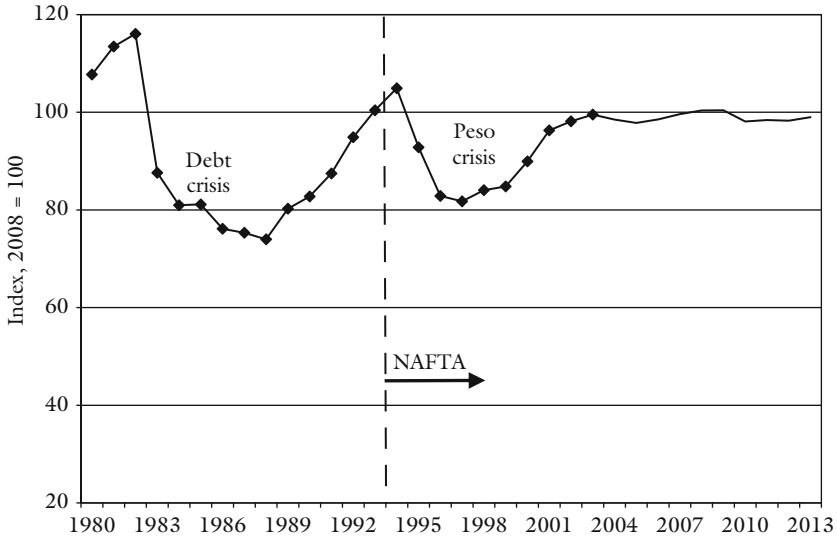

Fig. 7.5 Real hourly compensation in Mexican manufacturing industries, annually 1980–2013. *Sources*: INEGI, Banco de México, and author's calculations

have taken place around a long-run trend for average real wages that is at best flat, and at worst slowly declining. On the whole, labor simply has not gained much either in real earnings or in employment from the tremendous expansion of exports of the past few decades.

The overall distribution of income in Mexico is, of course, better measured by inequality at the household level rather than by wages for industrial workers alone. Gini coefficients and other standard indicators generally showed rising inequality from the 1980s through the mid-1990s (i.e., during the debt crisis and early years of trade liberalization), and then decreasing inequality in the late 1990s and early 2000s—with somewhat of a reversal after the recession of 2008–2009. The period of rising inequality coincided with the country's opening to trade and the increase in the skilled wage premium. The decrease in inequality in the late 1990s and early 2000s appears to have been caused mainly by domestic factors. Esquivel et al. (2010) and Lustig et al. (2013) attribute this decrease in inequality mainly to increased progressivity of fiscal policies (especially on the expenditure side, including new transfer programs) and the increase in the relative supply of skilled labor due to rising education levels (as discussed above).

The evidence of declining inequality in the late 1990s and early 2000s should be taken with caution, however, because the standard measures are based on data sources that do not adequately incorporate the income of the wealthiest groups (e.g., top 1% or higher). Esquivel (2015) reports that when the standard measures are adjusted to better reflect top-bracket incomes, inequality (as measured, e.g., by the income share of the highest decile) increased rather than decreased after the mid-1990s. Esquivel (2015) also finds that the income share of the top 1% in Mexico is the highest in a group of 24 countries for which comparable data were available, and documents the astoundingly high and rapidly increasing wealth of the small elite of Mexican billionaires relative to total national income (and relative to the income of the poorest groups). Esquivel (2015) and Guerrero et al. (2009) show that billionaire-controlled industrial groups have disproportionate political influence, which enables them to maintain privileged oligopoly positions and to exact high oligopolistic rents from Mexican consumers in key sectors such as telecommunications.

Convergence

Given the ambitious goals that Mexico set for its economic integration strategy, an important measure of inclusion (or the lack thereof) is the degree to which that strategy has enabled the country to achieve con-

vergence in average living standards with its neighbor to the north. Unfortunately, however, there has been no convergence in either per capita income or labor productivity between Mexico and the United States since the former liberalized its trade and joined NAFTA. Figure 7.6 shows three measures of Mexico's labor productivity and per capita income, all taken from the most recent version (8.0) of the Penn World Tables (PWT) and measured as percentages of their respective US levels at PPP.[20] All of these measures generally improved during the era of import substitution policies between the 1950s and 1970s, indicating that Mexico was converging with the United States during those decades, although the relative productivity measures stagnated in the 1970s and the final increases in these measures (especially per capita income) around 1980 were associated with the unsustainable oil boom and debt build-up which occurred at that time. All three measures collapsed during the debt crisis of 1982–1986, and fell again during the peso crisis of 1994–1995.

Of course, divergences that occurred as a result of macroeconomic crises cannot be blamed on economic integration. Nevertheless, there is no

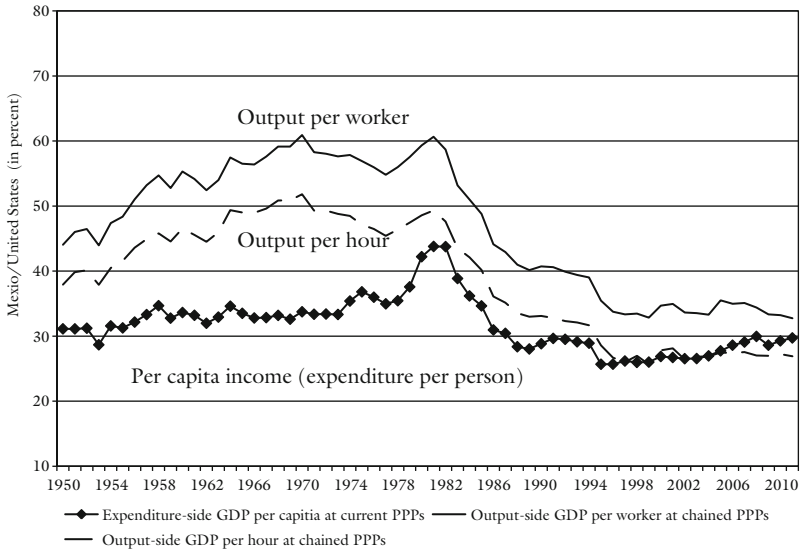

Fig. 7.6 Per capita income and labor productivity, at Purchasing Power Parity (PPP), Mexico as a percentage of the United States, 1950–2011. *Sources*: Penn World Tables 8.0 (Feenstra et al. 2013) and author's calculations

evidence of a long-term increase in Mexico's relative productivity or per capita income compared to the United States since the country's initial trade liberalization (recall that Mexico joined GATT in 1986) or the formation of NAFTA (1994). On the contrary, as of the last year for which data are available (2011), Mexico's per capita income was no higher relative to the US level than it was in the early 1990s prior to NAFTA, and its relative labor productivity was lower than in the pre-NAFTA years. Even more distressingly, by 2011 all the convergence that Mexico had achieved between 1950 and 1980 had been completely reversed; its labor productivity was a smaller percentage of the US level than in 1950, and its per capita income was about the same percentage of the US level as in 1950 (around 30%). Similarly, there has been no convergence of Mexican wages toward US levels in the past few decades. In 1993, the year before NAFTA went into effect, the average Mexican production worker in manufacturing earned 18% of the hourly compensation of a typical US production worker; by 2012 (after various fluctuations in between), this percentage had fallen to 16%.[21] Economic integration has thus not sufficed to revive the process of convergence since the reversals caused by the financial crises of the 1980s and 1990s.

Conclusions

After a generation of focusing on trade liberalization policies, Mexico has established itself as a leading exporter of manufactured goods and a key link in global value chains, especially those targeted on ultimate sales to the US market. However, the slow growth of the US market and increasing Chinese penetration of that market have limited the expansion of Mexican exports since 2001, in spite of some gains from a lower peso in the last few years. Furthermore, the broader benefits of this export success have been attenuated by various factors, including heavy reliance on imported inputs, exchange rate fluctuations, limited job creation, regional concentration of industries within Mexico, and a relatively low level of R&D activity at a national level. As a result of these limitations and other factors, median real wages in manufacturing have not increased significantly in the last two decades, while millions of Mexican workers have migrated to the United States in search of jobs at higher wages. Contrary to initial expectations, the greatest gains in employment and wages within the manufacturing sector have accrued mostly to the more highly educated workers, while total employment in that sector has decreased since it peaked around 2000.

The Mexican case thus suggests caution in relying upon trade liberalization and economic integration policies as the primary instruments for promoting more rapid growth and more inclusive development. Undoubtedly, such policies do boost trade, and they can also lead to upgrading of the industrial structure, increased productivity in the exporting firms, and eventually—with assistance from public policy—the birth of domestic innovative activities. Nevertheless, there are no automatic linkages from these sorts of gains to broader gains in aggregate growth and welfare, and the gains that are reaped (as well as any costs or losses) may be very unequally shared. This does not mean that countries like Mexico should not open their economies, promote exports, or seek to become a part of global value chains, but it does mean that the outcome of such efforts—especially the inclusivity of the gains—depends on the entire package of policies that accompanies the opening of trade at both the micro and macro levels.

A good example of the need for a more integrated and comprehensive policy approach is found in the frequently cited area of education. The overwhelming evidence of increased relative demand for more skilled labor in the modern and successful firms makes it imperative for Mexico to focus on educational reforms that can improve the quality of basic (primary and secondary) education and enhance access to tertiary education, especially in the technical fields. Nevertheless, the fact that returns to higher education began to fall after the supply of more highly educated workers increased in the late 1990s and early 2000s suggests that merely expanding and improving education is not sufficient. Unless the demand for more educated labor keeps pace with the supply, the returns to higher education will diminish and the incentives to seek it will fall. Moreover, in the absence of adequate employment opportunities at rising wages domestically, some highly educated workers will seek to migrate abroad where they can earn higher incomes.[22] Therefore, policy makers need to be just as concerned about boosting the demand for skilled labor through measures that can attract and retain more high-technology production as they (rightly) are about boosting the supply of such labor through educational policies.

One key condition for attracting and keeping globally mobile industries is maintaining a competitive exchange rate, which Mexico has not done consistently throughout the period since it liberalized its trade. Much recent research has found that competitive exchange rates are a vital ingredient in achieving and sustaining rapid growth in emerging market

nations (see, e.g., Hausman et al. 2005; Rapetti et al. 2012). Berg et al. (2012) find that avoiding exchange rate overvaluation is especially important for maintaining a long duration of rapid growth. Blecker and Razmi (2008) stress the importance of exchange rates between a given emerging market nation like Mexico and other rival emerging market nations like China. This chapter has shown that Mexico's exports have exhibited the best performance (controlling for other factors) when the peso was at a competitive level, while exports have grown more slowly when the peso has been overvalued.

Recognizing the centrality of a competitive exchange rate also points to the need for more accommodative and pro-growth macroeconomic policies in general. Although a full discussion of macro policies would be beyond the scope of this chapter, it seems clear that unleashing Mexico's growth potential requires a renewed emphasis on the demand side as well as on the supply side.[23] Mexico needs a better balance of internal and external sources of demand than it has had in the past—either under the import substitution regime of the 1940s to the 1970s, when the economy was largely closed to trade and growth was mainly internally oriented, or under the trade liberalization regime since the late 1980s, in which the economy is wide open and growth is mainly dependent on the dynamism of exports and other external factors (Blecker 2009). Redistributive policies that would further boost the incomes of the nascent middle class and social inclusion policies that would bring informal sector workers into the formal modern economy are essential for providing the domestic demand growth that Mexico needs to accompany its export promotion efforts.

Fortunately, rather than facing a conventional equity-efficiency tradeoff, Mexico is in a position in which enhancing inclusion and promoting growth can potentially go hand in hand.[24] Higher wages and income levels, in addition to boosting domestic demand, would also foster incentives to innovate. In addition, the country needs increased investment in public infrastructure, improved provision of credit to the private sector (especially for small and medium-sized firms), and expansion of the innovation policies that promote domestic R&D efforts. Ultimately, the goal should be to achieve a "virtuous circle" of rapid and balanced growth in which real wages rise in tandem with increasing productivity. Mexico needs to work on all these fronts to achieve its economic potential and foster the inclusive growth that past reforms and integration efforts have promised but not delivered.

Acknowledgments The author gratefully acknowledges helpful comments from Antoni Estevadeordal, Eric Hershberg, Carlos Ibarra, Julio López, Jaime Ros, and Barbara Stallings on earlier drafts. The usual caveats apply.

Notes

1. See Esquivel and Rodríguez-López (2003), Verhoogen (2008), Carrillo et al. (2012), and Carrillo and Gomis (2014), among many others.
2. Data from Ibarra and Blecker (2015), who took the export data from the Mexican Instituto Nacional de Economía y Estadística (INEGI, www.inegi.org.mx). Nominal exports in US dollars were converted to real volumes of exports using the US producer price index for industrial commodities from US Bureau of Labor Statistics (BLS), www.bls.gov.
3. This figure for 2012 is taken from the World Bank's *World Development Indicators* online database, and is used for international comparative purposes. According to the Mexican data source (INEGI) cited in the previous note, the figure was closer to 80%.
4. We focus on nonpetroleum imports here to make the Mexican share more comparable to the Chinese share, because China does not export petroleum to the United States. Growth rates are computed using real nonpetroleum imports measured at chained 2009 prices.
5. See, among others, Gallagher et al. (2008), Feenstra and Kee (2009), Hanson and Robertson (2009), and Dussel Peters and Gallagher (2013).
6. The Mexican trade data discussed in this paragraph are drawn from Blecker (2014a, b), who in turn obtained the data from INEGI.
7. Correlation coefficients and growth rates for industrial production are author's calculations from the same data sources given for Fig. 7.2. I am indebted to Gerardo Esquivel for suggesting this way of analyzing Mexican–US economic integration and for supplying historical data for Mexico.
8. Author's calculations based on data from INEGI and the US Bureau of Economic Analysis (BEA, www.bea.gov).
9. Based on data from Timmer and de Vries (2007), labor productivity in Mexican services fell from 60 to 38 (in thousands of constant 1993 pesos per employee) between 1971 and 1995, and then increased but only to 43 (in the same units) from 1995 to 2005.
10. Data on productivity at the sectoral level for 16 Asian and Latin American nations were obtained from the Groningen Growth and Development Centre (GGDC) 10-Sector Database, which applies a common methodology to all countries—but, unfortunately, provides data only through 2005.

The methodology is described in Timmer and de Vries (2007); the data are available at http://www.rug.nl/research/ggdc/data/10-sector-database.

11. Bolio et al. (2014) use the Economic Censuses of 1999 and 2009 which, in reality, are based on data for 1998 and 2008. These censuses exclude the agricultural and government sectors.
12. In this study, multinational enterprises are defined as conducting innovation in Mexico if they satisfy the following criteria in their Mexican affiliates or subsidiaries: "(a) they have an R&D department or unit, (b) they recognize that the R&D activity they realize [in Mexico] is used in other affiliates [in other countries], (c) they have linkages with educational centers for developing R&D in Mexico, and (d) they have sought government support for these same ends" (Carrillo and Gomis 2014: 398, author's translation).
13. Note that we attribute the Economic Census data here to the years in which the data were gathered, rather than the years in which the censuses were released as in Bolio et al. (2014) (see previous note). Complete data for 2000 are not available as only quinquennial Census data are available prior to 2007, but the data for the maquiladoras—where most of the job growth occurred—indicate that employment continued increasing until 2000.
14. Author's calculations based on data for 1993–2012 from World Bank, *World Development Indicators*, online database, http://databank.worldbank.org/data/home.aspx.
15. Author's calculations from INEGI's Encuesta Mensual de la Industrial Manufacturera (EMIM), http://www.inegi.org.mx/sistemas/bie/.
16. See also Moreno-Brid et al. (2005) and Fujii Gambero and Cervantes-Martínez (2013).
17. Data from INEGI. Due to small surpluses with other nations, mainly in Latin America, Mexico's overall deficit in goods trade for 2013 was only $1 billion.
18. Based on author's analysis of INEGI data.
19. Although this is an admittedly imperfect measure, the distinction between nonproduction and production workers correlates well with the distinction between employees with higher and lower levels of educational attainment, and data by educational level are not readily available for the manufacturing sector. The data given here are author's calculations based on various surveys of the manufacturing sector available from INEGI's Banco de Información Económica, http://www.inegi.org.mx/sistemas/bie/.
20. A fourth measure, expenditure-side real GDP per person at chained PPPs, is almost identical to the similar measure at current PPPs, and hence is omitted to avoid cluttering the graph. For a similar analysis using earlier

versions of the PWT and other data sources, see Blecker and Esquivel (2013).

21. Source: BLS, "International Comparisons of Hourly Compensation Costs in Manufacturing, 2012", August 9, 2013, and author's calculations.
22. Hanson (2006: 898–899) notes that, contrary to popular perceptions, "individuals with moderate to high education levels have the highest likelihood of migrating abroad."
23. For various perspectives on Mexico's macroeconomic policies and the causes of its slow growth in recent years see, among others, Levy and Walton (2009), Moreno-Brid and Ros (2009), Arias et al. (2010), Hanson (2010), and Ros (2013).
24. Much recent research finds that, more generally, greater distributional equity and sustained rapid growth are compatible in the long run. See, for example, Berg et al. (2012) and Lee (2013).

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CHAPTER 8

Middle Classes and Education in Latin America

Osvaldo Larrañaga and María Eugenia Rodríguez

Introduction

Other chapters in this book have strongly emphasized education as a key element in promoting productivity and, consequently, economic growth. In particular, it has been said that education in science and technology is necessary for promoting innovation. But education is also important for social inclusiveness. This chapter explores the connection between education and inclusion through the role of private schools in Latin America. As will be seen, the region's middle classes are seeking to improve opportunities for their children by leaving public schools for private institutions. The result is increasing inequality in societies as a whole.

The middle classes have played a leading role in the social dynamics of a large number of emerging countries that have seen their economies and

For further details on the source data used here, refer to O. Larrañaga & M. E. Rodríguez, (2014), Educación y clases medias, in A. Foxley & B. Stallings (Eds.), *Economías latinoamericanas: Cómo avanzar más allá del ingreso medio*, 431–488, Santiago, Chile: CIEPLAN.

O. Larrañaga (✉) • M.E. Rodríguez (✉)
Poverty Reduction and Inequality, United Nationals Development Program, Santiago, Chile

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their inhabitants' incomes grow in recent years. The surge of the middle classes has created worldwide expectations for the positive effects they can have on the development of these countries and for the international economy. Latin America has not been exempt from this trend. During the 2000s, per capita gross domestic product (GDP) grew at an average annual rate of 2.6% in the region, and income inequality dropped as a result of a narrowing pay gap between unskilled and highly skilled workers and an increase in cash transfers to the poorest segments (Lustig and López-Calva 2010). Between 2000 and 2008, the poverty rate in the region fell from 42 to 30%. The population with incomes above the poverty line, but still in a vulnerable situation, increased from 35 to 38%, while the middle class expanded from 22 to 29% of the total population (World Bank 2012).[1]

Government-provided public goods and social services are a key element of the well-being of a country's population as a whole and of the mid-level sectors in particular. Education stands out among the social services for its importance in a country's development. It is a key element for creating human capital and enhancing productivity. Additionally, it helps to foster an informed citizenry that is aware of its rights and duties in the public sphere, creates human and social interaction skills, and produces a national identity and shared values, among other impacts.

Specifically, education is a major asset for mid-level segments throughout the region and, for a great many of its members, has likely been the main factor accounting for their current socioeconomic standing. As a matter of fact, the abovementioned World Bank paper shows that education is a major predictor of upward mobility in the region, either from poverty into emerging sectors or from these to the middle class (World Bank 2012).

This chapter analyzes how the education systems in the more comparatively developed countries in Latin America are responding to the demand for more and better education coming from mid-level segments, including both the consolidated middle class and the emerging or vulnerable middle class. We show that there is a growing middle-class movement away from public education and into private elementary and secondary schools. This development is a private solution by the middle class to address the issue of education quality, but it has potential negative implications for society at large in terms of exclusion and increasing inequality. The core question here is how to reconcile the demand by the middle class for a quality education with the need for the education system to be an effective means for equalizing opportunity and promoting social integration.

This study looks at the eight countries with the highest levels of relative development and, consequently, largest middle classes in the region: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, and Uruguay. Two major micro-data databases were used: the latest household surveys conducted by the Economic Commission for Latin America and the Caribbean (ECLAC) Statistics Division and the data on educational achievement and characteristics of schools and households from the 2012 Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) test. It should be noted that this chapter is not about educational issues as a whole in these countries, but rather about those aspects most closely related to the demand created by the middle classes.

The rest of this chapter is divided into three major sections. The first section measures the middle classes and emerging sectors based on household survey micro-data. The second section analyzes middle-class participation in private schools in the context of the outcomes offered by schools to their graduates and the overall effects on the education system. The last section discusses relevant public policy challenges going forward.

A Definition of the Middle and Emerging Classes

There is no single definition of the middle class in the specialized literature. Rather, there are multiple definitions generally tailored to the intended purposes of the respective analyses.[2] Most of the recent economics literature on the middle classes uses definitions based on monetary income. In this respect, there are measurements based on absolute indicators and others based on income distribution by country.

For the purposes of this study, two target groups were identified: the consolidated middle class and emerging households. The first group includes households with a daily per capita income of US$10 and below the 90th percentile of the distribution. The second group includes households with daily per capita incomes of US$4–10 purchasing power parity (PPP).

The daily per capita income floor of US$10 (PPP) used here to define the consolidated middle classes would be "the absolute minimum income for a person to have the economic security associated with middle class status in today's global economy, and therefore the incentives and the potential to exercise political rights in his or her own interests" (Birdsall 2010). Underlying this definition is the notion that individuals with a daily income over US$10 have reached an economic situa-

tion sufficiently consolidated as to participate and feel included in their country's current economic development model. The US$10 threshold was also used in the World Bank Report (2012) on economic mobility in the region. In this case, the consolidated middle class has reached a financially secure income level, in the sense that these households exhibit a low likelihood (10%) of falling into poverty (López-Calva and Ortiz Juarez 2011).

The upper 90th-percentile limit separating the middle classes from high-income segments is less well established and should be understood as a definition that maintains the traditional approach of linking the top decile with the highest incomes. The referenced World Bank Report uses a threshold of US$50 per day—also an arbitrary choice and one that makes the middle class a part of virtually all of the higher-income population (including the 96th to the 99th percentiles of income distribution, depending on the country).

Emerging households are those that are above the poverty line but whose income levels continue to be low in terms of consumption capacity. The threshold of US$4 (PPP) per person per day is an approximation of the average poverty line used by the countries in the region (World Bank 2012). This group shows a measure of financial vulnerability in the sense that its income may drop below the poverty line if household members run into adverse situations including unemployment, debilitating illnesses, and others. For this reason, these sectors are often referred to as "vulnerable."

Economic growth in the region has enabled a process of upward mobility among social segments. The World Bank Report shows that around 15% of the population crossed the poverty line to join the (vulnerable) emerging class during 1995–2010, while close to 20% of the population moved from this segment into the consolidated middle class (World Bank 2012).

Income mobility affects households' own perceptions. Systemic income increases not only bring material well-being but also bring the expectation of further future progress. These households have access to new consumer goods and services such as housing, vehicles, and travel. Part of this consumption is symbolic in the sense that it distinguishes its users from their peers. When a family purchases their first vehicle, they not only gain access to a more convenient means of transportation that gives them more freedom of movement, but the purchase is also a sign of progress and differentiation within a given socioeconomic stratum (Franco et al. 2010).

It is very likely that consumption increases are considerably higher than the income increases reported by household surveys. There are two

reasons for this. On the one hand, there has been a major growth in consumer credit that makes it possible for families to finance expenses above their income levels. During 2000–2009, consumer credit as a percentage of GDP doubled in the major economies of the region (De la Torre et al. 2012). On the other hand, technological changes and market globalization have created more favorable quality-to-price ratios in tradeable consumer goods such as vehicles, home appliances, clothing, and others. Some of these changes do not show up in price indexes, so real income measurements tend to underestimate the actual increase in consumer purchasing power.

Measuring the Middle Classes

The measurement of socioeconomic levels carried out in this study relied on micro-data from the most recent two rounds of household surveys, conducted in 2009 and 2012, respectively. In each case, the population was classified according to the above-mentioned per capita income thresholds, and the average of both measurements was calculated to make this household classification more robust.

The results show that 35.1 % of the population of the selected countries is in the middle class, while another 36.5 % are in the emerging sector (Table 8.1).[3] The size of a country's middle class grows as that country's per capita income increases. So Argentina, Chile, and Uruguay show the largest consolidated middle classes, ranging from 40 to 50 %.[4]

Table 8.1 Population distribution by socioeconomic groups (%)

	Argentina	*Brazil*	*Chile*	*Colombia*	*Costa Rica*	*Mexico*	*Peru*	*Uruguay*	*Average*
Poor	16.1	22.0	10.0	31.1	16.0	19.0	23.0	10.0	18.4
Emerging	32.9	36.0	38.0	37.9	36.0	43.1	38.0	30.0	36.5
Middle-class	41.0	32.0	42.0	21.0	38.0	27.9	29.0	50.0	35.1
High-income	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Household surveys for each country for the years 2009–2010 and 2011–2012. Simple average for both survey rounds shown

Mid-Level Segments and School Education in Latin America

The connection between the middle class and education comes mainly from the 2012 PISA test micro-data. The PISA test is an effort by the OECD to determine whether 15-year-old students from different countries have acquired a basic set of knowledge and skills considered essential for functioning in society. The 2012 version of the test assesses language, mathematics, science, and problem-solving in 34 OECD member countries, 28 non-OECD countries, and three "economies."[5] The sample included 310,000 cases representing a population of close to 28 million students. The PISA test also collects student, household, and school data through questionnaires filled out by the students, their parents, and school administrators.

For the purpose of this study, it was necessary to identify students from the middle and emerging classes. The PISA test database does not include any income data that would make it possible to replicate household survey estimates, but it does provide a socioeconomic index based on household assets, parental education, and occupational status (weighted by the principal components method).

The classification of students into socioeconomic groups was based on this index and on the relative size of each group reflected in the household surveys in Table 8.1. The method assumes that household income classification is essentially the same as that used in the PISA socioeconomic index, which yielded the following results: 25.9% poor; 41.6% emerging; 25.9% middle class; and 6.9% high income. It should be noted that student distribution throughout the socioeconomic brackets differs from the population distribution shown in Table 8.1 because youths tend to be overrepresented in lower-middle household groups.

According to the PISA data, the percentage of middle-class students attending private schools is close to 80% in Chile, 50% in Argentina, 42% in Peru, and around 30% in the other countries, except for Mexico, where the figure is 25%. For the emerging sector, private education is a less frequent option, with the exceptions of Chile and Argentina, where 56% and 32 %, respectively, of students from these households attend private schools. In Colombia and Peru, this figure ranges between 15 and 20%, while in the other countries it falls below 10% (Table 8.2).

In most Latin American countries, private schools must be paid for by the families themselves, while public schools are fully funded by the gov-

Table 8.2 Student enrollment in private schools and public funding (%)

	Argentina	*Brazil*	*Chile*	*Colombia*	*Costa Rica*	*Mexico*	*Peru*	*Uruguay*	*Average*
Middle-class	48.8	30.6	79.1	29.4	30.2	25.1	41.8	31.9	39.6
Emerging groups	32.2	8.4	55.8	14.7	6.0	6.6	20.2	4.1	18.4
% of public funding in private schools	58.7	4.8	64.4	27.4	17.1	1.7	3.0	1.2	22.4

Source: Based on household survey micro-data and 2012 PISA tests

ernment and are free of charge. This explains the higher level of access to private schools among the middle classes than among emerging segments. Nevertheless, in some countries access to private schools is facilitated by public funding of private education, thereby reducing the costs to families. Based on information provided by school administrators, in Chile, the state covers 64.4% of private school budgets, while the figure is 58.7% in Argentina and 27.4% in Colombia.[6] These are aggregate figures that include schools that receive some budgetary assistance as well as schools that receive none at all and cover their expenses exclusively from household payments. It should be clarified that the availability of public funding for schools does not mean that families get free education, but rather that they only need to cover a portion of the cost.

There are three major unanswered questions about the relationship between the middle classes and private education. The first is whether this is part of a trend or if it is stable over time. The second question pertains to the reasons behind opting for a private education across the various middle-class segments. The last question has to do with the effects of private schools on the overall outcomes of the education system as a whole.

Evolution over Time

In order to answer the first question, it was necessary to rely on historic household survey data available on the Socio-Economic Database for Latin America and the Caribbean (SEDLAC) website.[7] This source

Table 8.3 Increase (percentage points) in private school students by household income quintile, circa 2000–2011, elementary school level

	Quintile 1	*Quintile 2*	*Quintile 3*	*Quintile 4*	*Quintile 5*
Argentina	5.1	10.2	10.7	11.8	0.7
Brazil	0.6	2.6	2.7	3.9	2.2
Chile	19.8	15.2	13.2	5.9	3.4
Colombia	–0.8	1.7	5.3	12.6	8.8
Costa Rica	0.0	–0.8	1.4	6.1	8.4
Mexico	0.5	–0.1	–1.2	0.7	–1.9
Peru	1.4	6.6	15.5	20.2	23.5
Uruguay	1.4	6.6	9.6	14.6	14.9
Average	3.5	5.3	7.2	9.5	7.5

Source: SEDLAC, based on household surveys for each country, http://sedlac.econo.unlp.edu.ar/esp/estadisticas-detalle.php?idE=20. Chile's estimates are based on the CASEN survey as the SEDLAC figures don't include schools that receive private education grants

has tracked the percentage of students attending private schools by income distribution quintile since the early 2000s. Quintiles do not match the socioeconomic brackets defined here, but they allow for a sufficiently close approximation. The middle class is thus centered in the 4th quintile, with partial overlaps in the two adjacent quintiles, while the emerging sector is mostly centered in the 2nd and, partially, the 3rd quintiles.[8]

The data in Table 8.3 shows a clear increase in the percentage of middle-class children attending private elementary schools in the countries included in the study, with the sole exception of Mexico. The most relevant changes occur at the level of the 4th quintile in Peru, Uruguay, Colombia, and Argentina, with increases of more than 10 percentage points over a single decade. The results for secondary education are similar but slightly smaller and, in the case of some countries, headed in the opposite direction. Nevertheless, going forward, the shifts observed in elementary education should be replicated as the students move through the academic cycle. There is also clear evidence of a significant increase in the percentage of emerging-segment students attending private schools, as shown by the 2nd and 3rd quintile figures. The major increases in the 2nd and 3rd quintiles occur in Chile, Argentina, Peru, and Uruguay.

Attributes of Private Schools

The growing trend among mid-level segments of selecting private schools can be explained in two ways. First, the continuing growth of Latin American economies since the early 2000s has brought a rise in household income and has increased the percentage of households able to pay for their children's education in private schools. This trend is well documented in studies such as those by the World Bank (2012), OECD (2011), and López-Calva and Lustig (2010). Second, private schools are appealing because they offer a set of results and features that are valued by families. The following analysis lays an empirical groundwork for this assertion based on the information contained in the micro-data results of the PISA test. The analysis focuses on middle-class students, as this group shows a significant private education element in the countries included in the study.

The better quality of learning achieved by students in private schools is evident in terms of their educational results. A comparison of PISA reading test results among middle-class students from private and public schools shows a significant advantage for the former. In terms of the standard deviation percentage of PISA test scores for the respective countries, the gap hovers around 25% in Mexico, 80% in Brazil and Uruguay, and ranges from 50 to 66% in the other countries. These differences are very significant and reflect outcome gaps that should be key for explaining the middle-class trend of leaving public education for private schools.

Other school features are valued by families as well, such as the amount of teaching materials and resources, availability of qualified teachers, autonomy in managing resources, disciplinary environment, and the ability to adapt curricula and teaching methods.

The information provided by school administrators and other sources for the PISA tests makes it possible to identify indicators for measuring the referenced dimensions (OECD 2012). For purposes of this study, the value of these indicators in public and private schools was calculated and then each student in the school was linked to the respective indicator. This study only compares middle-class students, or, similarly, it compares schools weighted by the number of middle-class students in them.[9]

Resource availability in schools is measured through an index that includes teaching materials, computers, Internet connectivity, teaching software, audiovisual resources, lab equipment, and libraries. The index scale ranges from 0 to 100.

In order to measure resource availability, an index was developed based on the availability of (1) lab equipment; (2) teaching materials; (3) computers; (4) Internet connectivity; (5) teaching software; (6) library resources; and (7) audiovisual resources. Middle-class students attending private schools in every country included in the study are provided with considerably better teaching resources than those attending public schools. The resulting resource gap is statistically significant in all countries.

The PISA test database does not include information about the amount of funding available to schools, but it is very likely that private schools attended by middle-class students have higher funding levels available to them, which explains their comparative advantage in terms of teaching resources. Adding to this is the fact that these schools serve an overall population primarily comprised of students from the middle- and higher-income brackets, while public schools attended by middle-class students serve a socioeconomically more diverse population. There is also evidence that public schools operate at low efficiency levels and therefore have less teaching resources available to them than what their funding allows for. These two latter aspects are further reviewed below.

Regarding teaching resources, every country in the region shows a difference that favors private schools when it comes to teacher availability. The relevant index here takes into account whether there are enough qualified teachers in science, mathematics, language, and other subjects. The differences are considerably less pronounced than those pertaining to teaching resources, although they are statistically significant throughout the region, with the sole exception of Colombia.

A third feature of interest is the degree of autonomy afforded to schools in managing their resources. The decision areas examined were teacher hiring and dismissal, teacher base salaries, salary increases, school budgeting, and the internal allocation of budgetary resources within schools. The more responsibility school administrators have to allocate resources, the higher the value of this indicator.

It has been shown that public schools attended by middle-class students have very little autonomy to manage their own resources when compared to private schools attended by students from similar backgrounds. Public school scores in the region reveal almost no decision-making freedom in this regard. For their part, private schools show significant variability among countries. Private school administrators in Colombia and Peru have the highest levels of autonomy, while those in Uruguay have substantially lower levels.

The next feature is the degree of school autonomy to choose their teaching methods and curricula. School administrators were asked to assess whether principals, teachers, and other educational authorities were involved in the selection of textbooks, course content, courses offered, and student assessment practices. The index on freedom to define curricula was calculated based on the number of responsibilities assumed by school administrators or teachers in these areas.

In every country in the region included in the study, public school administrators and teachers showed a low degree of autonomy in defining curricula, although higher than that for resource management. The index's average value was 22.6 in the 0–100 scale, compared with 58.4 for the private schools in the same countries. Here, there is a higher variance among countries in the region. Public schools had less freedom to define their own curricula in Costa Rica, Mexico, and Uruguay than in the other countries in the region. On the other hand, private schools in Peru exhibited the highest level of curricular autonomy, while those in Mexico and Argentina showed the lowest levels.

Lastly, discipline in the schools was assessed. Here, the relevant information came from the PISA test questionnaires for students, who reported on characteristics pertaining to classroom conditions, including noise and disorder, delays in starting classes, and the ability to work well in the classroom. The resulting index increases with higher levels of discipline. However, there is considerable similarity in the average level of discipline in the public and private schools attended by middle-class students.

All told, private schools offer a mix of results and features that make them more attractive than public schools to those who can afford them. The availability of public co-funding for these costs in some countries was taken into account. The following section examines the overall effects of private schools on the educational system as a whole.

Effects at the Country Level

This section explores whether the operation of private schools in the region impacts segregation of the school system, resource-allocation equity, and levels of educational achievement. The efficiency of public education is also analyzed. The following discussion suggests hypotheses and explanations, rather than definitive answers. The latter require a level of analysis beyond the scope of this study.

Segregation

An important function of the educational system is its contribution to social integration. This takes place through the dissemination of rules and values that are shared not only by the inhabitants of a country but also through the peaceful coexistence of students from different social, ethnic, and cultural backgrounds in a shared physical space. This fosters tolerance and the establishment of interpersonal bonds of trust, which contribute to democracy and social cohesion.

The following analysis revolves around the socioeconomic variable, given that this is the most significant dimension of the divisions that occur in Latin American societies. An often-cited criticism of private education is that it constitutes a segregated space that shelters the children of affluent families who can afford to pay for education.

The percentage of students in the 4th and 5th quintiles in each school was used as an indicator to analyze the socioeconomic breakdown of the schools. Quintiles were calculated within the student population of each country using the socioeconomic index of the PISA test. In Latin American countries, the 4th and 5th quintiles include those in the highest-income bracket and most of the middle class (the portion with the highest income levels).[10] The classification by quintiles allows for a comparative analysis with other countries where the PISA test was administered and which act as an external reference point for the region's outcomes.

The described indicator is equivalent to asking with what percentage of students from their socioeconomic level do the students from the 4th or 5th quintiles interact on a regular basis. The answer would be 40% if this group were equally distributed among all the schools in the country. A percentage above 40% would indicate that a particular group tends to be concentrated in a subset of schools. For instance, a result of 80% would indicate that, on average, students in the 4th and 5th quintiles attend schools where 80% of enrolled students belong to those same quintiles. This implies that there are many schools with a null or very low presence of students from the higher quintiles.

The results in Table 8.4 illustrate that there is a strong socioeconomic segregation in the region's private schools, which show an indicator of 81.4% as the regional average. At the country level, the indicator reaches a 57.9% average, as a result of including both public and private schools.

Table 8.4 Socioeconomic breakdown, % of students in quintiles 4 & 5, by school

	Private schools	*Public schools*	*Country total*
Argentina	66.3	44.0	54.9
Brazil	86.8	39.7	56.6
Chile	69.3	31.7	62.0
Colombia	81.0	47.3	56.2
Costa Rica	89.2	42.4	57.5
Mexico	88.4	48.7	58.0
Peru	79.8	45.3	60.4
Uruguay	90.1	38.6	57.5
Average for 8 Latin American countries	81.4	42.2	57.9
Average for OECD countries with 20%+ private schooling share	56.7	44.4	50.6

Source: 2012 PISA tests micro-data

Note: Average results based on student data for quintiles 4 & 5

The OECD member countries with the highest private school enrollment were shown for comparative purposes. These are nine countries where private education comprises 20% or more of total enrollment. The segregation indicator for these countries is significantly lower, especially in private schools, where it reaches an average of 56.7%, compared to 81.4% for the Latin American countries studied. This shows that segregation is not inherent to countries with significant private school enrollment. Whether this is the case or not depends on the funding and regulations governing the operation of both public and private schools.

Another challenge faced by private schools regarding segregation pertains to student selection practices. In theory, these schools select candidates with higher academic potential and/or better behavioral history. This would lead to better results on learning tests at the expense of public schools, who are burdened with students that are harder to educate.

Based on information provided by school administrators, 53% of the students in the region attend private schools that select students based on tests designed to assess their knowledge and/or recommendations from their former schools. Conversely, only 29% of public schools follow this practice. The gap in favor of private schools prevails in all of the Latin American countries considered in this analysis, with the exception

Table 8.5 School admissions as % of students attending schools that always administer admission tests or request referrals from other schools

	Private schools	*Public schools*	*Country total*
Argentina	25.0	9.2	14.5
Brazil	32.9	19.5	21.8
Chile	45.3	26.1	38.3
Colombia	73.9	36.9	42.7
Costa Rica	76.6	45.8	50.5
Mexico	62.0	49.3	50.9
Peru	50.9	23.3	29.8
Uruguay	57.4	21.4	27.5
Average for 8 Latin American countries	53.0	28.9	34.5
Average of OECD countries with 20%+ private schooling share	50.6	44.4	56.7

Source: 2012 PISA tests micro-data

of Mexico, where a high percentage of public schools also seems to follow this practice (Table 8.5).

The OECD member countries with a significant private school element show a great variability in the way they select students, ranging from countries where this practice is virtually nonexistent (3.7% in Spain) to countries where it is virtually universal (97.4% in the Netherlands). However, all of the OECD countries show great similarity in selection practices between private and public schools. Therefore, student selection in these countries would not depend on whether a school is public or private, but rather on rules that are applied to the educational system as a whole.[11]

Equity in Allocating Resources Among Schools

The distribution of educational resources among schools may have an egalitarian bias if it favors students from poor and vulnerable households, thereby making education a space for leveling opportunity. The opposite could also occur, namely, that education becomes a vehicle for replicating inequality, if access and quality depend on household resources. This is a risk associated with private schools to the extent that access to them costs money and depends on household financial capabilities. Nevertheless, resource distribution in public schools may also be unequal, depending on the standards used to fund these institutions.

The relationship between education and equity is particularly important in Latin America, given that one of the most serious issues in the region is high inequality. This fact in itself makes it difficult to adopt more equitable educational policies, as one of the facets of inequality is an asymmetric distribution of influence over public policy decision-making. As a result, privileged segments of society lobby to maintain institutional arrangements that favor them.

In order to analyze this issue, a coefficient of concentration of educational resources was calculated, measured by the relevant index in the PISA tests. This required ranking the student population in each country according to the socioeconomic index and then correlating this distribution with the availability of educational resources in the schools they attend. The concentration coefficient indicates whether school resources increase or decrease according to the relevant household socioeconomic level, which yields progressive or regressive distributions of educational resources.

Figure 8.1 shows the concentration coefficient as a percentage of the Gini Socioeconomic Index for Latin America and OECD countries. The higher this ratio, the more educational resources are concentrated in the more affluent segments. Low but positive values indicate that educational resource distribution is much less concentrated than household resources, but still with some proportionality between both distributions. Conversely, negative values for this ratio indicate that educational resources are being concentrated on students from vulnerable households.[12]

Seven of the eight Latin American countries have the highest rankings for this indicator, which suggests that the organization of education

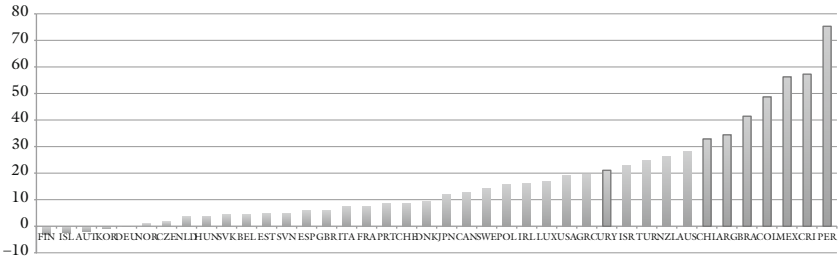

Fig. 8.1 Ratio of resource concentration in schools as % of Gini Socioeconomic Index: LA and OECD. *Source*: 2012 PISA tests micro-data

systems in the region is far from contributing to more equality of opportunity. The figure shows that most of the countries in the region are real outliers if compared with the norm among more developed countries. The exception is Uruguay, ranked 12th out of a total of 40 countries considered for this analysis.[13]

Conversely, among OECD member countries, 15 show significantly low values for this indicator, in the 0–10% range. Another five countries show a negative indicator, meaning that resource distribution among schools favors students from socioeconomically disadvantaged households.

At the regional level, no evidence was found supporting a connection between the presence of private schools and the indicator for inequality in the allocation of educational resources. Chile and Argentina are the countries with the highest levels of overall private school enrollment, but they also have the lowest indicators for inequality in the allocation of educational resources behind Uruguay. The opposite case occurs in Costa Rica and Mexico, which show a high level of inequality in the allocation of educational resources and a relatively low presence of private schools. Inequality in the distribution of educational resources is not exclusively inherent to private schools in Latin America.[14]

Education Management Inefficiency

A recurring criticism of the public provision of goods and services is the lack of efficiency in turning expenditures into available resources. In this area, the governments of the Latin American countries in this study allocated 4.4% of GDP to education during 2006–2008, compared to an average of 5.2% for the OECD. This is too small a funding gap to explain the low educational resource levels prevalent among public schools in the region, and casts doubts on the efficiency of public management.

For a more in-depth analysis of this issue, a regression analysis was conducted between the public school resources index and the spending on public education as a percentage of GDP for the 40 countries included in the 2000 PISA test, controlling for per capita income. The regression results were used to predict the level of resources that public schools should have available based on public spending and per capita income. There is no spending data available to carry out this analysis for private schools.

The results show that for all of these countries except Uruguay, public schools operate with a level of educational resources that is substantially

lower than the corresponding level of spending for the sector. A low ratio between resources and spending points to inefficiency, in the sense that the country could have better equipped public schools, considering the amount of money invested in this sector.

Another aspect of efficiency is the degree of autonomy school administrators have in allocating resources within their schools and for managing curricula and evaluations. The relationship between these variables and better functioning schools is not necessarily linear. Very low or null levels of independence in these areas deprive schools of management leverage that is necessary for a better use of resources and a closer matching of the curricula to student characteristics. On the other hand, excessive levels of autonomy may point to a lack of direction and coordination within the education system, forcing school administrators to take on responsibilities beyond their capabilities.

In this regard, it is helpful to compare autonomy indicators from the eight Latin American countries studied with those of OECD member countries that have the best educational results (achievements that would validate adopted educational practices). On the subject of educational resource management, high-achieving OECD member countries grant less autonomy to private schools and more to public schools as compared to Latin American countries. Therefore, there is a narrower (although still significant) gap between public and private schools than in the region as a whole.

Regarding curriculum management, on average the OECD countries with the best educational results grant a considerably larger measure of autonomy to public schools compared to Latin America. Additionally, these countries show a higher degree of autonomy among private schools, but the gap is much narrower than that of the eight Latin American countries.

Therefore, compared with the countries that achieve the best education outcomes shows, public schools in Latin America operate with very low levels of autonomy for managing resources and, especially, curricula.

Learning Achievement

One last factor to assess is learning achievement, measured by the PISA test results. Test scores are divided into six levels based on acquired skills. Level 1 denotes a level below the minimum required for effective and productive participation in society. For example, students in Level 1 of the

reading test find it difficult to understand what they read, locate simple information in a text, interpret basic content, and identify word similarities and differences.

Table 8.6 shows the percentage of students who scored a Level 1 in reading for each country in Latin America, distinguishing between middle- and emerging-class students. For comparison purposes, a similar result is reported for the average level among OECD member countries, showing students at the same socioeconomic index score range as middle- and emerging-class students in Latin America. The differences in levels of development between both groups of countries are thus controlled.

In Costa Rica, about 17% of middle-class students do not attain basic reading levels by the time they turn 15. In Chile, this level is close to 22%, while in Mexico and Colombia it varies between 25% and 30%. In Uruguay, Brazil, and Mexico, a full 30–35% of middle-class students score below the sufficiency threshold on the reading test. The percentage in Argentina is even higher, hovering around 40%.

This evaluation is even direr in the case of students from emerging-segment households. The percentage of middle-class students who score below the minimum on the reading test exceeds 50% in Argentina, Colombia, Peru, and Uruguay. The percentage on the mathematics test exceeds 70% in these same countries, with the exception of Uruguay.

Table 8.6 Percentage of level 1 students (below the sufficiency threshold), 2012 PISA, reading

	Middle class	*Emerging class*	*Country*
Argentina	39.2	60.3	53.1
Brazil	34.0	48.8	50.6
Chile	21.6	35.9	31.8
Colombia	29.1	50.8	50.5
Costa Rica	17.0	32.1	30.1
Mexico	26.9	39.4	39.8
Peru	34.2	57.6	59.8
Uruguay	30.4	50.6	46.0
Average for 8 Latin American countries	29.1	46.9	45.2
OECD average	12.5[a]	25.2[a]	15.8

[a]Includes students with similar scores in the socioeconomic index for the respective middle class and emerging groups in Latin America

Sources: 2012 PISA tests micro-data

On average for the countries in the region, 29.1% of middle-class students and 46.9% of emerging-class students failed to achieve the minimum PISA test reading score necessary to function in society. These figures are very high and reveal a serious problem in the quality of education throughout the region that impacts even economically consolidated households. In the case of OECD countries, the averages are 12.5% for middle-class students and 25.2% for emerging-class students. A comparison among countries without controlling for the socioeconomic variable reveals that the percentage of students underperforming in reading is three times higher, on average, in the Latin American countries included in the study than in OECD member countries.

The results for the mathematics test are even worse. In Latin America, on average, almost half of middle-class students fail to reach the minimum level required to function in society, while a full two-thirds of emerging-class students failed the test.

As mentioned above, within each country in the region, middle-class students achieve better results in private schools. The question is whether this result is maintained at the national level, when countries with varying participation in private schools are compared. The cross-country regression analysis shows that a higher presence of private education is associated with higher average PISA test scores, and this outcome applies to Latin America as well. This information only has value as a working hypothesis and is not evidence of a strict relationship between private school presence and higher PISA test scores.

Conclusion

This study has explored ongoing developments in education where the public provision of these services or public policy on education funding and regulation are lagging behind the demands and expectations of society at large and mid-level groups in particular.

At the elementary and secondary school levels, there is an exodus of the middle classes from public and into private schools. The middle-class flight from public education is explained by the better results offered by private schools as compared with public institutions. The former offer their students better learning results, a higher endowment of educational resources and teachers, higher levels of independence in resource and curriculum management, and in almost every country, a better disciplinary environment. An increase in this migration into private schools is foreseeable in

the near future, as incomes continue to increase and a larger portion of the population becomes able to afford private school education for their children. This is a rational decision by families who seek the best possible education for their children and are able to afford it.

Nevertheless, this is hardly a satisfactory situation for society as a whole because, in a region of high inequality, the privatization of education could turn into yet another source of increased inequality, with all the associated problems such a situation poses for social cohesion and national development. The data analyzed supports this concern, since private schools in the region operate in high levels of social segregation and refuse access to less affluent households by pricing them out. In any event, there is also an issue of repressiveness in the distribution of educational resources in countries with a low presence of private schools, so equity problems are not limited to the region's private sphere.

The unfavorable results yielded by Latin America's education systems in the area of equity are compounded by poor results in achievement and learning. This presents a rather bleak outlook for education in the region.

In any case, the fact remains that higher attendance in private schools is driven by household decisions. Given the perceived lower quality of public schools, it does not appear to be politically viable to force the middle classes to send their children to them. The issue, therefore, is how to reconcile a family's legitimate pursuit for a better education for their children with the contribution that education systems must make toward social cohesion and equity. It should also be taken into account that this middle-class migration contributes to the weakening of public education to the extent that public schools end up with the students that need more educational reinforcement and whose families are politically less savvy to press for improvements in the education their children receive.

At the international level, two models have proven effective in matching equity in the education system with good educational results and household preferences.

The first one is the model of private schools that operate under the same model as public education. This is the case of the Netherlands and, with some nuances, those of Belgium and Ireland. In these countries, 60–70% of students attend private schools. Private schools are fully funded by the state in the Netherlands, while in Belgium and Ireland public funding amounts to 85% of schools' budgets. A family's financial capacity is not a relevant factor in choosing a private school. Therefore, the percentage of students attending private schools in the Netherlands is similar across the

socioeconomic spectrum, while Belgium and Ireland show slight socioeconomic variation.

This model yields good educational results, in addition to contributing to social cohesion. The Netherlands and Belgium lead European countries on learning quality as measured by the PISA tests, while students in Ireland achieve at the same level on average as all the OECD countries.

The second model is that of excellence in public education. The three countries located outside of Asia that have obtained the best results in the latest PISA tests are Finland, Canada, and New Zealand.[15] A full 93–97% of students attend public schools in these countries, proving that there is nothing inherent to public management that would prevent anyone from obtaining an excellent education. However, public education models vary within each country. In Canada and Finland, school administrators have a low level of autonomy in managing their educational resources, as well as in selecting curricula or teaching methods. By contrast, in New Zealand, schools enjoy a high degree of autonomy on these fronts. In Finland, schools have no admission requirements, while one-fourth of public schools in Canada and New Zealand administer admission tests.

The models described above could be used as a reference for Latin America. The system of private schools that operate under public rules could be especially interesting to countries with higher private education enrollment, such as Chile and Argentina, while the model of public education of excellence could serve as a guide for countries with a stronger public school tradition, such as Mexico and Costa Rica.

However, there is a considerable distance between the excellent education models and the educational systems in Latin American countries. In order to get closer to the model of private schools that are publicly regulated, household payments will need to be replaced by budgetary funding, and discriminatory admissions practices for private schools must be eliminated. A key feature associated with private schools is teaching freedom, which results in the presence of education providers connected to different religious denominations, value systems, and teaching methods. In these cases, it is legitimate to ask that families agree with the guidelines set by the school, with the understanding that a common minimum curriculum will be set by public policy.

When it comes to public schools, major increases in funding, authority, and management competence are necessary to get closer to the model of

excellent public education. In Latin American countries, problems related to the inefficient use of public funds for education must be resolved.[16]

It should be noted that international best practices are only points of reference to be taken into account when assessing what paths to follow on a case-by-case basis. Education systems are the result of historic processes specific to each country and include idiosyncratic features that cannot be replicated in other environments. Reforms are not designed solely from a technical perspective, but must be considered in light of political economy to make the changes viable. The players involved in education have their own interests and ideologies, as well as the capabilities required to be the leaders in the reforms that are possible.

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Notes

1. Definitions of the middle class are discussed below.
2. See Birdsall et al. (2000), Easterly (2001), Solimano (2008), Birdsall (2010), ECLAC (2010), Torche and López-Calva (2010), Cárdenas et al. (2011), Lora and Fajardo (2011), and OECD (2012).
3. All the country averages shown in the text are simple averages, not weighted by the population of each country. It should be noted that the results differ from those in the World Bank Report as more recent household surveys were used and also because of differences in income thresholds and between the ways that household surveys are processed by the ECLAC (this study) and by the SEDLAC (World Bank Report).
4. The classification used here is an approximation, as it is based on a single-dimension approach (monetary income) that is insufficient for characterizing complex social categories. Also, it should be taken into account that there is a degree of discretionality in the definition of the cutout thresholds used here, that the surveys underestimate income levels in proportions that vary across countries, and that the exchange rate adjusted for PPP may be affected by factors that hamper the comparability of measurements among countries.
5. These are Shanghai (China), Hong Kong (China), and Macau (China).

6. It should be noted that these data come from surveys and are subject to sampling errors.
7. See http://sedlac.econo.unlp.edu.ar/esp/index.php.
8. This reflects the population distribution shown in Table 8.1.
9. It is important to note that these indicators are on a scale of 0–100, while the OECD uses indicators that have been standardized by the mean and standard deviation of the relevant variables.
10. Table 8.1 shows that the combined middle-class and high-income brackets amount to 45% of the total student population, which is the average for the eight regional countries included in the study.
11. The countries with highest participation in private schools are the Netherlands, Belgium, and Ireland. While in the Netherlands admission tests are the norm, in Belgium (a neighboring country to the Netherlands) they are the exception. Private schools in Ireland tend to have a Catholic orientation and families are expected to belong to that religion, while in Belgium a similar amount of both public and private schools ask that families accept their philosophical or pedagogic orientation.
12. Clearly, the ultimate effect of education on equity hinges on quality. If the quality of education is poor, concentrating resources on the poorest students does not do much to help equity.
13. The PISA tests were administered to another 23 non-OECD countries. The relative ranking of Latin America does not vary much when all of these countries are taken into account, while two other cases (Thailand and Indonesia) join the ranks of "outliers."
14. A cross-country regression analysis confirms the lack of correlation between the percentage of private school enrollment and the concentration index for the region.
15. Japan, Korea, Hong Kong, and China (Shanghai) achieve comparable or better results, but there are cultural differences that make it difficult to compare their education systems with those of other countries.
16. Other elements of education in Latin America call for reform or strengthening, such as the expansion of preschool education or early teacher training. However, these are side issues within education systems rather than issues specific to the middle classes that are the focus of this study.

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