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Missing Links: Foreign Investment and Industrial Development in Costa Rica and Mexico

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Abstract This article offers an analytical framework for understanding the missing links between FDI and development, and applies it to the high technology sectors of Costa Rica and Mexico, the two countries in Latin America that have attracted the highest percentage of FDI in manufacturing. Since the advancement of knowledge-based assets in this sector is at the heart of structural change and development, we focus specifically on the conditions that enable or prevent positive knowledge spillovers from FDI. We identify two main reasons for the missing links between high-tech FDI and the development of indigenous knowledge-based assets in Costa Rica and Mexico. First, their governments did not have a coherent strategy, which would have spelled out the needed government policies to advance national capabilities, overcome market failures, and support the integration of national producers into TNCs' global production networks. Second, there were limitations on the spillover potential from FDI. In Costa Rica and Mexico, technology or scale requirements for inputs made it difficult for large TNCs to source domestically beyond simple inputs like packaging materials. In Mexico, fundamental changes in the organization of global production chains in the computer industry led TNCs to rely on their global contract manufacturers rather than work with potential Mexican input suppliers.

Keywords Foreign direct investment · Industrial development · Costa Rica · Mexico

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Introduction

With the increasing fragmentation of value chains across national borders, foreign direct investment (FDI) has been expanding rapidly over the last 20 years. Anticipating possibilities for new development opportunities, policymakers in developing countries have competed fiercely for FDI. They have high expectations that FDI will have a positive impact on economic growth and development: at the macro level through increases in investment, employment, foreign exchange, and tax revenue, and at the micro level through positive spillovers that will advance the host country's knowledge-based assets. Some economists and international organizations have fuelled these expectations, based on assumptions about functioning markets and technology differences between producers in developed and developing countries.

But these expectations contrast sharply with realities on the ground. That is particularly true with respect to FDI's most important potential contribution to the long-term development of the host economy: the advancement of knowledge-based assets. Econometric and case studies have shown that the hoped for spillover effects often do not materialize in developing countries.

Since technological advancements are the driving force behind the development process and technological spillovers are at the heart of the FDI-development nexus, it is critical to understand the conditions under which FDI leads to spillovers. Many economists have argued that spillovers do not materialize when the technology gap between foreign and national producers is too large or the national absorptive capacity is below a minimum threshold (e.g., Lipsey and Sjöholm 2005).

In this article we go beyond this argument in two important ways. First, we argue for the need to incorporate the *potential* for FDI spillovers into the analysis and the interaction between FDI spillover potential and domestic absorptive capacity. Second, we probe into the reasons for the absence of domestic capacity. We focus on the prevalence of market failures and the need for government actions to address such market failures, in the context of a coherent, proactive development strategy.

We then use this framework to analyze why the spillovers from high-tech FDI in Costa Rica and Mexico have been so limited. The two countries make particularly interesting case studies for analyzing the FDI-development nexus. Though very different in size, they are the only two countries in Latin America to have attracted large shares of FDI into the manufacturing sector, particularly into the production of high-tech goods (see Table 1).

Sizeable high-tech FDI in the two countries is often seen as synonymous with development success. Moran (2007) has singled out both the Costa Rican and Mexican high technology stories as smashing successes. Such positive assessments miss a critical part of the story, as the ability to attract high-tech FDI does not automatically translate into an ability to reap technological spillovers. The metric for success for Moran and others is the increase in FDI, and particularly the increase in high-tech FDI. Our metric for the success of the FDI-development connection in Costa Rica and Mexico is FDI's lasting impact on the host countries' technological and managerial knowledge-base, and there the story is one of unrealized potential, missed opportunities, and the loss of valuable time to adopt a proactive strategy aimed at maximizing spillovers from high-tech FDI. In both economies, high-tech FDI did not lead to significant spillovers, in spite of their different sizes. Spillovers

Table 1 Distribution of FDI by sector, 1996–2005[a]

	Manufacturing	Natural resources	Services
Argentina	20.7	40.9	38.4
Bolivia	8.5	48.7	42.9
Brazil	28.2	3.7	68.1
Chile	11.2	25.6	63.2
Colombia	19.3	21.3	59.4
Costa Rica	68.1	2.0	29.9
Ecuador	3.8	80.	15.6
El Salvador	26.2	1.9	71.8
Mexico	47.8	1.1	51.1
Peru	15.0	9.6	75.5
Venezuela	40.2	0.9	58.9

[a] 1996–2004 for Argentina, Bolivia, Chile, Peru; 1997–2004 for Costa Rica; 1999–2005 for Venezuela
Source: ECLAC (2007, 40)

were small in the Costa Rican economy where the small size of the economy imposes extra limitations on the possibilities for spillovers. They were also small in the larger Mexican economy where the strategy of import substituting industrialization (ISI) had created a much more diversified manufacturing sector holding out the potential for greater spillover possibilities.

We argue that the missing links between high-tech FDI and the advancement of indigenous knowledge-based assets in Costa Rica and Mexico are the limited and changing FDI potential on the one hand and, more importantly, the absence of a coherent, proactive development strategy on the other. Starting in the 1980s, governments in both countries followed Washington Consensus policies, liberalizing markets, reducing government intervention in the economy, and abolishing industrial policies (e.g., Williamson 1990). Trade liberalization and FDI inflows were considered important drivers behind economic growth. But free trade policies and FDI attraction do not constitute a development strategy; nor do they guarantee development success. Significant market failures, particularly imperfect information and coordination failures, can prevent the achievement of competitiveness for national producers. Imperfect markets with high barriers to entry make it harder for national producers to integrate into TNCs' global production strategies. If such obstacles are widespread, government collaboration with the private sector is critical to enhance national absorptive capacity.

In Mexico and Costa Rica, such government actions have not materialized in any significant, coherent, and coordinated way. In Costa Rica, the failure to conceive and implement a comprehensive strategy for an FDI-linked advancement of national technological and managerial capabilities means that the potential of an FDI-linked development strategy has not been realized. In Mexico, this failure has had even graver consequences. Not only was the greater potential suggested by the more diversified and seemingly advanced manufacturing sector under ISI not realized in the phase of free trade and FDI attraction, but it also was actually reduced under the competitive pressures of international competition.

In addition, the potential for FDI-generated spillovers was limited in both countries. In some cases, technology and scale requirements for inputs made it

difficult for large TNCs to source domestically beyond simple inputs like packaging materials. In Mexico, furthermore, fundamental changes in the organization of global production chains in the computer industry led TNCs to rely on their global contract manufacturers rather than work with potential Mexican input suppliers.

Since this article focuses primarily on high-tech FDI, it is important to distinguish from the outset between high-tech products and high-tech processes. When late developers attract FDI in high-tech products, such FDI will start in the more standardized aspects of the production process. While spillovers from lower tech processes in parts of high-tech products will be smaller than suggested by the product name, the key question is whether FDI production processes become more sophisticated over time. Equally critical is whether national absorptive capacity expands in synch to generate dynamic positive interactions with FDI production, thus engendering a virtuous cycle of advancing national knowledge-based assets. To date, we have only seen limited FDI movement up the value chain in both Costa Rica and Mexico. The absence of a comprehensive, coordinated development strategy is—again—a key explanation why such a virtuous circle has not been set in motion. This absence stands in stark contrast to the experience of countries like Singapore, where targeted, comprehensive government policies have interacted with TNC strategies to generate a virtuous cycle of knowledge-based asset expansion.

In the next section, we summarize the standard arguments about the FDI-development nexus and the main empirical findings. In the third section, we offer an expanded analytical framework for understanding the missing links between FDI and development. In the fourth and fifth sections, we analyze why high-tech FDI generated so few spillovers in Costa Rica and Mexico. We conclude with policy lessons for other countries.

Brief Literature Survey

Economic theory suggests that foreign investment can advance the development of indigenous knowledge-based assets through two different channels: competitive pressures and spillovers. Most of the theoretical and empirical literature focuses on the competition effect, where the presence of foreign corporations forces domestic producers of the same good to become competitive. Indigenous producers are thought to reduce X-inefficiencies and incorporate new technology into the production process, thus raising the productivity of their own operations, and the average productivity in the industry.

Spillovers generally refer to knowledge and technology transfers. Based on the assumption that TNCs enjoy technological advantages and therefore higher levels of productivity, FDI is expected to transfer knowledge, intended or unintended, from TNC affiliates to local firms. The concept of knowledge spillovers encompasses both technology and "tacit" knowledge, that is, know-how as applied in any aspect of production, including management. There are three possible channels for spillover effects: the supply chain effect, the human capital effect, and the demonstration effect. The latter two can work both at the horizontal and the vertical levels. TNC training can provide workers with new knowledge and skills, the benefits of which cannot be completely internalized by these corporations. Labor mobility ensures that

knowledge carries over to other companies. The demonstration effect might generate spillovers as well, as domestic producers are exposed to TNCs' products, marketing strategies, and different production processes.

The most significant vertical spillovers are likely to happen through the first channel, the supply chain linkage. Potential indigenous input suppliers for TNCs become actual input suppliers, as they learn to meet international quality standards, on-time delivery and technological efficiencies that permit competitive pricing. TNC affiliates might help indigenous producers to upgrade their technological capabilities, directly through assisting with technology acquisition and sharing of relevant production knowledge, or indirectly through the expectation of high quality standards and feedback on technical specifications of suppliers' output. In the best-case scenario, the newly acquired competitiveness will form the basis for supplier-oriented upgrading.

It is also possible that FDI generates no spillovers at all. If the TNC production process involves few skills or if the input requirements are of a scale or technological sophistication that domestic sourcing is not considered an option, then the basis for knowledge transfer is missing. If domestic producers are displaced from the market altogether, then externalities may actually be negative.

Over the past 20 years, a large empirical literature has emerged on the existence and extent of FDI-generated spillovers, both in developed and developing countries. In broad terms, the studies are of two types: econometric analyses and case studies. The econometric studies usually investigate whether the level or growth rate of productivity of domestic companies is higher in industrial sectors where TNCs are more important.

There are at least as many studies finding negative spillovers as there are studies reporting positive spillovers. Generally speaking, regressions based on cross-section data tend to find positive spillovers, while those based on panel data are more likely to find negative spillovers. A statistically positive impact was found, for example, by Kokko (1996) for Mexico in 1970, but only when enclave sectors are excluded; by Sjöholm (1999) for Indonesia in 1991, and by Dimelis (2003) for Greece. A negative impact of FDI on domestic industrial productivity was found, for example, by Aitken and Harrison (1999) for Venezuela, Konigs (2000) for Bulgaria and Rumania, and Laplane et al. (2000) for Argentina, Brazil, and Uruguay when FDI was aimed at serving the domestic market.

In an exhaustive overview of 40 studies, Görg and Greenaway (2004) found that only 6 studies reported evidence of positive spillovers, none of them in developing countries. Moreover, 6 of the 28 studies of developing and transition economies found evidence of negative spillovers.

In sum, existing empirical evidence makes it clear that the theoretically postulated spillover effects frequently do no materialize in reality. They do not happen automatically just because a country is able to attract FDI in the first place.

Analytical Framework

We argue that the development of significant spillovers is conditioned by the interaction between two key factors: the spillover potential of the particular type of

foreign investment in the host country and the host country's absorptive capacity for spillovers. The determinants of FDI spillover potential and country absorption capability are summarized schematically in Fig. 1.

The first factor that determines the potential of foreign investment to generate spillovers is the type of FDI. Investment in resource extraction generally provides very limited potential for spillovers, as it tends to be very capital intensive and have no linkages to the host economy. In contrast, FDI in the manufacturing sector has higher spillover potential. The extent varies though with the technology intensity of the production process. Due to the R&D intensive nature of high-tech products, their production is likely to contain a greater element of knowledge production and involve a broader and more sophisticated set of skills. As a result, the spillover potential from FDI in the production of high-tech goods is particularly high.

As pointed out before, regardless of the average technology intensity of a product, the production of any good spans a gamut of different processes, some of which are routine and standardized, and others that add much greater value. To the extent that late developers can draw in high-tech FDI, they are likely to attract FDI in the production of parts and processes that are more standardized. Initially the spillover potential from the production of high-tech products can be quite low. The key question is whether FDI will remain at that level, or whether—over time—TNC affiliates upgrade toward higher value-added and skill-intensive production.

The second major factor shaping FDI spillover potential is the TNCs' global production strategy and supply chain development. More than ever before, TNCs are developing and managing global networks where key business functions are allocated around the globe, and reallocated when the competitive dynamics in the industry warrant it. Different parts of the value chain may be produced by TNC affiliates themselves (internalized production) or they may be produced by

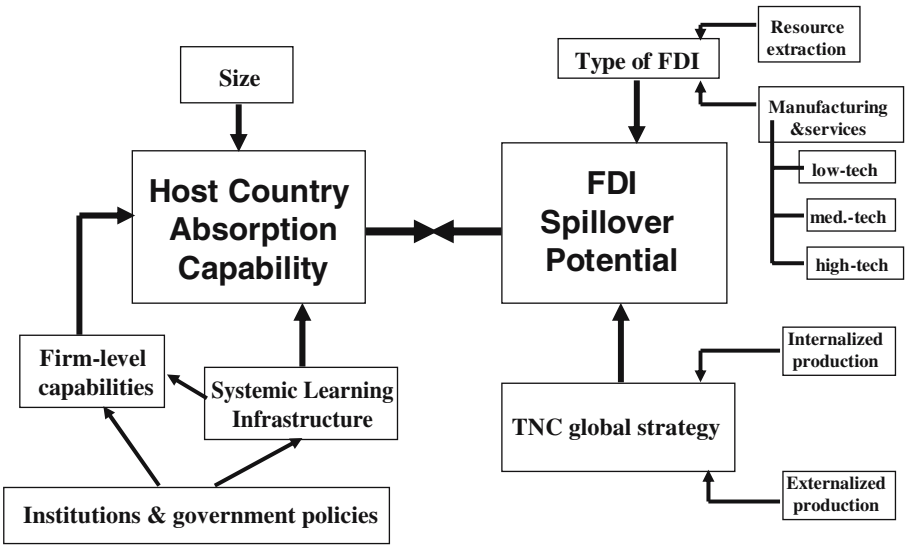

Fig. 1 Critical contingencies for the realization of FDI-related spillovers

unaffiliated companies through arms-lengths contracts (externalized production). The extent of internalized versus externalized production varies from TNC to TNC, even in the same industry, depending on which activities a TNC considers to be part of its core capabilities. Generally speaking, R&D, product design, and marketing under the company's brand name are core competencies of TNCs and are thus internalized. Yet, over the last few years, we have witnessed a growing trend toward subcontracting not just of standardized parts, but also of aspects of design, marketing, and overall coordination (UNCTAD 2005, 2002; Sturgeon 2002; Yusuf 2003; Dicken 1998).

TNCs' interest in sourcing in the developing host country depends on the degree of internalized production, use of global sourcing, and technological requirements. If production is highly internalized, the TNC affiliate will have little interest in sourcing beyond non-tradable services and very standardized inputs like packing materials. If the production of inputs requires a high degree of technological sophistication, a TNC may opt for inputs from suppliers with whom it has already developed a long-standing relationship and who have a track record of high quality production.

The spillover potential from a particular type of FDI can change over time, as a result of changes in the structure and management of global value chains. The rise of contract manufacturers (CMs) in recent years is a pertinent point, which—as we will see later—played an important role in the Mexican case. During the 1990s, increased competition among TNCs in the computer industry induced some brand-name companies to move to a global integrator supply chain management system, where the brand name company concentrates on R&D, design, and marketing, while production was outsourced to contract manufacturers. Externalizing production in that way allowed TNCs to reduce costs as well as risk. Since CMs produce equipment for several different clients in the same industry, they are able to leverage larger volumes in negotiations with input suppliers on a global scale and thus achieve lower unit costs (Paus 2005: 34–37). Consequently, the rise of CMs often reduces the spillover potential of FDI, as national producers only have the possibility to become input suppliers at a much lower tier.

The existence of FDI spillover potential is a necessary condition for the realization of spillovers, but it is not a sufficient condition. The other—often more important—factor is the host country's ability to absorb spillovers. The size of the economy is one element conditioning national absorptive capability. If the economy is small, size imposes obvious limitations on the number of fields in which the country can have absorption capabilities. Limited human and physical resources necessitate more specialization, particularly in fields where economies of scale do not play a significant role.

The level of development of the systemic learning infrastructure is a critical determinant of the host country's absorption capability. The average years of schooling and the skill level of the work force, the interaction between institutions of higher learning and the private sector, the existence and embeddedness of technological research institutes all have an impact on a country's absorption capability. They also shape firm-level capabilities. A firm's ability to absorb new technology is developed through learning by doing. In such a process, a company does not simply copy a blueprint and follow a specific set of instructions. It needs to

develop the understanding and absorption of the tacit, nonembodied knowledge involved. These learning processes are most successful when they happen in a context where workers have the requisite skills and where companies have access to the necessary information and financing and are part of a larger network of producers where synergies and agglomeration economies are generated.

The development of firm-level capabilities and of a systemic learning infrastructure is shaped by the institutional context in which firms operate, by the legacy of past development policies, and by current development policies. ISI was based on the recognition that free markets by themselves do not generate a dynamic shift of comparative advantages toward higher value added activities. To bring about such structural change, governments used infant industry tariff protection, public investment in learning infrastructure and in key productive activities deemed too risky and large scale for private producers (e.g., steel production), and industrial policies and regulations aimed at developing national capabilities in specific sectors (e.g., domestic content requirements for foreign investors). The success of these policies varied considerably across countries. Governments that minimized rent seeking through the enforcement of reciprocal control mechanisms (e.g., Amsden 2001) and operated in a strong institutional context were generally much more successful in advancing domestic knowledge-based assets and firm-level capabilities and competitiveness (e.g., Rodrik 2006).

In the current era of Washington Consensus policies, many governments rely on market forces to foster competitiveness and domestic capabilities. Yet the hoped for advancement of capabilities will not materialize when markets are imperfect and market failures are pervasive (e.g., Paus 2004). When indigenous producers have imperfect information and face high financing costs, risk, or barriers to entry, they are not likely to compete successfully with transnational investors or become competitive input producers. When governments fail to address coordination failures and imperfect and missing markets, it is difficult for domestic producers to become competitive producers. In addition, markets are inherently inadequate in developing the systemic learning infrastructure needed for building national technological capabilities. Coordinated government actions among the relevant institutions are crucial for advancing such a learning infrastructure.

Latecomers in the development process, which were able to attract high-tech FDI and benefit from spillovers, were those where governments adopted comprehensive proactive policies to enhance national linkage capabilities, maximize spillovers, and set in motion a virtuous cycle of interactive upgrading of TNC and national productive activities. We briefly point to three country cases where proaction rendered considerable success in that respect: Taiwan, Singapore, and Ireland.

In Taiwan, a nation that was able to become a true latecomer in the high-tech sector, the government helped to facilitate the development of productive capabilities and scale economies. R&D in Taiwan was conducted with government labs, and indigenous firms were able to "ramp up" scale to meet demand because the Taiwanese government provided access to capital (Amsden and Chu 2003). With the global restructuring of the computer and electronics industry in the 1990s, existing indigenous CMs were able to scale up their activities and directly contract with the leading tier flagship firms, thus capturing the market and opportunity to serve as CMs. Some Taiwanese firms are now among the leading global CMs. Others went

on to a further graduation to become original equipment manufacturers (OEMs) and original design manufacturers (ODMs) (Amsden and Chu 2003).

Singapore has had a philosophy that TNCs are to be "tapped" for the assets that they bring to a country and thus encourages TNCs not only to locate in Singapore, but also to foster innovation in local firms by the formation of industrial clusters. Coordinated by an Economic Development Board, Singapore was able to induce many US firms in the disk-drive sector to come to the country. Through tax concessions, infrastructure building, and skills training of local firms Singapore was able to link the foreign firms with assembly operations as well as engineering-based support industries such as plastic injection molding, electroplating, and others (Lall 2005; Huff 1995).

Large amounts of FDI in the Irish economy, especially in electronics, computer software, and medical instruments, were a key driver behind the doubling of the country's GDP p.c. during the 1990s. Successive governments had a clear vision of using FDI to advance growth and structural change. Initially, the investment promotion agency, the Irish Development Authority (IDA), went after any foreign investment that would create jobs. By the late 1970s, the agency started to focus on FDI with high-tech content. Continued government investment in infrastructure and education (made possible in part through the Structural Funds of the European Union) together with IDA's skill in courting TNCs aggressively and working with the requisite national institutions to meet human capital and other needs of foreign producers were critical elements behind the high economic growth. Nonetheless, the development of national linkage capability came only as an afterthought; it started with the National Linkage Program in 1985, nearly 30 years after the establishment of the IDA (Paus 2005). Linkages, particularly in the electronics industry, increased notably during the course of the 1990s, though they have been declining again in recent years, as internal and global conditions have changed, and TNC affiliates have relocated commodity production to Central European countries and China.

One of the factors Taiwan, Singapore, and Ireland have had in common are governments with a strategic view of the policies they need to adopt to ensure the economy's advancement in the context of an increasingly highly competitive global economy. A recent example of the Irish government's proactive approach is because it ordered a science and technology foresight study in 1998, at a time when the economy was booming and huge amounts of FDI were entering the country. More important, the government devised policies to implement the report's recommendations of shifting toward a focus on R&D in ICT and biotechnology, for national as well as foreign companies, as the driver behind the next development phase.

Whether Ireland's new strategy will be successful is an open question. Comprehensive, proactive policies do not guarantee success. The absence of such policies is likely to result in development failure, especially if national technological capabilities are lacking and market failures are pervasive.

High-tech FDI in Costa Rica and Mexico: Background

We now turn to an analysis of the FDI-development nexus in Costa Rica and Mexico, using the analytical framework developed above. We concentrate on high-

tech FDI—medical instruments and electronics in Costa Rica and the computer industry in Mexico—because, in principle, high-tech FDI has a greater potential to lead to important advances in the host country's knowledge-based assets. Our analysis is based on quantitative and qualitative evidence. For the latter, we draw heavily on insights from primary interviews with government officials and private decisionmakers: in the case of Mexico, we focus on the main area of computer production in Guadalajara, Jalisco; in the case of Costa Rica, we focus on medical instruments and electronics in and around San José.

Costa Rica and Mexico are the two middle-income developing countries in Latin America that have attracted a considerable amount of high-tech FDI in recent years. They have roughly the same GDP p.c. (see Table 2), and they have followed a similar set of policies like the rest of Latin America. Until the early 1980s, both had pursued an ISI strategy, which had been very successful in generating economic growth and diversification of the manufacturing sector, but not necessarily in achieving international competitiveness. In the 1980s, governments in the two countries mostly abandoned the previous strategy of articulated development priorities and intentional government intervention. They liberalized trade, embraced FDI inflows without restrictions, and sharply reduced the role of the government in the economy.

With all the commonalities between the two countries, there is one key difference: size. The Mexican economy is 25 times larger than the Costa Rican economy. We would expect such a size difference to have clear implications for the national absorption capability for spillovers. In a smaller country like Costa Rica, ISI policies could only lead to limited diversification of the manufacturing sector, even with ISI developing in the regional context of the Central American Common Market. In contrast, in Mexico, the larger domestic market allowed the government to promote an indigenous high-tech sector. Thus, in the larger country, FDI may advance the knowledge base of the country through the competition effect, in addition to the spillover effects that can occur in both the small and the large country. Furthermore, a large economy should hold out greater potential for spillovers through backward linkages, as scale requirements would be less limiting.

Costa Rica has traditionally depended on the export of bananas and coffee, and later clothing, as the main force behind economic growth. During the 1990s, FDI inflows to Costa Rica increased steadily (see Table 3). Between 1997 and 2003, 65% of FDI inflows went into industry, with about a third of the latter in electronics (Paus 2005, 144). Although Costa Rica had attracted FDI into the electronics industry before, the big quantitative and qualitative jump came in 1996 when Intel decided to invest US$300 million into the establishment of a microchip factory outside of San

Table 2 GDP and population in Costa Rica and Mexico, 2004

	Costa Rica	Mexico
GDP p.c.[a]	$9,466	$9,766
GDP[a]	$40.3 billion	$997.6 billion
Population	4.3 million	102 million

Source: World Bank (2006), World Development Indicators, on-line, accessed November 2006.
[a] In international $ (PPP)

Table 3 FDI inflows into Costa Rica and Mexico

	Costa Rica		Mexico	
	Net FDI Inflows			
	Millions of Current US $	% of GDP	Millions of Current US $	% of GDP
Average 1970s	44	2.3	602	0.8
Average 1980s	70	1.8	2,080	1.1
1990	163	2.8	2,549	1.0
1991	178	2.5	4,742	1.5
1992	226	2.6	4,393	1.2
1993	247	2.6	4,389	1.1
1994	298	2.8	10,973	2.6
1995	337	2.9	9,526	3.3
1996	427	3.6	9,186	2.8
1997	408	3.2	12,830	3.2
1998	613	4.4	12,409	2.9
1999	629	3.9	13,414	2.8
Average 1990s	352	3.0	8,441	2.2
2000	409	2.6	17,077	2.9
2001	454	2.8	27,687	4.5
2002	662	3.9	15,477	2.4
2003	574	3.3	12,279	1.9
2004	620	3.4	17,377	2.5

Source: World Bank, World Development Indicators, on-line, accessed November 2006.

José. Even though Baxter had been in Costa Rica since 1987, it was only with the demonstration effect from Intel's investment and then Abbot's investment in 2000 that FDI in medical devices rose noticeably.

Costa Rica was able to attract high-tech FDI due to a combination of factors: the legacy of its past development policies—especially in education and infrastructure, the country's political and macroeconomic stability, its proximity to the US market, its generous tax incentives to attract FDI, and the acumen of its foreign investment promotion agency CINDE (Coalición Costaricense de Desarrollo Económico). The country has a long tradition of broadening access to education, from obligatory and free primary education in the nineteenth century to mandatory secondary education in the 1940s, to an expansion of third-level education in the 1970s. As a result, Costa Rica has a fairly well-educated labor force. Though labor is relatively more expensive than in competitor countries for high-tech FDI at similar income levels, it is also considered to be more productive because of the relatively high level of social services in the country.

Costa Rica's Free Zones, like those in many other developing countries, offered very attractive conditions to TNCs. Companies producing for export can import inputs duty-free and enjoy a 100% exemption from profit taxes for eight years, and a 50% exemption for another 4 years. Not surprisingly, nearly all FDI in the manufacturing sector is in the Free Zones.

Finally, CINDE has been very effective in marketing the country's location-specific assets to potential foreign investors. Established and funded by USAID in 1982, CINDE initially went after any investment it could attract. The response came

primarily from TNCs in the clothing industry, given the USA's preferential tariff treatment under the Caribbean Basin Initiative and tariff provision HTS 9802. In the first half of the 1990s, CINDE became more focused in its pursuit of FDI. It started with targeting foreign investors in the electronics sector, then it added FDI in the production of medical devices, and lately it has also been seeking out FDI in IT-enabled services. CINDE's focus on the electronics sector eventually led to Intel investing in Costa Rica rather than in Brazil, Chile, or Mexico, the other Latin American countries on the TNC's shortlist. In addition to Costa Rica's location-specific assets, the key determinant of Intel's location choice was the very close collaboration among all relevant agencies to respond to Intel's concerns (Paus 2005; Mortimore and Vergara 2004; Spar 1998).

In contrast to Costa Rica, Mexico's larger size allowed it to promote the development of an indigenous high-tech sector during the ISI period, a sector that became relatively vibrant by the 1980s. Mexico's high-tech antecedents date as far back as the 1940s, when—under ISI protection—national companies began to manufacture radios and radio components. From the 1950s until 1980, Mexican firms manufactured televisions and related parts as well. The government targeted the computer industry in the late 1970s as part of the strategy of the National Council on Science and Technology (CONACYT) to increase Mexico's national self-sufficiency in technology. CONACYT established a PC program (Programa de Computadoras) to develop a domestic computer industry (supported by the surrounding electronics industry) that could not only serve the domestic market but also emerge as a key exporter for Mexico.

TNCs were limited to 49% foreign ownership of firms in the sector. They had to invest between 3 and 6% of gross sales into R&D and create research centers and training programs. Domestic parts and components had to account for at least 45% of value added for personal computers and 35% for minicomputers. New Mexican-owned firms could receive fiscal credits and low-interest loans from government development banks.

In search of domestic markets and export platforms, the foreign firms that came were IBM, Hewlett Packard, Digital, NCR, Tandem, and Wang. IBM and Hewlett Packard were the leaders and accounted for 63% of all computer production. The other foreign firms were responsible for approximately 18%, and wholly owned Mexican firms made up another 18%.

By the mid-1980s, Mexico's strategy no longer meshed with the strategic interests of TNCs. In 1985, IBM requested 100% ownership of a state of the art plant it planned to build in Guadalajara, Mexico's second largest city in the western state of Jalisco. The Mexican government agreed to the demand in exchange for an $11-million Center for Semiconductor Technology in Guadalajara that would train a number of Mexican engineers and developers from 1988 to 1994. The IBM exemption laid the groundwork for full-blown liberalization and subsequently large inflows of TNCs in the 1990s. After IBM was granted 100% ownership, Hewlett-Packard demanded and received an exemption as well, but without any commitments toward local development. By 1987, other foreign firms were also allowed to work outside of the PC program (Dedrick et al. 2001).

Numerous factors account for TNCs' interest in locating their high tech assembly operations in Mexico: labor unions were weak and wages were relatively low;

proximity to the USA was of paramount importance; and tariffs on high-tech imports, which had been over 20% in the 1980s under the PC program were lowered to zero under NAFTA; and Guadalajara was the ideal region for high-tech FDI, as it had five major universities and numerous technical schools and industrial parks that could host research activity and graduate an adequately skilled workforce (Gallagher and Zarsky 2007).

The government adopted numerous policies to attract TNCs to Mexico. Nationally, one program allows firms to import their inputs duty-free as long as more than 65% of their output is exported (Dussel et al. 2003a, b). The Jalisco state government supplemented these federal programs with a regional plan to attract firms and suppliers. The state's Economic Promotion Law reduced or eliminated state and municipal taxes for firms that located to the region. In addition, the Guadalajara branch of the national chamber of commerce for the IT industry, CANIETI (Camara Nacional de la Industria, Electronica, de Telecomunicaciones e Informatica) works to attract large TNCs to the region and hosts trade shows and workshops on the industry. A more regional organization named CADELEC (Cadena Productiva de la Electronica) was founded in 1998 with funding from CANIETI, the United Nations Development Programme, and two other federal agencies. CADELEC's mission is to match suppliers with the large TNCs (CADELEC 2004; Palacios 2001).

Manufacturing and financial services accounted for close to 75% of all FDI inflows into Mexico between 1994 and 2002. Agriculture, mining, and construction each received less than 1%. The majority of manufacturing FDI went to the automotive, electronics, and apparel assembly sectors. Foreign investment in Jalisco's high-tech sector formed the bulk of Mexico's electronics FDI and skyrocketed between 1995 and 1998, when it reached $742 million. By 2003, FDI in Jalisco's high-tech sector had fallen back to 1995 levels because of a change in global strategies of TNCs in the computer industry, the attractiveness of China, and a contraction in US demand for high tech goods (Gallagher and Zarsky 2007).

The Missing Links in the FDI-Development Nexus: Costa Rica

High-tech FDI has led to significant structural change in Costa Rica's exports and manufacturing sector. Electrical machinery, which includes most of the high-tech electronic and medical instrument products, increased its share in total exports from 1.4% in 1997 to 24.6% in 2003. This seeming transformation has not been mirrored by a transformation of indigenous technological capabilities, because FDI spillovers have been limited.

Although there have been some positive spillovers from FDI through the training, education, and demonstration channels, spillovers via backward linkages have been small. The missing links are rooted in the interplay between limited FDI spillover potential and limited national linkage capability; in the end, the latter has been more important than the former. Even though Costa Rica has had some of the elements needed to advance national spillover capabilities, the absence of a coherent development strategy and a coordinated multiagency implementation agenda are the fundamental reasons for the weak link between FDI and development.

Backward Linkages

Supply chain development through FDI has been limited. Between 1997 and 2005, TNCs' expenditures on national material inputs and services increased in absolute terms from nearly $100 million to around $370 million. But they declined in relative terms: as a percentage of imports, national expenditures declined from 11.8 to 10.4% during this period (see Table 4).[1] The electronics sector has been even less connected with the domestic economy than the clothing sector, which is noted for the scant use of local inputs, as foreign investors operate under HTS 9802. Even though electronics and medical devices accounted for two-thirds of Free Zone exports in 2005, they made up only 18% of the Free Zone's national expenditures.

Packaging and printing materials and different services are the main inputs that TNCs source in Costa Rica. Only a few national firms have succeeded in becoming competitive suppliers of other products to high-tech TNCs, and—to date—only a few international input suppliers have followed their TNC clients to Costa Rica.

Theoretically, FDI in high-tech products holds out greater potential for spillovers than FDI in low-tech products. In the case of Costa Rica, that potential is reduced considerably for two main reasons. First, most of the high-tech FDI is at the low end of the spectrum of technology intensity, involving assembly type jobs; though in the case of Intel, testing and assembly of microchips is substantially more involved than "assembly" would suggest. Second, the large high-tech TNCs in Costa Rica (Intel, Abbot, Baxter) source the major inputs from the company-internal global network; i.e., much of the production is internalized among the affiliates spanning the globe. In addition, many of the key inputs that are outsourced cannot be produced in Costa Rica at this juncture, either because the requisite scale is too large or the technology is too sophisticated. Nonetheless, we found evidence in Costa Rica that some of a TNC's sourcing is partly dependent on local capabilities. For example, while protection of know-how and quality control has kept production of most key parts in-house at Baxter's medical device plant in Costa Rica, the TNC's affiliates in Singapore and Puerto Rico source some of those parts in the host country because there is no quality difference between in-house and local quality.

Compared to the large high-tech TNCs, many of the small and medium-sized TNCs in Costa Rica in the electronics and medical instruments sectors are eager to buy inputs domestically. For many of them, the investment in Costa Rica was their first investment abroad. Smaller TNCs do not have the global reach to internalize production across many borders. Consequently, they have a greater interest in achieving cost reductions through local sourcing, as long as technological sophistication, quality, and scale permit it. Even in areas where scale requirements did not constitute an obstacle to local supply provisions, Costa Rica's absorption capability for spillovers via input supply has generally not been sufficient.

One reason for the insufficient domestic linkage capabilities are particular shortcomings of the ISI strategy. Companies were protected by tariffs, but no

[1] We use the economic data for the Free Zones as an indication of TNC behavior. That is a reasonable approximation since nearly all FDI in manufacturing is in the Free Zones, though a few foreign companies operate outside the zones, and very few Costa Rican companies operate in the Free Zones. The import data in Table 4 include intermediate inputs as well as capital goods.

Table 4 National expenditure by companies in the Zona Franca Regime, 1997–2005

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total (Mill. of US$)	98.9	232.7	228	139.1	206.9	244.5	269.3	335	368.3
National expenditures as a % of imports									
Total	11.8	13.1	10.9	7.2	9.3	10.0	10.8	11.9	10.4
Machinery, electrical materials and comp.	6.6	5.8	4.4	2.7	3.1	2.4	2.6	2.6	2.0
Precision instruments and med. equipment	5.7	10.8	8.1	8.4	4.0	5.0	6.1	6.0	7.8
Agroindustry	63.0	64.1	44.7	74.3	82.7	77.7	86.2	84.0	78.1
Textiles, clothing, leather and shoes	5.4	12.0	15.3	4.7	6.2	5.7	5.5	7.6	6.0
Services	17.9	18.7	13.3	10.8	20.6	17.6	25.5	24.0	25.8
Plastic, rubber and their manufactures	15.7	33.7	27.3	33.4	25.2	27.4	15.5	24.4	24.7
Chemical and pharmaceutical prod.	54.8	34.2	32.2	30.4	36	28.3	41.4	47.2	23.3
Metal products	33.2	6.0	1.4	1.9	7.0	7.8	14.9	37.9	41.0
Agriculture, life stock	0	0	0	4.5	97.6	97.8	96.7	97.2	90.6

Source: Procomer

reciprocal control mechanisms were in place that required domestic producers to become internationally competitive. The experience of the successful Asian Tigers shows that control mechanisms involving export requirements were particularly effective (Amsden 2001). When the Costa Rican economy opened up in the 1980s, and when high-tech FDI arrived in the 1990s, many domestic producers turned out not to be competitive suppliers for TNCs. Since they were operating in a context of widespread market failures, it was unlikely that they would become competitive on their own. Many had imperfect information about needed technology and quality, and they faced high financial costs because of underdeveloped capital markets and high risks because of the uncertain outcomes in the new competitive environment.

Most potential domestic input suppliers have been unable to meet quality expectations since they do not have the necessary technological know-how or meet minimum quality standards like ISO certification. Others have not attempted to become TNC input suppliers, as it is a high-risk undertaking in a Catch-22 context. To become actual input suppliers, national producers need to invest in ISO certification and new machinery. Yet finance capital is expensive in Costa Rica, and the manufacturer will not know for certain whether a contract with a TNC will be forthcoming if he invests. On the other hand, a TNC is rarely willing to commit to a contract without knowing that the Costa Rican producer can deliver the requisite quality consistently and in the time frame required.

Finally, the demands on entrepreneurship are different in the highly competitive environment of a liberalized economy in the early twenty-first century, compared to the demands in the less competitive context of ISI. It is hard to assess the relative importance of the Schumpeterian entrepreneur in Costa Rica's insufficient domestic absorption capabilities. "Tienen otra cultura" ("they have a different mindset") was a frequently voiced concern in response to the interview question why national manufacturers are having difficulties in becoming competitive input suppliers.

In the literature on the FDI-development nexus, Costa Rica is often held up as a success story, both with respect to the targeted pursuit of FDI and to the

effectiveness of CINDE, particularly in attracting Intel to Costa Rica (e.g., ECLAC 2007, Mortimore and Vergara 2004; Mytelka and Barclay 2004). There is no question that Intel has played a critical role in Costa Rica's economy. The corporation accounted for nearly 25% of the country's exports between 1999 and 2006.[2] The demonstration effect of Intel's decision to invest in Costa Rica has been huge for TNCs scouring the globe for profitable investment opportunities.

Contrary to claims in the literature, the successful pursuit of Intel was not the outcome of a deliberate development strategy with a clearly defined role for FDI. Since abandoning ISI in the early 1980s, Costa Rican governments have not had a strategy in which FDI's role in the country's economic development was clearly articulated. The effective, coordinated, multiagency pursuit of Intel resulted from the initiative of then President José Figueres, but his administration missed the opportunity to institutionalize such a coordinated multiagency strategy. Initiatives rooted in an individual, even if it is the country's president, do not substitute for the institutional basis needed to ground a development strategy with a clear role for high-tech FDI.

The absence of such a larger coherent development strategy, which would spell out how the FDI-development nexus is supposed to materialize, is also reflected in the lack of a plan to develop national absorption capacity. The existence of CINDE is based on the recognition of market failures, i.e., information and coordination failures. Advertising Costa Rica's location-specific assets presumes that TNCs do not have sufficient information about them. Targeting foreign companies in prioritized areas reflects the belief that coordination failures are important; that is, clusters in key areas will not form on their own, but they are desirable because of possible agglomeration effects.

The recognition of market failures did not carry over to the development of national linkage capability, at least not in any significant and systematic way. Over the years, there has been no shortage of calls for proactive linkage creation policies in Costa Rica, as well as incipient moves in that direction.[3] At one point in the second half of the 1990s, there were at least three programs. Since these programs were partly competing with one another, not coordinated, and mostly paper tigers, they did not last long.[4]

The launching of Costa Rica Provee (CRP) in 2001 was the latest attempt to promote indigenous linkage capability. A pilot project co-funded by the Inter-American Development Bank, CINDE, and the export promotion agency PROCOMER.CRP's charge was to identify potential national input suppliers and turn them into actual input suppliers of TNCs. CPR's formal integration into PROCOMER in 2004 was a promising step toward the institutionalization of

[2] Intel also contributed substantially to the increase in the country's imports.

[3] Mortimore and Zamora (1999: 34) describe how the Arias Administration (1986–1990) articulated the intention of putting an industrial re-conversion program in place. It was not geared toward linkage development specifically, but more broadly toward increasing the competitiveness of the national manufacturing sector, as tariffs were reduced and import competition increased. Working groups in three sectors were to identify problems and propose solutions, but there never were any proposals for concrete actions, and the funds were eventually used for other purposes.

[4] For details see Paus (2005).

linkage promotion. The institution has been an effective matchmaker between national input suppliers and TNCs operating in Costa Rica., with the number of linkages facilitated by CRP growing from 18 in 2003 to 140 in 2006. The value of first-time linkage contracts was $3.2 million in 2006.

Nonetheless, without greater resources—financial and human capital—CPR cannot bring about a qualitative jump in domestic linkage capability. In 2007, it had a staff of seven people and a budget of $275,000.[5] Furthermore, it provides training and consulting, but unfortunately no financing. Access to credit at reasonable interest rates is still a hurdle for many small companies that do not have the collateral needed for bank loans.

The process of developing linkages is slow and gradual, as the experience of Singapore, Ireland, Thailand, and other countries has shown.[6] For such a process to be successful requires that the advancement of knowledge-based assets and the promotion of linkage capability move to center stage, financially and institutionally. The creation of linkage capability has to be taken as seriously as the attraction of FDI, and both goals have to be pursued in tandem. The creation of linkage capability requires synergetic, institutionalized cooperation among all the relevant players in the areas of technical training, financing, and market information.

Training and Education

Although high-tech FDI in Costa Rica has not induced many knowledge spillovers through backward linkages, it has generated some spillovers through training and education. In 2001, 55% of exporters reported to have a training system, compared to 16% of companies producing for the domestic market only. Among exporters, the percentage of foreign companies with a training system was nearly 20 percentage points larger than for national companies, 68% versus 51% (Paus 2005: 182; IICE 2001).

High-tech producers in Costa Rica employ a larger percentage of skilled workers, which offers the potential for greater knowledge spillovers. In 2000, skilled labor constituted 13.4% of employment in the Free Zones without Intel, and 21% when Intel is included. In metal manufacturing, where most high-tech FDI is concentrated, the percentage of skilled labor was 18.7% without Intel and 29.6% with Intel (Larudee et al. 2001). At times, foreign companies provide training in skill areas that are not widely available in the host country, e.g., in computer numerical control. Labor mobility will ensure that such knowledge then spreads more broadly. A 2004 survey of local input suppliers to TNCs showed that 6.2% of their managers, 27.6% of their engineers, and 31% of their technicians had previously worked for a transnational corporation (Monge et al. 2004).

In addition to the accumulation of skills and knowledge in the production process and the positive spillovers that come with labor mobility, foreign high-tech companies have had an important impact on upgrading the technical curriculum at Costa Rica's universities. That is particularly true for Intel. Both the engineering school at the University of Costa Rica and the Technological Institute of Costa Rica

[5] Roberto Calvo from Costa Rica Provee kindly provided the data regarding CRP.

[6] For details on Ireland, see Paus (2005), on Singapore, Huff (1995), and on Thailand, Lauridsen (2004).

have contracts with Intel to collaborate on the development of curricula for technical careers. The goal is to provide the most up-to-date skills and knowledge needed at different levels, from technicians to engineers, which would support an expansion of the sector and—potentially—a move up the value chain within the sector as well.

Technical training in Costa Rica, especially in computer technology, has led to a growing national software industry. Its origin predates the arrival of Intel and other high-tech TNCs, but its subsequent development was aided by the presence of high-tech TNCs, as these corporations expanded the availability of trained personnel. It is not coincidental that the software industry in Costa Rica has developed primarily on its own. With no barriers to entry and plenty of opportunities for niche production, it is easier for producers to establish themselves on a small scale, given requisite training and access to funding. As a result, companies in Costa Rica have increasingly been looking to export IT-enabled services. The lack of venture capital has been a major problem, just as it has been for other companies in Costa Rica.

One can expect that high-tech FDI in a middle-income country like Costa Rica starts out at the lower end of the skills spectrum. The critical question is whether TNC production moves up the value chain over time. So far, that has not happened often. Big high-tech companies like Intel and Baxter have shown little movement up the value chain in their production processes in Costa Rica. Rather, they expanded into the area of IT-enabled services; for example, Procter & Gamble and Intel have established large operations in shared business services and Hewlett Packard and IBM in back office services. While such IT-based services have created valuable employment, they have done little to advance the technological and managerial know-how in the country.

One important reason for the lack of upward movement is the insufficient development of domestic knowledge-based assets that would make it attractive for TNCs to move production in the country into technologically more sophisticated areas. When Intel-Costa Rica celebrated 10 years of operations in Costa Rica in March 2007, Intel president Craig Barrett criticized the lack of technological advancements in the country and the insufficient attention to progress in education (*La República* 2007). It is ironic that the tax exemptions granted to Intel and other TNCs under the rules of the Zona Franca mean that these companies do not directly contribute to an increase in the tax revenue needed for significant improvements in infrastructure and education. Costa Rica's tax ratio of 13% is too low to fund all the needed investments in infrastructure and education.

The Missing Links in the FDI-Development Nexus: Mexico

In spite of the existence of an indigenous computer industry and a much larger economy in Mexico, the significant amount of FDI in the IT sector generated relatively few spillovers, just like in Costa Rica. There, like in Costa Rica, the scarce spillovers found in Mexico are due to the lack of a coherent strategy by the Mexican government. In addition, the potential for spillovers was constrained because TNCs strategically decided to import their inputs rather than source locally, and because Mexican firms lacked much of the absorptive capacity necessary to capture spillovers that were available. These limitations could only have been overcome by government policy embedded in the private sector, which was lacking.

Dating back to the 1980s, numerous analysts from both Mexico and the USA have examined how much foreign electronics firms generated spillovers to nationally owned firms in Guadalajara. Although the merits of Mexico's ISI-based buildup of a computer industry have been debated, it is well known that Mexican-owned firms had substantial capacities to manufacture IT products and components (Austin 1993; Peres 1990; Dedrick and Kramer 2001). In the early 1990s, two influential studies saw great promise for the emergence of a globally competitive IT industrial cluster in Guadalajara with strong local linkages (Wilson 1992; Shaiken 1990). While they found only limited evidence of FDI spillovers, both studies concluded that the sector was poised to flourish because local suppliers were abundant.

Numerous studies, including this one, have established that such a promise did not materialize. Signs were already evident as early as 1998, when the Economic Commission for Latin America and the Caribbean concluded that industrialization in the electronics industry had become almost completely "internationalized" and was beginning to resemble a "parallel economy" that had few linkages in Mexico (ECLAC 1999). Since then, the literature has been extensive and too large to cover in this article. Enrique Dussel et al. (2003a, 2004), and Rivera Vargas (2002) have made key contributions. Their books include chapters on spillovers, wages and training, research, and development and learning. These contributions generally conclude that the record on spillovers in Guadalajara has been mixed at best. In addition to field visits to Guadalajara from 2003 to the present, our analysis builds on, confirms, deepens, and expands this earlier work, and compares the findings with the case of Costa Rica. We refer to the earlier work where relevant in the analysis below.

Competitive Pressures and Backward Linkages

Unlike Costa Rica, Mexico had numerous indigenous high-tech firms before the high-tech FDI boom in the 1990s. The Jalisco region had indigenous firms that manufactured their own computers, such as Scale and Electron Computers. It also had wholly owned or joint-venture assembly manufacturers such as Unisys, Cumex, and Mexel. Below these two tiers of firms were numerous niche suppliers such as Electronica Pantera, Microtron, and others (Palacios 2001; Rivera Vargas 2002; Wilson 1992). These indigenous firms worked alongside TNCs and some supplied global firms such as IBM, Motorola, Hewlett Packard, and Kodak. By 1987, Mexico was only 14 percentage points short of its goal of having 70% of domestic demand met by domestic supply (Peres 1990).

Nearly 20 years later, the domestic computer industry is almost extinct, and few domestic input producers have become integrated into the global production chains of the IT TNCs operating in Mexico. Between 1985 and 1997, the number of indigenous electronics firms in Guadalajara declined by 71% (Rivera Vargas 2002), and 13 of the 25 indigenous electronics firms that were still in existence at the end of 1997 had been closed by 2005 (Gallagher and Zarsky 2007).

Although we focus here on the computer industry, it is important to understand that the rise and fall of national producers in this sector is not unique. The automotive sector in Mexico has had a similar experience. Moran (1998: 53–56) found that the integration of Mexican producers into the global sourcing and

marketing strategies of multinational car companies in the 1980s generated many spillovers to local firms and local communities. Rather than build on this success, there is evidence that spillovers in the auto sector are no longer prevalent (Mortimore and Vergara 2004).

In general, backward linkages have hardly grown since the inception of NAFTA. Table 5 shows the use of domestic inputs for Mexico's export sector before and after NAFTA. The share of domestic inputs in total inputs has grown by less than two percentage points since NAFTA. In a large study covering 52 Mexican industries, Romo Murillo (2003) finds that foreign presence is negatively correlated with backward linkages. Econometric analyses, looked broadly at the effects of FDI on the Mexican economy between 1970 and 2000, found that investment liberalization was significantly correlated with increases in investment and subsequent exports, but also led to a higher incidence of imports and the displacement of local firms (Dussel et al. 2003b; Pacheco-Lopez 2005). The electronics sector has even fewer linkages than the average in manufacturing, with the national input share hovering around 2%.

All of the CMs we interviewed import more than 95% of their inputs from overseas; official statistics say the average for the region is 96.3%.[7] Most of the CMs are working with local firms that supply cardboard boxes, shipping labels, cables, wires, and disposal services. This finding suggests that although the share of national inputs has increased—though it still remains very small (see Table 5)—the composition of the input suppliers has changed from national high-tech firms to national shipping and disposal firms.

The decline of the national computer-related industry in Guadalajara must be understood as the outcome of a drastic decline in the potential for FDI spillovers on the one hand and insufficient absorptive capacity for spillovers on the other. The potential for spillovers in Mexico became constrained as high-tech TNCs worldwide dramatically changed the organization of the global value chains, with the outsourcing of most production to contract manufacturers. Instead of sourcing locally, TNCs encouraged their US-based contract manufacturers and other suppliers to colocate to their own different assembly and production locations (Sturgeon 2002). Mexico was no exception. HP and IBM literally "invited" US-based CMs to Guadalajara rather than work with local or national firms to incorporate them into their global production networks. Oligopolistic firms like HP and IBM opted for inputs from suppliers with whom they had already developed a long-standing relationship and who had a track record of high-quality production. By the mid-1990s, US-based CM giants Jabil Circuit, SCI-Sanmina, Flextronics, and Solectron (along with NatSteel from Singapore) had established plants in Guadalajara that conducted virtually all of the manufacturing for HP and IBM. For HP's part, they have also moved much of the manufacturing to Asia (Dussel 2005).

One reason why TNCs gave preference to multinational CMs and other Asian suppliers over Mexico's domestic firms is the lack of competitiveness of domestic producers (Austin 2004; Dussel et al. 2003a, b). Mexican firms lacked the capital to

[7] Based on a comprehensive study on the learning levels of subcontractors in Jalisco during the peak period of 1996–1997, Dussel (1999) found similar results: he estimated that the value added by Mexican firms to total production is only about 5%.

Table 5 Use of domestic inputs in Mexico's export sector, 1990–2006 (1,000 of current Mexican Pesos)

Sector	1990	1993	1999	2003	2006
All industries					
All inputs	32,171,039	56,628,991	529,151,329	719,826,926	n.a
National Inputs	3,198,158	5,243,675	48,013,888	82,038,088	n.a
National share	9.9%	9.3%	9.1%	11.4%	n.a.
Electronics					
All inputs	4,272,927	6,819,654	60,959,951	86,931,211	190,451,140
National Inputs	51,339	95,274	1,173,240	1,780,876	4,200,493
National share	1.2%	1.4%	1.9%	2.0%	2.2%

Source: INEGI 2007

increase scale for export and the new global markets available from NAFTA. Many also lacked the ability to meet the quality standards imposed by TNCs. Finally, indigenous firms lacked the information and marketing capabilities needed to link with the globally networked firms.

The domestic firms were crowded out of the process because of two key market failures: imperfect competition as well as coordination and information externalities. In terms of imperfect competition, domestic firms faced entry barriers because of the oligopolistic nature of the industry. They needed considerably increased economies of scale to export or supply at the levels demanded from new markets and suppliers. They needed to compete with contract manufacturers whose very basis of competitiveness is large economies of scale.

The Mexican government failed to "correct" market failures with proactive government policies. It did not adopt in a significant and coherent way the kind of policies that, for example, the governments of Taiwan and Singapore had pursued. Instead, the government's liberalization and tax policies accentuated TNCs' bias toward importing inputs by putting local firms at a competitive disadvantage to foreign suppliers (Dussel et al. 2003a, 2004; Gallagher and Zarsky 2007). Mexican indigenous firms also failed to link with foreign firms because of coordination and information externalities. Domestic firms were not as competitive as they needed to be to create linkages with TNCs. Under the ISI strategy, these firms were protected by tariffs, but no reciprocal control mechanisms were in place that required domestic producers to become internationally competitive. When liberalization occurred, the national producers had to compete on a playing field of imperfect competition already biased toward powerful foreign firms.

Many firms had imperfect information about needed technology and quality, and the TNCs had imperfect information about the existence of some fairly vibrant potential suppliers on the ground. Domestic firms also had enormous difficulty in developing needed capacity on their own. The TNCs came to Mexico in the aftermath of a peso crisis that left most domestic firms with little back-up funds. Moreover, Mexico has had an underdeveloped capital market that has only worsened since the crisis and liberalization period—making it difficult for domestic firms to access credit on their own. Although Mexico has a development bank (NAFIN) to provide credit to small- and medium-sized industries, NAFIN credit to SMEs in Jalisco fell by 75% between 1990 and 2001 (Gallagher and Zarsky 2007).

Looking back, the move by the leading multinationals to shift toward contracting out their assembly operations presented a real opportunity for the Guadalajara region. In the early 1990s, there were a handful of local firms involved in some kind of electronics manufacturing—some of whom were already CM assemblers (Wilson 1992). This is exactly the kind of opportunity that Taiwanese firms had seized years earlier. There is no guarantee that Mexican companies would have become competitive contract manufacturers with the right set of government policies, but the chances would have been much higher. Without a coherent set of policies to address market failures, Mexican firms lacked the means to become competitive. Now, with most of the local firms wiped out in Guadalajara and some of the TNCs moving to China, it is an enormous challenge for Mexico to regain the lost ground.

Training and Education

Although high-tech FDI in Mexico has not led to many knowledge spillovers through backward linkages, it has generated a modest amount of spillovers—like in Costa Rica—through training and education, research and development, and spin-offs. However, these spillovers have been limited because of the low potential for knowledge spillovers in Mexican high-tech production. First, TNCs see Mexico as a place for assembly operations only, and therefore conduct little R&D or operations that could generate knowledge spillovers. Second, the absorptive capacity of the Mexican employees and supplier firms is limited as well. As in the case of backward linkages, the Mexican government (with one exception in the 1980s) did not step in to address these asymmetries.

Mexico is a low link in the global electronics commodity chain. The CMs in the region are conducting the final assembly and subassembly of high-tech products. The firms employ thousands of workers who work on assembly lines; they receive initial training for their part of the process and little else throughout the rest of their tenure at the plant.

The limited potential of technological spillovers is evident from the human capital requirement for the work in Guadalajara's electronics firms, discussed in the previous section. A recent study estimates that 73% of employees have a high school education or below; 66.1% of all workers in the plants have the equivalent of a middle school education or less; only 6.9% of employees have graduated from high school, and .52% has graduate training. However, 100% of all employees in Guadalajara's plants are Mexican (Partida and Moreno 2003).

The shift toward subcontracted employment is another aspect of the employment process in Guadalajara that makes spillovers more difficult. As wages in the region began to creep up relative to foreign competitors, the majority of workers in the sector (72%) was hired and paid by the more than 25 employment firms in the region; 68% of the subcontracted workers receive all their training at the employment firm, not from the high-tech firm itself (Partida and Moreno 2003). The nature of these subcontracts is temporary, which increases turnover rates. Our interviews suggest that the higher-skilled workers are most likely to move from one high-tech TNC to another TNC rather than to a local firm.

Nonetheless, we did find that a very limited amount of R&D is being conducted in Guadalajara by foreign firms and local suppliers, as well as in collaboration with local universities. In all of our interviews with the large multinationals and CMs, we

were told that no R&D is conducted in Guadalajara, though at times in the past it had been. In the case of IBM and HP, R&D is conducted in the USA. Rivera Vargas (2002) found that eight of nearly 60 electronics firms in the Guadalajara region were involved in some type of collaboration with area universities. In each of these cases, foreign firms were working with universities to conduct quality control efforts and perfect assembly procedures for existing plants.

Although the general trends suggest a paucity of knowledge spillovers, a small but burgeoning software and design industry has emerged in Jalisco. Much of this movement traces back to the late 1980s when IBM set up a training facility that would boost local technological capacities (the *Centro de Technología de Semiconductores*, CTS). Although IBM no longer continues to be part of CTS, the center has led to a handful of spin-offs that continue to spawn interesting developments 20 years later. According to an Intel official, the key benefit of CTS was the exposure of Mexican engineers to technology—specifically, how to develop integrated circuits and computers. With IBM's involvement, CTS trained about 60 engineers in total. At its peak, there were 32 people, but there were generally 25 engineers in training at a given time. Many engineers left CTS to seek engineering jobs in the USA. Yet three firms spun off from CTS: TDCOMM, Mixval, and DDTEC. In 2004, only Mixval was still in operation, TDCOMM had been acquired by Intel Venture Capital in 2000 (Gallagher and Zarsky 2007).

This section has shown how relatively few knowledge spillovers were generated as a result of high tech FDI in Jalisco, largely because of the low technology level of production in the firms, TNC strategies, and weak absorptive capacity on the part of local firms. Yet the example of IBM's training facility in the 1980s is one indication of how these challenges can be addressed.

Lessons from the Costa Rican and Mexican Experiences

Even though Costa Rica and Mexico had the location-specific assets to attract high-tech FDI, FDI has generated few spillovers and contributed little to the advancement of knowledge-based assets in the two economies. The limited FDI spillovers are the result of both low FDI spillover potential and insufficient domestic absorptive capabilities. Three main factors explain the limited spillover potential of high-tech FDI in Costa Rica and Mexico. First, the technology and scale requirements made it difficult for large TNCs to source key inputs in the host countries. Second, the move toward contract manufacturing in the computer industry led TNCs to rely on their global contract manufacturers rather than work with potential Mexican input suppliers. Third, high-tech production in both countries started with lower-tech assembly processes, and did not move up the value chain much over time. Like in the rest of Latin America, foreign R&D expenditures in Mexico and Costa Rica have been small.[8]

[8] In 2002, US majority-owned foreign affiliates spent 1.3% of all R&D expenditures in Mexico; the percentage for Costa Rica was negligible. The percentage for China was the same as for all of Latin America and the Caribbean combined, 3.1% (UNCTAD 2005: 22).

Scale, global structural changes and lower-tech assembly production have limited the spillover potential of FDI in other late-developing countries as well. Yet some of them have derived much greater development benefits from FDI than Mexico and Costa Rica. The explanation has to be sought in the insufficiency of domestic absorptive capabilities. Economy size is not the critical variable. To be sure, a large economy holds out the potential for greater breadth in potential domestic absorptive capacity. On the other hand, the experience of Singapore, and to some extent Ireland, indicates that small country size is not an insurmountable obstacle to the development of linkage capability. Rather, the decisive factor in the successful realization of an FDI-development nexus is the pursuit of a comprehensive development strategy to enhance national technological and managerial capabilities. A comprehensive strategy would spell out the role of FDI in the development process, the requisite policies to overcome widespread market failures and advance domestic spillover absorption capacity, and the strategies to mobilize resources for needed investments in human resources, infrastructure, and eventually in R&D.

Such a comprehensive strategy was absent in both Costa Rica and Mexico, which explains why Mexico could not capitalize on the greater spillover potential that its larger and more diversified economy offered. Under the Washington Consensus, governments in both countries had great faith in the power of liberalized markets to render economic stability and growth, and for FDI to generate technological and managerial spillovers. Governments did not completely abdicate the use of targeted policies to overcome market failures. Special policies to attract FDI, including the establishment of investment promotion agencies, were to counter TNCs' imperfect information about the nature of the countries' location-specific assets. The proaction aimed at FDI attraction has not been matched by analogous consistent policies to promote indigenous linkage capabilities, policies embedded in a broader strategy to expand domestic knowledge-based assets.

Our article contributes to the growing body of evidence that the Washington Consensus does not constitute a viable development strategy. When market failures are pervasive, markets will not generate competitiveness and linkage capability of the national industrial sector. When the gap between domestic linkage capability and TNC expectations regarding input quality and price is too big, the possibilities for spillovers via linkages are very small. Imperfect information, high risk, barriers to entry, coordination failures, and perhaps insufficient Schumpeterian animal spirits are significant obstacles to the development of a competitive indigenous supply sector, notwithstanding the occasional successful local supplier. Based on an analysis of the lack of backward linkages from TNCs in Thailand in the 1990s, Lauridsen (2004: 568) argues: "To be effective there must be a 'vision' about supplier development through backward linkages, and this vision should be built upon a strong political commitment and be shared among all stakeholders."

The same market failures that prevent the automatic development of national linkage capability are also the ones that prevent advancement and diversification of indigenous economic activity more generally, in the manufacturing sector and otherwise. It is important to understand that an FDI-supported dynamic virtuous cycle of advancing domestic knowledge-based capabilities can only result from the

positive interaction between growth in domestic capabilities and upgrading of FDI over time. When domestic linkage capabilities do not advance sufficiently, high-tech FDI will not move from low-tech assembly to more sophisticated production.

Changes in TNCs' global sourcing strategies reduced the potential for positive spillovers in the 1990s. In the electronics industry, economies of scale and global reach became critical for the competitiveness of producers of standardized products and parts. The comet-like rise of contract manufacturers as of the mid-1990s made it impossible for Mexican producers to become first-tier suppliers to international computer producers in Mexico.

Yet, where domestic linkage capability exists in technology, quality, and delivery, there is potential for either becoming suppliers at a lower tier level or of a product where scale economies are less important. Smaller TNCs, like many of the ones that invested in Costa Rica, do not have global networks of production and have greater interest in sourcing domestically. Particular industries, like the medical device sector in Costa Rica, offer greater potential for spillovers, since scale is usually not a factor, though technological and regulatory requirements become more stringent.

In defining a strategy for the advancement of domestic knowledge-based assets and linkage capability, Costa Rica and Mexico, like other developing countries, confront three major challenges. First, they need to avoid the mistakes of the ISI strategies, where lack of control mechanisms to discipline recipients of targeted benefits, like tariff protection and subsidized credit, made the achievement of industrial competitiveness difficult. Second, governments have to find control mechanisms that are compatible with today's international trade agreements. Control mechanisms commonly used in the past, like export performance requirements for domestic producers and domestic content requirements for foreign investors, are no longer available policy options under WTO rules and bilateral trade agreements (Abugattas and Paus 2008; Gallagher 2005). Governments have to use the existing policy space for targeted intervention, e.g., coordination policies, information provision, subsidies for services, subsidies for R&D. Whether the existing policy space is sufficient for the adoption of effective capacity-promoting policies is the subject of much debate (Paus and Shapiro 2007; Shadlen 2005; Gallager 2005; Wade 2003). Third, governments have to find ways to fund the needed investments in infrastructure and human capital that are critical for the advancement of domestic absorptive capabilities.

Meeting these three challenges seems daunting. If governments want to engender a virtuous FDI-development cycle in the context of a broader development strategy, they have no choice but to embrace these challenges. The growing fragmentation of production on a global scale and the increased competition in international markets, especially with the rise of China and India, have raised the bar for participation in a TNC's global production network and reduced the time period during which spillovers can be absorbed. Both factors ratchet up the urgency of proactive policies to overcome market failures and support the development of indigenous technological capabilities.

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