Chapter 11

Regional Integration and Productivity

One of the key rationales for what has been called the "new regionalism" is to increase productivity. While economists since Adam Smith and his pin factory have known that productivity enhancement is not an end in itself, it is arguably the principal source of economic growth and rising standards of living. As such, it takes on particular importance to regions such as Latin America and the Caribbean, where long-term sustainable growth has long been an elusive goal. Growth in the region has trailed that of East Asia since the 1960s, and in the past two decades has fallen below the overall developing country average (IDB, 2001).

Growth accounting exercises that isolate the contributions of inputs (e.g., capital, education and labor) and total factor productivity to the growth process suggest that Latin America has been not only slow in accumulating inputs, but also particularly weak in raising productivity. The World Bank (1991) estimates that the region's average productivity growth over 1967-87 was zero, whereas the averages for East Asia and the developing countries as a whole were, respectively, 1.9 and 0.6 percent. The IDB (2001) estimates that productivity in Latin America declined in the 1980s and 1990s despite gains achieved elsewhere, particularly in the developed world.

Against this backdrop, it seems clear that by promising productivity gains, the move to regional integration has touched a raw nerve in the region. Why and how these gains are supposed to be delivered in Latin America, and what empirical evidence is available to date to support those positions, is the focus of this chapter. It gives particular attention to the two largest economies in the region, Brazil and Mexico, and to the performance of their manufacturing sectors. Given the size, geography and relative sophistication of their economies, these two nations might not be wholly representative points of comparison for all Latin American countries, but their experiences are nonetheless important because they involve two alternative modes of integration in the region: North-South and South-South agreements. Mexico pursued North-South integration through NAFTA, whereas Brazil signed South-South agreements, joining Mercosur. These divergent strategies provide a valuable policy experiment in terms of assessing implications for productivity growth.

Why Regional Integration Matters for Productivity

Regional integration is, perhaps above all, about promoting trade and investment among countries (see Chapter 2). One can argue, then, that the nature of the costs and benefits involved is, to a great extent, the same as that of a process of unilateral, non-preferential integration into the world economy. This is particularly true for the "channels" that might impact productivity. Yet, there are some important specificities related to the preferential nature of integration that cannot be overlooked. For analytical purposes, it is worth looking first at the more general (non-preferential) case of integration and then move on to the specifics of the regional schemes. Hereafter, the term "integration" is used in the sense of the general process of economic (trade and investment) integration, be it preferential or otherwise. For the specific cases of integration, the terms regional (or preferential) or global (or non-preferential) integration are used. The literature usually refers to two main channels through which integration might affect productivity: trade and foreign direct investment.

The Trade Channel

The linkages between trade and productivity can operate in at least three dimensions: the economy as whole, the sector, and the firm. The first dimension is the best known and has been around since the work of the classical economists Adam Smith and David Ricardo. The other two dimensions have only recently gained importance in the debate.

The economy-wide dimension. The classical argument for free trade, immortalized by Ricardo's wine-and-cloth example, contains the very first attempt to deal with the trade-productivity issue. The basic idea is that trade increases economy-wide productivity by reallocating resources towards those sectors in which a country has a comparative advantage. More recent theoretical developments have exploited other possibilities while adding some ambiguity to the results. The first breakthrough came from the new theories of trade, which have shown that there are also gains to be reaped from the advantages of large-scale production (Helpman and Krugman, 1985). What these theorists have done, first, is to highlight the importance of "increasing return" industries, where average costs fall as production increases due to large fixed costs associated with machinery or research and development. Second, it has been shown that trade, by enlarging the potential market of these industries, provides untapped opportunities to reduce costs and, therefore, increase productivity. Yet, theorists have also made clear that these potential gains might turn into losses if countries have those industries dislocated by imports.

Even though one can hardly overestimate the importance of gains from comparative advantage and scale, they cannot be relied upon to induce sustained increases in productivity. They tend to produce a one-time jump in the level of productivity without providing fuel for constant improvements. In economists' parlance, they are level and not growth effects (Lucas, 1988).

It was to take another theoretical breakthrough to show the links between trade and sustainable productivity growth, and it came at the hand of the "new growth theories" of the late 1980s. The key was to assume, unlike the "old" growth theories (Solow, 1956), that the production of knowledge takes place within the course of economic activity and is driven just as any other activity by the profit motive. This new view of technology allowed for exploring new trade-productivity links based on two main stories: learning-by-doing, and innovation. The former assumes that technological progress is mainly the by-product of the learning that occurs when firms are producing goods or installing equipment (Young, 1991). The latter, in turn, views technological change as driven mainly by deliberate efforts to produce knowledge, such as research and development (Grossman and Helpman, 1991).

In learning-by-doing, the impact of trade on productivity is indirect and depends to a great extent on what happens to the composition of the post-trade GDP. If trade leads to a specialization in sectors where the potential for learning is high, the end result tends to be clearly positive. Yet, if the opposite happens, productivity growth might fall.

In the innovation case, the links are broader in scope and the potential benefits are higher. Trade is seen to boost productivity in two ways. First, it expands the range of intermediate inputs available, and, therefore, allows producers more flexibility in matching their input mix to the technology available (Ethier, 1982). Second, it increases producers' access to foreign knowledge in a number of ways, such as imported intermediate inputs, imitation of import varieties (Keller, 2001), and access to knowledgeable buyers (learning-by-exporting) (Westphal, 2001). The nature of the input effect is similar to the traditional gains from trade and therefore can be seen as a "level effect." Access to knowledge, however, has a permanent impact on the ability of countries to learn and produce knowledge, and, as such, can be seen as the basis for sustainable productivity growth. The effectiveness of this second factor, however, hinges crucially on how easily knowledge spills across the borders and on what happens to knowledge-producing sectors after trade.

Firm and sectoral dimensions. It was not until the early 1990s that economists began to focus on the microeconomic foundations of trade and growth theories.[1] This effort to understand what was happening to sectors and firms produced a series of hypotheses about the micro-linkages between trade and productivity, covering issues such as the availability of world-class inputs, technology acquisition via imports or exports, import discipline, and higher turnover.

The first two micro-channels are basically the same effects discussed in the new growth theories, but now seen in a microeconomic setting. The last two are the main contributions of this literature and therefore deserve more attention. The import discipline effect, "the oldest insight in this [trade policy] area" according to Helpman and Krugman (1989), affects productivity in at least three ways: by reducing the slack in firm management (so-called X-efficiency); by forcing firms to increase their output and therefore improve their scale efficiency; and by increasing the firms' incentive to innovate.

The gains accruing from better firm management are quite intuitive, but economists have problems in putting a solid theory behind them because they run against one of the pillars of modern microeconomic theory: the assumption that firms maximize profits. The scale efficiency gain is basically the result of competition preventing firms from restricting output and raising prices. Higher competition results in lower prices and higher output, which, in turn, lowers average costs. This result, though, depends heavily on the assumption made about how easily firms enter and exit markets (Tybout, forthcoming).

Finally, the argument about incentives to innovate, which is key to linking trade to long-term productivity growth, is also quite intuitive, but its theoretical foundations are somewhat shaky. Rodrik (1992) and Goh (2000), for instance, reach totally different results when trying to model the impact of protection on innovation. The former argues that trade might reduce the firms' incentive to innovate if their market shares are reduced by imports, whereas the latter says that protection reduces innovation because it raises the opportunity cost of technological effort.

As for the high-turnover hypothesis, it is related to trade effects at the sectoral level. The argument is that "trade can promote industry productivity growth without necessarily affecting intra-firm efficiency"(Melitz, 2002). This is because the simultaneous expansion of imports and exports forces the least efficient firm to contract or exit and the most efficient to expand. As with the comparative advantage case, this "share effect" is basically a one-time gain.

The Foreign Direct Investment Channel

The more important insights about the FDI-productivity linkages would only come to light in the second half of the 1980s, when the pieces of a more formal general theory of the multinational firm began to be put together (Blömstrom and Kokko, 1998, and Markusen and Maskus, forthcoming). This literature points to four main effects: an entry effect, competition, knowledge spillovers and linkage effects.

All these conduits are close cousins of the trade-related channels. The first is the FDI counterpart of the turnover argument. The idea is that the entry of world-class competitors raises the average productivity of industry. One can also draw a parallel between the pro-competitive effect and the import discipline hypotheses. As in the case of trade, FDI is expected to improve firm management, raise scale efficiency and provide more incentives to innovation. Once again, though, solid theoretical foundations do not match the intuition behind this hypothesis. The entry of large multinational firms in limited domestic markets raises the possibility of collusion, which makes the results even more difficult to pin down.

Knowledge spillovers and linkage effects are the channels more likely to have long-term implications for productivity growth, since they might improve the firms' ability to innovate. FDI knowledge spillovers are said to take place when local firms increase their productivity by copying the technology of affiliates of foreign firms. Although widely believed to be an important source of technology diffusion, particularly to developing countries, it also has its limitations. First, there is the issue of absorptive capacity. Without a qualified workforce or investments in R&D, spillovers from FDI are unlikely (Saggi, 2000). And second, given the foreign firms' strong interest in protecting their competitive edge and, therefore, in minimizing

[1] For a review of this literature, see Tybout (2000 and forthcoming).

Box 11.1 Externalities and Linkages

Economists define externalities as actions by firms (or individuals) that affect other firms (or individuals), but are not reflected in their costs and benefits. Externalities can be transmitted by market transactions or bypass the market altogether. The former is called pecuniary externalities and can be found, for example, when the investment made by an automobile company generates enough demand for the development of an auto parts industry. Among those that bypass the market, the so-called technology externalities (Scitovsky, 1963) stand out. A good example is the hiring of highly trained workers of a foreign firm by its local competitor.

Thanks to the work of Hirschman (1958), externalities (pecuniary or not) transmitted across the production chain also became known as linkages. They are said to be "backward" when producers generate positive externalities to suppliers, and "forward" when suppliers generate positive externalities to producers. In the automobile company example given above, the firm's demand for auto parts is seen as part of its backward linkages.

technology transfer, spillovers are more likely to be "vertical" (among their clients and suppliers) than "horizontal" (among their competitors) (Kugler, 2000).

Finally, the rationale behind the linkage effects is similar to the input availability channel discussed in the "new growth" theories, but the transmission mechanism is more complex. The argument relies on the concept of pecuniary externalities (see Box 11.1). FDI is believed to generate positive pecuniary externalities to local firms by improving the local supply (quality and variety) of intermediate goods (Markusen and Venables, 1999). This happens both directly through investment in these industries (forward linkages), or indirectly through investment in final (consumer) goods, which could create enough demand and technology spillovers for the establishment of intermediate industries (backward linkages).

What Does Regional Integration Specifically Bring to Productivity?

The preferential character of regional integration adds some specificity to the way trade and FDI channels operate. This is particularly important for trade-related linkages, where there are two major issues worth considering: comparative advantage and the scale effects. On the FDI side, the changes are mainly related to the level and type of flows, and since the impact on productivity is at best indirect, these changes are discussed elsewhere in this report (Chapter 10).

Comparative advantage. When integration is regional, the traditional comparative advantage gains from trade are no longer assured. To understand why, one has to come to terms with the concepts of trade creation and diversion discussed in Chapter 3. Trade creation generates exactly the same gains experienced by a country that opens up unilaterally. So there is nothing specific about it. Trade diversion, though, reduces productivity and is very specific to regional agreements, since it can only arise because of preferences given to partner countries. This productivity loss arises because the importer country is not buying from the most efficient suppliers and the exporter country is moving away from its comparative advantage. True, this loss might be compensated, as discussed below, by scale gains generated by these very same preferences. As far as comparative advantage is concerned, though, the impact of trade diversion is negative, and, accordingly, the overall productivity impact of regional integration is ambiguous, depending on the balance between trade creation and diversion. Venables (1999) gives more nuances to the trade diversion story by arguing that this type of loss is more likely in South-South (e.g., Andean Community) agreements than in North-South (e.g., NAFTA) ones because, inter alia, the North concentrates the most efficient producers of the goods most likely to be imported by the South (see Chapter 3).

Scale. In contrast to comparative advantage effects, the specificities of regional integration regarding scale are not so clear-cut. What is readily evident is that the potential gains from scale are much higher in the context of non-preferential worldwide integration than in a regional setting. The former offers the world, the latter only a region of this world. This, though, is just one part of the story. The other part lies in the uncertainty of these scale gains. There is always the threat of increasing returns industries being dislocated by imports, the more so for a developing country whose domestic market is limited and whose firms, as a consequence, face size disadvantages. These scale losses might also have long-term negative implications for productivity growth. The smaller the markets, the lower the financial viability of R&D activities. What a firm can learn depends not only on the volume of output produced at each point in time (so-called static economies), but also on the cumulative output across time (so-called dynamic economies, along the lines of the learning-by-doing story examined earlier).

One can argue, then, that regional integration involving a smaller number of partners lowers the risk of damaging dislocations, while at the same time boosting the (static and dynamic) scale advantages of the member countries vis-à-vis the rest of the world either through trade creation or diversion (Devlin and Ffrench-Davis, 1999).[2] This might be particularly relevant for South-South integration, where the difference in market size among member countries tends to be smaller and the size disadvantages with respect to the rest of the world more pressing. The flip side of South-South agreements, though, is that small differences in size might be especially damaging for the smaller and poorer members. In the absence of institutional safeguards, the combination of scale disadvantages and agglomeration economies (i.e., the advantages that arise when firms locate close to each other) might concentrate the more productive industries in the larger partners (Venables, 1999). In North-South agreements, this risk would be mitigated by the differences in input costs such as that of labor, which tends to favor the smaller and poorer countries. Moreover, one can also argue that Southern countries have more to "learn" in North-South agreements (i.e., the potential knowledge spillovers through trade and FDI would be higher), given that the stock of knowledge is concentrated in the North.

The Evidence on Regional Integration

Looking first at the macro, economy-wide level, the results for the 1990s—the decade when virtually all of Latin America embraced integration—are not very encouraging. True, there has been no effort to establish any causality between integration and productivity. Yet, the examples that exist suggest that for most countries, what few integration-related gains that occurred were not strong enough to offset other negative influences such as the region's extreme macroeconomic volatility.

The IDB (2001) found that Latin America's total factor productivity (TFP) (see Box 11.2) fell by 0.6 percent a year in the 1990s, with only six of 22 countries showing TFP growth.[3] The report attributes these results mainly to the region's poor educational levels (low absorptive capacity) and fragile public institutions (poor incentives to develop and assimilate new technologies). Baier, Dwyer Jr. and Tamura's (2002) results are even more disappointing, with TFP in the region dropping by approximately 2.9 percent a year. Fajnzylber and Lederman (1999) somehow buck the trend, reporting 1.1 percent TFP growth for Latin America during 1990-95. However, their analysis does not cover the whole decade and they do not take into account changes in human capital (basically education), which can drastically reduce the TFP "residual."

Looking at the sectoral level and more specifically at manufacturing—the most protected sector during the import substitution years—the picture is not so gloomy. Figure 11.1 shows that labor productivity in the region's largest countries grew substantially during the 1990s, particularly in Argentina, Brazil and Mexico. These three countries outperformed the United States (though not Korea) by a large margin, suggesting a reduction in the productivity gap vis-à-vis the country considered to have the best practices in technology. Although impressive, this evidence has some important pitfalls. First, since labor productivity does not take into account all the inputs used in production,

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[2] One could also argue that regionalism, by formally guaranteeing market access among member countries, reduces the uncertainty that might restrict the scale (or enlarged market) gains (see Chapter 3).

[3] They were Chile, Argentina, Uruguay, the Dominican Republic, Peru and Barbados.

Box 11.2 How to Measure Productivity?

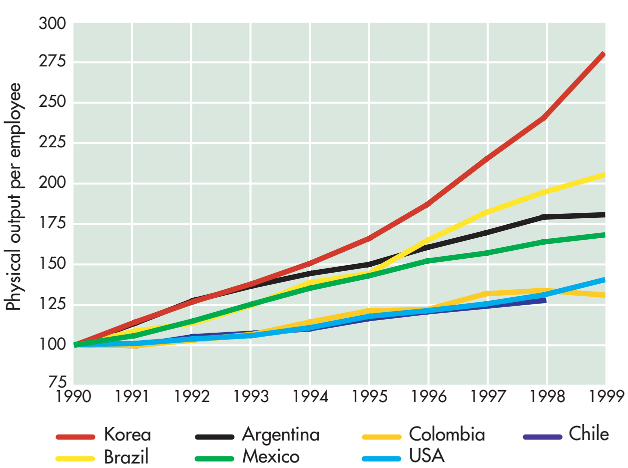
Productivity looks at first sight to be a very simple concept: the ratio of output to input. Yet it is not that simple, since this concept admits different measurements. The most intuitive and widely used is what is called labor productivity, i.e., output divided by the number of workers. It does not take a high level of sophistication to see that this is only a partial measure—all the other inputs used in production, such as machinery and raw material, are not accounted for. This can lead to misinterpretations, such as labor productivity growth being read as improvements in technology, when it is not more than the result of an increase in the number of machines (capital stock) per worker.

Given this drawback, economists came up with the notion of total factor productivity (TFP), which is defined as the ratio of output to all inputs combined. Most TFP analysis focuses on how it changes over time and uses the "production function" approach pioneered by Solow (1956). In this approach, TFP growth is measured by the residual growth rate not explained by inputs. For example, assume that a firm's output has grown 3 percent a year in the last five years. Its capital stock also grew at about the same rate, whereas the number of employees grew at only 1 percent per year. Assuming that this firm uses only these two inputs and that their share of total output is, respectively, one-third and two-thirds, input contribution to output growth would be 1.7 percent a year (one-third x 1 percent plus two-thirds x 3 percent). So, the TFP contribution would be 1.3 percent per year, which is the difference between output (3 percent) and input growth (1.7 percent).

This so-called Solow residual is supposed to measure the impact of technical and organizational innovations that happen within firms (industries or countries). In practice, though, due to difficulties in measuring the flow of inputs, particularly capital stock, and in estimating the firms' technology (production function), this residual ends up capturing other unwanted contributions. This problem prompted one economist to argue that this residual is a "measure of our ignorance" (Abramovitz, 1956). Despite the difficulties, TFP is the profession's best available tool to measure productivity changes.

Figure 11.1 Labor Productivity in Manufacturing in Selected Latin American Countries, Korea and the United States

(Index)



Source: Country Statistical Offices.

it gives only a partial view of what actually happened in terms of technology. Second, this data only cover a handful of countries in the region. Finally, as with the macro-evidence, the evidence tells little about the causal relationship between integration, regional or otherwise, and productivity.

Studies based on firm-level data have made progress in addressing the first and the last of these problems (Tybout, forthcoming). The number of countries studied, though, is still limited. For instance, studies on Mexico, Brazil and Chile report positive rates of TFP growth in manufacturing. For Mexico, Tybout and Westbrook (1995), covering the first period of trade liberalization (1986-90), put TFP annual growth at 1.8 percent. Calculations in this chapter (see next section) put the same figure for the NAFTA period (1993-99) at 1.1 percent. Muendler (2002) estimates 0.8 percent of TFP annual growth for Brazil over 1992-98, which covers most of the country's trade liberalization period, while this chapter finds annual increases of 5.2 percent for the second half of the 1990s. Finally, Pavcnik (2000) estimates 2.8 percent in TFP annual growth for Chile following the country's radical trade reforms (1979-86). To give some perspective to this story, similar plant-level studies on East Asia point to 3 percent or higher TFP growth after liberalization. Aw, Chen and Roberts (2001) speak of 3.2 percent annual TFP growth in Taiwan in the 1981-91 period.

On the issue of how much of this TFP growth can be ascribed to trade liberalization, most of these studies concentrate on the trade channel and more specifically on the import discipline, scale and turnover hypotheses. Pavcnik (2000), Fernandes (2001), Tybout and Westbrook (1995) and Muendler (2002) find evidence of a strong import discipline effect in, respectively, Chile (1979-86), Colombia (1977-1991), Mexico (1986-90) and Brazil (1986-98). There is little evidence of important turnover or scale-related gains. Nonetheless, Pavcnik's (2000) estimates suggest that import discipline would have been dwarfed by the turnover effect, and Muendler (2002) finds that the elimination of trade barriers increases the likelihood that low-efficiency firms will shut down, which in the long run would have a positive impact on aggregate productivity.

Evidence is more limited on the other trade effects, particularly those that are believed to impact not only the level but also the rate of productivity growth. On the availability of world-class inputs and related technology acquisition effects, Muendler (2002) finds a positive but relatively unimportant impact on productivity in Brazil. Yet, Alvarez and Robertson (2000), working with plant-level data from Chile and Mexico, detect a significant and positive relationship between importing intermediate inputs and innovation in the latter country.[4]

Evidence based on country and sectoral level data also point to a positive input effect. Blyde (2002) finds that technological spillovers diffused through imported machinery have a positive impact on productivity. Estimates by Schiff, Wan and Olarreaga (2002) point to North-South and South-South technological spillovers, diffused through imports. North-South spillovers would be higher and would affect mainly R&D intensive industries, whereas South-South spillovers would be relevant mostly to other types of industries.

The acquisition of knowledge through exports is also the subject of a few studies, although the evidence is mixed. Clerides, Lach and Tybout (1998) found no evidence of learning-by-exporting on plant level data for Colombia (1981-91) and Mexico (1984-90). Results from Alvarez and Robertson (2000), however, point to a strong link between exporting and investment in innovation in both Mexico (1993-95) and Chile (1993-95). The World Bank (2000), based on plant-level data for Mexico over 1990-1998, found suggestive signs of learning-by-exporting.

Finally, the (scarce) evidence on the FDI channel tends to support the prevalence of vertical (inter-industry) over horizontal (intra-industry) spillovers and to highlight the importance of countries' absorptive capacity.[5] Aitken and Harrison (1999) find that foreign equity participation raises plant productivity in Venezuela (1976-89), but also that horizontal spillovers are negative. Likewise, Kugler (2000) reports limited horizontal spillovers for Colombian manufacturing plants over 1974-98, but finds evidence of "widespread inter-industry spillovers from FDI." Results from Kugler (2000) as well as Kokko, Tansini and Zejan (1996) support the relevance of absorptive capacity. The former shows that the absorptive capacity of local firms lagged behind that of foreign firms, which, in turn, would explain the prevalence of vertical (generic knowledge) over horizontal (specific knowledge) spillovers in Colombia. The latter find evidence that horizontal spillovers among Uruguayan plants (1988) were virtually non-existent, except for a small group of firms whose technological gap vis-à-vis foreign plants was relatively small.

Integration and Productivity in Brazil and Mexico

Whether through the trade or FDI channels, the evidence on how integration might affect productivity seems to make up only part of a story that, while generally consistent with what the theorists say, still lacks some main chapters. When it comes to the more reliable microeconomic, plant-level analysis, coverage of

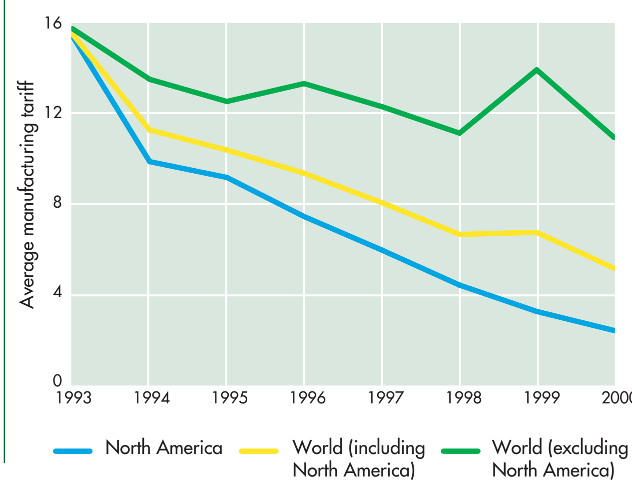
[4] They were unable to test the link between imported inputs and innovation in Chile due to data limitations.

[5] For a general review that includes studies from other regions, see Blomström, Kokko and Zejan (2000).

the countries in the region is still very limited, just as is discussion about the long-term growth effects of integration on productivity. One of the key missing chapters of this story seems to be the specific effects of regional integration.

The dearth of evidence on regional integration is understandable, since most of the efforts to study it are relatively new. To deal properly with this issue, one must confront two challenges: first, to distinguish between the competing forces that affect a country's productivity; and, second, to differentiate between preferential and non-preferential integration. The discussion that follows provides some initial evidence of how integration in the Americas has affected productivity, with a focus on Brazil and Mexico during the 1990s.

Figure 11.2 Average Manufacturing Tariff, Mexico, 1993-2000
(In percent)



Source: López Córdova (2002).

Changes in Trade and Investment Policies

Both Brazil and Mexico moved towards integration after at least half a century of import-substitution policies. These policies—an arsenal of tariffs, quotas, import licenses, multiple exchange rates, FDI regulations and soft loans—were effective in promoting growth and in pushing their economies through a substantial structural change. Yet, by the late 1970s there were clear signs that the model was no longer sustainable. Productivity after an initial period of high growth set into a downward trend and by the early 1980s was clearly stagnated (see Bacha and Bonelli, 2001, on Brazil, and World Bank, 1998, on Mexico). This slowdown, compounded by macroeconomic mismanagement, eventually lead to the collapse of the old regime amid the debt crisis of the 1980s. The countries' response to that technological and economic stagnation was integration into the world markets.

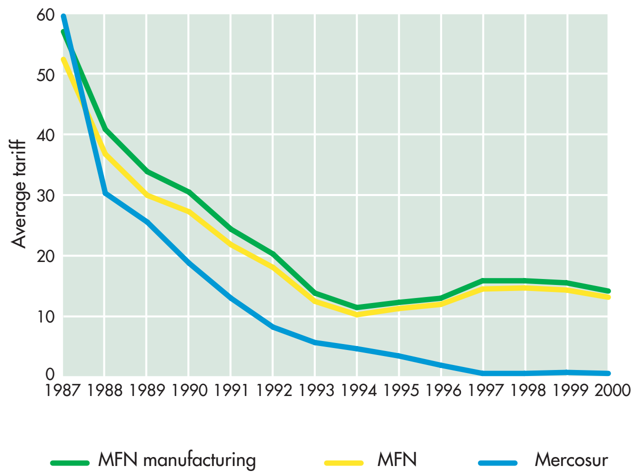
Mexico moved first and faster, and by the early 1990s had already made substantial progress. Tariffs on a most favored nation (MFN) basis fell from 28.5 percent in 1985 (the first year of trade liberalization) to 11.4 percent in 1993, while only 192 tariff lines were subject to import licenses—in contrast to 1982, when all imports were subject to them.[6] In manufacturing, tariffs fell from around 30 percent in 1985 to 15.5 percent in 1993, although in general they were less subject to import licensing requirements. From 1994 on, as a result of NAFTA, these tariffs declined even further and more rapidly. While in 1993 only around 15 percent of imports from the United States were subject to tariffs under 10 percent, in 1994 that figure reached 60 percent. By the year 2000, less than 1 percent of manufacturing imports faced duties of 10 percent or higher. As a result, Mexico's average tariff on manufacturing imports from the world was only 5 percent in 2000 (Figure 11.2). Some industries such as textiles and apparel saw MFN tariffs increase during the 1990s. The share of Mexico's trade subject to MFN tariffs has declined, however, since the country has established a network of free trade agreements in the Americas and with European nations. Trade liberalization was accompanied by FDI deregulation, also deepened by NAFTA, which led to the removal of most sectoral restrictions and approval and performance requirements.[7]

Brazil, by contrast, took longer to open up. The removal of nontariff barriers and a drastic drop in tariffs had to wait until 1990. The average for MFN tariffs fell from 52 percent in 1987 to 9.9 percent in 1994 and edged up to 12.9 percent by 2000, reflect-

[6] See Ten Kate (1992) and López Córdova (2001).

[7] See Dussel Peters, Paliza and Diaz (2002).

Figure 11.3 Average MFN and Mercosur Tariff, Brazil, 1987-2000
(In percent)



Source: For MFN, Kume, Piani and Bráz de Souza. (2000) and Receita Federal. For Mercosur, Estevadeordal, Goto and Saez (2000) and Receita Federal.

ing Brazil's response to the 1995 Mexican crisis.[8] Tariffs on manufacturing followed a similar trend, with the average dropping from 57 percent in 1987 to 11 percent in 1994 and rising marginally to 13.9 percent by 2000. As in Mexico, trade liberalization was deepened by a regional trade agreement, Mercosur, and was associated with deregulation on FDI. The former brought the intra-regional average tariff from 59.5 percent in 1987 (one year after the first Brazil-Argentina agreement) to close to zero in 2000 (Figure 11.3), and the latter extended national treatment to foreign firms except for a few sectors (such as investments in communications services).

These policy changes had a profound impact on trade and investment flows in both countries. In Mexico, both imports and exports boomed. Total imports grew on average by 16.3 percent a year during 1985-2000, followed closely by exports, which reached an average growth of 14.2 percent a year. Manufacturing exports and intra-regional (NAFTA) trade were the key factors behind the export take-off. The share of manufactured goods in total exports rose from 27 percent in 1985 to 83 percent in 2000, whereas NAFTA's share of total Mexican trade went from 78 to 83 percent (and the share of total exports from 80 to 91 percent) during the same period.[9] There was also rapid growth in FDI, with average flows increasing from \$2.6 billion over 1980-88 to \$5.7 billion over 1989-93. During the initial NAFTA period (1994-2000), FDI flows received another boost, reaching an average of \$14.5 billion (see Chapter 10).[10]

In Brazil, the trade boom was mainly restricted to imports, which increased on average by 13.8 percent a year in the post-liberalization period from 1990-2000. Exports also grew, but at the much more modest rate of 5.8 percent. The changes in the export composition were also modest, with manufacturing exports increasing their share of total exports from 54 to 58 percent over the same period. Exports to Mercosur, though, proved to be more dynamic, increasing at 16.8 percent a year, which raised the regional agreement's share of total exports from 5.6 percent in 1990 to 14 percent in 2000 (and from 6 to 20 percent in the case of manufacturing exports). The share of Mercosur in Brazil's total trade followed a similar trend, jumping from 7 to 14 percent over the same period.[11] FDI flows also responded to the new regime, but only after inflation was controlled in the second half of the 1990s.[12] Average flows, which were close to \$1.3 billion over 1980-94, climbed to \$19.3 billion over 1995-2000.

Figure 11.4 presents a good picture of what all these changes in trade flows meant for manufacturing in the two economies. There are three issues worth noting. First, the two countries were in distinctly different positions when they moved into trade liberalization. In the first year of Mexico's trade reforms, 1985, the import penetration ratio in manufacturing was 9.3 percent (Weiss, 1999, not shown in the figure), whereas in Brazil, in an equivalent year (1989), the same figure was 4.9 percent. In other words, Brazil went much further down the import-substitution road. Second, import penetration increased substantially in both countries, but the "openness gap" remained consider-

[8] See Kume, Piani and Bráz de Souza (2000).

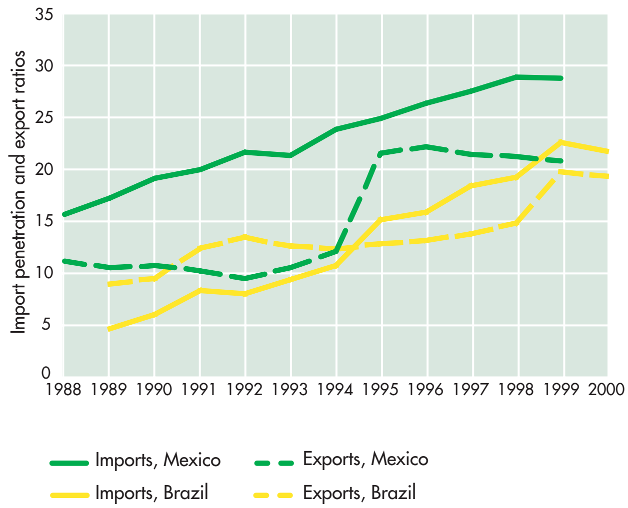
[9] Mexican trade data is from Banco de México (www.banxico.org.mx). Unless otherwise stated, figure includes maquiladora (in-bond assembly) trade.

[10] Due to methodological changes, pre- and post-NAFTA figures are not strictly comparable. See Dussel Peters, Paliza and Diaz (2002).

[11] Brazilian trade data is from Secex (www.mdic.gov.br).

[12] See Pinheiro, Giambiagi and Moreira (2001).

Figure 11.4 **Brazilian and Mexican Import Penetration and Export Ratios in Manufacturing, 1988-2000**
(In percent)



Note: Import penetration is imports divided by domestic consumption. Export ratio is exports divided by output. Data for Mexico do not include maquiladoras.
Source: IDB calculations based on IBGE and INEGI manufacturing surveys.

able and in favor of Mexico. And third, export ratios (excluding Mexico's maquiladora exports) also showed an upward, if more volatile, trend in both countries, but the gap between them was and remained much smaller than that of import penetration, despite the differences in export performance.[13]

Productivity Performance

In light of this substantial opening of the Brazilian and Mexican economies, one should expect to find a measurable impact on economic efficiency in the two countries. The importance of this impact, though, would likely vary in each country given the differences, inter alia, in the macroeconomic environment, initial openness, depth and scope of the reforms, and the regional integration strategy. Some of these issues are particularly relevant. For instance, as mentioned before, Mexico was considerably more open than Brazil when the new trade policy was put in place. One could argue, therefore, that Brazil stood to gain relatively more from opening up than Mexico. Accordingly, productivity might have grown faster in Brazil than in Mexico in the first years of the reforms.

On the other hand, on the issue of the depth and scope of reforms, there is little doubt, judging by the level of tariffs and trade indicators, that Mexico was much more aggressive in pursuing trade-related gains than Brazil. The option for a North-South regional integration agreement can be seen as part of this aggressiveness. By linking up with the United States and Canada, given the differences in size and resources involved, Mexico got much closer to achieving free trade at a multilateral level than Brazil with Mercosur. Involving countries of limited size and similar resources, Mercosur was bound to offer more limited trade-related productivity gains (or costs), at least when seen as an end in itself. So, if one believes that integration gains tend to outweigh costs, a reasonable premise would be that Mexico would have better performance in terms of productivity, or at least would reap more trade-related gains, than Brazil.

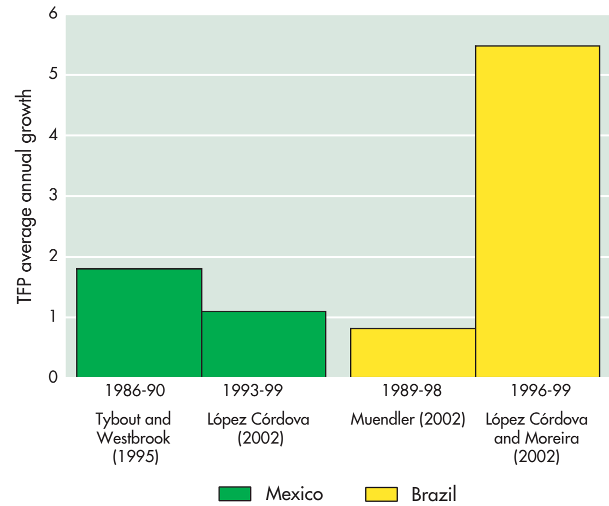
In order to ascertain such possibilities, one first needs to gauge the behavior of productivity in the two economies. To this end, the following discussion relies on micro-data for the Brazilian and Mexican manufacturing sectors. (Appendix 11.1 provides a description of the methodology used herein).[14]

Figure 11.5 presents aggregate indices of total factor productivity (TFP) for Brazilian and Mexican manufacturing during their respective periods of trade liberalization. Two estimates with similar firm-level methodologies covering different periods are included for each of the two countries: for Brazil, Muendler (2002), which covers most of the liberalization period (1989-98), and this chapter's estimates, which refer to the second half of the 1990s (1996-99); and for Mexico, Tybout and Westbrook (1995), which cover Mexico's non-preferential liberalization (1986-90), and this chapter's estimates, which focus on the NAFTA period. Keeping in mind that this comparison should be taken with some caution, given that the

[13] Manufacturing exports (defined as SITC 5 to 8, except for 68) grew at an average rate of 22 percent a year in Mexico and 5.4 percent a year in Brazil over 1990-2000.

[14] For Brazil, we use firm-level data, whereas for Mexico we rely on plant-level data. The text employs the term "firm" indistinctly. The sample of Mexican plants used in this estimation does not include maquiladora (in-bond assembly) plants. Productivity figures for Brazil come from López Córdova and Moreira (2002), and for Mexico from López Córdova (2002).

Figure 11.5 Total Factor Productivity Average Annual Growth in Manufacturing, Post-Trade Liberalization: Brazil and Mexico
(In percent)



Source: Country Statistical Offices.

methodologies are similar but not exactly the same, the results suggest that productivity growth in Mexico was higher during the first, non-preferential period than in the regional period. One possible explanation would be that the policy changes were more radical in the first period and, therefore, most of the level effects occurred during this time. A second possibility would be that there were factors other than trade policy, such as the 1994-95 peso crisis, that might have affected the periods differently.

For Brazil, the 1989-98 estimate suggests that productivity growth was positive but significantly lower than that of Mexico in both periods, which might be seen as supporting the aggressiveness argument raised above. Yet, the estimates for the second half of the decade support the initial conditions argument, showing impressive productivity growth that outstrips that of Mexico's NAFTA period and would be considered high even by the East Asian standard of 3 percent or more of TFP growth. Given that the most radical changes in trade policy, including Mercosur, took place in the first half of the decade, this might imply that stagflation, which prevailed for most of the first half of the decade, would have been a major drag on Brazil's productivity, particularly on trade-related productivity gains. This also underlines the difficulty in looking at the impact of integration without controlling for other relevant factors at play.

Before moving into a more careful attempt to uncover the trade-productivity links in these two countries, it is worth looking behind these aggregate figures to get a sense of, first, how trade orientation correlates with productivity growth among manufacturing industries and, second, what was the relative importance of intra-firm vis-à-vis intra- and inter-industry gains.

TFP by trade orientation. Figures 11.6a and b, relying just on this chapter's estimates, show that there were wide differences in productivity performance among manufacturing industries. Trade policy, to the extent that it treats industries differently, might be one of the key factors behind this variation. As a first approximation to evaluating such a possibility, Figures 11.7a and b distinguish TFP performance according to industry or plant characteristics. Leaving plant characteristics aside, one would expect to find that, in the context of a more liberal trade regime, those industries that are more exposed to competition from imported goods or that participate more actively in foreign markets would perform better than industries where little trade takes place.

Figures 11.7a and b offer some support to the view that import discipline is an important force behind productivity improvements.[15] Productivity growth among Brazilian import-competing industries was higher than in the manufacturing sector as a whole, reaching 7.2 percent a year over 1996-99. The performance of industries that compete with Mercosur imports was also above average, but was not as impressive as that of the import-competing industries in general. In Mexico, import-competing industries were also the top performers, with annual productivity growth of 4.2 percent over 1993-99. They were followed closely by industries that compete with North American imports. Exporting industries in both countries experienced more modest productivity growth of 4.3 percent a year (Brazil) and 1.6 percent (Mexico).

[15] Import-competing and exporting industries are defined as those in which import penetration or the ratio of exports to output, respectively, are above the median for the manufacturing sector as a whole. Non-traded industries are those that are neither import-competing nor exporting.

Figure 11.6a Brazil: Annual Total Factor Productivity Growth, 1996-99
(In percent)

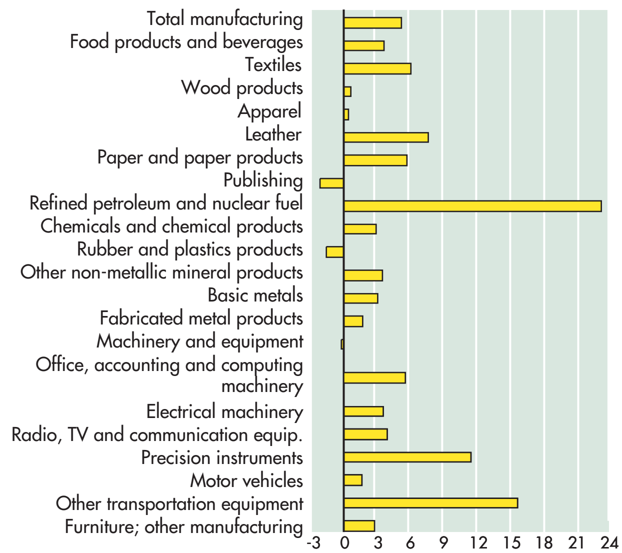
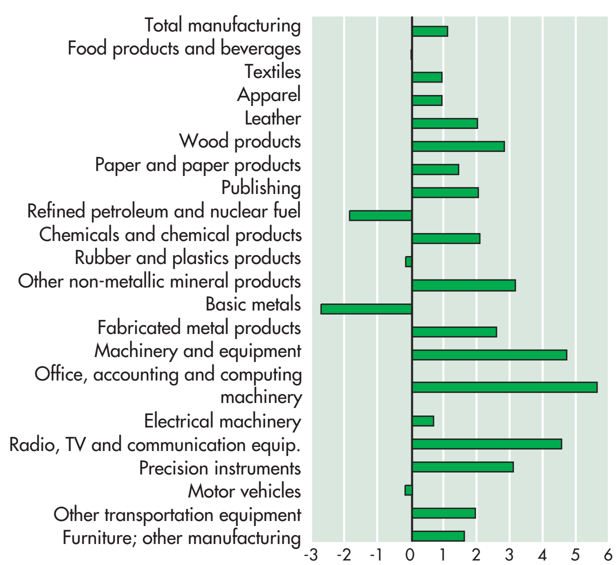


Figure 11.6b Mexico: Annual Total Factor Productivity Growth, 1996-99
(In percent)



Source: López Córdova and Moreira (2002).

However, whereas in Brazil exporting industries grew below the manufacturing average, particularly those exporting to Mercosur, this was not the case in Mexico, where regional and international exporting industries performed at or above average.

The lower relative growth rate of exporting industries in both countries could be explained by the possibility that, in order to participate in foreign markets successfully, producers must show a degree of efficiency, leaving less room for additional productivity improvements. The relatively better performance of exporting industries in Mexico, though, might reflect the post-NAFTA export boom, something that Brazil could not replicate with Mercosur. But, perhaps, the more telling contrast in Figures 11.7a and b is the poor performance in both countries of industries with few trade links.

Intra-firm versus reallocation gains. Another way of looking behind the aggregate figures is to decompose annual changes in TFP into three effects: intra-firm gains (i.e., variations in productivity that occurred inside the firms resulting from technological and managerial innovations); intra-industry reallocation or turnover, reflecting changes in market share between low and high productivity firms within the same industry; and inter-industry reallocation, measuring changes in TFP brought about by shifts in the composition of manufacturing output (e.g., the share of the car industry rises whereas that of textiles falls). The details of this decomposition are in Appendix 11.1.

The results in Figures 11.8a and b show that reallocation effects in both countries, particularly across industries, were a major force behind productivity growth. In Brazil, reallocation accounted for 51 percent of total productivity growth, with reallocation across industries explaining 63 percent of total reallocation gains. In Mexico, the importance of these effects was even more pronounced and was the overwhelming factor behind TFP growth. As in Brazil, shifts in the composition of manufacturing output accounted for the lion's share of the reallocation gains. Although one cannot attribute these changes directly to trade on the basis of this evidence alone, it does clearly suggest, first, that trade might have played a role in the replacement of low productivity firms by higher productivity ones. Second, as indicated by the inter-industry reallocations gains—particularly important in industries

Figure 11.7a Brazil: Annual Total Factor Productivity Growth, by Industry or Plant Characteristics, 1996-99
(In percent)

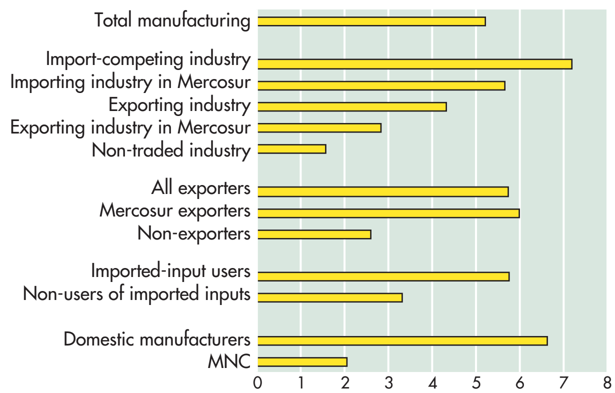


Figure 11.8a Brazil: Productivity Decomposition
(In percentage share)

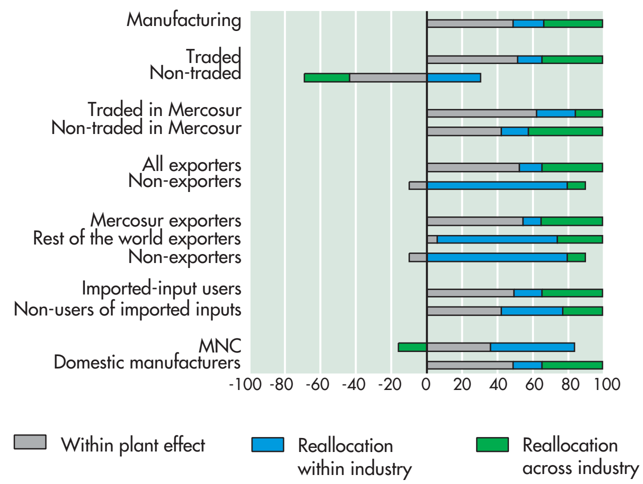
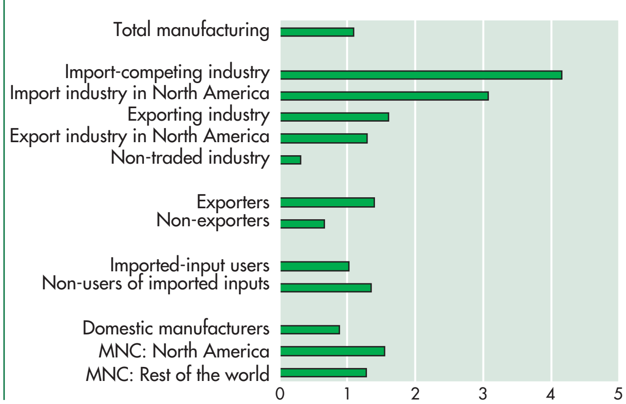
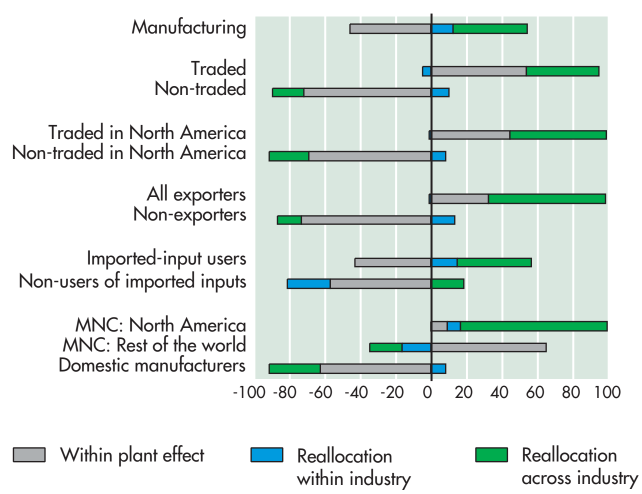


Figure 11.7b Mexico: Annual Total Factor Productivity Growth, by Industry or Plant Characteristics, 1996-99
(In percent)



Source: López Córdova and Moreira (2002).

Figure 11.8b Mexico: Productivity Decomposition
(In percentage share)



Source: López Córdova and Moreira (2002).

more exposed to trade (traded industries)—the dislocation of increasing return or knowledge producing industries by imports might not have been significant, or, at least, not significant enough to offset comparative advantage and scale gains.

When industries are grouped by trade orientation, what stands out is that in both countries, traded industries accounted for almost all TFP growth and intra-firm gains. This exercise also hints at the relative importance of the regional agreements for both countries. Although it is extremely difficult to disentangle regional from extra-regional effects, NAFTA seems to have played a major role for Mexico, explaining virtually all TFP and intra-firm improvements, whereas Mer-

Table 11.1 Firm Productivity and Integration in Brazil and Mexico: Summary of Econometric Evidence

Channel	Brazil		Mexico	
	TFP level	TFP growth	TFP level	TFP growth
Competition from imports				
Tariff elimination	na	Positive	Positive	Positive
Import penetration	na	Positive	Positive	Positive
Foreign direct investment				
Foreign ownership of firm	Positive		Positive	
Spillovers				
Intra-industry	0	0	Negative	0
Through backward linkages	Positive	0	Positive	Positive
Through forward linkages	Negative	Negative	Positive	Positive
Net effect	0	0	Positive	Positive
Exporting activity				
Exporter status	na	0	na	Negative
Exports/sales	na	Positive	na	0
Mercosur exports/sales	na	0	na	na
Preferential access to U.S. market	na	na	Positive	0
Imported inputs	Negative	0 or positive	Positive	Negative

Note: See Appendix 11.1 for details of these estimations.
Sources: Muendler (2002), López Córdova and Moreira (2002), and López Córdova (2002).

cosur seems to have played a more subsidiary role for Brazil (33 percent of total TFP growth).[16]

Integration and Productivity Links

While Figures 11.7 and 11.8 are highly suggestive of positive links between trade liberalization and productivity growth, one cannot yet conclude that trade policy, or trade itself, was behind the contrasting industry performance or the intra-firm or intra- and inter-industry gains. Indeed, establishing such a link proves rather challenging, since a number of events affected the economies of the two countries during the same period, from the devaluation of the Mexican peso in December 1994 and the Brazilian real in 1999, to rapid U.S. productivity growth and the Asian financial crisis in the second half of the decade. In order to provide more conclusive indications of whether trade liberalization, either regionally or otherwise, has had a positive impact on productivity, the following discussion relies on econometric evidence. This evidence seeks to isolate trade and FDI from the other forces that influence manufacturing efficiency. Some of these forces are specific to a firm, such as its age and size, while others reflect industry-wide characteristics and macroeconomic conditions that are external to the firm. The latter include, inter alia, industrial output concentration (either across firms or regions), exchange rate fluctuations that affect external supply and demand, and changes in domestic consumption over the business cycle. Appendix 11.1 describes the econometric approach.

Import discipline. Table 11.1 summarizes the main results of the econometric exercise used for analyzing trade liberalization in Brazil and Mexico. A first finding is that heightened competition from foreign goods resulting from the elimination of import duties has had a substantial and positive impact on productive efficiency. For Brazil, Muendler (2002) analyzes trade policy during 1986-98 and finds that tariffs are inversely correlated with TFP change in a large sample

[16] Industries traded in Mercosur and NAFTA were defined as those whose import-penetration and export ratio were in the fourth quartile of their distribution. Although this definition ensures that the regional markets are important for those industries, it does not eliminate overlapping with industries traded in extra-regional markets.

of manufacturing firms. Although the author focuses on Brazil's unilateral trade liberalization, his period of analysis coincides with the creation of Mercosur. He concludes that a 10-point reduction in tariffs would have increased TFP (in logarithms) by 2.8 percent. Moreover, he finds that import penetration explains a good deal of the increase in TFP growth.

Similarly, the experience of Mexico from 1993 to 1999 confirms that tariffs negatively impact both the level and the growth rate of productivity. Since tariffs on the rest of the world also affect productivity, one should consider total Mexican duties and not simply those applied on North American goods.[17] Nevertheless, the previous discussion suggests that NAFTA has been, by far, the main factor behind tariff changes in Mexico during the 1990s. Quantitatively, as the estimates in Appendix 11.1 suggest, the 10-point reduction in import duties over 1993-99 would account for an increase of between 5 to 9 percent in total factor productivity. Since productivity grew by around 7 percent during the period, the estimates suggest that tariff cuts during NAFTA's first six years contributed significantly to the sector's average growth, offsetting other forces that affected productivity negatively during the 1990s. In addition, the elimination of Mexican tariffs also had a positive impact on productivity growth, with a 10-point reduction in import duties increasing the growth rate by 10.5 to 13 percent. Greater presence of foreign goods in the Mexican market, as measured by the ratio of imports to output, also had a substantial impact on productivity.

Scale and learning by exports. As argued earlier, global and regional integration may also be conducive to enhanced efficiency through economies of scale and learning associated with improved export opportunities in the expanded market. Both Brazil and Mexico saw the proportion of manufacturing firms that participate in world markets increase during the 1990s: from 39 percent in 1996 to 44 percent in 1999 in Brazil, and from 28 to 43 percent in Mexico over 1993-99.[18] At the same time, the proportion of exports as a proportion of firm output in the two countries rose from 11.6 to 16.9 percent in Brazil over 1996-99 and from 14.6 percent in 1993 to 27.6 percent in 1999 in Mexico. In Brazil, the proportion of firms exporting to other Mercosur countries increased in tandem, from 28 to 32 percent. Although the data available for Mexico do not contain information on where exports went, there is some indication that the preferential margin on Mexican products entering the U.S. market that resulted from NAFTA's tariff phase-out has increased the probability that a manufacturing plant becomes an exporter.[19]

Has export activity induced higher productivity among Brazilian and Mexican manufacturers? As Figures 11.7a and b illustrate, exporters in both countries seem to have experienced more rapid productivity growth than non-exporters. In Brazil, Mercosur exporters experienced even faster TFP growth. The following discussion considers whether such results hold under the more rigorous econometric analysis described in Appendix 11.1.

Consider first the case of NAFTA. An increase in the preferential margin enjoyed by Mexican exporters in the U.S. market over their competitors from the rest of the world suggests that NAFTA would have created export opportunities for Mexican producers that, in turn, would have translated into more rapid productivity growth. Another possibility, though, is that the preferential access to the U.S. market would have lessened the incentives for Mexican manufacturers to improve their efficiency. The econometric results show, however, that an increase in the tariff margin in favor of Mexican goods in the U.S. market is positively associated with an increase in productivity. A 1 point increase in the tariff preference granted to Mexican producers yields a 0.5 percent increase in productivity (see Appendix Table11.2).

That conclusion differs from findings by other authors that fail to find a causal link between exporting and productivity growth, and which argue that, instead, high productivity plants are what make inroads into foreign markets. To further explore this issue, one may ask whether productivity growth among

[17] Total Mexican duties are calculated as the trade-weighted average of preferential and non-preferential rates.

[18] These percentages refer to the proportion of exporters in a sample of manufacturing firms in Brazil and Mexico, which are biased toward medium-sized to large firms. The corresponding figures for all manufacturing firms would be smaller.

[19] The latter stems from an econometric exercise that estimates the probability that a plant is an exporter. The preferential margin in the U.S. market on Mexican goods is positively correlated with the probability of exporting.

exporters is higher than in non-exporting firms in Brazil and Mexico.[20] The evidence in this regard is ambiguous.[21] TFP growth among Brazilian manufacturers seems to be positively correlated to the ratio of exports to sales, with a 1 percent increase in the ratio of exports to sales increasing annual productivity growth by around 0.1 percent. In contrast to the results presented in Figures 11.7a and b, exports to Mercosur do not seem to provide a further bounce to productivity. There is little to suggest, though, that exporting induces productivity growth among Mexican producers. In fact, being an exporter actually seems to reduce productivity growth among Mexican producers, as in the U.S. data analyzed by Bernard and Jensen (2001). As in that study, however, our previous discussion regarding Figure 11.8 argued that reallocation of resources toward exporting firms is an important channel for industry-wide productivity gains.

Imported inputs. Another way that integration by Brazil and Mexico might have enhanced manufacturing efficiency is through better availability of world-class intermediate inputs. From 1996 to 1999, the proportion of Brazilian firms using imported inputs increased slightly, from 31.4 to 33.7 percent, and imported inputs went from 22.7 percent of material costs to 23.2 percent. The use of imported inputs in Mexico seems to have risen more rapidly, as they went from 27 to 32.5 percent of all non-wage costs of production from 1993 to 1999. The proportion of all plants using imported inputs rose from 51.5 to 55 percent during that seven-year span.

Is there evidence suggesting that the expanded use of imported inputs favored productivity improvements? Figures 11.7a and b show that while in Brazil users of foreign inputs saw productivity rise faster, the opposite was true for Mexico. A more careful look at the data for Brazil and Mexico using econometric techniques shows that the impact on productivity is modest, at best. For instance, Muendler (2002) argues that foreign inputs contributed minimally to Brazilian manufacturing TFP growth during 1986-98. The use of imported inputs may actually have a negative impact on productivity growth (see Appendix Tables 11.1 and 11.2). That could happen if, as Muendler (2002) argues, firms fail to adjust their operations at the same time that their use of imported intermediate goods increases, rendering them unable to make appropriate use of the more expensive imported inputs. For Mexico, imported inputs do have a positive effect on the level of productivity, but their quantitative impact is rather small. The estimates suggest that the 5.5 percent hike in foreign input use in Mexico from 1993 to 1999 resulted in TFP growth of 0.2 to 0.3 percent over the entire period.

The FDI channel. Beyond the trade effects analyzed so far, there is the issue of whether higher FDI inflows have had an impact on productivity in Brazil and Mexico. Figures 11.7a and b compare TFP growth differentials between domestic and foreign producers. Whereas in Mexico productivity growth of foreign firms (particularly those from Canada and the United States) outpaced that of domestic producers, TFP of domestic manufacturers in Brazil grew faster. However, once one takes into account productivity differences in industry and firm size, Brazil's results are reversed: foreign firms outpaced domestic ones by 5 percentage points, whereas in Mexico, foreign firms maintained the lead.

The better performance of foreign producers in Mexico and Brazil suggests that their increasing presence might have had a positive impact on productivity growth. The FDI impact might have reflected the combination of entry, competitive, knowledge and linkage effects discussed earlier. To disentangle the contribution of each one of these effects is a daunting, if not impossible, task. Yet, by using information on ownership and on the firms' cost and demand structure (see Appendix 11.1), it was possible to estimate at least part of the overall impact of FDI on productivity, and to assess whether its effects were more important to the foreign firms' competitors (intra-industry effects) or to their buyers and suppliers (inter-industry effects).

The result shows that the intra-industry effects in Brazil were negligible, whereas in Mexico they reduced the level of productivity. In both countries, however, the growth rate of productivity was unaffected. In contrast, in the two countries, foreign firms had positive and statistically significant effects on the level of productivity of the buyers of their products. In Mex-

[20] Bernard and Jensen (2001) perform such an exercise on U.S. data.

[21] See Appendix Tables 11.1 and 11.2.

ico, the same held true with regard to suppliers of foreign firms, but in Brazil the impact was actually negative. In terms of productivity growth rates, the impact on both buyers and suppliers of foreign firms was positive in Mexico, whereas only the effects on suppliers were statistically significant for Brazil, and they reduced productivity growth.

In order to get a feeling for the quantitative impact of these findings, consider an increase of 1 percentage point in the output produced by foreign plants as a proportion of total industry output, both in the industry to which a firm belongs, as well as among its buyers and suppliers. As a result of negative intra-industry effects, productivity would fall by 0.15 percent among Mexican manufacturers.[22] FDI impact on the buyers of its products raises productivity by 0.7 percent in Brazil and by 1.1 percent in Mexico. Last, the effect on suppliers leads to a 0.4 percent fall in Brazilian productivity and to a 0.4 percent increase in Mexico. When one considers these opposing forces in the aggregate, the net FDI effect on the productivity of Brazilian firms is statistically negligible, while in Mexico, FDI has a net positive effect that indicates that FDI results in a point-by-point increase in total factor productivity.

Conclusions

Economic theory suggests that integration can be the handmaiden of productivity growth, either through trade or foreign investment. This potential is particularly important for a region that, with but a few exceptions, has a dismal record on productivity and has been struggling in recent decades to get back on a sustainable growth path. The theory also indicates that both global and regional integration can offer substantial productivity gains. Because it involves larger markets and a broader spectrum of comparative advantages, global integration offers larger potential gains. Regional integration, though, can be a strategic stepping-stone to global integration by speeding up negotiations, mitigating adjustment costs, and offering safeguards against the downside risks of integration.

After more than a decade of pro-trade policies throughout the region, the empirical evidence on the relevance of these productivity-related gains is still rather sketchy. Economy-wide measures of productivity suggest, with a few exceptions, a rather gloomy scenario of low or even negative productivity growth. Yet, analysis of manufacturing, by far the sector most affected by integration in the region, suggests a different and more upbeat story, indicating perhaps that the gains did not reach the economies' non-tradable side. In any case, this type of sectoral analysis, based on more reliable plant-level data, covers only a handful of countries in the region, offering little basis for generalization.

Against this backdrop of scarce evidence, the case study of Brazil and Mexico throws some light on the more general links between productivity and integration and on the nuances of different strategies of regional integration. The results show that productivity growth in manufacturing was positive in both countries, reversing a downward trend that prevailed until the 1980s. The two countries also coincided in three other points. First, they did not show signs of a change in the composition of output that would indicate economies of scale losses or damage to knowledge producing sectors. Second, and as a consequence, they experienced reallocation effects that accounted for most of the productivity growth. And third, when it comes to direct evidence on trade-productivity links, import discipline emerged as the dominant effect. The results on learning-by-exporting and FDI effects varied between countries, but they seem to have played a minor role in both Brazil and Mexico. Brazil shows some signs of learning-by-exporting, while Mexico shows almost none, despite its higher export orientation and the export boom of the 1990s. Regarding FDI, foreign firms appear to have had a positive impact on their buyers and suppliers in Mexico, despite the lower local content and greater export orientation of Mexico's industry, whereas in Brazil, their overall impact was statistically insignificant and only buyers of goods produced by foreign firms appear to have been favored.

Regarding the strategy of regional integration, Mexico's more aggressive stance with NAFTA seems to have paid off, at least as far as productivity is con-

[22] Recall that intra-industry spillovers in Brazil are negligible.

cerned. Tariff reductions as part of the agreement appear to have had a sizable positive impact on productivity growth, which added to the already substantial gains reaped during the period of non-preferential liberalization. As the theory suggests, the differences in labor costs between NAFTA partners appear to have kept the threat of damaging dislocations in increasing returns and knowledge-intensive sectors at bay.

On the other hand, there is not enough evidence to argue that Brazil's more cautious approach to trade, which involved Mercosur, was misguided. The fact that the preferential and non-preferential liberalizations were carried out simultaneously makes it very difficult to disentangle regional and nonregional effects. What one can argue without erring too much on the side of speculation is that the lion's share of Brazil's productivity gains during this period came from the non-preferential liberalization, given that Mercosur at its peak did not account for more than 17 percent of Brazil's total trade. And this comes as no surprise in view of the relative size and resources of Brazil's partners in the regional agreement. The little evidence uncovered in this regard points to learning-by-exporting gains on Mercosur trade, but these gains do not appear to have been any different from those from exports to the rest of the world. Considering the limits of Mercosur gains, the importance of the import-discipline effect and the fact that productivity growth only took off in the second half of the 1990s, it is tempting to believe that Brazil would have had a better performance if it had pursued a more aggressive approach towards integration, that is, one that would not have excluded Mercosur, but that would have gone beyond it, in search of more sizable trade gains.

Leaving strategic and counterfactual considerations aside, the bottom line seems to be that both Brazil and Mexico reaped important productivity gains from integration. It is perhaps too soon to tell how much of these gains were "level or growth effects" or whether or not the "integration shock" will produce the same sort of rapid, sustainable and long-term productivity growth seen in East Asia. That will depend very much on the long-term effects of import discipline on the countries' rate of innovation. In any case, one could not realistically expect that integration would do the entire job. When it comes to a stable macroeconomic environment and investment in education, technological capabilities and institutions—all key ingredients of productivity growth—both countries (not to mention the entire region) still lag behind their counterparts in East Asia.

Appendix 11.1 Empirical Methodology

This appendix summarizes findings on the impact of integration in Brazil and Mexico on total factor productivity in manufacturing.[1] The underlying analysis relies on firm- or plant-level data, which pose challenges but allow for better estimates of productivity.

Methodology: The analysis applies an algorithm by Olley and Pakes (1996) to account for simultaneity and sample selection issues in estimating parameters of a Cobb-Douglas production function with labor (skilled and unskilled), material and capital inputs, and output as the dependent variable. Different production functions were estimated for 8 manufacturing industries (industries 31–38 in the International Standard Industrial Classification, revision 2). Productivity was defined as output unexplained by the inputs.

Aggregate productivity growth in Figures 11.6 and 11.7 was calculated as the output-weighted average of firm-level productivity growth, excluding the lower and upper 1 percent tails of the distribution of TFP to remove outlying observations. Figure 11.8 extends the productivity decomposition of Griliches and Regev (1995) by distinguishing between intra- and inter-industry reallocation of resources. That decomposition requires aggregating across firms in industries with different production functions, so TFP estimates were normalized as in Pavcnik (2000) by subtracting the productivity level of a "reference firm" in the initial year (1996 for Brazil, 1993 for Mexico). Thus, implicit TFP growth rates in Figure 11.8 are not readily comparable to those in Figures 11.6 and 11.7.

With the productivity estimates in hand, one may explain a firm's efficiency as a function of trade policy variables (e.g., tariffs), foreign capital participation and FDI, exports, imported input use, as well as other controls needed to prevent omitted variable biases. Thus, one may estimate equations of the form:

$$Productivity_{ijt} = \beta_1 Trade_{ijt} + \beta_2 FDI_{ijt} + controls + \varepsilon_{ijt}$$

where the dependent variable, Productivity in plant i, belonging to industry j, during year t, is measured either in log-levels or in log-differences. The availability of panel data allows tracking each plant over time and controlling for unobserved plant characteristics via fixed-effect panel techniques.

Since trade policy is potentially endogenous—for example, less productive industries may receive more protection from policymakers—one needs to find appropriate instrumental variables to obtain consistent estimates of the coefficient β_1 in the previous regression equation. In the Mexican case, the analysis uses the NAFTA tariffs as instruments for the actual Mexican tariffs on world trade, as well as for U.S. tariffs on Mexican goods. NAFTA tariff phase-out negotiations finished in August 1992. Moreover, according to NAFTA Annex 302.2, paragraph 2, the base rates for determining import duties after applying the staging category agreed upon "generally reflect the rate of duty in effect on July 1, 1991." Thus, we can safely consider that they are exogenous (not influenced by plant-level TFP levels during the 1993-99 period). Moreover, they are highly correlated with actual tariffs.

To address the potential endogeneity between import penetration and productivity, we used a gravity equation approach to estimate trade flows based on geographical variables. This estimate was used as an instrumental variable in the regression analysis.

Data: The data come from annual industrial surveys in Brazil (Pesquisa Industrial Anual) and Mexico (Encuesta Industrial Anual) on approximately 11,000 manufacturing firms (in Brazil) and 6,500 plants (in Mexico). These data were complemented with trade, tariff and other information from official sources in Brazil, Mexico and the United States.

To measure intra- and inter-industry spillovers from FDI, the analysis uses information on the percent of equity owned by foreigners (1996 for Brazil, 1993 for Mexico). We assume that the structure of ownership remained unchanged through 1999. A firm is considered to be "foreign" if foreigners owned more than 50 percent of equity. The proportion of industry output produced by foreign plants in each industry was taken as the measure for foreign capital participation. To account for the possibility of spillovers from industries upstream or downstream in the production process, we consider average foreign capital participation in industries with backward or forward linkages based on input-output information for each country.

[1] See López Córdova & Moreira (2002) and López Córdova (2002).

Appendix Table 11.1 Total Factor Productivity and Integration in Brazil: Regression Results

Independent variables	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8	Reg 9	Reg 10
	Dependent variable: TFP (log)			Dependent variable: Change in TFP (log)						
Exporting activity										
World exporter (dummy)					0.0024 (0.0087)					
Mercosur exporter (dummy)						0.0082 (0.0088)				
Exports/sales							0.0009 (0.0004)**			
Mercosur exports/sales								0.0008 (0.0010)		
Imported intermediate goods										
Imported-input/material costs		–0.0009 (0.0002)***							–0.0004 (0.0002)	
Imports/material costs			0.0006 (0.0001)***							0.0003 (0.0001)***
FDI spillovers										
Intra-industry (%)	–0.1358 (0.1000)	–0.1391 (0.0999)	–0.1349 (0.0999)	0.1131 (0.1009)	0.1131 (0.1009)	0.1122 (0.1009)	0.1134 (0.1008)	0.1129 (0.1009)	0.1116 (0.1009)	0.1133 (0.1008)
From forward linkages	–0.4939 (0.1854)***	–0.4809 (0.1853)***	–0.5067 (0.1852)***	–0.4022 (0.1870)**	–0.4021 (0.1870)**	–0.4021 (0.1870)**	–0.4032 (0.1870)**	–0.4039 (0.1870)**	–0.3966 (0.1870)**	–0.4076 (0.1870)**
From backward linkages	0.9778 (0.2707)***	0.9671 (0.2707)***	0.9915 (0.2705)***	0.4310 (0.2732)	0.4312 (0.2732)	0.4285 (0.2732)	0.4443 (0.2732)	0.4300 (0.2732)	0.4266 (0.2732)	0.4393 (0.2732)
Number of observations	29,103	29,103	29,100	29,103	29,103	29,103	29,103	29,103	29,103	29,100
Number of firms	10,859	10,859	10,858	10,859	10,859	10,859	10,859	10,859	10,859	10,858
Within R^2	0.0103	0.0110	0.0115	0.5892	0.5892	0.5892	0.5893	0.5892	0.5892	0.5893
F statistic for null hypothesis (Sum FDI spillovers = 0)	1.89	1.88	1.91	0.31	0.31	0.29	0.37	0.30	0.31	0.32

Notes: All regressions were estimated using fixed effects on a panel of firms. All regressions include the following controls: size, industry output (excluding the plant's own output), capacity utilization, industrial and geographic concentration indices, U.S. consumption, log of exchange rate times, U.S. PPI in the industry, and year dummies. Regressions 4 to 10 also include log TFP in year t. Standard errors in parentheses.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Appendix Table 11.2 | **Total Factor Productivity and Integration in Mexico: Regression Results**

Independent variables	Dependent variable: TFP (log)				Dependent variable: Change in TFP (log)					
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8	Reg 9	Reg 10
Competition from imports										
Mexican tariff on total imports (%)	–0.0050	–0.0087	–0.0084	–0.0087	–0.0122	–0.0119	–0.0118	–0.0120	–0.0110	–0.0119
	(0.0023)**	(0.0022)***	(0.0022)***	(0.0022)***	(0.0021)***	(0.0021)***	(0.0021)***	(0.0021)***	(0.0020)***	(0.0021)***
Imports/industry output			0.0216				0.0186			
			(0.0060)***				(0.0058)***			
Exporting activity										
Exporter (dummy)								–0.0083		
								(0.0049)*		
Exports/sales									–0.0182	
									(0.0145)	
U.S. tariff (Mexico-rest of the world)	–0.0046	–0.0052	–0.0053	–0.0053	–0.0029	–0.0028	–0.0028	–0.0029	–0.0010	–0.0026
	(0.0021)**	(0.0020)**	(0.0020)***	(0.0020)***	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0019)	(0.0020)
Imported intermediate goods										
Imported inputs/total non-labor costs				0.0463						–0.0422
				(0.0155)***						(0.0149)***
FDI spillovers										
Intra-industry (%)		–0.1509	–0.1458	–0.1519		–0.0310	–0.0269	–0.0324	–0.0256	–0.0304
		(0.0570)***	(0.0570)**	(0.0570)***		(0.0548)	(0.0548)	(0.0548)	(0.0515)	(0.0548)
From forward linkages		1.1427	1.0755	1.1387		0.7169	0.6602	0.7140	0.6845	0.7194
		(0.1740)***	(0.1746)***	(0.1740)***		(0.1677)***	(0.1683)***	(0.1677)***	(0.1593)***	(0.1676)***
From backward linkages		0.3964	0.4120	0.3989		0.2815	0.2954	0.2845	0.2319	0.2798
		(0.0788)***	(0.0789)***	(0.0788)***		(0.0759)***	(0.0759)***	(0.0759)***	(0.0722)***	(0.0758)***
Observations	26,703	26,683	26,683	26,683	26,703	26,683	26,683	26,683	25,903	26,683
Number of plants	5,302	5,302	5,302	5,302	5,302	5,302	5,302	5,302	5,191	5,302
Within R^2	0.0142	0.0144	0.0164	0.0145	0.3638	0.3653	0.3662	0.3650	0.3595	0.3656
Chi^2 statistic for null hypothesis (Sum FDI spillovers = 0)		49.56	46.31	49.39		25.89	23.87	25.82	24.33	25.982

Notes: All regressions were estimated using two-stage least squares on a panel with fixed effects. Instruments are NAFTA-negotiated tariffs to control for potential endogeneity of tariffs in Mexico and the United States. All regressions include the following controls: age, age squared, size, industry output (excluding the plant's own output), capacity utilization, industrial and geographic concentration indices, U.S. consumption, log of exchange rate times, U.S. PPI in the industry, and year dummies. Regressions 5 to 10 also include log TFP in year t. "Mexican tariff" is the ISIC (rev 3) 4-digit industry tariff on world imports, weighted by trade. "U.S. tariff" is the difference between effective tariffs on Mexican imports and on imports from the rest of the world in the industry. FDI variables refer to the fraction of output produced by foreign plants; linkages were calculated using Mexican input-output data as weights. Standard errors in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

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