Chapter II

Structure, specialization and growth

A. Introduction

It was argued in chapter I that, in order to attain high rates of growth in the long run, the region must achieve structural change towards sectors which are more knowledge-intensive and enjoy robust demand growth. The reallocation of resources to these sectors will create a production structure with higher levels of Schumpeterian and Keynesian (or growth) efficiency. The former paves the way for more learning, more innovation and greater dissemination of innovations. The latter makes it possible for productivity gains to be matched by upswings in demand in both the domestic and external markets. The combination of these two types of efficiency —which, taken together, define what has been called the “dynamic efficiency” of the production structure— generates a virtuous growth path in which productivity and employment both rise at the same time.[1] When, however, diversification is very weak, growth slows, fewer jobs are created and the few jobs that are created are in lower-productivity sectors. This can cause aggregate productivity to fall, as shown in the vicious-cycle growth path depicted in table I.3 (see chapter I).

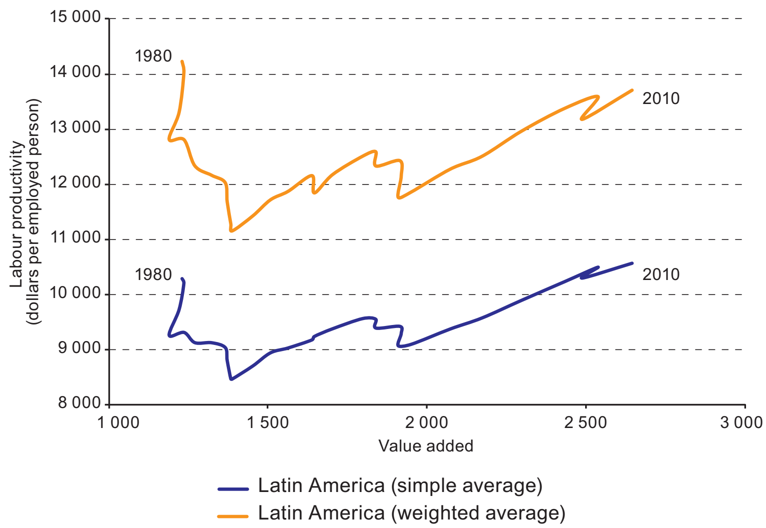
During the last three decades, the growth paths of some countries have enabled them to achieve steady increases in productivity, whereas others have followed erratic growth paths in which crises have curbed productivity, with the result that, when they do start to grow again, they are starting from lower productivity levels than they had before the crisis.

Differing growth paths are shown in summary form for the countries of Latin America in figure II.1 and for selected countries in the region and beyond in figure II.2. In these graphs, labour productivity is plotted on the vertical axis and the economy’s value added is plotted on the horizontal axis. Each point on the curve represents a year covering the period starting in 1980 and

[1] See Astorga, Cimoli and Porcile (2012).

ending in 2010, so that the curve shows the path of productivity and employment over time. Figure II.1 shows the path for Latin America, whereas figure II.2 compares the path of a group of countries within and outside the region. For the purposes of comparison, three European countries whose exports are heavily weighted towards natural-resource-intensive goods (Denmark, Finland and Norway) are included along with the countries of Latin America. The path of the Republic of Korea is also shown because it is one of the most successful cases of catching up and convergence with developed countries in the second half of the twentieth century.[2]

Figure II.1
LATIN AMERICA (12 COUNTRIES): LABOUR PRODUCTIVITY AND VALUE ADDED, 1980-2010[a]
(Dollars and billions of dollars; base year=2000)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp/; and World Bank, World Development Indicators (WDI) [online database] http://databank.worldbank.org/, 2012.

[a] The following countries were selected for inclusion in this figure on the basis of availability of the relevant data: Argentina, Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, Ecuador, Honduras, Mexico, Panama, Paraguay and Peru. The weighted average is based on GDP.

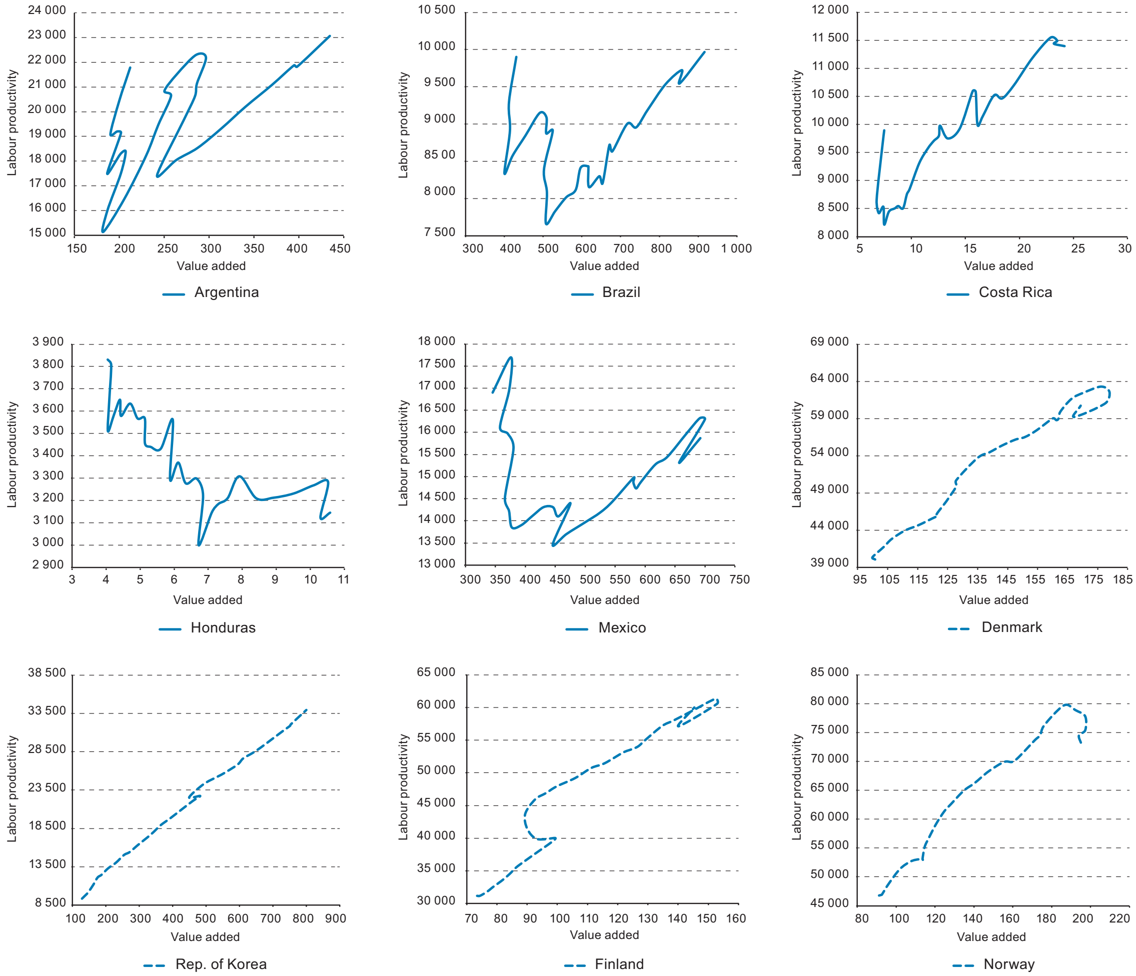
Virtuous growth paths yield curves with fairly stable positive slopes. Vicious-cycle periods correspond to productivity losses. What the above figures bring out is the fact that the Latin American countries have witnessed steep declines in their productivity during crises or recessions, such as those that occurred in the 1980s and late 1990s, which were not fully offset in the recoveries that followed. For the region as a whole, a comparison of its productivity at the start (1980) and the end (2010) of this period does not show any significant improvement (see figure II.1). In some countries, in fact, a considerable decline has occurred over these years. As will be seen in chapter III, the adverse impact of the 1980s crisis, which can be seen here for all the countries, weakened their long-term growth rate.

[2] The Caribbean economies are discussed separately in another section of this chapter.

Figure II.2

SELECTED COUNTRIES: COMPARISON OF LABOUR PRODUCTIVITY AND VALUE ADDED, 1980-2010

(Dollars and billions of dollars; base year=2000)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp/; World Bank, World Development Indicators (WDI) [online database] http://databank.worldbank.org/, 2012; and Organization for Economic Cooperation and Development (OECD), The Labour Force Survey (MEI) [online database] http://stats.oecd.org/, 2012.

Note: The points on the figures correspond to the years covered by the period from 1980 to 2010.

The region's performance marks a stark contrast with the steady upward trend of productivity and GDP in the other countries in the sample. The Republic of Korea and the sample European countries have seen a steady increase in both variables except during the 2008 crisis. There has been no "lost decade" or "lost half decade" (indicative of a vicious cycle) for them, as there have been in Latin America. The best-performing Latin American country in the sample,[3] Costa Rica, raised its productivity by 15% between 1980 and 2010 and lost a great deal of ground in the 1980s; the worst-performing country in the sample among the countries outside of the

[3] The Latin America sample includes the three largest economies (Argentina, Brazil and Mexico) and two Central American countries (Honduras and Costa Rica). The performance of some countries in the region has been better than that of the sample countries, as indicated in chapter I.

region was Denmark, which boosted its productivity by nearly 70% and did not experience any productivity declines (until 2008, at least).

The economies in this sample that are not in the region have also had to grapple with major shocks but, apart from the deep depression of 2008-2009, those shocks did not drive down their productivity. There have been cases in which GDP has declined, as in Finland when the Soviet Union (a major export market) was disintegrating and in the Republic of Korea during the 1997-1998 Asian crisis. Nonetheless, productivity growth did not falter until the closing years of the period under study, which bespeaks the presence of highly shock-resistant economies that are far less vulnerable to the ups and downs of the world economy.

Employment trends are reflected in the slope of the curve in figures II.1 and II.2: the steeper (flatter) the slope, the less (more) labour absorption there has been. The fact that the slope has always been positive in the European countries and the Republic of Korea indicates that newly created jobs have been in keeping with aggregate productivity gains. In the Latin American countries, on the other hand, productivity losses have been associated with low GDP growth rates and increases in employment, which indicates that the jobs that are being created are in lower-productivity activities and are often of poor quality.

The average rate of unemployment in different periods is shown in table II.1, in order to provide a more detailed picture of the behaviour of the labour market. There is no significant difference between the average unemployment rates for the Latin American and other countries in the sample.[4] This suggests that the sustained productivity growth in Europe and the Republic of Korea was not associated with higher unemployment. Given the striking differences between the unemployment insurance schemes in Europe and Latin America, the impact of the same unemployment rate in terms of inequality and poverty is very different in the two regions. An additional factor to consider in the comparison is that, in Latin America, unemployment may be hidden in the form of informality or underemployment, which means that the countries of the region have to maintain especially high growth rates in order to curb structural heterogeneity.

Table II.1
SELECTED COUNTRIES: AVERAGE UNEMPLOYMENT, 1980-2010 [a]
(Percentages)

Period	Argentina	Brazil	Costa Rica	Honduras	Mexico	Denmark	Finland	Republic of Korea	Norway
1980-1985	4.6	6.6	7.8	9.8	4.9	9.2	5.1	4.3	2.6
1986-1990	6.6	3.8	5.6	9.6	3.5	6.8	4.2	2.9	3.5
1991-1995	10.4	5.1	4.9	6.0	3.8	8.8	13.3	2.5	5.5
1996-2000	14.9	6.7	5.9	5.7	4.5	5.7	11.7	4.5	3.8
2001-2005	15.9	10.3	6.6	6.8	4.4	5.0	8.9	3.7	4.2
2006-2010	8.6	8.4	6.2	4.9	5.5	4.9	7.5	3.4	3.1
Average 1980-2010	10.0	6.8	6.2	7.2	4.4	6.8	8.3	3.6	3.7

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official figures.

[a] A number of countries in the region changed their methodology for measuring employment during the period under study: Argentina and Brazil did so in 2003, Costa Rica in 2009 and Mexico in 2005 (with a transitional application for 1997-2004).

[4] There are sizeable differences both between European countries (e.g. between Finland and Norway) and between Latin American ones (e.g. between Argentina and Mexico).

Less closely regulated markets (where short-term contracts are commonly used and the cost of firing or laying people off is low) are not sufficiently responsive in low- or no-growth situations. Microeconomic response capacity in the face of external shocks is not enhanced because firms can easily dismiss staff or can quickly close their doors; rather, it depends on firms' capacity to use their existing assets (including their human capital) in new ways, to produce new products, devise new processes and find new markets. "Freeing up" factors of production does not ensure that they will be used in new activities, especially when learning and tacit knowledge inputs are required that can only be acquired through experience in production and investment.[5] To enhance the creative side of the Schumpeterian creative destruction process, policy should be aimed at providing greater scope for the achievement of dynamic efficiency rather than simply focusing on reducing the cost of the destruction of lagging capacity and backward sectors.

Heightening the creative dimension of global competition is no easy task, and few countries have succeeded in narrowing the productivity and income gap separating them from the more developed economies. The more successful cases of convergence have been in Asia, where active industrial policies have been coupled with macroeconomic policies designed to boost competitiveness (see chapter I). Cases where convergence has been achieved are not necessarily going to repeat themselves in the same way or at the same pace, but they nonetheless offer important lessons that provide information about the factors that made convergence possible in some cases and not in others. These lessons should be incorporated into the structural change and development policy agenda for the twenty-first century.

Peneder (2002) has noted that the development process necessarily engenders "Schumpeterian trails" of structural change. Countries that have managed to converge with the growth trends of industrialized economies have done so by embarking on intensive learning processes that have ushered in new export and production sectors. The historical evidence provided by these successful experiences points to a process of diversification whereby the resources channelled towards innovation opened up new investment opportunities and led to the creation of new production sectors. Services and industries responded to the new demands of more advanced technology and, as a result, more knowledge-intensive sectors gained a greater share in manufacturing, while more sophisticated goods increased their share of exports. Export sectors became more diversified and gained access to more demanding markets in which product differentiation is crucial for competitiveness. External and domestic demand stimuli generated growth impulses to which the economy was able to respond endogenously, thereby creating higher-productivity jobs. As this process proceeded, two gaps —the external gap between the countries of the region and the international technological frontier, and the internal one, which has left many workers on the sidelines in terms of higher-productivity activities— began to narrow. If a suitable institutional structure for the promotion of structural change and proper industrial policies are not in place, however, then this virtuous-cycle process will be cut short.

This chapter is divided into four sections. This introduction is followed by section B, which offers a comparative analysis of the speed of structural change in different countries and regions that shows how far Latin America has lagged behind in this respect. A wide range of indicators

[5] Reducing the number of hours worked in economies where there is greater employment protection (as in Europe) can provide much the same degree of labour-market flexibility (which is needed to cope with hard times) as layoffs can (Abraham and Houseman, 1993). Combining flexibility and greater protection is less costly (in both material and psychological terms) for workers and can yield additional benefits, such as the continuity of learning curves (Bértola and Rogerson,1996).

are used to trace the shift in the production structure that underlies virtuous growth patterns. This section also discusses the microeconomics of the learning process, since it is important to understand what forces and obstacles form the background for the dynamics of innovation, the international diffusion of knowledge and the increasing incorporation of knowledge into production (i.e. which forces drive the attainment of dynamic efficiency). In a world of open economies, firms that lag behind in technological capabilities cannot survive, and firms, as well as economies, whose institutions do not promote learning will suffer. These learning processes are especially important in enhancing the value of natural resources and ensuring the environmental sustainability of growth. These issues will be covered at the end of this section.

Section C deals with the relationship between structural change, growth and specialization. The reason why the discussion in this section will focus on trade and specialization is because of its link to the production structure. Income elasticities of demand for exports and imports, in particular, can be seen as a reflection of the production structure's dynamic efficiency. Sectors having a higher income elasticity of demand (i.e. those that produce the goods for which demand climbs when world income rises) tend, as well, to be more knowledge-intensive. And this is why an analysis of these elasticities provides useful information about the production structure. Another reason for undertaking a close analysis of trade is because the ratio between the income elasticity of demand for exports and the income elasticity of demand for imports is a good indicator of the economy's long-term growth rate. An economy cannot grow at rates that entail a steadily rising deficit on current account as a percentage of GDP (Rodríguez, 1977; Thirlwall, 1979; Moreno-Brid, 2002; Cimoli, 1988; Cimoli, Porcile and Rovira, 2010). This being so, an analysis of the elasticities of trade in goods and services provides a way of linking the production structure with the long-term rate of growth.

Section D brings the chapter to a close with an analysis of the role played by one of the key variables in macroeconomic policy —the real exchange rate— in determining an economy's pattern of specialization. The discussion of the subject in this chapter draws upon the growing body of literature concerning the links existing among the real exchange rate, the production structure and growth. These links develop mainly through the diversification and knowledge-intensity of a country's exports. At the same time, it is clear that the use of the real exchange rate as a development tool can lead to problems in terms of income distribution and trade imbalances in other parts of the world. This is why it is so important to realize that a competitive real exchange rate must go hand in hand with income distribution and industrial policy, on the domestic front, and with the international coordination of policies (including Keynesian policies aimed at boosting global demand). This coordination is necessary to avert the chronic trade surpluses associated with export drives based on a persistently depreciated real exchange rate. This kind of strategy creates imbalances in other parts of the world and cannot be used by all the countries at the same time; to think that this would be possible is to fail to recognize the existence of a fallacy of composition.

B. Structural change and convergence

1. The microeconomics of learning

As was also the case for modern growth theory, understanding why growth rates differ across countries and regions was the starting point for the pioneering work done by ECLAC. In those studies, ECLAC noted that the "slow and irregular" international diffusion of technical progress brought about very different economic structures in different regions of the world, giving shape to what is characterized as the "centre-periphery" system. Technical progress was initiated at the centre, where innovation and the diffusion of technology went hand in hand with the emergence of new economic sectors and new capabilities. This gave rise to a diversified, increasingly knowledge-intensive production structure in which job creation and productivity gains were spread out fairly evenly throughout the production system. As a result, the structure of the economies at the centre was not only diversified, but also homogeneous (with small productivity gaps between sectors and productive units), since it was capable of absorbing most workers into high-productivity sectors. At the periphery, however, the penetration of technical progress was limited to a few areas of activity, giving rise to an undiversified, heterogeneous production structure (few sectors and large productivity gaps). This structure was unable to offer jobs to a large percentage of workers, who sought refuge in low-productivity activities (such as underemployment and subsistence activities). The main issue, then, from the structuralist perspective, was to speed up the diffusion of technology and formation of new capabilities and capacities.[6] This would sustain a process of structural change in which the periphery would become increasingly homogeneous and diversiified.

The pioneers of development theory formulated many of the ideas that mainstream economic theorists would accept only years later (such as, for example, that the production structure matters and that technological dynamics can generate international and regional divergence). However, when the foundational contributions to development theory were made, their understanding of the dynamics of technical progress was very limited. There was, in particular, no microeconomic theory about the learning process or innovation that could provide an intellectually rigorous basis for development macrodynamics. They were not yet clear about what the barriers to technological diffusion were or about how policy could be used to promote technological convergence. This all changed in the late 1970s when evolutionary theories of technical change were developed (Rosenberg, 1982; Dosi, 1988; Narula, 2004; Cimoli and Dosi, 1995; Katz, 2008; Cimoli, Dosi and Stiglitz, 2009).[7] Today, a much fuller understanding has been achieved of the determinants of convergence at both the international and regional levels.

The literature on the subject brings out the following points, which are helpful in understanding the obstacles to developing countries' technological and productive convergence with advanced countries:

- Learning is localized, with firms learning within the context of existing technological capacities and abilities (technological base).
- Learning is, to a great extent, a tacit process and, in many cases, the technology cannot be copied or transferred in codified form (as in manuals or instructions) because actual production experience is of crucial importance.
- Innovation and the diffusion of technology should be viewed as closely linked processes, since diffusion will not occur unless the firms that are imitating new technologies make an effort to improve and adapt them to their production capabilities and the specific

[6] The term "technology" will be used in this study in a broad sense that encompasses the entire range of knowledge and tools used in the production of goods and services in the various areas of the economy. Heterogeneous and homogeneous structure refers to the extent of the differences in labour productivity between production units and sectors.

[7] Conventional economics also began to devote more attention during this period to the issues of information asymmetries, coordination and externalities of technical change. For a review of the debate, see Cimoli and Porcile, 2009.

conditions existing in their markets. This holds true not only for major innovations and new paradigms, but also for the diffusion of mature technologies. The success stories of convergence are typified by an ongoing effort to use exogenous technology as a platform for a local learning process rather than as a substitute for it. Consequently, efforts in this direction should not be based on an assumption that there is a radical separation between innovation and diffusion or between incremental adaptations or innovations and imitation (Katz, 1997 and 2008; Cimoli and Katz, 2003).

- Increasing returns to learning are a factor that accounts, on the one hand, for rapid capacity-building and, on the other, for widening lags. Firms that innovate or adopt more sophisticated technology in a given time period are more likely to innovate or adopt new technologies later on, and this may give rise to virtuous (or vicious, in the case of lagging companies) cycles of learning, innovation, diffusion and growth (Arthur, 1994).
- Increasing returns are found not only at the level of firms, but are also apparent industry- or country-wide and are generated by complementarities among production assets, technological assets and institution-building and by the mutual reinforcement of investment, technical progress and growth (Rosenstein-Rodan, 1961; Ros, 2002). This cumulative process had been foreseen in the Kaldor-Verdoorn law, according to which gains in output induce productivity gains. Later studies have shown that it is valid for a wide range of learning processes. These processes have been identified and analysed in the literature and include not only learning-by-doing (the classic mechanism identified by Arrow, 1963) but also learning-by-using, learning-by-interacting, learning-by-exporting and learning-by-observing.[8]

An understanding of the role that increasing returns play in technical progress is an essential element for industrial policy design. If endogenous forces tend to reproduce the predominant production and learning patterns, then it will be very unlikely that the economic system can evade a low-growth trap on its own. Path dependence, lock-in and hysteresis all have a strong influence on the relationship between technical change and specialization. Proactive policies are therefore essential if developing countries are to reshape their incentives and encourage structural change in economies where inertia and the endogenous reproduction of low-growth structures prevail (Cimoli and Rovira, 2008).

Technical progress does not occur evenly across all sectors; instead, some sectors are more innovative and stimulate technological diffusion more than others. There is a clear-cut relationship between aggregate R&D in an economy and the relative size of knowledge-intensive sectors within it. Some of them are producers of innovations, while others acquire and incorporate those innovations (they are supplier-dominated, as suggested by Pavitt, 1984). Although the diffusion and adoption of technology require endogenous technological efforts by the recipient firms, the leadership postion is generally occupied by those firms that devise and produce innovations. The capacity to innovate and to realize productivity gains is not distributed evenly across sectors, and the evidence shows that the relevant technological and capacity-building trajectories for a given sector may take shape in other, often far-removed sectors.[9]

8 See Arthur (1989 and 1994), Buchanan and Yoon (1994) and León-Ledesma (2002).

9 For example, backward or forward production linkages in the mining sector involve capacities in the production of transport equipment, sophisticated mechanical or electrical/electronic machinery and information and communications technologies that local firms do not master.

The validity of the concern evidenced by development theorists about the production structure and about external and internal technological gaps has been corroborated in the recent literature. The pivotal role of increasing returns (and the corollary: the existence of cumulative processes and path dependence) is reflected in most models of international divergence and models of the new economic geography, which are now part of the standard approach to regional economics. The above factors, related to the microeconomics of the learning process, make it possible to look at the supply side from a new, unconventional vantage point. The dominant technological and production patterns are underpinned by endogenous mechanisms that reinforce these patterns. The role of public policy is to build institutions and create new incentives that will facilitate the coordination over the long term of the agents that innovate and support technological diffusion and to help ensure that resources are channelled towards activities that promote learning and its dissemination to less advanced (usually smaller) firms. As discussed in chapter I, these institutions supplement the price system in some cases, while in others they generate the "distortions" required to escape from path dependence (Amsden, 1989; Wade, 1990; and Chang, 2001).

Technical progress stems from an interactive process of trial and error and from information sharing among a large, varied group of agents that in many cases have differing objectives, rules and organizational structures (e.g. public agencies, firms, universities and research centres). In order to fuel technical progress, a formal or informal institutional framework is needed to coordinate the interaction of these agents and induce them to engage in cooperative behaviour that will encourage innovation and its diffusion (Metcalfe, 2001). There are externalities that can be capitalized upon, but only if appropriate coordination mechanisms are in place, especially in the transformation to a pattern of sustainable growth (Rodrik, 2008). A central role is played by industrial and macroeconomic policies (see chapter VI), which have a direct influence on aggregate demand, the economy's nominal and real stability, the solvency of financial institutions (via macroprudential regulation) and even on income distribution, while they also establish incentives and build or reshape institutions. The diversity of policies and institutions —and of ways to achieve dynamic efficiency— lies behind the differing development patterns and economic performances seen in each country and in each time period. Their effects on growth patterns will be explored in the next section, focusing on a set of indicators that measure the intensity of technological learning and structural change, which are the drivers of long run growth.

2. Indicators of structural change

The first step in constructing indicators to gauge the production structure's level of dynamic efficiency is to identify the variables that reflect that attribute. Several variables can be used as proxies, which capture different aspects of the innovation and learning processes. The second step is to define the level of aggregation to be used in the analysis. Some activities are more dynamic than others (in both the growth-Keynesian and Schumpeterian senses); when working with aggregates, some degree of internal heterogeneity is inevitable.[10] Since it is impossible to construct indicators that are completely free of biases or imperfections, or define a level of aggregation which is perfectly homogeneous, the strategy that has been used to measure dynamic efficiency in this section is to present an array of diverse indicators. If they all point in the same direction, then a reliable measurement of the level of dynamic efficiency of a given country's production structure can be obtained. When indicators point towards divergent conclusions, an analysis of the

[10] This heterogeneity can skew the indicators, and the risk of this occurring increases as the level of aggregation rises.

weaknesses and strengths of each indicator can help researchers to try to determine which factors account for that divergence. The strong and weak points of each indicator are discussed in annex I.1 The indicators used for assessing the intensity and direction of structural change from a comparative perspective are the following:

(i) The classic indicators of technological effort and outcomes (investment in R&D and the number of patents per capita, respectively);

(ii) Relative productivity, defined as the ratio between the levels of labour productivity in a given economy and in an advanced economy used as a point of reference. (The United States is generally used as the benchmark because it is at the leading edge in technology and has strong investment and trade links with Latin America and the Caribbean.);

(iii) The percentage medium-tech and high-tech exports (X_HMT/X), based on Lall's classification, in total manufacturing exports;

(iv) The ratio between the share of engineering-intensive sectors in total manufacturing value added (S_i) and the share of those same sectors in a benchmark economy (S_R —in this case the United States economy): EIS = (S_i / S_R). It is assumed that, the greater the EIS share, the greater the knowledge-intensity of a given industry;

(v) The adaptability index (AI) is the ratio between the share of dynamic exports and the share of non-dynamic exports in total exports (i.e. the percentage of the former relative to the percentage of the latter in relation to total exports). Dynamic exports come from sectors in which world demand, measured by the world export value, is growing faster than the average;[11]

(vi) The indicator of the level of sophistication of exports (EXPY) developed by Hausmann, Hwant and Rodrik (2007)[12] is based on highly disaggregated trade statistics and is designed to reflect differences in the quality or sophistication of exports. Exports from high-income countries are regarded as being more knowledge-intensive than the exports of low-income countries. The reasoning underlying this distinction is based on the perception that richer economies have greater technological and marketing capabilities that allow them to compete in differentiated products in more demanding markets. The EXPY index is an indicator not only of Schumpeterian efficiency, but also of Keynesian efficiency, in that it is more likely that the income elasticity of the more sophisticated goods and services that are exported by rich economies will be greater than the income elasticity of poor economies' exports.

Indicators (i) through (iv) are indicators of capabilities in a broad sense and primarily capture the level of Schumpeterian efficiency. Indicator (v), on the other hand, is an indicator of

11 Although the most dynamic sectors have generally been the most modern manufacturing industries (those producing mechanical, electrical, electronic and transport equipment and the like), this has not always been the case at the product level, since there are also some quite dynamic agricultural and mining products.

12 The first step in building this indicator is to construct the PRODY, which is a weighted average of the per capita incomes of countries that export a given product, using the revealed comparative advantage in that product as the weighting factor. Each product is associated with a PRODY. Then the EXPY indicator is calculated for each country using the weighted sum of PRODY values, with weightings being given to each good according to its share of the export basket. A high EXPY value indicates that the country in question mainly exports goods that are also exported by high-income countries.

the dynamism of external demand and captures all dynamic sectors, regardless of their production or technological base, thereby providing information mainly about the level of Keynesian efficiency. Finally, indicator (vi) captures both types of efficiency, since it relates to the ability to produce more sophisticated goods aimed at high-income markets. Two of the six indicators (EIS and X_HMT/X) refer to the manufacturing sector, while the other four (relative productivity, R&D plus patents, AI and EXPY) are aggregates that refer to all economic sectors.

As mentioned earlier, these indicators should be used in conjunction with one another in order to obtain an integrated or fuller picture of the capacities present in the production structure, since any one of them, used alone, captures only a portion of those capacities. (The biases associated with each indicator are explored in annex I.1).

3. Analysis by region and by country

In order to compare the dynamic efficiency indicators for the production structure of Latin America with those of other regions, the countries have been classified into different groups. On the one hand, Latin America has been divided into two subregions: South America and Central America. The situation in the Caribbean countries will be looked at separately, since they do not have the same indicators as those used for Latin America. In addition, data for the region's three largest economies (Brazil, Mexico and Argentina) are analysed individually, given the extent of their influence on the regional economy. On the other hand, the emerging economies of Asia are used as a benchmark, since (as noted in chapter I), they are development success stories that have narrowed the per capita income and technology gaps between them and the developed world.

The developed economies have been divided into two groups: mature economies whose total exports include a large share (over 70%) of primary resources and natural-resource-intensive manufactures, and mature economies in which these kinds of exports represent a smaller share of the total (under 70%). The division of the developed economies into these two groups is intended to show that natural resources do not constitute an obstacle or a "curse" in terms of structural change. They can actually serve as a platform for making the move to new sectors and activities that incorporate increasing amounts of knowledge. More specifically, the argument is that the production structures of the economies in the first group are very different from those of the Latin American countries, even though natural resources have a similar weight in their export patterns. This difference in their structures reflects differences in how rents from natural resources were used, in response to industrial policy and the countries' ability to administer macroeconomic prices in such a way as to foster the production of new tradables.

Table II.2 shows that the classic indicators of technological effort and technological outputs (R&D and patents, respectively) yield lower values for Latin America than for other regions, regardless of whether these measurements are made by subregion (South America and Central America) or individually for the region's largest economies (Argentina, Brazil and Mexico). These differences are even greater when the comparison is based on patents than when it is based on expenditure on R&D, which indicates that Asia has been more efficient in patenting the outcome of R&D than Latin America.

Latin America has also lagged behind in terms of relative productivity. A comparison of, for example, South America with the developing economies of Asia shows that the level of productivity in the former is just one eighth of what it is in the reference country (the United States), while in Asia it is one third. The same is true of the indicator for knowledge intensity in manufacturing, since the relative weight of engineering activity in Latin America is less than one fourth of what it is in the developing Asian economies. The adaptability index, for its part, is not only lower for South America but the trend in this indicator is much less favourable for South America than for Asia. The adaptability index more than quadrupled in Asia between 1985 and 2007, whereas it doubled in South America. Central America has a stronger trend, with its adaptability index rising from 0.2 in 1985 to 1.1 in 2007 thanks to the headway made by export-assembly industries.

Table II.2
SELECTED REGIONS AND COUNTRIES: STRUCTURAL CHANGE AND TECHNOLOGICAL EFFORT INDICATORS

	Relative productivity [a] *(percentages)*	AI [b] (1985)	AI [b] (2007)	X_HMT/X [c] *(percentages)*	EXPY [d]	Engineering-sector share (EIS)[e]	Patents [f] *(per million inhabitants)*	R&D [g] *(percentages of GDP)*
Argentina	25.7	0.1	0.2	22.0	10.4	0.4	1.0	0.5
Brazil	11.7	0.4	0.9	32.0	11.4	0.7	0.5	1.0
Mexico	19.8	0.3	1.1	60.5	13.2	0.6	0.6	0.4
Developing Asia[h]	33.8	0.5	2.3	64.3	14.6	0.9	17.2	1.3
South America	12.1	0.3	0.6	18.5	9.1	0.2	0.4	0.4
Central America	11.0	0.2	1.1	34.2	11.2	0.2	0.3	0.2
Mature natural-resource-intensive economies [i]	71.3	0.5	1.3	32.4	14.1	0.8	55.2	2.0
Mature economies [j]	76.3	0.8	1.5	64.6	15.0	1.1	126.1	2.4

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database]; TradeCAN, 2009 version [online database] http://comtrade.un.org/db/default.aspx; World Bank, World Development Indicators (WDI) [online database] http://databank.worldbank.org/; Organization for Economic Cooperation and Development (OECD), The Labour Force Survey (MEI) [online database] http://stats.oecd.org/; European Commission, Eurostat [online database] http://epp.eurostat.ec.europa.eu/, 2012.

[a] Relative productivity: Labour productivity relative to its level in the United States, 2001-2010 average (simple average for aggregates). For this indicator, South America includes Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Ecuador, Paraguay and Peru, while Central America includes Costa Rica, Honduras and Panama.

[b] AI: Adaptability index. Ratio of the percentage of total exports accounted for by dynamic sectors to the percentage represented by non-dynamic sectors. Dynamic sectors are defined as those in which world demand for their export products is growing faster than it is for products on average.

[c] X_HMT/X: Percentage of total exports consisting of medium- and high-technology manufactures in 2007 based on the classification developed by Lall.

[d] EXPY: Indicator of export sophistication, computed as the average PRODY (weighted by export share). This latter indicator is the average (weighted by each country's revealed comparative advantage) per capita income level of the countries that export a given product. The indicator was calculated for 2008.

[e] EIS: Index of the relative share of high-technology sectors in total manufacturing output as compared to the level of technological intensity in the United States (2005). For this indicator, South America includes Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Ecuador, Peru, the Plurinational State of Bolivia and Uruguay, while Central America includes Costa Rica and Panama, and the mature economies are France, Italy, Japan, Sweden and the United Kingdom.

[f] Patents: Patents issued by the United States Patent and Trademark Office (USTPO) per million inhabitants; 1990-2010 average.

[g] R&D: Expenditure on R&D as a percentage of GDP for 1996-2009. The averages are computed on the basis of the available data for each country in each year.

[h] Developing Asia" includes China, Hong Kong SAR, Indonesia, Malaysia, the Philippines, the Republic of Korea, Singapore and Thailand.

[i] Mature natural-resource-intensive economies" denotes a group of countries with high per capita GDP in which exports intensive in natural resources account for over 30% of total exports: Australia, Denmark, Finland, Ireland, New Zealand and Norway.

[j] Mature economies" denotes France, Germany Italy, Japan, Sweden, the United Kingdom and the United States.

The high values for medium- and high-technology exports (X_HMT/X) registered for Mexico and Central America stand out. Mexico's indicator for this variable is higher than those of the mature natural-resource-exporting economies and similar to those of the developing economies of Asia. These results are in keeping with the fact that the AI and EXPY indicators are better for Mexico and Central America than they are for South America. They do, however, appear to run counter to the results for the other technological capacity and structural change indicators shown in table II.2. This is because the high values for X_HMT/X in Mexico and Central America are heavily influenced by exports from their free trade areas and those sold under special re-export regimes that allow for the temporary importation of inputs for exports; these values are therefore attributable to low labour costs rather than to knowledge intensity. The low values for the other variables (such as patents, relative productivity and EIS) attest to the absence of capacity-building. In short, these indicators, taken as a whole, show that the region's production structure is less efficient in both Keynesian (growth) and Schumpeterian terms than a large sample of other countries.

These findings provide a picture of the general trend of structural change in different regions and in the three largest Latin American economies. In order to look beyond the averages, however, it is important to analyse individual countries (see table II.3). When this is done, it can be seen that the country-level analysis corroborates the findings at the regional level. None of the Latin American countries —not even the most industrialized ones, such as Brazil and Mexico— has an EIS indicator equal to the EIS indicator for the European countries, even though many of the latter, such as Denmark, Finland or Norway, are small economies that export a significant portion of natural-resource-based products. Brazil, which has the most highly developed industrial sector in the region, and whose population and resource endowments have made it one of the biggest economies in the world, has a lower EIS indicator than Australia does. Argentina, which is often compared with Australia, is far behind it in terms of the share of output accounted for by engineering. A small economy that has been extremely successful in bringing about structural change, such as Finland, has an engineering sector that accounts for a similar share of its total output to the engineering sector in the United States. This is also true of the Republic of Korea, which is perhaps the most emblematic case of convergence in the post-war period. The region's low EIS ranking shows up its weakness in terms of dynamic efficiency; in its effort to change its production patterns, Latin America clearly still has a long way to go.

Table II.3
SELECTED COUNTRIES: RELATIVE SHARE OF ENGINEERING ACTIVITIES IN THE AGGREGATE VALUE OF THE MANUFACTURING SECTOR (EIS), RELATIVE PRODUCTIVITY AND EXPY

	Relative share of engineering activities (EIS) [a]	Relative Productivity [b]	EXPY [c]
Argentina	0.40	26	10.4
Brazil	0.64	12	11.2
Chile	0.17	20	8.9
Colombia	0.24	n.a.	9.9
Mexico	0.64	20	12.5
Uruguay	0.18	n.a.	10.4
Australia	0.67	59	12.3
Denmark	0.87	78	14.0
Finland	0.94	73	15.0
Norway	0.76	101	10.8
Republic of Korea	1.07	38	14.8

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT online database [http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp/] and Competitive Analysis of Nations (TradeCAN) software.

[a] EIS: Index of the relative share of high-technology sectors in total manufacturing output as compared to the level of technological intensity in the United States (2005).

[b] Relative productivity: Labour productivity relative to its level in the United States, 2001-2010 average.

[c] EXPY: Indicator of export sophistication, computed as the average PRODY (weighted by export share). This latter indicator is the average (weighted by each country's revealed comparative advantage) per capita income level of the countries that export a given product. The figures correspond to 2008.

The same is true of relative productivity, which is much lower in Latin America. The poor performance of Brazil in this respect is striking and probably is a reflection of the huge differences between one region and another within that country. Some of the regions in Brazil have undergone very intensive structural changes (the South and Central-South regions) and have seen their production structures become much more diversified and complex, while other regions have lagged far behind. While the problems posed by inequalities and structural change certainly do have an external dimension, they also have a domestic one, and that domestic dimension is the source of the countries' heterogeneity.

The situation in the Caribbean is also very uneven. Four of the largest Caribbean countries (Belize, Guyana, Suriname and Trinidad and Tobago) export natural-resource-based products; the others (including Jamaica) have differing combinations of assembly industries, tourism (especially the Bahamas, Barbados and the countries of the Organization of Eastern Caribbean States (OECS)) and, in some cases, financial services. In the long run, the chief structural change in the subregion has been the shift from agricultural production (e.g. sugar cane and bananas) to these kinds of services. Between 1990 and 2010, the share of total output accounted for by agriculture fell by nearly two percentage points, and this descent was not offset by the small increase in the share of manufacturing production (see table II.4). Instead, the services sector was the greatest driver of GDP growth in the subregion during that period. In addition, the loss of preferential treatment and competitiveness strengthened distribution activities compared with production.

Table II.4
THE CARIBBEAN: TOTAL GDP GROWTH AND GROWTH BY ECONOMIC SECTOR, 1990-2010
(Percentages)

	Agriculture	Industry	Services	Total
		Share of total GDP		
1990-1999	11.4	26.9	61.9	100.0
2000-2010	9.5	27.4	63.2	100.0
		Sectoral growth		
1990-1999	0.8	2.8	3.0	
2000-2010	-0.6	2.7	3.0	
		Contribution to total GDP growt [a]		
1990-1999	0.1	0.8	1.9	2.7
2000-2010	-0.1	0.7	1.9	2.6

Source: World Bank, World Development Indicators [online database], and Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official figures.

[a] The contribution to GDP growth is calculated as the percentage of GDP multiplied by the corresponding sector's growth.

The Caribbean countries' integration into the international market, as measured by the ratio of exports of goods and services to GDP, climbed from 46% in 1990 to 55% in 2008, with that increase being a direct result of the performance of Trinidad and Tobago. The increased share in GDP of foreign trade was the net result of two quite different trends: while the growth of exports of goods outpaced GDP growth between 1990 and 2008, services exports rose more slowly (ECLAC, 2010b, chapter IV).

The qualitative change in these countries' position in the international market is reflected in the decline in the share of total exports represented by commodities from 42% in 1985 to about

37% in 2000, while the share of fuels and manufactures rose by a corresponding amount. In the latter category, the share of exports accounted for by the more technologically sophisticated products had stood at 6% in 1985, but had fallen to 1.4% by 2000, with no significant changes having been witnessed since then (Alleyne and Lugay, 2011). The export structure has also become much more concentrated: the 20 main products that represented 51% of total exports in the mid-1990s amounted to 70% of the total in the mid-2000s. The share of total exports represented by tropical goods (bananas, rum and sugar) shrank a great deal after the European Union put an end to the non-reciprocal trade preferences which it had been granting to Caribbean countries, along with countries in Africa and the Pacific.

4. Natural resources and dynamic efficiency

As in the case of other debates relating to development theory, the controversy surrounding the role of natural resources has moved from antagonistic positions towards a convergence of views. A brief overview of that debate will be given in the following paragraphs, along with a description of the common ground that has now been reached.

Until the mid-2000s, there were two opposing positions in the debate around natural resources and development. According to one school of thought, natural resources can be seen as a factor of production, just like any other. Countries with a generous endowment of such resources should specialize in them in order to capitalize upon the comparative advantages that they offer. This provides them with the foundation they need in order to position themselves efficiently in the world economy, and there is no reason why they should be afraid to embrace the type of specialization associated with an abundant endowment of any given factor of production, be it natural resources, physical capital or human capital. In contrast, and as mentioned in chapter I, other authors have focused on the negative growth effects of "Dutch disease": appreciation of the exchange rate, the rising cost of some factors of production (including labour) and the corresponding decline in the profitability of other tradables, whose production then ceases to be viable. The loss of such sectors is coupled with the loss of technological and production capacities that are important for long-term growth. This is all compounded by the corruption that often accompanies the capture and distribution of rents from the exploitation of natural resources. The literature on the "natural-resource curse" illustrates this view quite clearly (Sachs and Warner, 2001; Gylfason, 2004).

Another issue that figures in the debate is the adverse effect on income distribution of a reliance on natural resources. These resources are often owned by a select few, and wealth therefore tends to be more concentrated in a society that is heavily dependent on them. Since growth tends to be curbed by a concentration of wealth (Alesina and Rodrik, 1994; Cimoli and Rovira, 2008), this is yet another means by which natural resources stunt growth.

The effect that a concentration of income and the appreciation of the exchange rate have on consumption patterns has been less thoroughly discussed. The subject of consumption patterns in highly unequal societies and their effects on savings and production patterns was pioneered by Celso Furtado and emphasized by other Latin American authors, including, in particular, Fernando Fajnzylber (1983). These authors note that the more sophisticated consumption patterns developed in the advanced countries arose in conjunction with the development of technological and production capacities. In Latin America and the Caribbean, on the other hand, different consumption patterns have spread much more rapidly than technological and production capacities have. The imitation of advanced-country consumption patterns by the elite and upper-middle class in Latin America may have adverse impacts on accumulation, either by dampening increases in savings or because those patterns entail a very large component of imports and may therefore put pressure on the balance of payments.[13] Moreover, as access to consumer credit increases, more and more sectors of the population begin to adopt these consumption patterns. This leads to a contradictory situation in which, on the one hand, consumption patterns tend to converge and, on the other, wide productivity and income gaps between countries and between social groups within each country persist. This gives rise to what Fajnzylber called "showcase modernization", that is, a superficial type of modernization in which the objects produced by technologically more advanced countries are absorbed but the institutional, technological and learning patterns that made their production possible are not.[14] This happens, for example, when environmentally sustainable consumer goods and practices are simply imported but the endogenous capabilities required to use the associated production technologies are not developed.

The empirical evidence provided in the literature on natural resources in the past few years points to a number of factors that need to be taken into account. The first is that the presence or absence of natural resources does not, in itself, determine whether there will be more or less growth. In the long run, income convergence with developed countries has occurred as production diversifies. The significance of the role played by natural resources in promoting or hindering such diversification should therefore be an important consideration when evaluating their contribution to the development process

The second is that there have been a fairly large number of cases of Dutch disease around the world (Sinnott, Nash and de la Torre, 2010).[15] This occurs when macroeconomic prices (especially the real exchange rate and the unit cost of labour) depresse the relative profitability of tradables that are not directly linked to natural resources. To avoid this effect, structural and macroeconomic policies need to be put in place that will shift the relative price structure in favour of these goods. In other words, a boom in natural-resource exports will endogenously generate a relative price structure that will need to be corrected by proactive structural and macroeconomic policies in order to avert Dutch disease. A particularly important consideration to be taken into account when designing such policies is that, in Latin America and the Caribbean, Dutch disease has a financial, as well as commercial, dimension. This financial dimension is what Ros (2012) has dubbed the "Mexican disease". High levels of liquidity in international financial markets have, at various points in time, played a very important role in fuelling currency appreciation.[16]

[13] Hysteresis effects may ensue from certain types of consumer behaviour: when external credit is widely available, imported goods tend to be substituted for locally produced ones, and subsequent changes in the exchange rate may not be enough to reverse that process. This is especially true in elite groups, which have access to more sophisticated products. However, because of the increasing spread of consumer electronics produced in Asia, this phenomenon is being found in more and more sectors of society. Not a great deal is yet known about how this works and, given its potentially strong impact on the dynamics of productive accumulation, more research is clearly called for.

[14] The relationship among income distribution, consumption patterns and industrialization incentives has already been incorporated into conventional models.

[15] Even outside the context of the development debate, the literature on the determinants of international trade draws a clear distinction between static and dynamic comparative advantages and underscores the need to ensure that the former do not drown out the latter.

[16] Unlike export booms, short-term capital inflows are in some cases associated with an increase in foreign-currency debt or greater exchange-rate volatility, which are more likely to destabilize growth.

The third factor is that natural resource ownership and the generation, appropriation and distribution of the associated rents (i.e. their governance) differ across countries. The problems surrounding natural resources (especially energy and mineral resources) in terms of corruption and rent-seeking are an extremely important political economy issue. Rent-seeking behaviour is not confined to natural resources, of course, and its existence was one of the arguments commonly used against the protection of industry in Latin America in the 1960s and 1970s, since it was felt that protection generated rents and prompted management or owners to be more concerned with capturing those rents than with raising productivity. Rent-seeking is also a major factor behind the huge profits made in financial markets both within the region and elsewhere. The entry of short-term capital flows in pursuit of financial rents has much the same effect as natural resource endowments do in terms of the appreciation of the currency and the resulting negative impact on the production structure.

In the case of mining, hydrocarbons and, often, land, resource ownership is concentrated in very few hands. In many cases, the State owns all or a large share of these natural resources (this is the case of oil in Argentina, the Bolivarian Republic of Venezuela, Brazil, Ecuador and Mexico, the case of natural gas en the Plurinational State of Bolivia and the case of copper in Chile). In other cases, large domestic or foreign corporations own these resources and have to be taxed in order for the State to obtain a portion of the rents. Creating institutions that are capable of capturing these earnings and of contributing to the learning process, diversification and capacity-building is one of the most important policy challenges to be met in order to prevent outbreaks of Dutch disease.[17] These rent appropriation mechanisms can be a very important source of funding for the public policies that will be discussed in chapter VI.

The phrase coined by Nugent and Robinson (2010) —"endowments are not fate"—sums up the preceding discussion and implies that natural resources may be a curse or a blessing, depending on what institutions and policies each country chooses. Both the capture and use of rents and the creation of a relative profit structure that does not hamper the growth of non-resource-based tradables are tasks that need to be approached by means of institution-building and policy design.

The process of structural change requires diversification into other activities not directly based on natural resources. For example, if diversification encompasses engineering firms that are working for the mining sector in a given country, the activity in question will be growing with the help of the mining sector but will require capabilities and knowledge that are not spontaneously generated by that sector. The same is true, for example, if diversification moves towards manufacturing components or machinery used in mining production. In both cases, although a close relationship with the competitive base provided by the corresponding natural resource remains, there is a qualitative leap in terms of the type of production capacity and the physical and human capital involved, as well as in terms of the ensuing technological trajectory. These capabilities and technological paths will be very different from those associated with the initial production base, and they may give rise to other new activities and products that may be even further removed from that base. Moreover, the existence of a certain degree of diversification at the outset may be an important factor in determining the intensity of the upgrading and the

[17] A classic problem in collective action theory is that small, organized groups that have a great deal to win or lose if a given law is passed will be more influential than a large number of persons who will benefit from that same law only marginally.

interaction with natural-resource-based sectors. Initial diversification facilitates interaction. The capacities generated by Petrobras in Brazil, which started out from what was already a diversified industrial platform, is one example.

The technological potential of natural-resource-intensive sectors has changed with the advent of new technological paradigms and especially with the introduction of information and communications technologies (ICTs). ICTs have opened up windows of opportunity for developing countries, given the size of their agricultural and mining industries (Pérez, 2008). But in order to take advantage of these opportunities, developing economies have to build new capacities in areas where their pool of knowledge has generally been quite small. The performance of traditional sectors is increasingly tied to capacity-building in leading-edge sectors.

Access to ICTs, their appropriation and their use are all part of a system in which complementarities play a crucial role. For example, although the widespread introduction of mobile telephony in rural areas of Latin America and the Caribbean is allowing agricultural enterprises in the region to leap-frog stages of technological development, the fact remains that income levels, levels of education and the integration of producers into value chains and networks continue to constrain ICT access. In addition, the spread of "technology packages" in which ICTs are embedded in agricultural machinery and expert services acts as a catalyst for the dissemination of technology in the sector. Be all this as it may, the rate of technology adoption and the successful introduction of new technologies continue to depend on the development of domestic capacity that will enable producers to select, implement and utilize these technologies correctly and to interact with them and learn from them (Rodrigues and Rodríguez, 2012).In order to develop linkages, a sector must make the transition from activities that are primarily users of innovations to ones that produce them and that are therefore capable of redefining the conditions for growth, efficiency and competitiveness.

The findings presented in this section mirror the matrix of development patterns discussed in chapter I, which pointed up the existence of an "empty box" that signals the absence in Latin America of cases in which employment and productivity have risen in tandem over a sustained period of time. Within that matrix, a virtuous-cycle pattern was closely associated with structural change. The indicators show that, in those cases where there has been a virtuous cycle (as in the Republic of Korea and the European natural-resource-intensive mature economies), there has been a very rapid shift in production patterns towards knowledge-intensive activities that have close linkages with the economy as a whole. The outcome has been increasing employment coupled with stable GDP growth and ongoing productivity gains. Figure II.2 and table II.2 together show that a virtuous pattern (employment and productivity) is associated with a production structure that has a high level of dynamic efficiency.

5. Sustainable development and structural change

In Latin America and the Caribbean, new, more environmentally sustainable consumption patterns are taking shape, but they have not been accompanied by corresponding changes in the production structure. These new patterns have arisen, in large measure, as an imitation of the more advanced economies' responses to the evidence of increasing environmental constraints.[18] In these countries and, more recently, in others such as Japan and the Republic of Korea, greater environmental awareness has emerged, and concerns with environmental sustainability have been incorporated into new knowledge- and technology-intensive sectors. This opens up an opportunity for the region to meld Keynesian (or growth) with Schumpeterian efficiencies with a view to protecting the environment.

The structural change associated with this greater awareness of the need for environmental sustainability fits in with the development of dynamic comparative advantages based on production activities that are both more knowledge-intensive and less intensive in polluting emissions and materials. There is a debate about the confluence of the new paradigm of technological and structural change with environmental parameters (the "green economy").[19] The varying interpretations of what this term actually means, along with differences across countries in terms of their ability to implement the required changes, have made it difficult to reach a consensus. In order for a true green economy to function, an accumulation process must be in place capable of shaping a new technological paradigm. Many developed countries have advanced in this direction and accumulated significant technological capabilities which have further widened the gaps between them and the developing countries.

Targeted action has to be taken to find a way of resolving contradictions which cannot be worked out through the endogenous forces of the market process. Although the problem is by no means a new one,[20] up to now, environmental sustainability has not been assigned priority in the short term. In Latin America and the Caribbean, the prevailing development style is based on a production structure whose static comparative advantages are founded upon the exploitation of an abundant supply of natural resources, and this channels investment, innovation and technological development in that direction, as well as fostering energy (and especially fossil-fuel) intensity. This is why there is such a strong correlation among GDP growth, energy consumption and emissions of pollutants (see figure II.3). This bias towards the dominant pattern, together with a failure to internalize the costs associated with the deterioration of natural resources and ecosystems, has held back the move towards the types of structural change that would bolster more efficient, more knowledge-intensive and less environmentally harmful activities.

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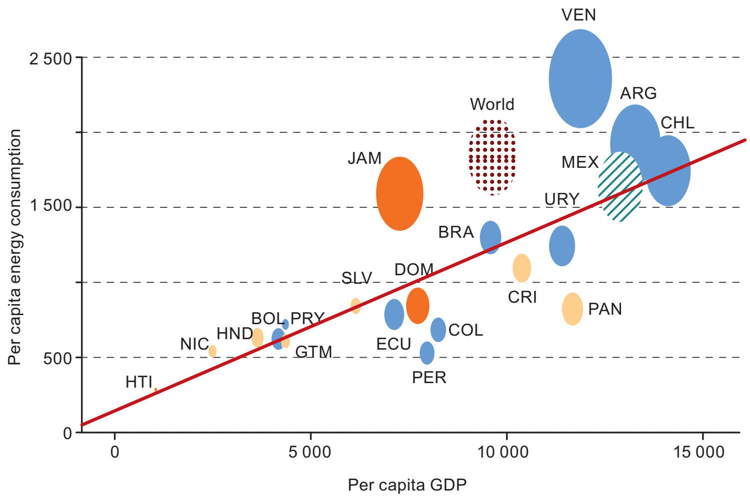
18 Climate change is the greatest (global) and more irreversible constraint, although there are other more local and regional ones as well. For the purposes of the discussion presented in this study, they will all be referred to as "environmental" constraints.

19 For example, the Republic of Korea launched a US$ 38 billion fiscal stimulus package designed to boost the development of 27 technologies closely linked to new green-economy sectors. In the Latin American and Caribbean region, on the other hand, incentives are predominantly targeted at building upon the energy-hungry and emissions-intensive development path. For a detailed analysis of policies aimed at bolstering sustainable development during the recent crisis, see Barbier (2011).

20 Prebisch (1980) observed that: "The exceptional impetus of the last few decades, up to recent times, was the effect not only of impressive technical progress, but also of the irrational exploitation of natural resources, especially energy, which, in turn, markedly influenced the orientation of techniques; [….]. It is only in recent times that technological research has concerned itself at all with the harm inflicted by technique on the environment. Such is the ambivalence of technique: its immense contribution to human welfare by virtue of the continuous increase in productivity, and, at the same time, its serious effects on the biosphere" (Prebisch, 1980).

Figure II.3
LATIN AMERICA: PER CAPITA GDP AND PER CAPITA ENERGY CONSUMPTION, 2008[a]
(Kilograms of oil equivalent and 2005 purchasing power parity dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, World Development Indicators (WDI) [online database] http://databank.worldbank.org/.

[a] The size of the circles indicates the level of each country's per capita emissions. The colours correspond to the different subregions: blue: South America; red: Central America; orange: the Caribbean.

Current production and consumption patterns are unsustainable because they generate huge economic, social and environmental costs which undercut their own medium- and long-term material foundations (Stern, 2007; de Miguel and Sunkel, 2011). Projections to 2020 indicate that, unless the private and public sectors take joint action to bring about a thorough-going technological change, the countries' current growth path will lead them to a situation in which they are faced with ever-greater environmental constraints and will be forced to take more drastic measures (see figure II.4).

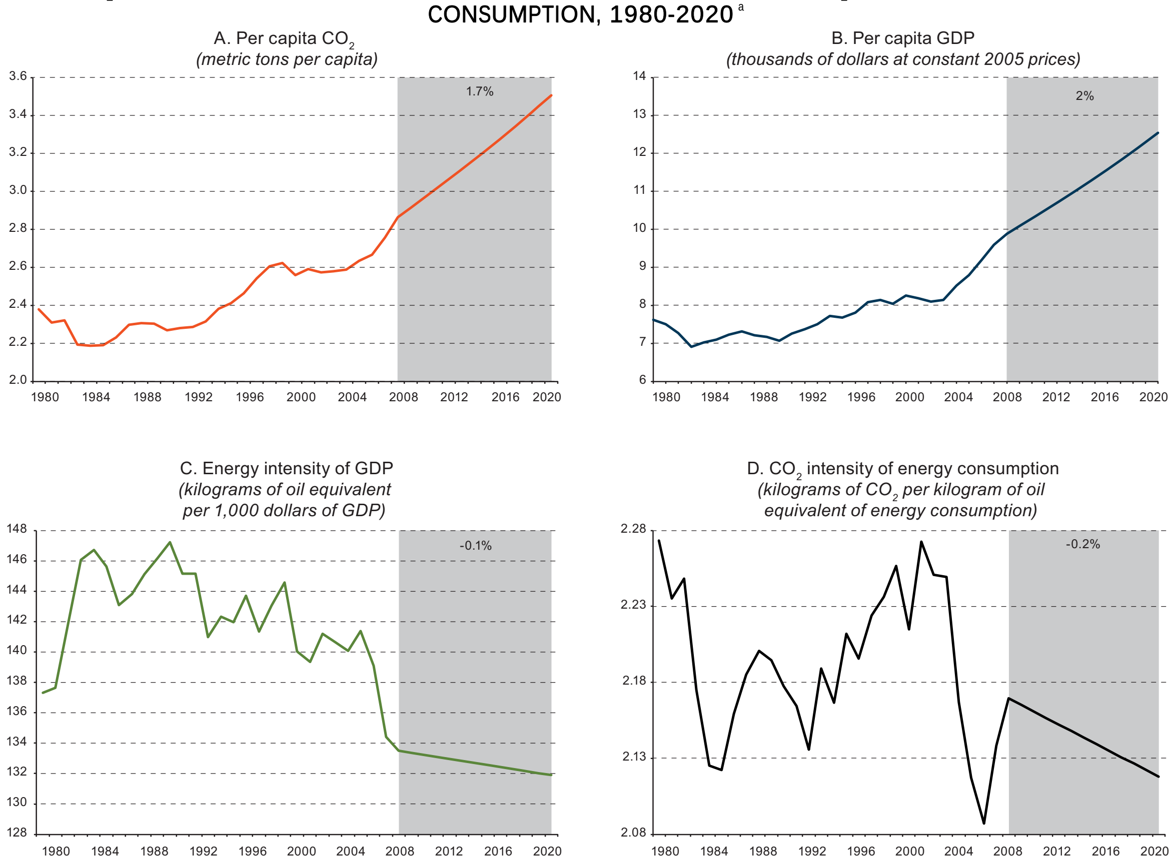
The sustainable development challenges faced by the region have become more formidable in recent decades as the evidence of global climate change continues to mount (IPCC, 2007). The aim of sustainable development on a basis of equality is to achieve economic growth through higher productivity growth, while curbing or reversing the destruction of natural assets and of the ecosystems in which they are found. As a result, the virtuous path of growth based on structural change, as proposed in this document, takes into account the negative externalities of production and the intergenerational cost of the deterioration of natural resources and ecosystems. A key strategic direction of industrial policy is to promote structural change that is compatible with environmental sustainability.

Environmental issues are now on the public agenda, thanks more to increasingly strong demands from the public than its inclusion on the economic agenda. The Latin American and Caribbean region is blessed with a very generous endowment of natural capital and biodiversity and has great potential as a provider of environmental services.[21] It therefore has the natural features that it would need to lay the foundation for structural change that will lead it towards sustainability and innovation, provided that it adopts the appropriate policies (United Nations, 2012).

21 Latin America and the Caribbean harbour one third of the world's renewable water resources and 12% of the world's arable land surface, account for one third of the world's bioethanol output, nearly 25% of its production of biofuels and 13% of its petroleum. The region has 65% of the world's reserves of lithium, 49% of its silver, 44% of its copper, 33% of its tin, 32% of its molybdenum, 26% of its bauxite, 23% of its nickel, 22% of its iron and 22% of its zinc; it accounts for 48% of the world's soy output and 21% of the world's natural forests. In addition, it is rich in biodiversity, with 6 of the world's 17 megadiverse countries: Bolivarian Republic of Venezuela, Brazil, Colombia, Ecuador, Mexico and Peru.

Figure II.4

LATIN AMERICA AND THE CARIBBEAN (21 COUNTRIES): BUSINESS-AS-USUAL SCENARIO FOR PER CAPITA CO_2 EMISSIONS, PER CAPITA GDP, ENERGY INTENSITY OF GDP AND CO_2 INTENSITY OF ENERGY CONSUMPTION, 1980-2020 [a]



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank statistics on greenhouse gas emissions (tons of carbon equivalent), energy consumption, per capita GDP measured by 2005 purchasing power parity dollars, the energy intensity of GDP (kilogram of oil equivalent per 1,000 dollars of GDP) and carbon intensity of energy consumption (kilograms of CO_2 per kilogram oil equivalent of energy consumption).

Note: The shaded parts are projections.

[a] Includes Argentina, Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Plurinational State of Bolivia, Trinidad and Tobago and Uruguay. For the purposes of the simulation, an annual GDP growth rate of 2% was used, and it was assumed that current energy-to-GDP and emissions-to-energy ratios remain constant.

Many Latin American economies have succeeded in sustaining growth despite the global slowdown, which has opened up opportunities for closing environmentally-related technological gaps. Clearly, the lion's share of expenditure on innovation and development and on patents that will contribute to environmental sustainability (renewable energy sources, electric and hybrid motor vehicles, energy-efficient buildings, water and waste treatment, etc.) is accounted for by Europe, Japan and the United States, but it is nonetheless true that the region has been in the vanguard of some technological innovations that are capitalizing on its natural resources and wealth of ecosystemic resources in ways that have positive social and environmental implications (see box II.1).

Box II.1

TECHNOLOGICAL INNOVATION FOR SUSTAINABLE STRUCTURAL CHANGE IN LATIN AMERICA

One of the most important developments in the global biofuels market is the possibility of producing ethanol from sugar cane. This is a very different type of ethanol from the ethanol that is produced from maize; it is more efficient to manufacture because it requires fewer inputs, is more energy-efficient and does not detract from the country's food security (BNDES/CGEE, 2008).

Brazil is an outstanding example in this respect. Its sugar-cane bioethanol programme is coming up with very promising results, ranging from research into high-yield varieties of sugar cane to the production of motor vehicle engines that can run on any mixture of gasoline and ethanol. The country's efforts in this direction were given a boost by the national PROALCOHOL programme of the 1970s, and this industry now employs some 500,000 people. Brazil has become a technological leader in this respect that others look to as an example and has developed synergies between sugar-cane biotechnology and the automotive industry that feed into supply and distribution infrastructure. Some of these innovations are now being used in other countries of the region as well.

Another example is the National Commission for Knowledge and Use of Biodiversity (CONABIO) in Mexico (Sarukhan and others, 2010), which developed a remote sensing system for the detection of forest fires. In 1998, an extraordinarily hot year worldwide, around 850,000 hectares of forest were lost in that country. In response, in 1999 Mexico launched the Hotspot Remote Sensing Detection Programme. This system receives satellite images eight times each day that are used to detect thermal anomalies, which usually signal forest fires. The report is sent electronically to firefighters in every state in Mexico in under 40 minutes. This system has reduced the damage caused by forest fires by over 30% by making it possible to mount an early response that reduces both the danger to human lives and the damage done. This capacity has been made available to the Central American countries as well, since the CONABIO satellite images include their territories. Outside the region, Germany is using this methodology to detect hotspots in Europe.

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Brazilian Development Bank (BNDES)/ Centre for Strategic Management and Studies (CGEE), *Bioetanol de caña de azúcar: Energía para el desarrollo sostenible*, Rio de Janeiro, Economic Commission for Latin America and the Caribbean (ECLAC)/United Nations Food and Agriculture Organization (FAO), 2008; and information provided by the National Commission for Knowledge and Use of Biodiversity (CONABIO) of Mexico.

In the cases discussed in box II.1, as well as in other outstanding examples in the region,[22] the State has provided leadership and vision for these efforts. In order to speed and expand the diffusion of sustainable technology, the countries will have to reinstate the central role of public policy based on a system-wide perspective. Price signals will have to be altered in order to permit further structural change and to advance beyond showcase modernization.

The blending of dynamic (Keynesian-growth and Schumpeterian) and environmental efficiencies requires changes to the existing incentive system, so that the region's patterns of specialization in production can be modified, new sectors can be opened up for sustainable development and the region's vulnerability to future environmental constraints can be reduced. These efforts need to be coupled with a consolidation of institutions in order to put in place proactive environmental policies that send out proper price signals and internalize externalities.

From the standpoint of Schumpeterian efficiency, greater opportunities for investing in clean (e.g. low-carbon) technologies can spur long-term economic development. An intensive, fast-paced effort in this direction can generate comparative advantages over the medium and long terms. If this is not done, future demands on the part of developed countries (for example, the reduction of carbon footprints) will nonetheless make these changes necessary, but they will then have to be brought about in a more disadvantageous, costly and reactive manner (Samaniego, 2010). If the global transition to a more environmentally friendly economic system is to work to

[22] Examples include biomedical and biotechnological research, the medical uses of copper manufactures, experimentation with new materials, bioplastics, the systematization of knowledge about biodiversity and appellations of origin in international trade.

the region's advantage, the region will have to build its industrial, scientific and technological capabilities and systemic competitiveness (ECLAC, 2008).[23]

In the environmental goods and services market, the region is confronted with some constraints both in the development of competitive advantages based on technological advances and innovation and in the achievement of competitive cost levels (even if using mature technologies) in production and service delivery. Even so, a region that is very diverse in natural resources and that can draw upon its indigenous peoples' vast knowledge about the use of biodiversity and ecosystems has a competitive advantage which, if it understands its value and uses it wisely, can allow it to reduce poverty, protect the environment and create cutting-edge, internationally competitive sectors of activity.

The region has an opportunity to close infrastructure gaps by making use of sustainable inputs and products, particularly in the areas of transport, water and sanitation, housing and energy, which will help to improve the living conditions of the poorest sectors of society. While making the transition to sustainable infrastructure is a matter of urgency in many parts of the region, it is even more so in the areas that are most vulnerable to the effects of climate change.[24] While many ways of building environmentally sustainable infrastructure are inclusive and beneficial for those involved, the countries must nonetheless deal with a number of institutional shortcomings and obstacles in implementing them.[25]

Incomplete urbanization processes offer production opportunities that can be merged with advances in environmental protection. The construction of sustainable "smart cities" can also help to engender a better, more efficient and more competitive business environment that is also more flexible in terms of structural change. This type of environment can engender social benefits that will act as incentives for new types of demand.[26]

In sum, given the need to make the transition to a development model founded on the principle of equality that can permit progress to be made in terms of social development, economic growth and environmental sustainability at one and the same time, the region and the entire world are confronted with an imperative for change. The establishment of a paradigm of sustainable development with equity can go hand in hand with structural change if active policies and effective economic management systems are put in place that reflect the true cost of environmental degradation, biodiversity loss and large carbon footprints that are putting global climate security at risk.

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[23] The United Nations Conference on Trade and Development (UNCTAD) has explored the potential of "green growth poles" as focal points for the promotion of energy efficiency, agriculture and renewable energy sources, as well as of low-carbon foreign direct investment (UNCTAD, 2010).

[24] The region is highly vulnerable to natural disasters, which will increase in intensity as climate change progresses. The cost of their impacts and of adaptation will be high, and the region would therefore stand to gain from a determined effort to reach a global emissions mitigation agreement that took signatories' differing levels of development into account. If global CO_2 emissions are to be reduced enough to stave off a climate crisis of unknown consequences for human life and the planet's ecosystems, current patterns of production, transport, consumption, energy use, land use and urban planning will have to be changed radically.

[25] The authorities frequently adopt piecemeal, short-run solutions rather than opting for more sustainable types of infrastructure as a consequence of institutional failings, the existence of supply networks that have taken shape under the influence of a regulatory framework that does not take externalities into account, high interest and discount rates, the brevity of political cycles and the pressure exerted by a growing population with basic unmet needs.

[26] The low-carbon infrastructure of smart cities opens the way for high-quality public transport, housing that incorporates new technologies and new types of materials, efficient water and energy use, efficient waste disposal, and urban planning systems that take areas prone to the impact of natural disasters into account.

C. International specialization and long-term growth

1. Externally balanced growth

In chapter I, it was shown that, in order for growth to be sustainable over the long run, export and import patterns should keep the current account deficit in relation to GDP within manageable levels (Moreno-Brid, 2003; Alleyne and Francis, 2008; Thirlwall, 2011). The line of causation will be traced below.

Limited diffusion of technical progress (at the international level and within developing economies, for the reasons outlined in section B.1) leads to a fairly undiversified production structure in which exports are largely made up of just a few commodities and which does not internalize the more knowledge-intensive activities involved in their production. When evaluated taking a long-term view, the goods in which the region specializes exhibit a low income-elasticity of demand for exports (ε). This long-term trend does not, of course, preclude more favourable short-term situations determined by the commodity lottery.

On the other hand, the generally undiversified nature of the production structure also means that the income elasticity of demand for imports (π) is very high. More specifically, the absence of linkages in its production matrix means that the region is heavily dependent on imports for investment and capital accumulation. This pressure on imports is augmented by highly imitative consumption patterns.

Thus, the most important determinant of elasticities is the way in which the production structure responds to internal and external demand. A high income elasticity of exports (ε) compared with the income elasticity of imports (π) is associated with a production structure that successfully adapts to worldwide and national demand in dynamic goods and services markets or segments. By contrast, where exports are much less income-elastic than imports, the current account deficit will tend to expand relative to GDP during high-growth periods (McCombie and Thirlwall, 1997; Blecker, 2011). Although the deficit can sometimes be supported by foreign capital inflows in the form of foreign direct investment, portfolio investment or debt flows, financing an expanding current account deficit will prove difficult in the long run, especially in a world in which international financial markets are highly volatile. The behaviour of elasticities is therefore an important indicator of an economy's capacity for externally balanced growth; the larger the ratio of elasticities, the higher the rate of balanced growth, all other factors being constant.[27]

The ratio of the income elasticities of exports and imports (ε/π) is determined by a number of factors, including the domestic and external production structures, demand patterns, technological patterns, the existence or absence of trade barriers, the nature of export financing mechanisms, and the types of tariff and non-tariff protective measures that are in place. The level of the real exchange rate and its volatility can also affect elasticities by influencing the production structure, especially the proportion of tradables produced relative to non-tradables, as will be seen in section D.

The important point here is that there are structural factors which underlie the trends in these elasticities: the response of imports to growth and the ability to keep the balance by achieving an

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27 See Rodríguez (1997) and Thirlwall (1979). Thirlwall (2011) has observed that this ratio had already been pointed out, in a statistical context, by Roy Harrod.

equally strong increase in exports (one that is capable of pulling the entire production apparatus along with it on a high-growth path) is a dynamic that is associated with the complexity, diversification and knowledge-intensity of the production matrix. In order to create a production structure with dynamic efficiency, industrial policies need to be put in place with a view to building up endogenous technological capabilities (Cimoli and Porcile, 2011) (see annex I.2).

More knowledge-intensive activities and sectors need to be internalized and the basket of goods and services that the region's economies produce needs to change in order to reduce the technological and productivity asymmetries that exist between the region and the rest of the world. The diversification and upgrading of the production structure open up more opportunities for international specialization in intra-industry trade.[28] Conversely, a very marked concentration in the production of a limited number of homogeneous, non-knowledge-intensive products reduces the scope for specialization. A higher level of knowledge-intensity in the production structure does not act as a substitute for trade, but instead opens up a broader range of trade opportunities and enhances the benefits of specialization.

2. Elasticities and the production structure

This section will take a look at how the income elasticities of the exports and imports of the various subregions and economies of the region have changed over time. An analysis of the cases of South America and Central America will be followed by an examination of the three largest Latin American economies —Argentina, Brazil and Mexico— using a different methodology (the multisectoral model of Araujo and Lima (2007) and Gouvea and Lima (2010)) to relate income elasticities of exports and imports to structural change. The multisectoral model has two important advantages: first, it makes it possible to observe the differences in the income elasticities of demand of the different sectors (classified by their degree of knowledge intensity); and, second, it makes it possible to analyse how changes in the export and import structure affects the income elasticity of exports and imports.[29]

(a) Elasticities by subregion

In South America the income elasticity of imports increased significantly at three different points in time (see figure II.5). The first was during the initial cycle of external borrowing, which was associated with the expansion of international liquidity in the second half of the 1970s. The features of this cycle, as well as the effects of capital inflows on the exchange rate and the production structure, have already been discussed in chapter I. As will be seen later on, changes in

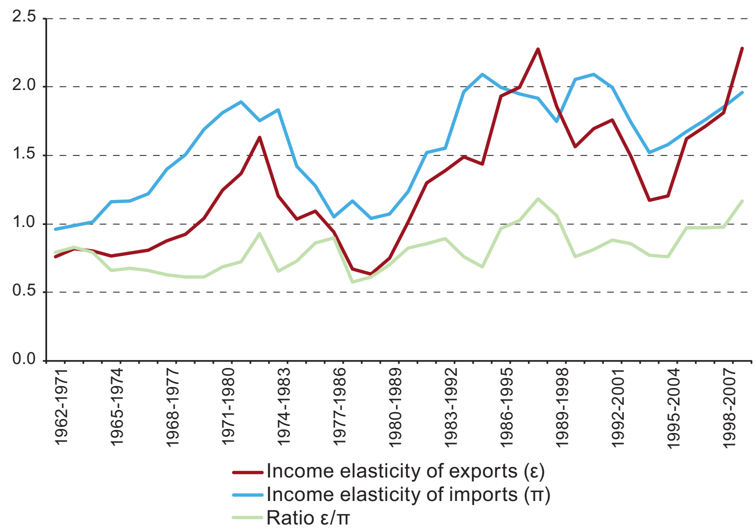
[28] In the early 1960s, ECLAC was drawing attention to the need to diversify exports, especially of manufactured goods. Prebisch (1986, pp. 212-213) recalled that he first criticized exaggerated forms of protectionism in 1961 in his treatise entitled *Economic Development, Planning and International Cooperation*. That same year, Prebisch noted that all industrialization activity was being directed towards import substitution while opportunities for industrial and new commodity exports were being neglected. He went on to observe that the common regional market and the development of industrial export trade among Latin American countries would lower production costs and open up opportunities for some industries to export to the rest of the world. He concluded by saying that policy incentives and cooperation with the major central economies could leverage this process.

[29] The elasticities for South America and Central America were estimated using the recursive regression methodology proposed by Pacheco and Thirlwall (2007) and the statistics for exports and imports of goods and services available in CEPALSTAT. The data used to analyse the sector-by-sector composition of exports and imports as input for the multisectoral model are from the United Nations Commodity Trade Data Base (COMTRADE), which contains statistics on trade in goods, but not trade in services.

the production structure (particularly those that entail the loss of tradables sectors as a result of exchange-rate appreciation and volatility) resulted in a weaker (less integrated) production matrix with higher income elasticities for imports.

Figure II.5

SOUTH AMERICA: INCOME ELASTICITIES OF IMPORTS AND EXPORTS, MOVING AVERAGES, 1962-2007



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp/.

Imports plummeted in the 1980s as a result of the debt crisis and the depreciations that occurred in its wake (along with the downturn in investment). In the late 1980s and early 1990s, however, once the region had regained regular access to external credit (with the advent of a new cycle of trade liberalization, exchange-rate appreciation in some countries and a more generous supply of external capital), there was another upswing in the income elasticity of imports which brought it to even higher levels than those seen in the 1970s. Although it is difficult to determine exactly what the main cause of this steep rise was, the production sector's domestic capacity had been hard-hit during the "lost decade" and at this point was unable to respond to economic growth trends as it had done in the past. More specifically, as a consequence of the downturn in investment in the 1980s, domestic supply capacity in the 1990s was weaker, not only in terms of installed capacity, but also in terms of the technology needed to compete in a world where the pace of technical progress had accelerated.

The income elasticity of exports is generally lower than the income elasticity of imports, but, towards the end of this period, it climbed so sharply that the quotient of these elasticities was greater than unity. The lack of any industrial policy in most of the South American countries in the 1990s and subsequent years impeded a further diversification of production and of exports of goods and services.

The decrease in the income elasticity of imports in the 1980s and late 1990s did not stem from the existence of greater domestic linkages or from diversification into more knowledge-intensive sectors but rather from the contraction in investment and consumption sparked by the countries' need to service their debts. This entailed a cost in terms of the accumulation of physical, human and technological capital that dampened the next growth cycle.

A high income elasticity of imports should be a cause of concern only if it is not counterbalanced by a high income elasticity of exports. What is important is the relationship between the two variables. Thus, a steep increase in imports should be matched by a commensurate rise in exports in order to avert cumulative imbalances. It is particularly important to strike a balance in the ratio of current account deficit to GDP. In order to obtain the potential benefits of international trade in the form of increasing returns, technology and knowledge, the best possible scenario for a country is to sustain strong growth in both imports and exports, in line with long-term external equilibrium.

This virtuous-circle pattern of integration into external markets did not occur in South America. With the exception of a brief period in the late 1980s and first half of the 1990s, the income elasticity of exports was lower than the income elasticity of imports. As a result, the ratio of the two was generally less than unity. Towards the end of this period, the new demand patterns that arose from rapidly growing Asia (especially China) began to spur exports of natural resources. The income elasticity of exports rose accordingly, and the ratio of elasticities improved, approaching unity in the late 2000s.

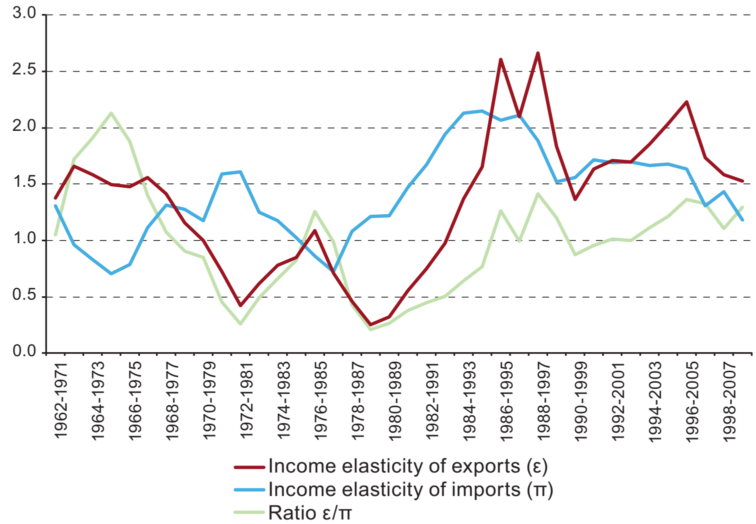
In the case of Central America, a strong improvement in the income elasticity of exports was seen in the 1960s as subregional integration efforts gained ground. Later on, in the 1970s, the ratio of elasticities fell sharply as the pace of growth in the world economy slackened and protectionism increased in the developed world. This was a time when the subregional integration process failed to make further headway and, in some cases, actually lost ground. In the mid-1980s, the income elasticity of imports and, later, of exports began to climb quite steeply. The income elasticity of exports increased more quickly, with the ratio rising to a level greater than unity by the 2000s. The reason for this change lies in the greater diversification of the production structure in Central America with the expansion of free-zone assembly industries, other non-traditional agricultural exports and investment in services such as tourism.[30] Meanwhile, however, a negative shock was generated by the deterioration in the terms of trade triggered by higher natural resource prices and competition from Asia in labour-intensive industries.

In sum, the combination of sweeping changes in the global economy and the domestic policies put in place by the countries of the region has caused the income elasticities of exports and imports to change over time. In South America, the income elasticity of exports remained below that of imports until the mid-2000s. In Central America, there has been a greater diversification of exports, and this has had a positive effect on the ratio of elasticities, which has stood above unity since the late 1990s.

30 Although trade statistics do not include remittances from Central Americans working in the United States, these remittances are becoming increasingly significant in reducing vulnerability in the balance of payments.

Figure II.6

CENTRAL AMERICA: INCOME ELASTICITIES OF EXPORTS AND IMPORTS, MOVING AVERAGES, 1962-2007



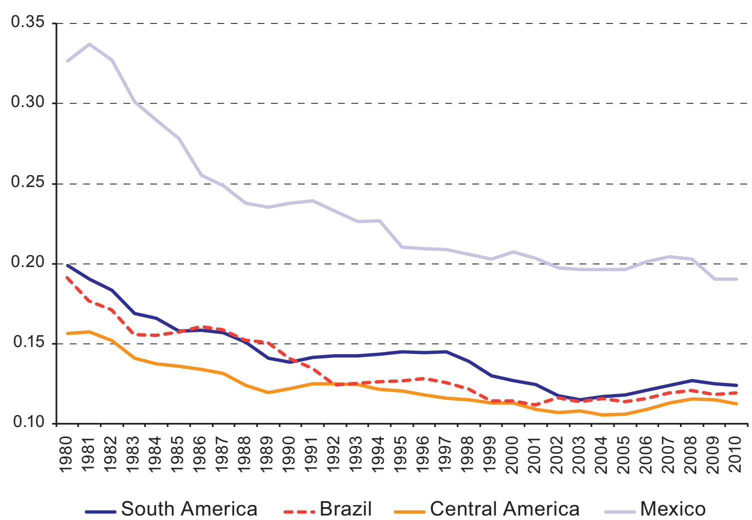
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp/.

(b) Parallel changes in the production structure

Changes in income elasticties are closely tied with changes in the production structure. This can be seen by looking at two of the indicators used in the preceding section: relative productivity (using the United States as a benchmark) and the number of patents per million people. Two factors stand out when relative labour productivity in Latin America is compared with that of the United States (see figure II.7).

Figure II.7

LATIN AMERICA: RELATIVE LABOUR PRODUCTIVITY COMPARED WITH THE UNITED STATES, 1980-2010



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp/; World Bank, World Development Indicators [online database] http://databank.worldbank.org/; Organization for Economic Cooperation and Development (OECD), The Labour Force Survey (MEI) [online database] http://stats.oecd.org/, 2012.

The first is the downward trend in relative labour productivity up to 2004, which widened the gap between the region and the United States. This occurred in both South America and Central America. The upward trend observed since 2004 is encouraging, but still quite tentative. A portion of the economic literature supports the view that, initially, the existence of some technological lag can be good for a country because it opens up opportunities for diffusion and convergence via technological spillovers. The data suggest, however, that not enough of this type of diffusion has occurred in the region to narrow the productivity gap. Increasing returns to technological innovation in advanced countries are actually widening their advantage over less technologically sophisticated countries. As stated earlier, imitation is not a simple or passive process but instead demands a huge investment in the learning process, and this type of effort has not been in evidence in the region, or, at least, not to the extent that would be necessary to reduce the gap.

The second is that the downward trend in relative productivity is not linear. Crisis periods (the 1980s and 1998-2002) trigger decreases from which these economies do not manage to fully recover afterward. In a world where technology is advancing so swiftly, a long, drawn-out crisis is not just a temporary setback, and a country that is lagging behind may not be able to regain the level of productivity that it had before the crisis. Figure II.7 illustrates the fact that post-crisis recoveries have fallen short of pre-crisis productivity levels, thereby generating this downturn in relative productivity. The post-2004 recovery shows positive Kaldor-Verdoorn effects at work, but there is a great deal of ground to be regained.

As for the other indicator, there has been an upward trend in the number of patents per million people since the late 1990s, with this trend being stronger in South America (see figure II.8). This upswing has been far smaller than in other world regions, however, and especially than in Asia. The patents taken out in the Republic of Korea for this period were not included in the figure because they are so much higher than anywhere else. In fact, in the early 1980s, the Republic of Korea had only one third as many patents per million people as Mexico did; in 1990, it had 10 times as many as Mexico did; and by the late 2000s, it had over 350 times as many.[31]

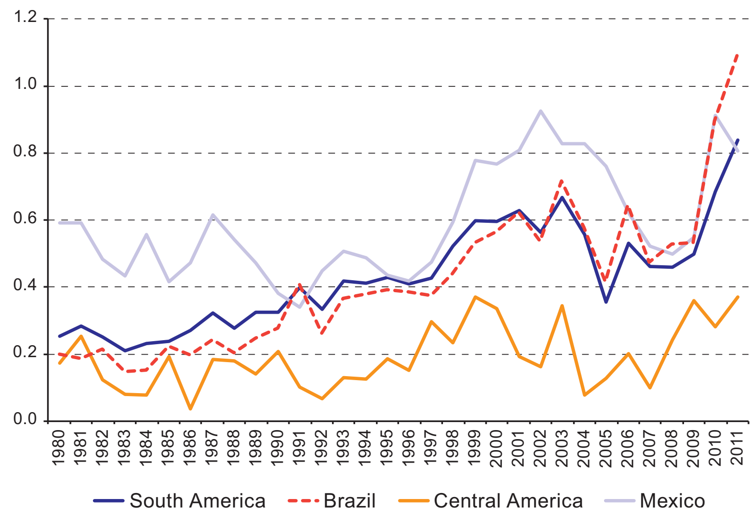
The “'Red Queen Paradox'” is in full swing: one has to run in order to stay in the same place. Latin America has not run fast enough, and the indicators on structure, productivity and the learning process attest to this.

The downturn in relative productivity in Central America and the low number of patents in that subregion reflect the fact that the upswing in the ratio of the elasticities of exports and imports in Central America is in large part a result of its free-zone exports, which generate few production or technological linkages with the rest of the economy. Thus, while diversification has had a positive effect on exports from Central America, the subregion is still faced with an industrial policy challenge. South America is confronted with a similar challenge, since the improvement in the ratio of its elasticities towards the end of the period under study is not a reflection of endogenous capacity-building either. Instead, this is the outgrowth of new patterns of global demand that have galvanized its traditional export markets. In other words, the higher quotient of elasticities in South America in recent years is a result of endogenous capacity-building and convergence in the Asian —not the Latin American— economies, which have (at least for the time being) redrawn the global trade map in a way that has benefitted the region’s natural-

[31] Mention has already been made of biases inherent in the use of the number of patents per million inhabitants as an indicator of technological capacity. Be that as it may, the trend in that indicator simply confirms, in a much more striking form, the situation as depicted by trends in relative productivity.

resource exporters. South America has yet to take up the challenge of converting the exogenous growth impulses generated by Asian demand into endogenous changes in its production patterns that will enable it to internalize long-lasting economic development forces.

Figure II.8
LATIN AMERICA: NUMBER OF PATENTS PER MILLION PEOPLE, 1980-2011



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of figures from the United States Patents and Trademark Office (USPTO).

(c) Argentina, Brazil and Mexico: a multisectoral model

An analysis of economic aggregates does not provide a clear enough picture of the link between structural change and elasticities. This link can be seen more clearly by its effects on the trade structure. In this subsection, the cases of Argentina, Brazil and Mexico (the region's three largest economies) will be analysed using a multisectoral model in which products are divided (using Lall's classic classification (2002)) into five categories: primary products (or commodities), resource-based manufactures, low-technology manufactures, medium-technology manufactures and high-technology manufactures (Gouvea and Lima, 2010; Jayme, Moreira and da Cunha, 2007). As noted in the literature, this classification suffers from some significant biases and limitations, but its results nonetheless provide useful information that contributes to a better understanding of the structural foundations of external vulnerability. The analysis shows that these three economies share certain features but also diverge from one another in significant ways. Some of their shared characteristics will be examined below.

One of these common elements is that the income elasticities of export demand are higher in medium- and high-technology sectors than they are in other sectors. This fits in with the idea that Keynesian (or growth) and Schumpeterian efficiencies go hand in hand with one another. The lowest elasticities are found in commodity sectors, while the elasticities for resource-intensive manufactures are, on average, very similar to those for low-technology manufactures (see table II.5 and annex I.3). Changes in the income elasticities of exports are associated with increases in medium- and high-technology sectors' shares of total exports. Information on trends in the income elasticities of exports and imports (and their ratio) and in the composition of exports and imports, classified into five product groups, for three countries of the region and two benchmark countries is available in annex I.4.

Table II.5
ARGENTINA, BRAZIL AND MEXICO: INCOME ELASTICITY OF EXPORTS, BY SECTOR, AVERAGE 1962-2008 [a]

Sector	Commodities	Resource-based manufactures	Low-technology manufactures	Medium-technology manufactures	High-technology manufactures	Other	Mean
Argentina	0.70	1.05	0.95	1.72	1.48	0.90	1.13
Brazil	0.75	1.41	1.26	1.91	2.15	1.54	1.50
Mexico	1.30	1.22	1.54	2.27	2.03	1.31	1.61
Mean	0.92	1.23	1.25	1.97	1.89	1.25	1.41

Source: Economic Commission for Latin America and the Caribbean (ECLAC).

[a] Elasticities are estimated on the basis of cointegration regressions.

Another is the sizeable increase in the income elasticities of import demand in the 1990s that occurred for reasons that have already been discussed: the abandonment of earlier policies designed to spur structural change without having introduced a new industrial policy package to take their place, a rapid process of trade liberalization in conjunction with an appreciation of the countries' currencies, and the impact that the downturn in investment had on the production structure during the lost decade of the 1980s.

There are also significant differences among these countries that stem from their implementation of differing industrial and macroeconomic policies during certain periods. The policies adopted by these three countries in the 1970s are one example. Argentina embarked on a first attempt at trade and financial liberalization in 1976-1981 that was cut short by the debt crisis, while Brazil, during the same period, made inroads in import substitution and export promotion.[32] The situation in Mexico in the 1970s represents an intermediate case, since Mexico neither pursued the implementation of substitution policies nor adopted a liberalization policy like Argentina's, while the discovery of vast oilfields allowed Mexico to become a major oil exporter in the second half of the 1970s.

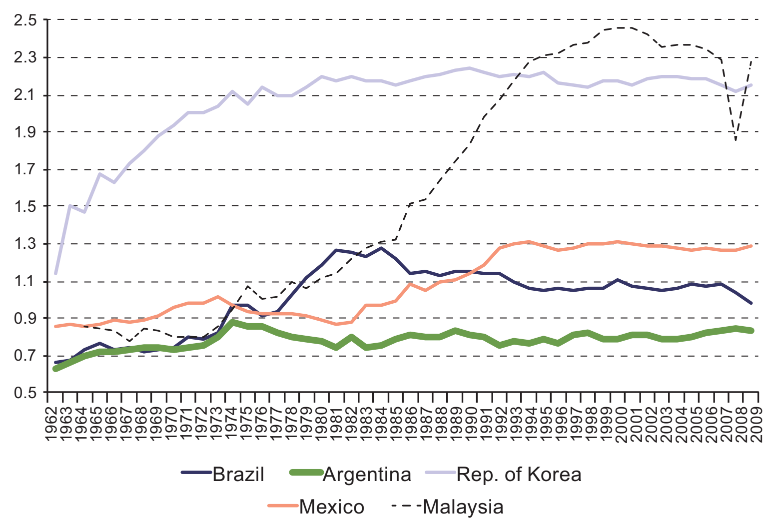
Considerable differences can also be seen in the 1990s. Between 1990 and 2002, Argentina implemented a fixed exchange-rate regime in combination with a trade liberalization policy. The real exchange rate appreciated sharply and the tradables sector had to make a radical adjustment (described in chapter I as a "defensive adjustment"). In Brazil, the exchange rate also appreciated while the Real Plan was in place (1994-1999), but to a lesser extent because Brazil was using a more flexible exchange-rate regime. In addition, even though industrial policy lost ground in Brazil, as in other countries of the region, some policy instruments, such as the financing from the National Bank for Economic and Social Development (BNDES), remained in place. All of these factors helped to avoid as sharp a drop in the ratio of elasticities as was seen in Argentina in the 1990s. In the case of Mexico, the factor that set it upon a different track from the path followed by Argentina and Brazil was its involvement in the North American Free Trade Agreement (NAFTA) starting in 1994. The major adjustment effort that this required, along with the special regimes introduced to spur imports for re-export, boosted the elasticities of both exports and imports. Since the response of imports was less robust, the ratio of elasticities rose during the 1990s.

[32] In 1974 (in response to the first oil shock and the ensuing worldwide recession), Brazil adopted a more thorough-going import-substitution policy under its second national development plan. It drew upon the abundant supply of international credit that was available in the second half of the 1970s to invest heavily in the establishment of highly capital- and scale-intensive intermediate and capital goods sectors.

Finally, trends in the income elasticity of exports and imports also diverged in the 2000s. The income elasticity of exports in Argentina trended upward in the latter part of the period under study, while it fell in Brazil. This could be accounted for by the sharper appreciation of Brazil's currency and its effects, from one time period to the next, in terms of the decline in the production of goods that compete with imports. In Mexico, the shift towards free-zone exports was clear to see, together with a considerable increase in the income elasticity of exports. It should not be forgotten, however, that these exports' production linkages with the Mexican economy are rather weak, and they therefore have a less positive impact on growth than they would otherwise have.

A comparison of these results with the figures for two Asian countries —the Republic of Korea and Malaysia— (see annex I.4) points up a number of interesting trends, including a rapid increase in higher-technology exports and the rising ratio between the income elasticities of exports and imports. The ratio of elasticities is over 3.5 in Malaysia and is nearly 4 for the Republic of Korea, whereas this same ratio is less than unity in Argentina and is only slight greater than unity in Brazil (see figure II.9).

Figure II.9
ARGENTINA, BRAZIL, MALAYSIA, MEXICO AND REPUBLIC OF KOREA: ELASTICITY RATIOS, 1962-2009



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official figures from United Nations Commodity Trade Database (COMTRADE) and World Bank, World Development Indicators.

Note: The elasticity ratio is equal to the income-elasticity of exports divided by the income-elasticity of imports.

In short, the estimate of income elasticities for exports and imports reflects changes in the weight of sectors having differing technological intensities. In addition, structural changes lead to changes in the composition of exports and imports over time that reshape the income elasticities of the economy as a whole (which are a weighted average of the elasticities in the various sectors). These compositional changes are the result of the interaction between external shocks and policies which alter the pattern of specialization. The paths followed by the countries of the region in this respect differ, depending on their industrial policies, macroeconomic policies and institutions. In the long run, an increase in the ratio of elasticities will be associated with an improvement in their economic performance, and a comparison between Asian countries and the region's three largest economies confirms this. Meanwhile, caution should be used in interpreting the results. A growth rate that is in keeping with long-term external equilibrium entails variables that are not strictly related to trade, and the existence of free-zone exports can lead to an inaccurate assessment of the technological capacities associated with a given production structure.

D. Real exchange rate and patterns of specialization

Balance-of-payments shocks affect macroeconomic performance and growth through a number of channels. These include exchange-rate appreciation during capital inflow and commodity booms and sharp depreciation and overshooting in times of crisis, both of which drive up the volatility of the exchange rate and relative rates of return. Other channels are procyclical lending and interest rate behaviour and the impacts of microeconomic adjustments on learning trajectories, on the installed capacity utilization rate and on employment.

These factors will be discussed in greater depth in later chapters. This section looks at one in particular, the real exchange rate (RER),[33] which has played a key role in defining specialization patterns and the direction of structural change (Cimoli, 1992). This role has been discussed in recent literature on growth and structural change (McMillan and Rodrik, 2011; López and Cruz, 2000; Frenkel and Taylor, 2006; Frenkel and Ros, 2006; Bresser-Pereira and Gala, 2008; Frenkel and Rapetti, 2011). The impacts of RER level and stability are not neutral from one sector to another: a higher RER can favour goods-producing sectors with higher knowledge content for two reasons. First, because it favours tradable goods and services, many of which have higher technology content than the non-tradable goods and services most commonly found in developing economies, where commerce and unskilled personal services account for a significant share of the economy. The second reason has to do with the drivers of the competitiveness of different types of goods. Natural-resource-intensive goods continue to be exported even at very low exchange rates, because their competitiveness depends chiefly on resource endowment. Conversely, RER is crucial in sectors whose competitiveness relies on technological capacities, and in which productivity gaps work to the detriment of the region's firms. A competitive, stable RER allows new entries into activities where technological asymmetries exist (as long as they are not too large).[34] Lastly, the literature suggests that exchange-rate stability has a substantial impact on growth (Schnabl, 2007).[35] Volatility worsens uncertainty and depresses investment, especially in tradables. A highly volatile exchange rate represents a barrier to the large investments needed to enter into business in foreign markets.

The outcomes of two econometric exercises are described below (see details in annex I.5). The first exercise consists of three dynamic panel regressions performed for 111 countries for the period 1965-2005, using export concentration as the dependent variable (measured in three different ways, using the Gini, Theil and Herfindahl indexes: GI, TI and HI, respectively). In the

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33 In this section, the real exchange rate is defined as RER = P*e/P, where P* is the level of international prices, e is the nominal exchange rate (dollars per unit of local currency) and P is the level of prices in the relevant economy. There are different ways of defining the real exchange rate, and these will be discussed and used in chapter IV. This section uses the bilateral real exchange rate against the dollar, as in the Penn World Tables published by the University of Pennsylvania.

34 Empirical evidence tends to confirm that RER plays a role in the diversification and technology content of exports. For example, Freund and Pierola (2008) emphasize the role of the exchange rate in the emergence of new export products, which is in turn associated with rapid growth periods. Eichengreen (2008) concludes that a competitive RER boosts growth by providing an incentive to shift resources into manufacturing, which immediately raises productivity. Similar findings are reported by Sekkat and Varoudakis (2000); Berg and Miao (2010); and Rodrik (2008).

35 See also Eichengreen and Leblang (2003).

second exercise, the dependent variable was the weight of medium- and high-technology sectors in total exports (according to Lall's classification) for 110 countries over the same period. The explanatory variable was the level of RER and control variables included stocks of physical and human capital and the influence of natural resource endowment captured through indicators of agricultural, energy and mining stocks. Accordingly, the role of RER is discussed alongside the impacts of factor endowment, as traditionally proposed by international trade theory. Including a proxy for natural resources also allows us to assess whether the "curse" effect of natural resources exists from the point of view of diversification.

The control variables also included the economy's per capita GDP, as a proxy for efficiency, and its degree of economic openness ((X+M)/GDP) to control for the effect of protectionist policies or other barriers to trade that might affect the composition of trade flows. The proxy for trade openness also helps to isolate the effect of country size, since larger countries tend to have a lower ratio for (X+M)/GDP. The main conclusions of the exercises were as follows.

- Export diversification responded positively to RER. In all the model specifications and for all the diversification indicators used (Gini, Theil and Herfindahl indexes), RER was positively and significantly associated with export diversification (lower Gini, Theil and Herfindahl values). The results are therefore very robust.[36]
- The technology intensity of exports (reflected in the weight of medium- and high-technology sectors in total exports) was also positively associated with RER. This result, too, was found to be robust for different model specifications.
- Human and physical capital promote export diversification and a higher proportion of technology-intensive exports. This has to with greater supply capabilities, the prevalence of technology and the scales of the production process across a broad spectrum of manufactures. The effects of the control variables representing accumulable factors of production were not robust for all specifications, however.
- The regressions showed that the inertial component, or path-dependence, was an important factor in diversification. The more concentrated exports were at the starting point, the greater the tendency for them to remain so in the following period; the larger the proportion of medium- and high-technology sectors at the starting point, the larger it will be in the following period. The weight of the inertial component confirms the persistence of the pattern of specialization over time and is consistent with the idea that short-term shocks have long-term effects. There is a very strong thesis of rigidity in capacities, specialization patterns and structural change in the evolutionist strand of technical progress theory. The evidence found supports that perception and sends a clear signal in terms of policies, since it confirms their role in correcting limited diversification. Policies are necessary to counteract the endogenous forces that tend to reproduce existing patterns.
- Natural-resource endowments —arable land and energy and mineral resources per capita— tend to reduce diversification and the weight of the medium- and high-technology sectors in total exports. But this effect disappears —in the case of minerals and agriculture, but not for energy resources— when human capital is used as a control variable.

[36] These results coincide with ECLAC (2007), although that study used different indicators.

How may we interpret the ambiguous impacts of natural resources on export diversification and knowledge-intensity? They may be read in the light of the discussion in the previous section, which argues that natural resources are not per se either a curse or a blessing. They have a negative effect only when they reduce an economy's human capital endowment, i.e. when their rents are not channelled towards education and training. Conversely, when the effect of the human capital endowment is is controlled by including it among the explanatory variables, the negative influence of arable land on diversification and knowledge content of exports turns positive. Likewise, the negative effect of mineral resources on export diversification and knowledge-intensity ceases to be significant when the effects of human capital endowment are filtered out. In other words, the "curse" effect of natural resources exists only where they have a negative impact on capacity accumulation, especially on human capital.

Using RER as a policy instrument can cause problems on other fronts and a rise in the RER is not always conducive to growth. A first point to consider is that the real exchange rate cannot depreciate in all countries simultaneously. RER is a useful instrument for developing economies during a certain period and within certain limits, but it imposes costs on the rest of the world, with the risks —visible today— of exchange-rate wars, especially when large economies resort to competitive devaluation. A win-win situation for all countries would require globally coordinated growth policies. Unless expansion is coordinated and the costs of adjustment are distributed proportionally among countries with trade surpluses and deficits, the resulting trade tensions may prompt countries to defend their trade interests through protectionist measures (Cimoli, Dosi and Stiglitz, 2009).

A second point to consider is that a higher RER is often associated with falling real wages. Exchange-rate depreciation boosts competitiveness by reducing the unit cost of labour, thereby lowering real wages at given productivity levels. At least in the short run, therefore, a policy aimed at keeping RER competitive can compromise the equity objectives of economic policies. In the medium term other effects emerge: (i) export expansion may generate processes of leaning, investment and economies of scale that raise competitiveness, and raise real wages over time; (ii) formal employment levels may rise significantly, increasing the share of workers in national income by lifting them out of the informal and subsistence sectors. In this regard, it bears mentioning that the positive effects of rising formal employment on productivity and real wages over the medium and long terms would be felt earlier if education and investment were bolstered through industrial policies. Accordingly, industrial policies for structural change are needed to relieve the dependence of output and employment growth trajectories on RER. This issue is discussed in detail in chapter VI.

In other words, without a competitive RER, industrial policies cannot conquer external markets or appropriate their benefits in terms of scale and productivity; but policies basing competitiveness only on RER lead to long periods of spurious competitiveness and persistently high inequality. This brings us back to a point mentioned in chapter I: the importance of macroeconomic policies and industrial change policies acting together to sustain a virtuous growth pattern.

A third and final factor to consider in the management of RER is the possibility of inflationary effects. Economies with a higher RER tend to grow more, but also experience higher inflation (Frenkel, 2008). This not only has distributive implications, but also offers cause for concern in economies with a high-inflation history, like many in the region.

Even with these caveats, a competitive RER remains a variable for policy strategy. At the least, the international experience and the literature clearly suggest that economies should avoid exchange-rate appreciation associated with short-term capital inflows and international liquidity cycles, which have underlain several of the worst crises in the region since the mid-1970s. Lastly, RER volatility has a negative impact on growth, as discussed in the international literature (for example, see Eichengreen (2008) and Bello, Heresi and Pineda (2010)).

Summing up, a higher RER is associated with a more diversified export structure and a larger proportion of medium- and high-technology sectors (a proxy, albeit an imperfect one, for knowledge-intensive goods) in total exports. Natural-resource endowment promotes the concentration of exports in fewer commodities, but this effect disappears (except in the case of energy resources) when human capital is filtered out. Diversification and change in export composition require production and technological capacities to be built up over time and gaps with the technology frontier to be narrowed. RER is no sure guarantee of this outcome, and can generate other tensions in the global economic system, as well as unwanted distributive effects. Exchange-rate policy should therefore be closely associated with industrial policy to stimulate progress towards authentic competitiveness.