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TRADE OPENNESS AND TECHNOLOGICAL GAPS IN LATIN AMERICA: A 'LOW GROWTH TRAP'

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2002/14 **June 2002**

ISSN (online) 2284-0400

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Mario Cimoli and Nelson Correa*

INTRODUCTION

For the past quarter-century, the Latin American countries have been undergoing a process of structural adjustment which has included, among other actions, the elimination of the trade barriers adopted during the import substitution-based industrialization phase, the privatization of large domestic firms and the deregulation of the labour and financial markets. Regarding trade, the view of most policy makers and the more orthodox academics was that openness would enhance opportunities and was crucial for industrialization and growth in developing countries (Krueger, 1980, 1997; Srinivasan and Bhagwati, 1999).

Several years into this process, it may be acknowledged that the link between trade liberalization and growth is not working the way it should. The poor results of liberalization as a strategy for supporting a prosperous growth path are now evident and the weakness of this link is not merely a pathology specific to certain countries and/or historical situations. Rather, it is a widespread pattern in the region. Most of the Latin American countries have been unable to achieve the growth rates that prevailed in the import substitution period (Rodríguez and Rodrik, 1999; ECLAC, 2000; Ocampo, 2003).

In a general sense, development economists such as Prebisch, Nurkse and Kuznets anticipated this outcome. They asserted that trade liberalization and export promotion strategies would not necessarily sustain accelerated rates of growth and that trade could not be a sustainable engine of growth if the domestic market was not adequately developed and expanded. Moreover, they stated that heavy dependence on demand from developed economies could be a trap for less developed countries that were unable to develop their endogenous technological capabilities or to capture domestically the benefits of technological change (Prebisch, 1950; Nurkse, 1953; Kuznets, 1980).

International obstacles to growth are also identified in orthodox views regarding gains from trade. For example, the theory of comparative advantage states that nations with differing endowments of capital, labour and natural resources will gain by specializing in those areas where their relative costs of production are low and importing in those areas where their relative costs are high. Furthermore, the greater the differences in endowments between countries – and the differences between rich and poor countries are indeed great – the bigger the gains from trade are likely to be. However, in order to specialize in products with high value added and not be simply a source of low-wage labour and production for economically advanced countries, a country must have the capacity to absorb and retain talent, to produce new knowledge and,

* We are particularly indebted to O. Altimir, R. Buitelaar, G. Dosi, H. Escaith, M. di Maio, J. Moreno, J.A. Ocampo, W. Peres and G. Stumpo for their many valuable comments on previous drafts. This version has been much improved by the helpful suggestions of an anonymous referee. The usual caveats apply.

finally, to reduce the gap separating it from the technological frontier (Dosi, Pavitt and Soete, 1990).

Latin America's poor growth performance in the wake of liberalization strategies encapsulates a complex set of issues related to the role played by the trade balance, the specialization pattern and the process of accumulating technology. Latin America's balance of payments can act as a serious constraint on the attainment of faster growth. The acceleration of growth to rates closer to those of other countries has caused imports to grow more rapidly than exports and has weakened the mechanisms that relate exports to domestic growth. Thus, as the region becomes more dependent on exogenous demand for its exports, bottlenecks have arisen as the aggregate level of imports continues to exceed the capacity to export.

At a more micro level, this situation raises major questions concerning the accumulation of domestic technological capacity in Latin America and the gap that these countries exhibit with respect to the international productivity frontier (Cimoli and Katz, 2001; ECLAC, 2002). New patterns of production specialization and trade have emerged, with knowledge-intensive industries losing ground as a proportion of GDP while non-tradable activities, natural resource processing industries and "maquila"-type assembly operations (catering mostly to United States markets) increase their share. The "sources" of technological change and productivity growth have shifted significantly, with a rapidly increasing share of external "sources" emerging at the expense of domestic ones. Thus, the development of new ways of linking sectors and firms with foreign sources of know-how – and with the rapid diffusion of information technologies – has affected the pattern of accumulation of technological capacity in terms of structure and performance. As a result of these factors, the relative technology gap vis-à-vis the world's "best practice" frontiers has become smaller only in selected enclaves.

Building on these ideas, this paper presents an analysis of the growth pattern in Latin America and of how it depends not only on balance-of-payments conditions and the characteristics of the specialization pattern, but also on differences in technology and the capacity to capture the latter's benefits. The differences in technology will be introduced as one of the main variables that determine growth potential through the effect of what will be referred to here as the *technology gap multiplier*. In line with this approach, the analysis will also demonstrate that the incentives created by trade liberalization do not necessarily stimulate a virtuous path and that the growth rate must be reduced if trade equilibrium is to be preserved. Higher growth rates are possible only if there is an increasing deficit on the trade balance. The analysis will also show that a virtuous link between exports and growth requires an accelerated and cumulative capacity to reduce the technology gap in relation to more advanced economies.

The first section presents a simple model incorporating the technology gap into the traditional view that emphasizes the Harrod multiplier as a determinant of long-run growth potential. Section 2 introduces evidence on the functioning of liberalization strategies and their effect on growth performance. Section 3 discusses the dependency between exports and domestic growth and introduces the difficulty of reducing the technology gap as the main reason for the low growth trap that the region faces today. The fourth section of the paper presents, at a more micro level, a description of the variables that explain the current gap in technological capacity

and offers an overview of how the region came to specialize increasingly in knowledge-poor activities. The final section summarizes the findings and presents conclusions.

1. Openness, technology and growth: a simple model

The model presented is a simplified version of the one in Cimoli, Dosi and Soete (1986) and Cimoli (1988, 1994). Its main characteristics can be viewed not only in terms of modelling methodologies, but also in terms of how some properties of trading patterns and the asymmetries between them are considered. They can be summarized as follows. The first element relates to the national consumption pattern and trade specialization, which are approximated by the income elasticity of imports. The second stresses the importance of technology "gaps", which are approximated by differences in productivity growth. The last is the balance of trade, which determines the growth rate differential between trading economies, as has emerged from the Harrod trade multiplier and the well-known Kaldorian export-based models (Harrod, 1933; Kaldor, 1966, 1975; Dutt, 2001; Lawson, Palma and Sender, 1989; McCombie and Thirlwall, 1994; Thirlwall, 1979, 1997).

Recalling the original expression of the Harrod trade multiplier and including in it the technology gap (see appendix A), our trade multiplier may be expressed as:

$$\dot{y} = \frac{\Psi}{\varepsilon}\dot{x}$$

$$\psi = \dot{\pi}/\dot{\pi}^*, \text{and } \varepsilon = \dot{m}/\dot{y},$$

where

$\dot{y}$ is the income growth rate,
Ψ is the technological gap multiplier,
$\dot{\pi}$ is the productivity growth rate in the home country,
$\dot{\pi}^*$ is the productivity growth rate at the technological frontier,
ε is the income elasticity of imports,
$\dot{m}$ is the import growth rate,
Ψ/ε is the trade multiplier,
$\dot{x}$ is the export growth rate attributable to the growth of world demand and the income elasticity of demand for exports.

The above equation tells us that the rate of growth of domestic income which ensures macroeconomic equilibrium in an open economy is a function of domestic exports and the parameters reflecting the technology gap and import elasticity. In this sense, this equation can be taken as a formalization of Harrod's foreign trade multiplier, as revived by Kaldor and Thirlwall. Our approach differs from the latter, however, since it includes a proxy for the technology gap. That is, changes in domestic income are not only a function of foreign income and demand for imports, but are also dependent on the productivity gap and on the domestic capacity to upgrade

technology and diffuse it massively throughout the production system. When $\Psi=1$, the productivity growth rate is the same in the domestic and foreign economies. Thus, if Ψ is greater than 1, the domestic economy is reducing the gap with respect to the foreign one. Conversely, when Ψ is less than 1, the gap between the domestic and foreign economies is increasing. In the literature on technology and trade, ψ has been called the *technological gap multiplier* (Cimoli, Dosi and Soete ,1986; Cimoli, 1994).

This idea concerning the technology gap reflects the contributions of the 1960s in the field of technology and trade (Posner, 1961; Freeman, 1963; Hirsch, 1965; Hufbauer, 1966; Vernon, 1966). This approach has stressed international *asymmetries in technology* as the main determinant of trade flows and patterns of specialization. Technology is characterized as a good that is not free and that gives an important advantage to the first innovator country. Moreover, in a dynamic context, asymmetries in levels of technology and innovation capacity largely account for the evolution of each country's pattern of specialization and growth capacity. In Posner (1961), the pattern of trade is explained by countries' initially asymmetric access to technological knowledge in a world characterized by similar demand patterns. In this context, trade between countries will continue if differences in their respective abilities to innovate and imitate persist. After a certain interval, most countries can imitate the new commodity and restore technological parity, thereby eliminating the basis for trade. Freeman (1963) and Hufbauer (1966) have stressed the differences between the factors that determine specialization before and after the imitation process takes place. Thus, during the innovation process the effects of patents, commercial secrecy and static and dynamic economies of scale are the main determinants. However, once imitation occurs, the traditional process of adjustment in production cost and competitiveness will determine the specialization. In Hirsch (1965) and Vernon (1966), technological asymmetries are associated with distinct phases in a technology's evolution and a specific international distribution of innovation capacity in the production of new commodities. In the initial phase, innovative advantage is the main factor driving the production of new commodities in the advanced countries. Over time, the technology evolves into a mature phase characterized by the standardization of products and processes. In this latter phase, international competition is based on the technology transferred, productivity improvements and production cost advantages.

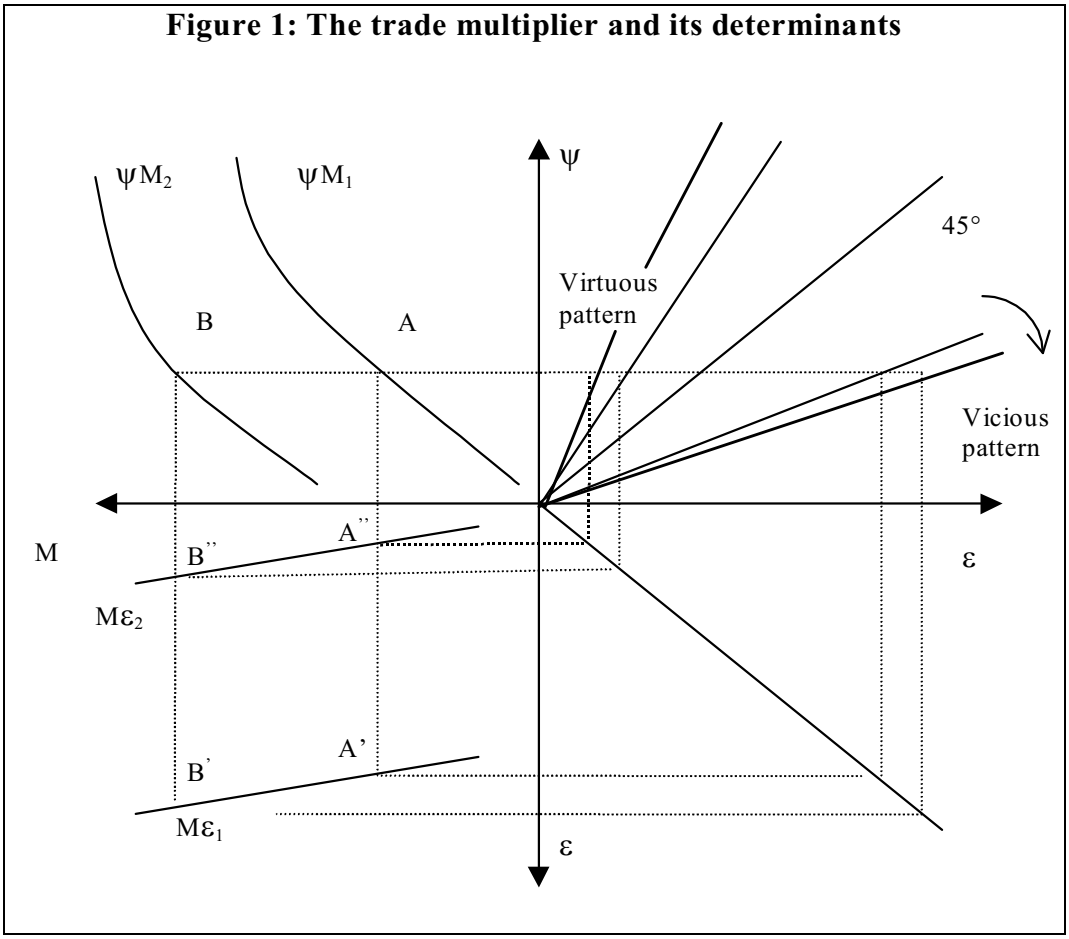
Many of these studies have undoubtedly scored points with policy makers, who have increasingly come to recognize the significance of technology for international competitiveness. The recent "structuralist-evolutionary" formal approach shows increasing attention to uneven international technological change as an engine of growth, with emphasis on the dynamics of specialization, as in Metcalfe (1989), Amable (1992, 1993) and Soete and Verspagen (1992), and on the dynamics of catching-up, as analysed in Verspagen (1990, 1991) and Dosi and Freeman (1992).

The above equation highlights the multiplier effects of the differences in technology between the two countries and the income elasticity of imports. Domestic growth is weighted by the technology gap, which accounts for the distance between the two countries' productivity growth rates. The extent to which exports can generate sustainable growth rates is thus limited when the existing technology gap is widening. Conversely, when the technology gap narrows, the domestic growth rate will be very sensitive to changes in exports. This rate is also inversely

related to import elasticity, which measures the proportional change in demand for imports with respect to a proportional change in domestic income. The growth rate is affected by an increase in imports as measured by ε, the income elasticity of demand for imports. The higher the value of ε, the lower the growth rate consistent with equilibrium on the current account. In sum, the potential for domestic growth is based on the growth rate's sensitivity to both the technology gap multiplier and the income elasticity of imports. Thus, a *virtuous growth path* can emerge when the reduction of the technology gap more than offsets the increase in import elasticity. Conversely, a *vicious growth path* emerges when the increase in import elasticity is greater than the reduction of the technology gap.

This analysis also implicitly pointed to the influence of international specialization on each economy's potential growth rates. Following is a simple analysis describing the role played by the specialization pattern in determining the trade multiplier ψ/ε. Figure 1 gives a simple description.

Figure 1: The trade multiplier and its determinants



The ψM curves in the top left quadrant indicate the various combinations between the technology gap multiplier and imports that guarantee equilibrium on the trade balance. The Mε curves in the lower left quadrant depict the home country's specialization pattern, and their

positive slant reflects the positive association between an increase in demand for imports and an increase in the income elasticity of goods consumed domestically (commonly known as Engel's law). A movement from $M\varepsilon_1$ to $M\varepsilon_2$ indicates that the home country has improved its specialization and reduced the income elasticity of imports. That is, the home country has improved its capacity to narrow the gap separating it from countries that produce goods with higher knowledge content and higher income elasticity. The top right quadrant shows the trade multiplier (ψ/ε).

For a given ψ and a specialization pattern indicated by $M\varepsilon_1$ – which implicitly define a domestic market that demands imports with high income elasticity – the multiplier obtained will be low and less than 1. In this case, an increase in exports will result in a worsening of the multiplier. That is, when the ψM curve moves left towards ψM_2 and imports move from A' to B' along the $M\varepsilon_1$ curve, the multiplier schedule in the top right quadrant will turn clockwise. Conversely, for a given ψ the multiplier will improve only when the specialization improves. This is the case when the $M\varepsilon$ curve moves to $M\varepsilon_2$, the combination between M and ε moves to point B'' and the multiplier moves to an angle above 45 degrees. To sum up, the trade multiplier ψ/ε improves to a virtuous path when the productivity gap narrows and/or the specialization pattern improves. On the contrary, if the productivity gap does not change and the specialization pattern is stable, an increase in exports will not produce an improvement in the multiplier.[1]

The assumption of equilibrium on the trade balance does not exclude the possibility that the actual growth rate may be higher than the one calculated under this assumption. Indeed, the balance-of-payments-constrained growth rate may be higher or lower than the actual growth rate. If it is higher, a trade surplus will emerge; conversely, if the actual growth rate is higher than the constrained one, the trade balance will deteriorate and a widening deficit will appear if the foreign trade multiplier does not improve. From a monetary standpoint, a current-account deficit may create financing problems and exchange-rate volatility. Deficits emerge when expenditure is higher than domestic income, and they can be financed by long-term capital investment or more short-term capital inflows. As is well known, the latter type of financing, given its high liquidity, can result in a country's becoming a hostage to international speculation and the perverse effects of devaluation (Moreno Brid, 1998/1999).

2. Liberalization strategies and performance

One way to determine how policies aimed at liberalization and the adoption of an outward orientation have influenced growth is to describe some of the main stylized patterns and constraints that characterized the Latin American economies following economic reform (Ocampo, 2003).

[1] Another way of looking at this model is from both the supply and the demand side. The supply side is reflected by the technology gap multiplier and differences in the dynamism of production structures (e.g., learning processes, sectoral networks, etc). The demand side is associated with the dynamism of world demand and the particular features of the specialization pattern.

Trade liberalization and export-led growth have affected growth rates positively.[2] In this context, the orthodox view suggests that the model of export-led growth relates to the possibility that export growth may set up a virtuous circle of growth if a country maintains its competitive position in world trade. However, a first glance at the actual situation reveals the difficulty of achieving the average growth rate that characterized the import substitution period (Ocampo, 2003).

The empirical analysis is based on two sets of data corresponding to different times in the reforms' implementation. The periods indicated in table 1 are discussed here, and a different period that excludes part of the 1980s is presented in appendix B. However, both sets of data confirm the analysis developed in the following sections.

Table 1: Timing of reforms

Country	Before Reform	After Reform
Argentina	1970 – 1990	1991 - 1999
Brazil	1970 – 1989	1990 - 1999
Chile	1970 – 1984	1985 - 1998
Colombia	1970 – 1989	1990 - 1999
Mexico	1970 – 1985	1986 - 1999
Peru	1970 – 1989	1990 - 1996
Uruguay	1970 – 1977	1978 - 1999

Source: Barbara Stallings and Wilson Peres, *Growth, Employment, and Equity: The Impact of the Economic Reforms in Latin America and the Caribbean*, New York, Brookings/Economic Commission for Latin America and the Caribbean (ECLAC), 2000; Joseph Ramos, "Neo-liberal structural reforms in Latin America: the current situation", *CEPAL Review*, No. 62 (LC/G.1969-P), Santiago, Chile, August 1997.

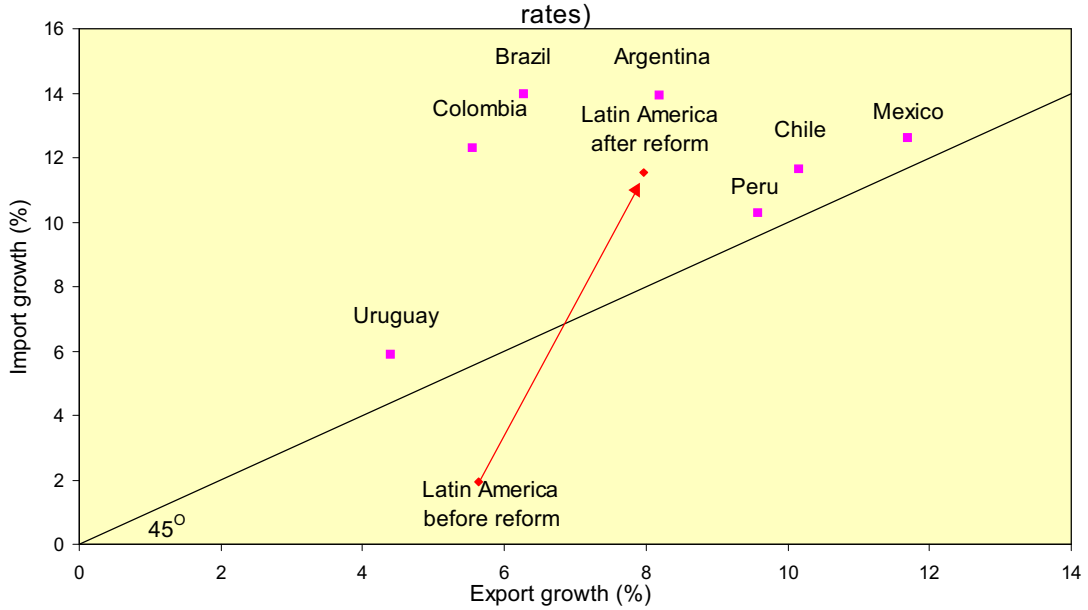
As the region has opened up, it has witnessed a large increase in both exports and imports. Exports rose from 5.28% to 8% after economic reforms were implemented. On the other hand, it is apparent that the trade balance is still a serious constraint on GDP growth (see figure 2 and table 1). Empirical evidence also shows that the average growth rate of GDP decreased between the pre- and post-reform periods and that the trade deficit widened (see figure 3). The role played by the balance of payments as a determinant of domestic economic performance emerged clearly in the post-reform period (Moreno Brid, 1999; Pérez and Moreno Brid, 1999; Frenkel and González, 1999; Holland, Vilela Vieira and Canuto, 2001). An actual growth rate higher than the balance-of-payments-constrained rate produces a balance-of-payments deficit. Thus, such a situation can result in the build-up of a huge trade deficit.

[2] Within this generalized trend in the region, the case of Chile stands out. The Chilean experience is considered a paradox in at least some of the heterodox literature on international trade and growth. Indeed, between the mid-1980s and the end of the 1990s, Chile experienced an impressive rate of growth for a country whose export vector consisted almost exclusively of natural resource-based products and standardized commodities characterized by low income elasticity of demand, let alone the fact that the production structure was undergoing a de-industrialization process. More recently, the country's growth has not been as strong and structural difficulties are emerging in the export sector in terms of creating new employment, diversifying manufactured commodities and/or developing local technological and productive linkages (Moguillansky, 1999).

The trend of these aggregate variables reflects the reinforcement of a specialization pattern that still focuses on product lines in which the region has advantages in terms of natural resources and cheap labour. Orthodox authors argued a priori that trade liberalization and market deregulation would automatically bring about a shift in the Latin American production structure.[3] In fact, within this general picture, it can be observed that most Latin American economies have followed the expected path, changing their specialization on the basis of their factor endowments: natural resources and labour. Geographically, two separate patterns appear to have emerged for Mexico and the Central American countries, on the one hand, and South America, on the other. The South American countries have intensified their specialization in natural resources and standardized commodities. These are now highly capital-intensive industries with low domestic value added. Firms producing for local markets – which are labour-intensive and engineering-intensive – have suffered most from trade liberalization and market deregulation initiatives. Conversely, countries such as Mexico and the Central American nations have greatly globalized their manufacturing and assembly activities based on cheap labour. The structural features of the specialization pattern have affected the capacity to achieve equilibrium on the current account (Katz and Stumpo, 2001).

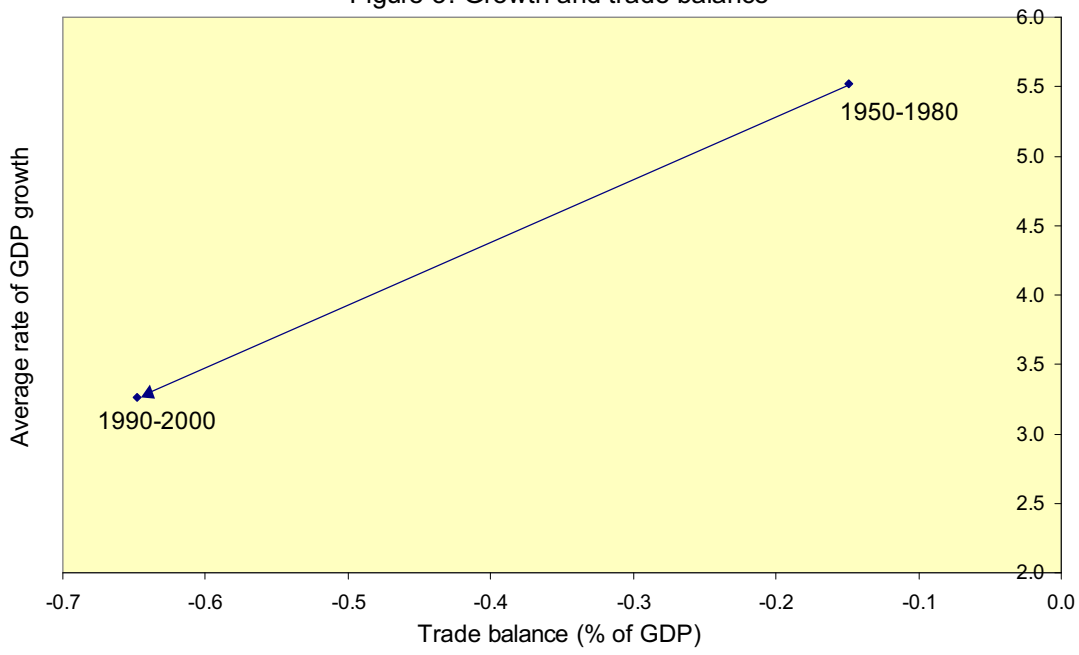
3 As Anne Krueger has argued, "Insofar as developing countries are relatively abundantly endowed with unskilled labour and relatively short of capital, trade with other LDCs is likely to increase the imbalance in factor availability, whereas trade with the developed countries may serve as a means of exchanging abundant factors for scarce ones" (Krueger, 1978). In this respect, trade liberalization would strengthen the region's comparative advantages by allocating resources for these production activities and would thus boost demand for unskilled labour, narrow the wage gap and reduce the anti-export bias of the import substitution era, during which the labour factor had been underused. Anne Krueger has also stated, "What is already clear is that the findings of the country studies support the view that altering trade strategies toward greater export orientation will certainly be consistent with the objective of finding more employment opportunities: scepticism based on the Leontief Paradox or factor-market distortion considerations does not seem to be warranted" (Krueger, 1978).

Figure 2: Imports and exports in the post-reform period (annual growth rates)



Source: ECLAC (Economic Commission for Latin America and the Caribbean). Note: Import and export growth rates for each period (before and after reform, see table 1) are calculated with unweighted averages, and each point above the 45-degree line represents the post-reform period (even the year 2000).

Figure 3: Growth and trade balance



Source: ECLAC (Economic Commission for Latin America and the Caribbean). Note: Trade balance and income growth for each period are calculated using the average weighted by country dimensions.

Prebisch conceptualized the balance-of-payments effects of differences in specialization and the income elasticity of demand for different types of products in the world economy. It is generally recognized and agreed that the income elasticity of demand for most primary commodities is lower than that for manufactured products. On average, the elasticity is probably less than 1, meaning that a decreasing proportion of income is spent on those commodities. In the two-country, two-commodity case, the lower income elasticity of demand for primary commodities will mean that for a given increment in world income, the balance of payments of primary commodity-producing developing countries will automatically deteriorate vis-à-vis the balance of payments of developed countries that produce and export industrial goods (Thirlwall, 1994). At a more general level, Pasinetti (1981) argues that the specific features of a specialization pattern are reflected by the elasticity of demand for imports, which is an approximation of the differences between domestic and foreign consumption patterns. Thus, in the present case, where Latin America specializes in knowledge-poor goods while its imports are associated with higher knowledge content, import elasticity and the change observed in it during the post-reform period can be expected to show an asymmetry.

3. The low growth trap and its structural determinants

The model introduced above can be considered a sort of "theoretical abacus" which reproduces different scenarios characterized by specific linkages between technology gaps, demand for imports and growth rates. Assuming that the specialization pattern is given, different scenarios can be represented on the basis of how the dynamics of productivity rates and their interplay interact with the growth rate (see table 2).

Table 2: Theoretical abacus of the trade multiplier

Pattern	Trade multiplier	Structural determinants
Virtuous	$\frac{\psi}{\varepsilon} > 1$	Income grows faster than exports. The domestic capacity to reduce the technology gap is greater than the increase in the income elasticity of imports.
Stable	$\frac{\psi}{\varepsilon} = 1$	Income grows at the same rate as exports. The domestic capacity to reduce the technology gap offsets the country's import requirements.
Vicious	$\frac{\psi}{\varepsilon} < 1$	Income grows slower than exports. Poor capacity to reduce the technology gap and fast growth in import requirements.

In Latin America, the trade multiplier declined after the liberalization process, dropping to less than 1.[4] A *vicious* pattern of export-led growth has been established in most countries of the region. Their multiplier moved from 0.43 to 0.22 between the pre-reform and post-reform periods. The vicious circle that was set up between export growth and income growth led the region into a *low growth trap* (see figure 4 and table 2). This contrasts sharply with the experience of some Asian economies, such as Korea, where the technological multiplier has increased in recent decades.[5]

The data and the results of applying the trade multiplier equation are presented in table 3. In all countries the actual rate of growth is higher than the balance-of-payments equilibrium growth rate. These results are reflected in the trade balance situation observed in the post-reform period. Most countries had built up surpluses at the beginning of the period. Now, the surpluses have been reduced and/or transformed into deficits. Moreover, deficits have increased at an accelerated rate. In this case, strategies for financing the trade deficit in the long run and pressures on the exchange rate will be the outcome of differences between the actual growth rate and the balance-of-payments-constrained growth rate.

This situation is rooted in the characteristics of the specialization pattern and, particularly, in the weak progress made in reducing the technology gap. Although Latin America has reduced the productivity gap, the reduction has not been as large as the increase in import elasticity.[6] In particular, when a country starts out with a wide technology gap, it is the reduction of this gap that will result in the clearest improvement in the domestic relative growth rate (that is, an increase in Ψ). However, if the demand for imports increases at a higher rate, the positive effect of reducing the technology gap is neutralized and/or eliminated. This is the case in Latin America, where the reduction of the technology gap was not enough to offset the striking increase in import elasticity. As in the Prebisch-Singer case, the negative impact on domestic

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[4] Ψ is calculated with respect to the United States, which in this case is the technological frontier. However, this result does not change if we consider more direct competitors such as Korea (see the following note).

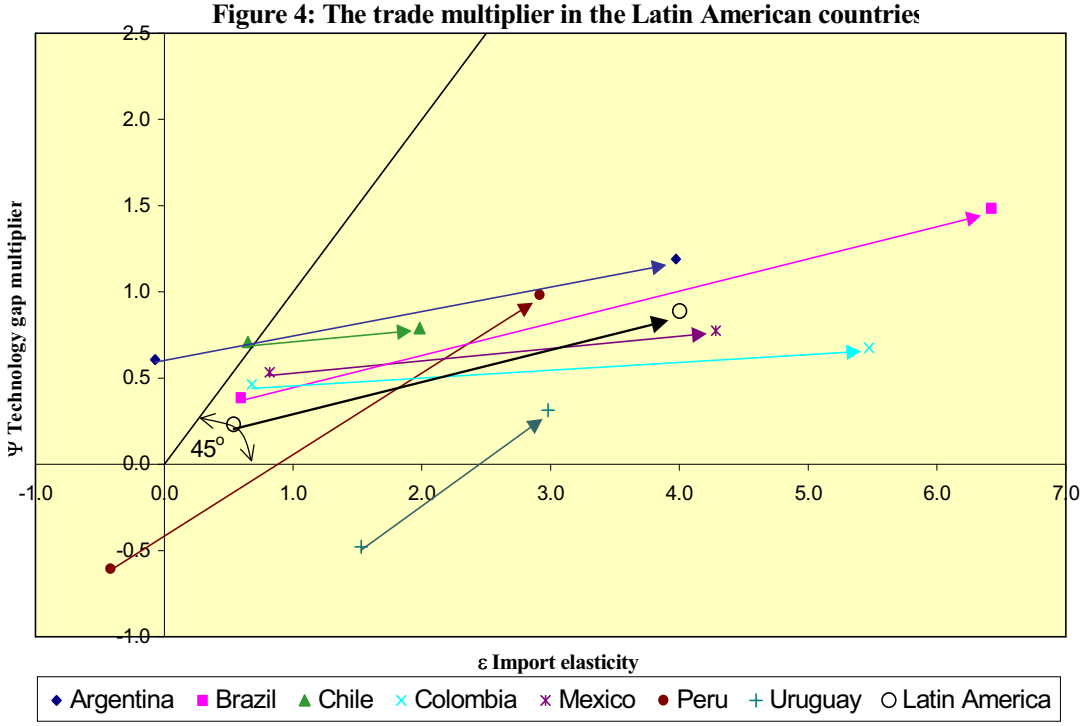
[5] The trade multiplier for Korea rose from 1.01 to 1.42 between 1970-1980 and 1981-1999. In this case, it is interesting to note that the technological multiplier increased and, at the same time, the elasticity of demand for imports decreased. Thus, a *virtuous* pattern was established. These contrasts between Latin America and Korea should be seen in terms of Korea's status as an economy that has consolidated the upgrading of its technological capabilities in the past few decades. One fact that explains the differences between Latin America and Korea is related to the concept of selective intervention, derived from the experiences of developmentalist approaches. For example, one of the keys to the success of this approach has been the ability to programme the level and composition of non-competitive intermediate and capital goods, as in South Korea, where quotas, directed credit and targeting were used in order to select those industries that were to provide foreign exchange through exports. The industries whose exports were promoted were those in which the country possessed a static comparative advantage, whereas the industries which enjoyed a protective policy were subject to the requirement that they should develop a dynamic comparative advantage. Thus, at the aggregate level, it was also possible to obtain a balanced portfolio in terms of sources and uses of foreign exchange. Among the industries that were supported to help them develop dynamic comparative advantages, it seems that the major actors in technological learning have been large business groups – the chaebols – which were able at a very early stage of development to internalize skills for the selection of technologies acquired from abroad, their efficient use and their adaptation and, not much later, were able to grow impressive engineering capabilities (Kim, 1993). This process has been further supported by a set of institutions and networks for improving and upgrading human resources (Amsden, 1989).

[6] The increase in import elasticity is observed over the long term. It is not a transitory phenomenon due to income changes, but mainly an effect of the specialization pattern.

income is represented as a combination of adverse structural conditions: a fast increase in income elasticity and a slow reduction of the technology gap.

Another finding concerns the link between exports and growth when exports are driven exogenously by growth in developed countries. Thus, if the trade multiplier decreases over time, the same rate of growth in domestic income can be achieved only if exports increase at a higher rate. Moreover, a slowdown in the growth of world demand for a country's exports and a reduction of the multiplier will amplify the negative impact on income growth.

Figure 4: The trade multiplier in the Latin American countries



Source: ECLAC (Economic Commission for Latin America and the Caribbean). Note: Each point represents the trade multiplier in the pre- and post-reform periods.

Table 3: The structural change in Latin America (before/after reform)

			Before reform		After reform	
Before reform	After reform	Countries	Import elasticity (ε)	Tech. gap multiplier (ψ)	Import elasticity (ε)	Tech. gap multiplier (ψ)
1970 - 1990	1991 - 1999	Argentina	-0.07	0.61	3.97	1.19
1970 - 1989	1990 - 1999	Brazil	0.59	0.39	6.42	1.48
1970 - 1984	1985 - 1998	Chile	0.65	0.71	1.98	0.79
1970 - 1989	1990 - 1999	Colombia	0.68	0.46	5.47	0.68
1970 - 1985	1986 - 1999	Mexico	0.82	0.53	4.28	0.78
1970 - 1989	1990 - 1996	Peru	-0.42	-0.61	2.92	0.98
1970 - 1977	1978 - 1999	Uruguay	1.53	-0.48	2.98	0.31

Table 4: Growth rate and trade balance applied to the model (after reform)

				Trade balance (% GDP)		
After reform	Countries	Actual growth rate	Balance of payments equilibrium growth rate	First year	Last year	Difference
1991 - 1999	Argentina	3.95	2.69	1.47%	-3.82%	-5.30%
1990 - 1999	Brazil	2.42	1.28	3.16%	-2.36%	-5.52%
1985 - 1998	Chile	6.75	4.21	7.45%	3.39%	-4.07%
1990 - 1999	Colombia	2.50	0.78	3.78%	-3.52%	-7.30%
1986 - 1999	Mexico	3.16	2.06	3.62%	2.48%	-1.14%
1990 - 1996	Peru	5.08	2.81	0.81%	-4.33%	-5.14%
1978 - 1999	Uruguay	2.06	0.45	1.96%	-4.43%	-6.38%

At the aggregate level the dynamics of productivity growth are the result of overlapping phenomena. Productivity growth has not been fast enough, nor has the restructuring of the pattern of production specialization involved enough high-value-added activities, to enable the region's countries to attain a significant improvement in their international competitiveness. The technology gap has been reduced only in tightly circumscribed production enclaves, and a new dualism has become more visible in the production system. At the same time, Latin America has radically modified the pattern of technology accumulation and knowledge diffusion across firms and sectors. Such changes are giving rise to a complex process of "destruction" of deeply rooted forms of production organization and of institutions, and gradually (and painfully) forcing the countries to establish an outward-oriented and deregulated incentive regime and a production system specializing in activities with low knowledge content (ECLAC, 2002).

4. Understanding the microeconomic sources of technology gaps

This section briefly outlines those characteristics which, at a more micro level, explain the pattern of technology accumulation and knowledge diffusion (for empirical evidence and an analytical formalization, see Cimoli and Katz, 2001, and ECLAC, 2000, 2002).

(a) New dualism of the production system

In the first place, the weak link between exports and growth reflects a new dualism in the production system and in the pattern of technology accumulation. The benefits of modernization have been very unevenly distributed. Many production activities have been seriously disrupted by trade liberalization and by the massive inflow of imports, particularly in technology-intensive fields, which have rapidly begun to de-verticalize their production organization technologies, replacing domestically-produced intermediate inputs with cheaper (and sometimes better) imported ones and reorganizing themselves more as assembly-type operations based on a much higher unit import content. The heterogeneity of responses has been quite dramatic, not only across production sectors, but also across individual firms within narrowly defined industries. Thus, failure and success tend to occur side by side even within the same production activity. The share of "large" firms – either local subsidiaries of transnational corporations or domestically-owned conglomerates – in GDP increased significantly during the adjustment process, while countless SMEs were forced to exit the market altogether.

Only a very small group of modernized export firms are becoming global in terms of their production orientation and their capacity to acquire foreign technology in international networks. The majority are much less efficient, and this tends to break down local networking activities and hold back knowledge diffusion. The modernized firms are, in fact, characterized by fewer linkages with domestic institutions of higher education and with local research centres and laboratories. Although universities have sought to improve and create linkages with the production system, they are hindered by two factors: their own bureaucratic organization and these firms' demand for knowledge from institutions and research centres located abroad. This is also true of the maquila industry in Mexico and Central America. The "maquila innovation system" mainly supports and stimulates networking activities with firms and institutions located abroad, thus reinforcing the knowledge and technological advantages of the developed economies.

(b) Specialization in products with low knowledge content

Following the trade reforms, the largest economies increased their share of production in sectors such as telecommunications, energy, natural resource processing industries that produce industrial commodities (such as pulp and paper, iron and steel, vegetable oil, etc.), maquila industries (electronics, television sets and video equipment, etc.) and the somewhat special case of the automotive industry, which has enjoyed special protection from the wave of liberalization. Other industries, such as footwear, garments and furniture, and industries that produce engineering- and knowledge-intensive products (capital goods, agricultural machinery, machine tools, pharmaceuticals), have seen their share decline throughout the continent.

Most Latin American economies have thus specialized on the basis of their abundance of factor endowments: natural resources and labour. Another relevant issue is the role played by large domestic firms and subsidiaries of multinational enterprises (MNEs) that have followed the international pattern in terms of product specialization and technology absorbed from foreign economies. Subsidiaries of MNEs, whose production is mainly concentrated in standardized products – particularly motor vehicles, other consumer durables and traditional manufactures –, have adopted the technologies developed by their parent companies in industrialized countries. The performance of large domestic firms cannot be understood without taking into account their learning efforts during the import substitution phase. It was during that period that these firms developed economies of scale to enable them to compete in the international market after the economy was opened up. This involved the adoption of plans, blueprints and designs for the domestic market, as well as efforts to improve organization and increase production capacity. Examples of such firms include large groups in the chemicals, brewing and glass container sectors, which not only increased their production capacity but also carried out research and development (R&D) activities to support the firms' knowledge base during the import substitution phase.

The long-term accumulation of local technological capacity has been hampered by the replacement of engineers with machines in the process of reorganizing production. Obviously, some of the engineering activities carried out in plant during the import substitution period, either to extend the life cycle of old machines or to perform technical activities, are now "embodied" in the new pieces of equipment and have been rendered unnecessary, so that frequently the engineers and technicians involved in such activities can be dropped from the payroll. Similarly, entire R&D and project engineering departments can be eliminated when firms become part of worldwide integrated production systems and R&D and engineering efforts are transferred to headquarters. The same is observed in the case of public firms providing telecommunications, electricity and transport services, which, after privatization, discontinued their domestic R&D and engineering departments and relied instead on their respective central offices for technology and engineering services. These changes in the organization of production involve the "destruction" of human capital and domestic technological capabilities and their replacement with capital "embodied" in new technology and with foreign-supplied R&D and engineering services. Some of the skills and technological capabilities rendered redundant by the new production organization arrangements can and have been successfully transferred to other areas of the economy – to a newly emerging and rapidly expanding software industry, for example – but there are clear differences across nations, regions and industries in the extent to which such redeployment has actually taken place.

Increasing returns associated with knowledge generation, when applied to the Latin American production structure, produce a widening of the technology gap for the vast majority of productive activities, resulting in a pattern of production specialization strongly biased against domestic knowledge generation. This process means that, while Latin America does actively participate in the globalization of production, its participation in the globalization of scientific and technological activities is very limited. As companies transfer only some of their R&D activities to Latin America, the present concentration of corporate R&D can be expected to lead, by and large, to even sharper international disparities in technological development. The internationalization of R&D is carried out within developed economies and regions with already-

proven technological advantages. Technological cooperation between firms seems, in practice, to exclude firms that do not already have an established reputation within the developed economies. This view is supported by the results obtained in empirical studies on the organization of research activities in multinational firms, which clearly show that even multinational companies perform most of their innovative activities in their home country.

5. Conclusions

The region has slowly narrowed the productivity gap and enhanced the competitiveness of its export sectors. However, the reduction of this gap was not enough to offset the extraordinary increase in the elasticity of demand for imports, so that the trade multiplier (ψ/ε) declined between the pre- and post-reform periods. In addition, the actual growth rate was higher than the balance-of-payments-constrained growth rate, and most countries have experienced a decrease in their balance-of-payments surplus and/or an increase in their balance-of-payments deficit.

A vicious pattern of export-led growth is under way in most countries of the region. What is more, it also seems that the mechanism that has been set up between export growth and income growth has led the region into a low growth trap.

The main reason for this lies in the structure of the production system and in modes of producing and diffusing technical change. A dual structure has arisen in which productivity improves in very small enclaves and few linkages are generated with the rest of the system. This pattern does not allow a higher increase and better diffusion of knowledge and technical change. Moreover, the poor diffusion of R&D activities and the replacement of local sources of knowledge are radically reducing opportunities for narrowing the technology gap.

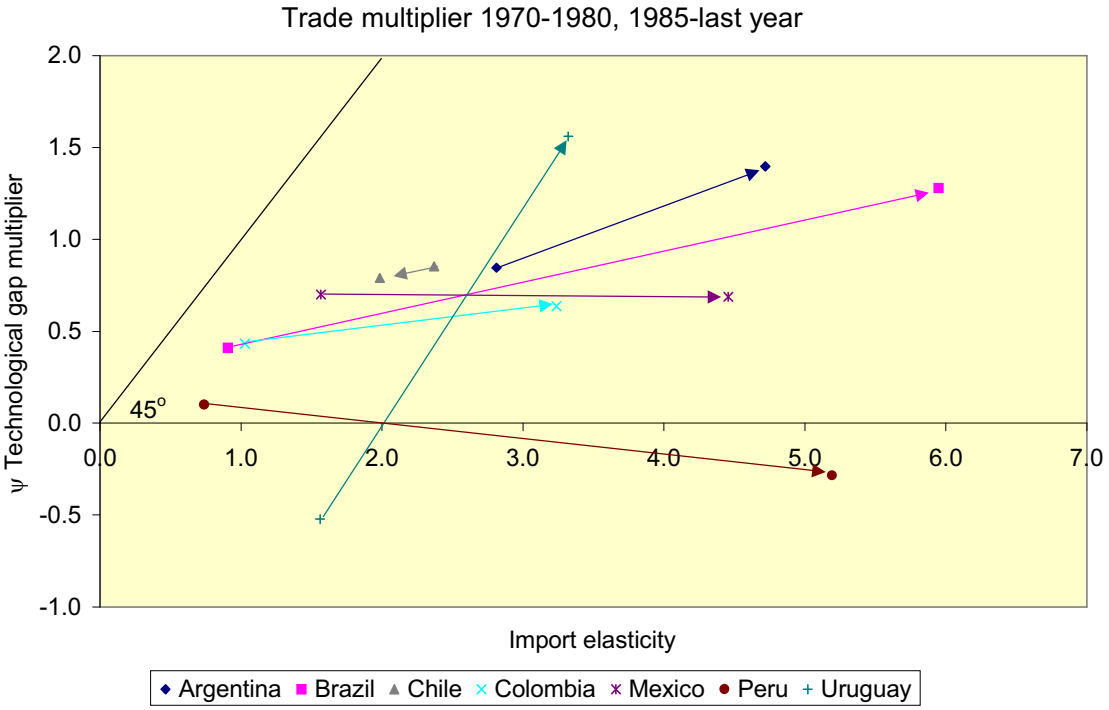
The economic reforms revealed the comparative advantages of the Latin American economies. Thus, a pattern of specialization based on allocative efficiency and static advantages predominates in most countries. Conversely, dynamic advantages require the development and diffusion of technical and organizational innovations and depend increasingly on access to advanced linkages between firms and knowledge flows. As a result, openness to trade has produced a disjointed structure that is unable to diffuse technological capabilities locally to produce an overall improvement across firms and sectors. Assuming also that technological opportunities vary across products and sectors, the specialization pattern through the revealed differences in income elasticities determine in *lato senso* the poor opportunities for growth of the region.

Appendix A

The main equation can be obtained on the basis of the foreign trade multiplier concept developed by Harrod (1933), Kaldor (1966, 1975) and Thirlwall (1979); that is: $\dot{y} = (1/\varepsilon)\dot{x}$. In Cimoli, Dosi and Soete (1986) and Cimoli (1994), this expression has been further developed with the incorporation of a proxy for the technology gap (Ψ); thus, the trade multiplier may be expressed by $\dot{y} = (\psi / \varepsilon)\dot{x}$.

This last expression is based on the following assumptions. To obtain an expression of the balance-of-trade equilibrium condition, we must now specify total domestic imports and exports. These are expressed by M and E, where M is the total demand for imports in the home country and E is the home country's exports (i.e., the demand for imports in the foreign country). The trade equilibrium condition measured in one currency is then M=E; or, when this initial condition is given, the balance-of-payments equilibrium on current account can be expressed by $\dot{m} = \dot{e}$ in terms of growth rates. To obtain an expression of the trade multiplier, we must now specify imports and exports. Using standard demand theory, imports may be thus specified as a multiplicative function of domestic income. Thus, $M=y^{\varepsilon}$, where ε is the income elasticity of demand for imports and y is domestic income. Export demand may also be expressed as a multiplicative function in which the arguments are world income (y^{*}) and the technological gap multiplier (ψ). Exports may be expressed by $E=y^{*\beta\psi}$. In accordance with the structuralist view (Prebisch, 1950; Bacha, 1978; McCombie and Thirlwall, 1994), we can argue that to maintain an income level equal to that of developed economies, Latin America must reduce its income elasticity of demand for imports or narrow the technology gap; that is, $y^{\varepsilon}= y^{*\beta\psi}$. Differentiating it, a dynamic version of the multiplier is obtained: $\varepsilon(\partial y/y) = \psi\beta(\partial y^{*}/y^{*})$. Substituting $\dot{x} = \beta\dot{y}^{*}$ in the last equation, we obtain: $\dot{y} = (\psi / \varepsilon)\dot{x}$. Note that $\dot{x}$ is the total export growth attributable to the growth of world income $(\dot{y}*)$ and the income elasticity of demand for exports (β).

Appendix B



Source: ECLAC (Economic Commission for Latin America and the Caribbean). Note: Each point represents the trad multiplier in the pre- and post-reform periods.

The structural change in Latin America (1970-1980, 1985-last year)

			1970-1980		1985-last year	
1970-1980	1985 - last year	Countries	Import elasticity (ε)	Tech. gap multiplier (ψ)	Import elasticity (ε)	Tech. gap multiplier (ψ)
1970-1980	1985-1999	Argentina	2.81	0.85	4.72	1.40
1970-1980	1985-1999	Brazil	0.91	0.41	5.95	1.28
1970-1980	1985-1998	Chile	2.37	0.85	1.98	0.79
1970-1980	1985-1999	Colombia	1.03	0.43	3.24	0.64
1970-1980	1985-1999	Mexico	1.57	0.70	4.46	0.69
1970-1980	1985-1996	Peru	0.74	0.10	5.19	-0.28
1970-1980	1985-1999	Uruguay	1.56	-0.52	3.32	1.56

Growth rate and trade balance applied to the model (1985-last year)

				Trade balance (% GDP)		
1985 - last year	Countries	Actual growth rate	Balance of payments equilibrium growth rate	First year	Last year	Difference
1985 - 1999	Argentina	2.99	1.97	3.55	-3.82	-7.37
1985 - 1999	Brazil	2.22	1.01	3.85	-2.36	-6.22
1985 - 1998	Chile	6.75	4.21	7.45	3.39	-4.07
1985 - 1999	Colombia	3.32	1.67	0.67	-3.52	-4.20
1985 - 1999	Mexico	2.69	1.66	2.47	2.48	0.01
1985 - 1996	Peru	1.90	-0.08	6.35	-4.33	-10.68
1985 - 1999	Uruguay	3.53	2.34	7.85	-4.43	-12.28

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