NATIONAL INNOVATION SYSTEM, TRADE ELASTICITIES AND ECONOMIC GROWTH

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RESUMO

As diferenças das elasticidades-renda de importação e de exportação das economias têm como conseqüência distintos graus de restrição externa ao crescimento das mesmas. Este argumento já foi apontado por Prebisch e por autores de cunho Kaldoriano. As explicações de Prebisch para esse fenômeno dizem respeito às diferenças de inserção internacional entre economias agrárias ou periféricas e industriais ou centrais. Os autores de cunho Kaldoriano, por sua vez, apenas se reportam a Prebisch para explicar porque as citadas elasticidades são diferentes entre produtos e entre países. Contudo, mesmo após sua industrialização várias economias continuam padecendo da restrição externa ao seu crescimento. O objetivo deste artigo é explicar as diferenças das elasticidades de comércio entre economias industrializadas. Pretende-se, assim, demonstrar por meio da literatura neo-Schumpeteriana as relações causais entre o grau de desenvolvimento do Sistema Nacional de Inovações, as diferenças nas elasticidades-renda de comércio, o grau de competitividade e o grau de vulnerabilidade externa, de uma economia.

ABSTRACT

Differences in income-elasticities of imports and exports among countries bring about different degrees of external constraints to growth. This argument has been pointed out by Prebisch and by authors in the Kaldorian tradition. Prebisch's explanations for this phenomenon relate to the differences in international insertion between agrarian / peripheral and industrial / central economies. Kaldorian authors, in turn, refer to Prebisch only to explain why such elasticities differ between products and between countries. However, even after undergoing industrialization processes, several economies still face external constraints to growth. The aim of this paper is to explain differences in trade elasticities among industrial economies. Therefore, it intends to demonstrate, by using the Neo-Schumpeterian literature, the causal relations between the development of a National Innovation System, the differences in income-elasticities of imports and exports, the degree of competitiveness and the degree of external vulnerability of an economy.

Palavras-Chave: Sistema Nacional de Inovações, Competitividade, Vulnerabilidade Externa

Keywords: National Innovation System, Competitiveness, External Vulnerability

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1- Introduction

The works of Prebisch (2000a; 2000b), as well as the ones related to Kaldor's (1994) growth theory, consider that differentials in growth rates between economies result from differences in their income-elasticities of imports and exports. Such differences in elasticities bring as a consequence different degrees of external constraint to economic growth. In an economy with a severe external constraint, growth would be viable in the short run through an increase in the net external liability and, therefore, in the country's external vulnerability. However, such vulnerability would imply low growth rates in the long run.

Prebisch's explanation for this phenomenon relate to the trade relations between agrarian and industrial economies, i.e., relate to the differences in international insertion between agrarian/peripheral and industrial / central economies. Authors in the Kaldorian tradition, in turn, refer to Prebisch only to explain why such elasticities differ between products and between countries. However, several economies still face external constraints to growth, even after undergoing industrialization processes. Therefore, it is necessary to present the reasons for the existence of income-elasticity differentials among industrial economies.

Fajnzylber (1983; 1990), who just like Prebisch was an author from the Economic Commission for Latin America and the Caribbean (ECLAC), argued that the external vulnerability of an agrarian economy and its severe external constraints to growth would not be surpassed by means of industrialization unless the latter had an "endogenous core of dynamization of technological progress". According to Fajnzylber, endogenous technical innovations in a developed and integrated capital goods industry are the key for competitiveness gains in an economy and, as a consequence, for releasing its external constraint to growth. Therefore, the endogenous production of technology would affect a country's income-elasticity of imports and exports, leading to a release of its external constraint to growth. However, Fajnzylber (1983; 1990) does not analyze this issue, i.e., he does not explain how the "endogenous core of technology production" affects a country's income-elasticities of trade.

The aim of this paper is to explain the trade elasticity differentials among industrial economies. It is intended to accomplish such task by demonstrating via the neo-Schumpeterian literature the causal relations among the degree of development of the National Innovation System, the differences in income elasticity of trade, the degree of competitiveness and the degree of external vulnerability of the economy. For that, the paper contains four sections beyond this introduction. Next section presents the explanations and its limitations for the competitiveness and external vulnerability differentials between economies, given by ECLAC authors mentioned above. In section 3, Kaldor's argument is presented, as well as other authors in the Kaldorian tradition, about the external constraints to growth, showing a gap in such arguments. In section 4, in order to overcome this gap, the causal relations among National Innovation System, income elasticity of demand for imports and exports, competitiveness and external vulnerability of an economy are built. Several indicators are presented in this section in order to present empirical evidences on such causal relations. Last section brings the conclusions of this work.

2 – ECLAC and the External Vulnerability of the Peripheral Economy

The idea of unequal development was elaborated by the ECLAC in the context of the Center-Periphery relationship. [1] The Center-Periphery dynamics would be associated to the historical-structuralist method of analysis of Latin American economies, as adopted by ECLAC. The historical focus is due to the transition period which Latin American economies were going through when Prebish (2000a) inaugurated the agenda of reflection and investigation of ECLAC. Such transition corresponded to the

[1] Unequal development is also discussed by several non-ECLAC authors.

change from the primary-exports growth model, outwards, to the urban-industrial model, of growing towards inside.

Prebisch's structuralist theory of peripheral underdevelopment was articulated to this focus. The structuralist perspective is due to the recognition that the transition towards "growing to the inside" would happen on an underdeveloped economic and institutional "structure", inherited from the primary-exports period. Such structure would condition economic trajectories which were unknown *a priori*.[2]

For ECLAC, there were structural specificities in the development of Latin American economies associated to generation and propagation of technical progress, to productivity gains, to economic growth and employment, to income distribution and to competitiveness and international insertion. Such set of structural specificities, mutually related and conditioned, would express itself on the peripheral condition of Latin American economies *vis-à-vis* developed economies (Center).

The Center-Periphery dynamics referred to the structure determining a specific pattern of international insertion: the Periphery producing goods and services with not very dynamic international demand, and importing goods and services with domestic demand in rapid expansion. That is, in the Center the income-elasticity of demand for primary goods imports would be less than one, whereas the income-elasticity of demand for imports in the Periphery would be greater than one (Prebisch, 2000b).

This pattern of international economic insertion would denote another peripheral specificity: a structural external vulnerability, which would bring about an external constraint to economic growth in Latin America. Such external vulnerability (and the peripheral international insertion) would occur via the deterioration of terms of trade between Center and Periphery over time, harming the latter. In this case, the international division of labor given by the relative endowments of factors of production would not allow the Periphery to benefit from technical progress occurring in the Center. The thesis of deterioration in terms of trade would frontally challenge the liberal postulation about the virtues of free international trade.[3]

The solution proposed by Prebisch would be thus the industrialization of the economies in Latin America, a process that would break up with their underdevelopment and with the Center-Periphery dynamics, allowing for the overcoming of specificities common to peripheral economies. However, after seeing various industrialization cycles in several Latin American countries since the Great Depression in the 1930s, the specificities of peripheral development were not overcome, considering the generation and diffusion of technology, as well as income distribution and also reduction of the external vulnerability of these economies.

Later on, Fajnzylber (1983 and 2000) contributed to the debate by arguing that the central feature of underdevelopment in Latin America is the insufficient incorporation of technical progress. According to Fajnzylber (1983), technological development is incorporated into the capital goods industry; i.e. the latter materially incorporates technical progress, being therefore an important channel of its diffusion. In addition, there would be a "virtuous cycle" between growth-technical progress (productivity)-international trade which has the capital goods industry as a basic causal element.

According to Fajnzylber (1983), the development of a "endogenous core of technological dynamization" and, thus, the development of the capital goods industry did not occur in Latin America. Therefore, the Latin American industry, although relatively developed in some countries in the region, ended up being fragile, i.e. with low competitiveness.

[2] For this reason, understanding Latin American economic development requires "studies and analyses in which economic theory with an universality 'stamp' can only be used under qualifications, in order to incorporate these historical and regional specificities" (Bielschowsky, 2000, p. 21, free translation).

[3] Regarding this point, see Prebisch (2000a, p. 71-72).

Fajnzylber (1983) understands a core of technological dynamization as a scientific-technological infrastructure closely inserted and related to the productive apparatus, in the way proposed by the neo-Schumpeterians.[4] According to the author, industrialization without the constitution of endogenous core of production of technology, although possible, does not lead to the overcoming of the peripheral specificities of an economy. On the other hand, innovations due to the endogenous core of technological progress increase the international competitiveness of an economy, stimulating exports while reducing its imports coefficient, reducing the degree of external vulnerability of the economy.

Despite the important contribution of Fajnzylber, the author is not clear about the reasons for the competitiveness differential that would appear between the economy specialized in technology-intensive goods and the economy specialized in goods with low technological intensity. Why do technological innovations increase the competitiveness of an economy? Why do they stimulate exports while reducing the import coefficient? In Ricardo's model of comparative advantages, or in Heckscher-Ohlin's model, for instance, free trade brings about gains for all the participating economies. Such gains are verified in a context of external balance, either static or intertemporal equilibrium, independently of the exports specialization of a country being based on technology-intensive goods or on natural resources and/or unskilled labor.

In the same way, although Prebisch (2000b, p. 181-185) explained why primary products present lower income-elasticity of demand in comparison with the income-elasticity of demand for industrialized products, his solution for the overcoming of the external vulnerability of peripheral economies did not show to be promising. After the industrialization of Latin American economies, the problem with the elasticities was not eliminated (McCombie e Thirlwall, 1994). In addition, the thesis of terms of trade deterioration is not consensual in the literature:

> "There has been some dispute in the literature whether the net barter terms of trade has moved consistently through history against the primary producing LDCs (less developed countries) as Prebisch claimed. (…) if no allowance is made for the war years, however, the terms of trade series look trendless." McCombie e Thirlwall (1994).

This questioning regarding the arguments of Prebisch and Fajnzylber will be discussed in section 4 of this paper. Before that, however, next section presents the arguments of Kaldor, McCombie and Thirlwall for the existence of differences in the degree of external constraints to growth in the economies.

3 – The Export-Led Growth Models

Aiming to contribute with the debate on the determinants of economic growth, Kaldor (1994) ascribes a central role to demand in the explanation of growth rate differentials among countries, when increasing returns to scale are assumed.[5] The author's focus is on the effect of net exports on the

[4] That is, in its constitution we would find a "large array of agents and motivations: industrial plants, technology institutes, basic science institutes, organisms which prepare qualified personnel at different levels, and ministries and central administration offices that define policies and norms; the creativity process occurs at the interaction between these agents and motivations (…), associated to the learning process, which is a determinant factor for competitiveness in the long run." (Fajnzylber, 1983, p.281, free translation).

[5] The concept of increasing returns to scale originates in Marshall (1982). This assumption constitutes an important contribution from Kaldor to theories of economic growth. Under increasing returns to scale the productivity of the factors of production increases as output grows. These are results of static increasing returns. The existence of such productivity increases even when production is declining results from dynamic increasing returns. The presence of dynamic returns as described by Kaldor (1994) opens the possibility that some portion of technological progress is determined endogenously to

economy's final demand, i.e. the increase in net exports would be fundamental to foster economic growth.

Kaldor's (1994) emphasis on the evolution of net exports as the main component of final demand led authors such as Thirlwall (1979), Dixon e Thirlwall (1975), Thirlwall e Hussein (1982), McCombie e Thirlwall (1994), Moreno-Brid (2003) to formalize export-led growth models. The maintenance of such hypothesis implies the use of "Harrod's foreign trade multiplier" (constant real terms of trade and equilibrium in the balance of payments), which leads to the conclusion that the growth rate of the economy is given by the ratio between the rate of growth of exports and the income-elasticity of demand for imports. Consequently, the performance of exports and imports, according to the assumptions of the model, play a decisive role in economic growth, as well as in the restrictions to growth, since current account deficits in the balance of payments may constrain economic growth.

Taking these considerations into account, Thirlwall (1979) derives the balance-of-payments constrained growth rate, known as Thirlwall's Law. According to this law, the growth rate of a country cannot exceed its balance-of-payments equilibrium growth rate, at least in the long run, since increasing current account deficits increase the risk of exchange rate devaluations until a recessive adjustment becomes inevitable.

According to McCombie and Thirlwall (1994),[6] the fact that economies export goods with different elasticities impairs growth with balance-of-payment equilibrium in developing countries. These countries' efforts to eliminate external deficits result in recession or inflation, amplifying the gap between developed and developing countries. These authors conclude that countries with lower income-elasticities of exports and higher income-elasticities of imports, in comparison with the rest of the world, will have lower growth rates in the long run. In order to reach such conclusion, the authors are based on Prebisch's (2000b) arguments.

In sum, according to Kaldor and the literature derived from his hypotheses, different growth rates among countries – particularly between developed and developing countries – may be justified by the tendency of a more severe external constraint to growth in the case of the latter group of countries, due to the characteristics of its growth. In addition, the macroeconomic adjustments required to lift the external constraint to growth are frequently reverted in the long run, hindering the sustainability of growth. A long-run strategy aiming at reducing this growth restriction would be the production of technological innovations in these countries, an argument which is implicit in Kaldor. This would bring about a change in the income-elasticities of exports and imports in the countries, promoting the reduction of growth rate differentials among the economies.[7]

However, Kaldor (1994), McCombie and Thirlwall (1994) and Dixon and Thirlwall (1994) do not explain the reason for differences in income-elasticities of exports and imports between countries. According to McCombie and Thirlwall (1994, p. 244),

> "The deeper question lies in why the balance-of-payments equilibrium growth rate differs between countries. This must be primarily associated with the characteristics of goods

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the economic system. See Oliveira et all (2006).

[6] McCombie and Thirlwall (1994) recognize the importance of income-elasticities of exports and imports for the performance of exports and imports, and build a model in order to indicate how such elasticities determine the growth rate of countries which are constrained by the performance of the balance-of-payments. Based on Prebisch's arguments, the authors consider two countries, one developed and one developing, with different elasticities.

[7] According to Oliveira et all (2006) Kaldor's theoretical construct does not disconsider the importance of processes of innovation and technological diffusion for economic growth. According to these authors, such processes were not present due to a methodological option made by Kaldor, who just wanted to point out to the set of relevant theoretical relations conditioning economic growth of countries, without giving details on the specificities of each component of growth.

> produced which determine the income elasticity of demand for the country's exports and the country's propensity to import. For countries with a slow rate of growth of exports, combined with a relatively high income elasticity of demand for imports, the message is plain: the goods produced by the country are relatively unattractive at both home and abroad (…) the argument probably has even greater relevance for developing countries."

But why are there differences in the degree of attractiveness of products? In other words, why would the attractiveness of goods produced in developing countries be lower than the ones produced in developed countries? In order to answer to these questions, the authors just mention Prebisch's (2000b) thesis about the income-elasticity of demand differentials. However, as we argued in the previous section, this thesis was built for the case of Latin America before industrialization. It only refers to differences in international insertion between the agrarian economy and the industrialized economy. Why do trade elasticities differ among industrialized economies? Next section intends to answer to the questions presented in this section and in the previous one, taking into account the role of technological progress for competitiveness gains and the reduction of external vulnerability of an economy.

4 – National System of Innovation, Competitiveness and External Vulnerability

The purpose of this section is to analyze the validity of the relationship between an economy's National Innovation System (NIS), its competitiveness and its external vulnerability. It is argued that the competitiveness of an economy depends on macroeconomic policies, particularly those to do with the real exchange rate, domestic interest rates and the government's fiscal balance. However, there is no consensus regarding the definition of the term "competitiveness of an economy" (Porter, 1990, p 3). There are economies such as Italy, Sweden and Canada, where the real exchange rate evaluated in the 1990's, but which were still considered to be competitive. Israel and The United States present high interest rates and fiscal deficits respectively. However, it cannot be argued that these economies are uncompetitive. It is also argued that competitiveness is the result of low unit labour costs and abundant natural resources but these factors are not characteristic of competitive economies such as Germany, Japan or Switzerland.

In this paper, an economy's competitiveness will be defined on the basis of its ability to compete with the rest of the economies in the world in both the international and domestic markets. Thus, the concept of competitiveness is relative and involves a comparison between economies regarding their ability to export and satisfy internal demand by domestic production. Therefore, the definition of competitiveness should be related to a county's relative capacity to generate surpluses in its Trade Balance

However, measuring an economy's level of competitiveness is no easy task. There are a bunch of variables relating to the overall economic situation which influence trade balance. Amongst these variables are those that depend on domestic economic policy, such as the economic growth rate, the real exchange rate, and policy regarding trade and subsidies, etc. There are also those variables which are exogenous in relation to political decision-making, such as the world economic growth rate or foreign partners' trade policies. These general factors exhibit short-term fluctuations but there are also structural factors which only present long-term changes and which also influence trade balances, such as the educational level of the workforce, the rate of technological progress and productivity and the institutional structure of the labour market or the financial system, etc.

Thus, the circumstantial factors, that are dependent on the economic policies adopted, may lead to consecutive trade surpluses in economies with low competitiveness. The opposite may also occur – highly competitive economies may have consecutive trade deficits for a long period of time as a result of circumstantial factors which affect the trade balance.

Nevertheless, if a model which eliminates such circumstantial economic factors is adopted, we can elaborate the concept of structural competitiveness, which refers to an economy's relative ability to generate trade surpluses when only structural factors are considered. According to this model, a very competitive economy has recurrent trade surpluses and an economy with low competitiveness has chronic trade deficits. So, competitive economies also tend to have Current Account surpluses in their Balance of Payments (CA), as long as economies with low competitiveness tend to have CA deficits.[8]

However, political economic decisions affect the external sector of the economy. This being the case, when it is sought to built an index of economic competitiveness, whose measurements are feasible, the aforementioned general economic factors must also be taken into consideration. An economy's low competitiveness tends to lead to the occurrence of trade deficits and, consequently, to an increase in its foreign debt. Meanwhile, foreign credit restrictions occur on a cyclical basis and force uncompetitive economies to adopt policies to regulate its external sector.[9] In this case, trade surpluses are often generated by the contraction of economic activity and devaluation of the real exchange rate, with the aim of balancing the CA account in uncompetitive economies. In the very competitive economies, on the other hand, the tendency to generate high trade surpluses may lead to the adoption of macroeconomic policies which cause deterioration in the trade balance. However, since these economies tend to be creditors in the international scenario, their CA balances tend to be higher than their trade balances, and, as a result the CA balance seems to reflect more accurately the competitive level of an economy than the trade balance. This means that the circumstantial factors that oscillate in the short-term have a greater influence on trade balances than on CA balances. CA balances are therefore a more accurate reflection of the influence of structural factors, which are stable in the short-term, than trade balances.

Therefore, the competitiveness is defined as its relative capacity to generate surpluses in Current Account. Thus, the size of the average CA balance over a fixed period of time is taken as the index of an economy's competitiveness.[10] This index is not valid only for economies which are the centre of the international financial system. The net capital inflows in the country where the main international financial market is located tends to be high and persistent and brings about economic policies that are associated with the occurrence of chronic CA deficits, even when the economy is competitive. This seems to be the case of the United States and the United Kingdom during the last few decades.

Once defined the concept and the index of an economy's competitiveness, we now intend to analyse the effects of technological progress on the level of competitiveness. An economy's level of competitiveness depends primarily on its export-import performance. Initially, therefore, the relationship between technical progress and exports will be explained. In this regard, the value of an economy's exports depends on three characteristics of the markets of the products exported, namely:

i) Market Structure of the export industries: The closer the exports to oligopoly, the greater the ability of the exporting company to fix the prices of its products, and, the higher the profitability and value of its exports tends to be.
ii) Dynamism of the market: The higher the rate of growth in demand in the market, the greater

[8] This happens because financing of trade deficits is usually carried out by means of surpluses in the Financial Account of the Balance of Payments, which increases the economy's external debt and contributes to future negative balances in the CA. In the case where economies have consecutive trade surpluses, they can be used to finance CA deficits in other countries and help to produce future CA surpluses in the creditor country.

[9] This argument will be explained later on and is compatible with the literature which employs the hypothesis of balance of payments constrained economic growth, à la Thirlwall and CEPAL.

[10] In addition, the greater the period of time used for calculation of the average CA surplus, the less intense the effects of the oscillations in the overall economic factors affecting the trade and CA balance will be.

the value of exports to that market tends to be.

iii) Level of market protectionism: The less the market is subject to protectionist policies, the greater tends to be the value of exports to that market.

In addition, the value of exports depends on a fourth factor:

(iv) Diversification of the economy's industrial structure.

Concerning the three aforementioned characteristics of a market, we argue that in international trade, the greater the level of technological sophistication of products (LTSP), the closer the structures of their markets resemble oligopoly, the more dynamic are their markets and the less they are subject to protectionist measures. Technological progress and its diffusion in an economy occur in the context of the development of that economy's NIS (Freeman, 2004; Nelson, 2005; Fagerberg, 1994; Dosi et all. 1994). Therefore, it affects the level of technological sophistication of its production and this, in turn, affects its exports.

The positive correlation between the LTSP and the degree of oligopoly is due to the fact that a product that is in the technology frontier, or close to it, cannot be produced in countries which do not possess a developed NIS. Production cannot just simply be transferred to other countries, given that few economies possess an NIS that is developed enough to enable them to manufacture such products. That means no heavy competition for these products in world markets and tacit or explicit agreements concerning price fixing for the goods in the international market is made possible. This situation supports an increase of the income elasticity of demand for the country's exports.

The positive correlation between the LTSP and the level of dynamism of its markets is due to the fact that a product which is in the technology frontier, or close to it, cannot be produced in a country which does not have a developed NIS. In this case, the demand for such a product can only be satisfied by means of imports from the few countries where the NIS is able to produce it, thus guaranteeing a world-wide market with increasing (dynamic) demand for this type of leading edge technology product. The higher the dynamism of the country's exports markets, the higher the income elasticity of demand for this country's exports tends to be.

The inverse correlation between the LTSP and the degree of protectionism in its domestic market is due to the fact that a product made by low level of technological content can be produced by many countries, even if the production costs are high in comparison to the world average. Domestic production is made viable by erecting barriers to importation of this type of product. However, if the technological content of the product is of a high level, it cannot immediately be produced even though barriers have been established if the country's NIS is not sufficiently developed to make it possible. In such cases, the domestic demand for the product can only be satisfied by imports and this would imply a low level of protectionism (in the domestic markets of a wide range of countries) and a high level of the income elasticity of export demand for high technology products.

Concerning the diversification of an economy's industrial structure, the more developed its NIS, the greater is the possibility of reaching the technological frontline in various areas of production. Therefore, the greater the degree of diversification of the industrial structure tends to be. Consequently, there is greater diversification in the range of its export goods, which favours growth in the value of exports, due to three factors, namely, i) domination of new markets that will be even more diversified to the extent that the range of exports becomes even more diversified; ii) stability of growth in the value of exports, since, the more diversified exports are, the greater the chance that a drop in price and/or demand for exports will be compensated for by an increase in the price and/or demand of another product in the range of exports; iii) increase in the income elasticity of export demand since the

export opportunities will be greater to the extent that there is greater diversification of the range of export goods.

Therefore, the four items examined – level of oligopoly, market dynamism, level of protectionism and diversification of the industrial structure – suggest that the more developed an economy's NIS, the greater its export coefficient and the value of its exports should be. Thus, the level of development of the NIS is positively correlated with the performance of the Trade Balance and the CA balance.

The relationship between the level of a country's NIS development and imports is also associated with these four items. Countries with a low level of NIS development are not capable of producing goods with high technology content and need to import such goods from high priced markets where there is oligopoly. In addition to this, the more dynamic a market for a particular good, the greater will be the demand in this market, thus favouring an increase in prices and making its imports more expensive – the positive correlation between LTSP and the degree of market dynamism has already been explained. Also, the lower the import barriers, the greater the value of imports. As already argued, there is an inverse correlation between the degree of a product's technological sophistication and the level of protectionism in its domestic markets.

Finally, the less developed the NIS, the less diversified an economy's industrial structure will be. Therefore, the more diversified its range of imports, the greater the proportion of internal demand that will be satisfied by means of imports. This leads to growth in both the income elasticity of import demand and the value of imports.

Therefore, in a country where the NIS is relatively less developed, the income elasticity of export demand tends to be lower than the income elasticity of import demand, leading to external structural vulnerability, as postulated initially by ECLAC-UN and Thirlwall.

It may be concluded that the more developed an economy's NIS, the greater will be the range of its sophisticated (technological) products, and that will cause an increase in the value of exports and reduce the value of imports. The opposite situation is also true. Therefore, countries whose NIS is developed tend to have a high level of competitiveness while countries that present undeveloped NIS tend to be uncompetitive.

The level of development of a country's NIS can be measured on the basis of that country's per capita production of patents compared to the per capita production in the world as a whole. According to Bernardes and Albuquerque (2003, p. 873) and Albuquerque (1999), patents are not an infallible means of measuring the level of technological development but, nevertheless, it is the method used in the literature and is useful in achieving this objective. Using data relating to science and technology indicators, Albuquerque (1999) concluded that the countries which have a developed NIS are: Germany, France, Italy, Japan, the United States, the United Kingdom, Denmark, Belgium, the Netherlands, Ireland, Austria, Switzerland, Canada, New Zealand, Australia and Israel. Countries which are at the stage of catching up are: South Korea, Taiwan and Singapore. All the other countries are in the category of Undeveloped NIS (Immature National Innovation System).

Therefore, in this article Albuquerque's (1999) classification was used to collect data on the international trade of two groups of countries: countries with a developed NIS (DIS) and those with an undeveloped NIS (UDIS). The following countries were selected to represent the DIS group:- Germany, France, Italy, Japan and Canada[11] and for the UDIS 16 countries from Latin America, Asia and Africa were chosen:- Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, The Philippines and South Africa.

[11] The exclusion of this group of two countries that are important in the world scenario, the Unites States and the United Kingdom, was justified above.

Table 1 shows the CA balance for the DIS and UDIS groups. An economy's average CA balance in any specific period is an indicator of its competitiveness during that period. For the period between 1966 and 2006 when data was available, the DIS group had an average CA surplus of US$68.2 billion and the UDIS group had an average deficit of US$16.4 billion. These figures are evidence that the economy's level of NIS development exercises a positive influence on its competitiveness.

Table 1 – Total and Average Current Account Balance, 1966 – 2005 (US$ billion)

	Sum of CA balances in the period: 1966-2006	Average in the Period: 1966-2006	Standard Deviation
DIS	2.548	63,7	78,4
UDIS	-690	-17,3	30,4

Source: Author's elaboration using data from World Development Indicators database, 2007.
DIS = countries with a developed NIS – G7 countries excluding USA and UK were taken as proxy;
UDIS = countries with an undeveloped NIS – were taken as Proxy: Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, Philippines and South Africa.

The products that are at the leading edge of technology, or close to it, are capital goods and manufactured goods in general. The former materially incorporate technological progress (Faynzylber, 1983), and the latter require more complex production processes and more aggregate value compared to primary and intermediate goods.[12] Thus, the higher the level of development of an economy's NIS, the higher the level of technological progress attained by that country and the more developed, integrated and competitive its capital goods industry is. In the same way, since the manufacturing sector incorporates a greater amount of technological content in comparison with other sectors, the greater the level of development of a country's NIS, the more diversified and competitive its output of manufactured goods will be. Therefore, if the level of development of a country's NIS is a relevant factor in determining the level of competitiveness of its economy, then countries which have a more developed NIS should have a capital goods and manufactured goods trade balance which has a tendency to be in surplus, whereas those countries which have a less developed NIS should have a trade balance which tends to be in deficit. Given this result, one would expect capital goods and manufacturing goods exports from countries with a developed NIS to present high shares in world exports, in comparison with countries with an undeveloped NIS.

Table 2 shows the average balance of the total trade balance in capital goods (CG), manufactured goods (MG) and primary goods (PG) for the DIS and UDIS groups of countries between 1980 and 2005. The different results obtained by these two groups show the importance of the level of development of an economy's NIS as regards the increase of competitiveness of an economy. In both groups, the trade balance average was in surplus but was much higher for the DIS group than for the UDIS group. In the case of the UDIS group the average CG and MG balance was in deficit, while the average PG trade balance was in surplus. In the DIS group, exactly the opposite situation was found.

[12] Technological progress is linked to the capital goods industry, since the latter materially incorporates the former and is an important channel for its diffusion. This type of industry is a crucial determinant of an economy's growth and competitiveness and acts as the basic link in the "virtuous circle" of growth – technological progress – international trade (Fajnzylber, 1983, p. 36). According to (Fajnzylber, 1983, p. 42), there is a structural trade deficit in developing countries, since their capital goods industry has a low level of technological complexity and integration.

Table 2 – Total Trade Balance in Capital Goods, Manufactured Goods and Primary Goods - 1980 to 2005 (US$ billion)

Period	UDIS				DIS			
1980-2005	TTB	CG*	MG	PG	TTB	CG*	MG	PG
Average	14	-42.5	-55.1	38.2	146.9	137.4	337	-58.6

Source: Author's elaboration using data from United Nations Statistics Division, World Trade Organization, 2007.
DIS = countries with a developed NIS – G7 countries excluding USA and UK were taken as proxy;
UDIS = countries with an undeveloped NIS – were taken as Proxy: Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, Philippines and South Africa.
TTB = total trade balance; CG = capital goods trade balance; MG = manufactured goods trade balance; PG = primary goods trade balance.
*For CG data is available only for 1995 and for the period 1998-2005.

Picture 1 presents the percentage share of total exports, capital goods, manufactured goods and primary goods in total world exports and by type of good, during the period 1980-2005. Overall exports from the DIS group represent a significant share of world exports. This group dominates almost 50% of total world exports, 57% of world exports of manufactured goods, and 51.9% of capital goods world exports. Exports from the UDIS group represent only 8.73% of total world exports. This group is responsible for 6.2% of world exports of manufactured goods and 8.8% of world exports of capital goods. For countries in the UDIS group, primary goods represent the largest share in world exports (16.4%), whereas this type of goods is the one with the lowest share in world exports from the DIS group (38.4%).

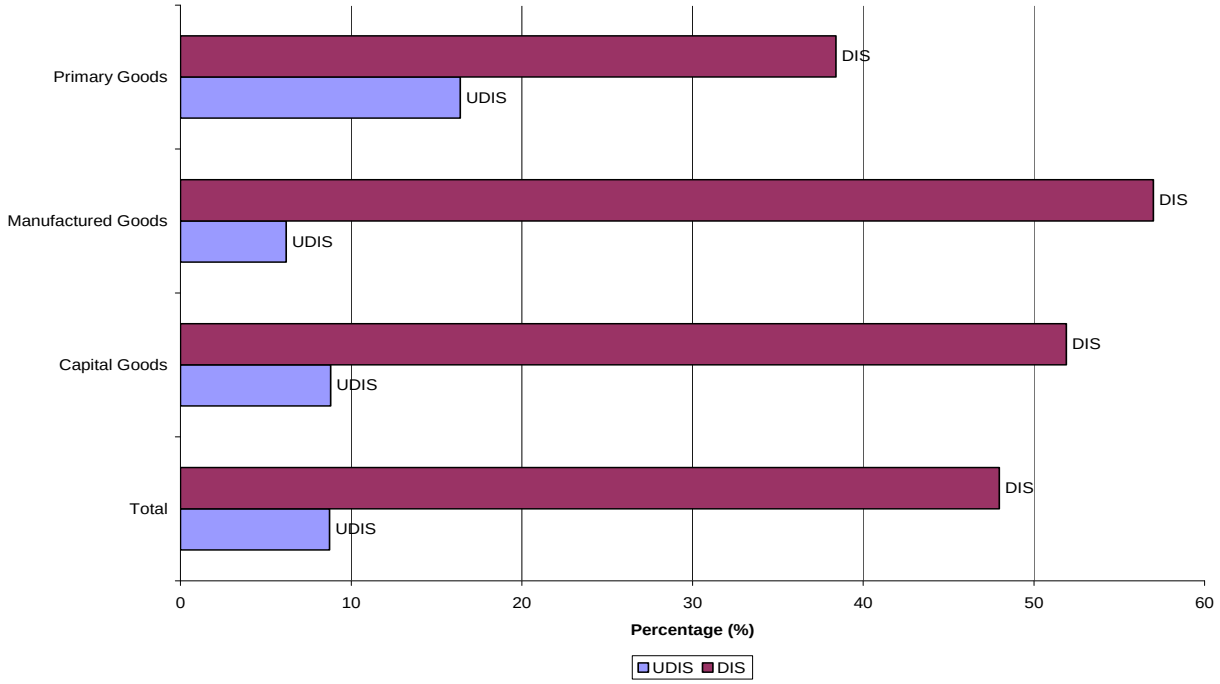
Therefore, in all the categories described here, the share in world exports from countries in the DIS group is always larger than the share from countries in the UDIS group. Even more, this gap is much larger for manufactured goods and capital goods, as compared to primary goods.

The large difference between the percentages of exports from the groups DIS and UDIS in world trade, especially for technology-intensive goods, associated with the results regarding trade balance and current account balance, show a non-competitive international insertion for countries in the UDIS group and a competitive external insertion for economies in the DIS group.

In the same way, when analyzing foreign trade from DIS and UDIS groups according to factor- and technology-intensity, it is expected that the trade balance in technology-intensive goods will be in surplus in countries where the NIS is more developed. The opposite should be the case in countries with a relatively less developed NIS. Table 3 presents the average trade balance in primary commodities, labor- intensive and natural-resource-intensive goods, as well as goods with high, medium and low technological level between 1980 and 2004.[13] The average trade balance for the UDIS group was in deficit for high, medium and low technology goods and in surplus for basic commodities and labour-intensive and natural-resource-intensive goods, while the result was exactly the opposite in the case of the DIS group.

[13] This classification was made by United Nations Conference on Trade and Development (UNCTAD, 2002).

Picture 1 – Exports share in world exports, by type of goods - 1980-2005 - (%)*



Source: Author's elaboration using data from United Nations Statistics Division, World Trade Organization, 2007.
DIS = countries with a developed NIS – G7 countries excluding USA and UK were taken as proxy;
UDIS = countries with an undeveloped NIS – were taken as Proxy: Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, Philippines and South Africa.
Total = total exports of goods;
*For Capital Goods data is available only for 1995 and for the period 1998-2005.

Table 3 – Trade balance in primary commodities, labor-intensive and natural-resource-intensive goods, and goods with high, medium and low technological intensity (US$ billion)

Period	**UDIS**					**DIS**				
1980-2004	PC	LNRI	HT	MT	LT	PC	LNRI	HT	MT	LT
Average	51.0	22.8	-24.8	-42.1	-7.8	-79.2	-4.7	56.4	218.6	42.3

Source: Author's elaboration using data from United Nations Statistics Division, World Trade Organization, 2007.
DIS = countries with a developed NIS – G7 countries excluding USA and UK were taken as proxy;
UDIS = countries with an undeveloped NIS – were taken as Proxy: Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, Philippines and South Africa.
PC = primary *commodities*; LNRI = labor- and natural-resource-intensive goods; HT, MT and LT are, respectively, goods with high, medium and low technological intensity.

These results can still be explained by the low share of technology-intensive goods in the total exports from the UDIS, which is quite lower than the share for countries in the DIS group, characterized by larger export shares of goods with higher technological intensity. The largest share in total exports from the UDIS group (table 4) is primary commodities (42.54% of total exports), followed by exports of goods with high technological intensity (20.71%). In the DIS group, exports of goods with high and medium technological intensity represent around 30% and 37%, respectively, whereas export share of commodities in total exports from this group is only 14.35%.

Exports of high and medium technological intensity altogether represent 34,9% of total exports from the UDIS group, against almost 70% of exports share of these goods in total exports from the DIS group. Picture 2 complements the argument by showing strict dominance of countries from the DIS group in world exports of goods with higher technological intensity, as compared to the UDIS group. Such difference is smaller in the case of primary commodities and labor-intensive and natural-resource-intensive goods, where the group UDIS is more competitive.

Table 4 – Export Composition by Factor Intensity - 1980-2004 - (%)

Period	UDIS						DIS					
1980-2004	PC	LNRI	HT	MT	LT	Total	PC	LNRI	HT	MT	LT	Total
Average	42.54	16.36	20.71	14.20	6.20	100.0	14.35	9.80	30.38	37.26	8.20	100.0

Source: Author's elaboration using data from United Nations Statistics Division, World Trade Organization, 2007.
DIS = countries with a developed NIS – G7 countries excluding USA and UK were taken as proxy;
UDIS = countries with an undeveloped NIS – were taken as Proxy: Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, Philippines and South Africa.
PC = primary *commodities*; LNRI = labor- and natural-resource-intensive goods; HT, MT and LT are, respectively, goods with high, medium and low technological intensity.

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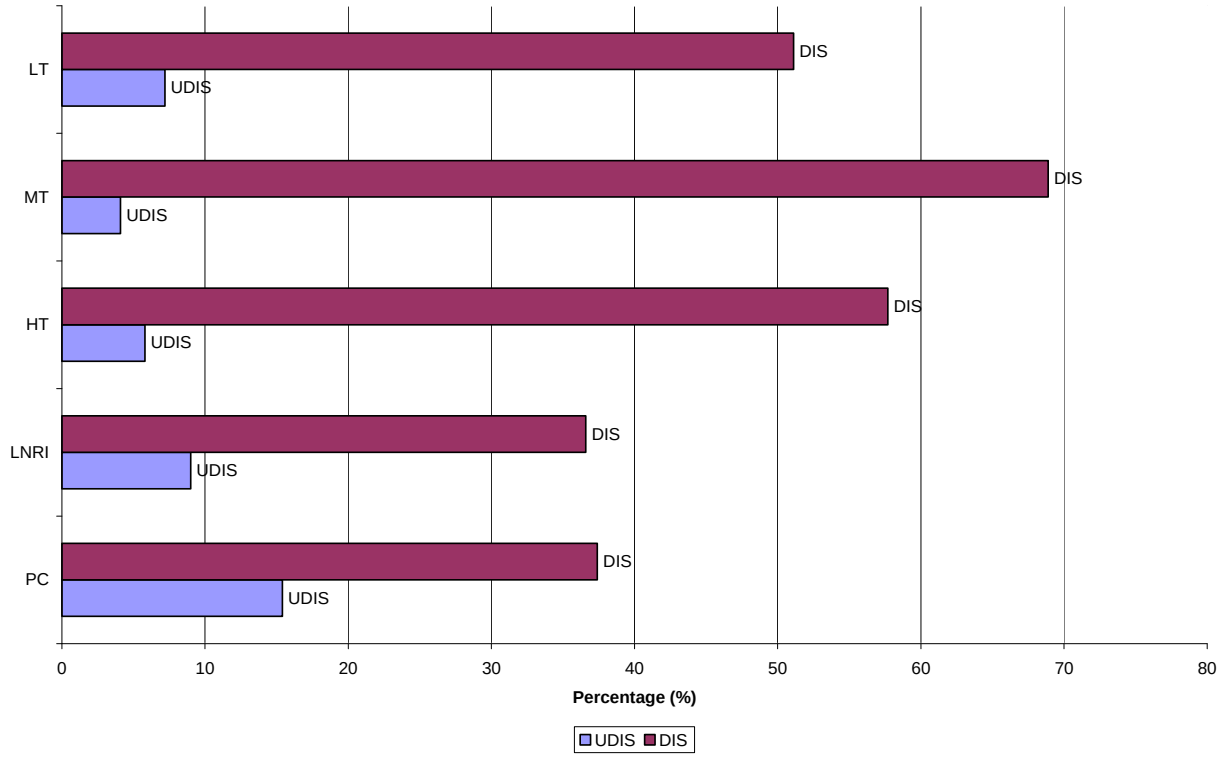
Picture 2 – Share of exports in world exports according to the degree of factor intensity - 1980-2004 (%)



Source: Author's elaboration using data from United Nations Statistics Division, World Trade Organization, 2007.
DIS = countries with a developed NIS – G7 countries excluding USA and UK were taken as proxy;
UDIS = countries with an undeveloped NIS – were taken as Proxy: Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, Philippines and South Africa.
PC = primary *commodities*; LNRI = labor-and natural-resource-intensive goods; HT, MT and LT are, respectively, goods with high, medium and low technological intensity.

The argument that technological innovation plays an important role in the external insertion of the economies is corroborated by the correlation coefficient between the share of each of the 23 countries of both UDIS and DIS groups (including USA and UK) in the world production of per capita patents and the share of each country in world exports of goods with high technological intensity (table 5). These coefficients are high and positive, showing an average of 0.95 for all the periods analyzed, and suggesting a high correlation between the level of development of the NIS in a country and its performance in exports of high technology goods.

Last of all, Table 6 shows the coefficients of correlation between the CA balance and the share in the world per capita production of patents in the 21 countries which make up the DIS and UDIS groups. The correlations are high and positive: 0.71 and 0.68 for the periods 1980-2005 and 1990-2005 respectively and confirm the importance of NIS development for the performance of these economies' current account transactions.

Table 5 – Correlation Coefficient between the share of each country in world production of per capita patents and the share of each country in world exports of high technology goods – sample of 23 countries

Period	1980	1985	1990	1995	2004	1980-2004	1990-2004
Correlation coefficient	0.95	0.96	0.96	0.95	0.93	0.94	0.93

Source: Author's elaboration

The 23 countries are: Germany, France, Italy, Japan, Canada, USA, UK, Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, Philippines and South Africa.

Table 6 – Correlation Coefficient between Current Account Balance and the share of 21 countries in the per capita world production of patents

Period	1970-2005	1980-2005	1990-2005
Correlation coefficient	0.74	0.71	0.68

Source: Author's elaboration

The 21 countries are: Germany, France, Italy, Japan, Canada, Brazil, Argentina, Bolivia, Colombia, Chile, Ecuador, Mexico, Peru, Uruguay, Venezuela, Malaysia, Thailand, India, Indonesia, Philippines and South Africa.

All these results endorse the argument that the relative level of development of an economy's NIS is an important determinant of its level of competitiveness. Countries with a more (less) developed NIS have a higher (lower) level of competitiveness. Given that the concept of competitiveness refers to an economy's capacity to generate CA surpluses, economies with a developed NIS tend to have a relative abundance of foreign exchange, whereas in countries with a less developed NIS there is a chronic shortage of foreign exchange.

If we define an economy's level of external vulnerability as the frequency with which it runs out of foreign exchange, we find that there is a high level of external vulnerability in countries where there is an undeveloped NIS. By the same token, there is a low level of external vulnerability in countries with a developed NIS. Therefore, there is a positive correlation between the level of development of an economy's NIS and its level of competitiveness and a negative correlation between its level of competitiveness and level of external vulnerability. Thus, other things being equal, the more developed an economy's NIS in relation to that of other economies, the lower the level of its external vulnerability will be.

The shortage of foreign exchange in an economy frequently causes a currency crisis. Therefore,

economies which have recurring exchange rate crises are precisely the ones which have a high level of external vulnerability. The inverse relationship between level of IS development and level of external vulnerability is backed up by empirical evidence. The economic history of the countries belonging to the UDIS group reveals a proportionately higher number of currency crises than that observed for the DIS group. The series of currency crises seen in the period from 1990 to 2006, for example, whose result was exchange rate devaluations that, in a matter of weeks, exceeded the 30% level, only happened in UDIS countries – in Mexico in 1994-95, in Asia in 1997, in Russia in 1998, in Brazil in 1999 and 2002 and in Argentina in 2001.

5- Conclusions

Authors from ECLAC, such as Prebisch and Fajnzylber, and from the Kaldorian tradition, like Thirlwall and McCombie, converge to the same explanation regarding the differences in economic growth rates among countries. These differences would derive from different levels of external constraint to growth of the economies. The external constraint to growth, in turn, would depend on the country's income-elasticities of imports and exports.

However, Prebisch's (2000a; 2000b) explanations for differences in trade elasticities among countries are not adequate when all countries under study are industrialized. In addition, his thesis on the deterioration of terms of trade is not consensual in the literature. The arguments by McCombie and Thirlwall (1994) are also insufficient, since they only refer to Prebisch in order to explain why those elasticities differ among goods and among countries.

For Fajnzylber (1983; 1990), the industrialization of an economy, when accompanied by the constitution of an "endogenous core of technology production", would affect its competitiveness and its trade balance, relaxing its external constraint to growth. That would only be possible, thus, if the constitution of this "endogenous core of technology production" modified the income-elasticities of trade in the economy. However, Fajnzylber does not analyze this issue, i.e. he does not explain how the "endogenous core of technology generation" of an economy would affect its income-elasticities of imports and exports.

In order to fill this gap, this paper built causal links between the development of a National Innovation System, changes in income-elasticities of trade, competitiveness and external vulnerability of an economy. For that, we initially discussed the concept of competitiveness of an economy and how to measure it. Afterwards, the correlations between relative development of the national innovation system, income-elasticities of trade, competitiveness and external vulnerability of an economy were theoretically demonstrated. Finally, the theoretical arguments were supported empirically through the construction of several indicators. We found that countries where the national innovation system is more developed dominate world trade and present structurally positive external balances. The opposite is the case for countries where the national innovation system is less developed.

The empirical evidence presented in this paper corroborate the argument that the relative development of the national innovation system in an economy is relevant to explain its competitiveness, its degree of external vulnerability and the intensity of its external constraint to growth. In this sense, it reaffirms the importance of stimulating the development of the national innovation system in developing economies as a way to consistently reduce the gap in growth rates between countries.

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