The role of manufacturing exports in the economic development of middle-income countries

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Abstract
The aim of this paper is to evaluate the role of the manufacturing sector in the development process through the first two laws of Kaldor. The first states that the higher the growth of industrial output, more significant is the growth rate of the product of the economy as a whole. The second law, known as the Kaldor-Verdoorn law, establishes a deterministic relation between growth of manufacturing productivity and output growth in the manufacturing sector. Additionally, it is tested the influence of manufactured exports in this process, given its importance as a source of autonomous demand and as a factor that relaxes the constraint to growth, and the relevance of the exchange rate, because it is assumed that its level influences exports of such products. Therefore, initially the article will present the behavior of manufacturing and exports in the recent past, more specifically since 1990, highlighting some stylized facts on the economic performance of countries according to the level of income, changes in investment rates, the centrality of manufacturing and exports of manufactures. Afterwards, it is performed a theoretical reflection on the importance of manufacturing and exports of manufactured goods to the process of economic development and a discussion on the role of the exchange rate and the systematization of a Kaldorian model to assess the importance of manufacturing and its exports to the development. Econometric tests are performed based on a dynamic panel data for a sample of 63 middle and high-income countries, excluding major exporters of fuels, in order to analyze whether there is any difference in growth dynamics between these two groups, for the period between 1990 and 2011. Additional controls were introduced in the model, associated with components of demand and supply constraints. Estimates attest the occurrence of the two Kaldor laws, demonstrating that output growth in the manufacturing sector is essential to increase economic growth and productivity, especially in middle-income economies. The results also confirm that manufacturing exports are relevant to the development process, and that the exchange rate contributes to this process in middle-income countries.

Key-words: economic development; international trade; manufacturing sector; middle-income countries

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Introduction

In 1966, Nicholas Kaldor published his seminal paper on the causes of United Kingdom’s low economic growth during that period. The paper had been originally written at that same year as a keynote lecture at the University of Cambridge. At that time, the most frequent explanations for Britain’s economy slowdown were institutional or based on the neoclassical growth theories. They blamed factors such as inefficient management of British firms, the greater emphasis of the educational system’s on humanities than on engineering, highly restrictive trade unions, the citizens unwillingness to work, insufficient investment, or distortions in the price system driven by governmental economic policies.

Although admitting that several of those factors might be plausible in the domestic context, Kaldor argued that they were not in comparative terms. Without going into the merits of the discussion, the author prepared an alternative approach based on the analysis of “development stages”, as done previously by Rostow (1956). Kaldor conducted an empirical, structural (i.e.: industrial), and comparative investigation, focused on the role that manufacturing sector plays in economic growth. His conclusion was that the British economy suffered from “premature maturity,” in which the manufacturing sector was losing strength in comparison to other economies of a similar income level. In his words, Great Britain “exhausted its growth potential before attaining particularly high levels of productivity or of average per capita income” (Kaldor, 1978[1966], p. 102).

Kaldor’s 1966 paper became an essential reference because it contains the embryo of the theoretical formulation that became known as “Kaldor’s growth laws”. These laws attribute crucial importance to the manufacturing sector for economic development. They put more emphasis on the aggregated demand, what differs from the theories of exogenous and endogenous growth developed since Solow (1950). In those theories factors operating on the side of supply would be of greater importance in explaining economic growth. Instead, Kaldor’s laws were more in line with the development theory, whose precursors were for example Rosenstein-Rodan (1943), Prebisch (2000[1949]) and Hirschman (1958), who had already argued about the relevance of aggregate demand and output composition by sector. Furthermore, as noted in McCombie (1980), the 1966 paper, together with another published in 1968 (“Productivity and Growth in Manufacturing sector: A Reply”), used empirical evidence to challenge the validity of two basic pillars of the neoclassical theory: the prevalence of constant returns to scale and the homogeneity of labour marginal product across all economic activities. Instead, Kaldor (1978[1966]) argues that manufacturing enjoys increasing returns to scale, and productivity is sector-specific, as one might infer from Verdoorn’s law (1949).

Kaldor’s work became an important turning point in the literature of economic growth. Its theoretical framework was continuously replicated for different groups of countries and periods of time since then, following the evolution of econometric methods for static- and dynamic-model data panels.

Among the factors operating on the side of demand in the economic development process, Kaldor found that net manufactured goods exports, initially of consumer goods and later on of capital assets, contribute to industrialization as imports substitution processes become exhausted and foreign demand is needed to avoid external constraints, so that the manufacturing sector output may rise above domestic demand and enable the process of structural economic change to

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1After all the United States was also experiencing low growth though allegedly American business classes were competitive, there was massive engineer training, etc.

2It is worth noting that, until 1962, Nicholas Kaldor’s growth models assumed a fully employed workforce, so that differences between countries’ growth rates would be limited to differences in productivity. However, starting from the 1966 paper, Kaldor breaks away from the full-employment and constant returns to scale assumptions to develop, over the years, a demand-driven notion of the growth of industrialized capitalist economies (Freitas, 2003).
continue.\(^3\) Subsequently, other authors, such as Chenery (1980) and, more recently, Haussman, Hwang & Rodrik (2006), Palma (2005) and Bresser-Pereira (2012), as will be seen ahead, also singled out that the raise of manufacture exports as an important mechanism in a country’s economic development process.

In recent years, Brazilian and international economic development literature has often addressed the topic of deindustrialization, discussing its ties with some economies’ lower growth rate in recent times, as in Brazil (Palma 2005, Bresser-Pereira & Marconi 2008, Carvalho & Kupfer 2008, Soares & Oreiro 2010, Nassif, Feijo & Araujo 2012). In this framework, keeping the foreign exchange rate at a competitive level tends to stimulate manufactured goods exports and, as a consequence, a change in the economy’s production structure toward a larger share of manufacturing and toward economic development itself - as argued by Rodrik (2008), Razmi, Rapetti & Skott (2009) e Bresser, Oreiro & Marconi (2012).

However, the questions raised about the relevance of the manufacturing sector for economic growth predates this later discussion. Therefore, the purpose of this paper is to assess how updated Kaldor’s laws are nowadays, applying one improved version of his methodology to investigate whether its results are still true. First Kaldor law states that the greater the growth of the manufacturing sector, the more expressive the overall output growth rate. The second law, also known as the Kaldor-Verdoorn law, establishes a deterministic relation between the growth of the manufacturing sector and the productivity growth of the manufacturing sector.\(^4\)

This task is done by means of a critical reconstitution of the 1966 arguments, estimating the two laws for a sample of 63 middle- and high-income countries in terms of gross domestic product (GDP), except major fuels exporters (which display specific characteristics and may skew the results) for the 1990-2011 period. The countries were grouped according to the World Bank’s income-level classification. The econometric models to estimate the laws are based on Arellano-Bond's (1991) model for dynamic panels. Finally, the model includes some supply and demand variables that Kaldor (1978[1966]) suggests as possible explanations for the different growth dynamics between middle- and high-income countries. The general hypothesis is that such variables contribute differently to the economic growth process in each group of countries. The role of manufactured goods exports will be emphasized, as well as of the level of the real foreign exchange rate in force, given the theoretical justifications provided throughout the text.

This paper includes five sections in addition to the present introduction. Section 1 introduces stylized facts and descriptive statistics intended to support the paper’s hypotheses, particularly in connection with the relation between growth, industrialization and manufactured goods exports. Section 2 provides a theoretical discussion on the role of the manufacturing sector in the economic development process based on the structuralist literature, as well as on the relevance of manufactures exports and of the exchange rate. Section 3 briefly discusses Kaldor’s 1966 paper and important criticisms to that, in order to then define the model to be used in this study. Section 4 describes variables of the model, data sources and the estimation method of the model presented in this paper. Finally, Section 5 summarizes main findings and provides conclusions.

\(^3\)The other factors Kaldor pointed out as relevant to demand-led growth include the change in consumption structure brought about by rising per capita income and domestic investment. On the supply side, constraints to growth arise from the scarcity of commodities used as inputs and of labour.

\(^4\)The author also analyzes the relation between productivity in other sectors and increased manufacturing output and defines it as positive, since increased manufacturing output stimulates a shift of labour from sectors with decreasing returns to another sector – the manufacturing sector in this case – where the returns are increasing.
Section 1. The recent behavior of the manufacturing sector and its exports

Here some stylized facts are introduced in order to clarify the motivation for the present research. That is, the importance of the manufacturing sector and its exports for economic growth today, as suggested by the theorists of demand-led development. The analysis also took investment into consideration. Manufacture exports and industrialization of the productive structure remain crucial factors for the growth dynamics of developing economies, despite recent changes in the international division of labour and international trade and, more broadly, in the capitalist system of globalized finance and production. A quick review of the production and exporting profiles of countries around the world suggests that:

a) Upper-middle-income countries (according to the World Bank’s criteria) are those whose manufacturing sector holds the highest share of value added, while high-income countries display a smaller share.

Graph 1
Percentage share of the manufacturing sector in value added at constant 2005 prices
Average for each group of countries categorized by income level
Source: UnData, United Nations, calculations by the authors

Graph 1 illustrates this fact. The manufacturing sector’s lower share of value added in high-income countries may be due to the inverted-U relation between the manufacturing sector’s share of value added and per capita income, as widely discussed in the literature by Rowthorn & Ramaswamy (1999), among others. This is as a result of changes in the consumption patterns of the population as their income rises, of technology changes, and to misguided macroeconomic policies (Palma, 2005). According to this curve, after a peak in the expansion of manufacturing, high-income economies would experience deindustrialization toward highly specialized services with higher value added.

Upper-middle-income countries, in their turn, are precisely those experiencing the process of change and consolidation of a more manufacturing-oriented productive structure. This shall be an important part of the process of attaining higher income levels, as put by Kaldor (1966) and Rostow (1956), among many others. Regardless, note also that the share of manufacturing in value added has been recovering in high-income countries since the mid-1990s.

Another issue associated with recent changes in the organization of production and labour processes may also have contributed to explaining that behavior observed in high-income countries.
Since the 1970s, the international division of labour ceased to reflect the traditional dichotomy between peripheral economies specialized in commodities and industrialized central economies. Firstly, because the very separation between production activities became increasingly hazy, considering, for example, the fact that manufacturing involves several activities and tasks associated to services (equivalent to 55% of the total in the US in 2010, according to McKinsey (2012)). Secondly, and closely related to the previous argument, global production chains have been developing based on a more profound reallocation of the various stages of production, marketing and sales, at a more complex level of tasks and activities that are increasingly less vertical and more horizontal (OECD/WTO, 2013).

No wonder, then, that in the sample selected for this paper, which includes 32 middle and 31 high-income countries – according to World Bank criteria –, the average share of the manufacturing in total value added between 1990-2011 for the two groups is quite similar, but higher in middle-income countries: 17% versus 18.4%. In terms of employment profile, given the data available, the respective percentages are 19.3% and 22%.

b) the share of investment in value added is more stable for high-income countries, but has been increasing among upper-middle-income countries.

Data in Graph 2 show that, in the period at hand, the share of investment in value added fluctuated more among middle-income countries than in high-income ones. One possible explanation for this fact is a greater sensitivity of investment to macroeconomic policies in those economies. An alternative explanation is the presence of greater oscillations in the activity levels of middle-income countries. In addition, investment in recent years has been higher in middle-income economies than in high-income ones. It is possible that the process of manufacturing consolidation may also lead to higher investment growth, because the first drives higher inter-industry demand and other strategies that lead greater growth in manufacturing than in other sectors of the economy.

Graph 2
Percentage share of investment in value added at constant 2005 prices
Average for each group of countries categorized according to income level
Source: UnData, United Nations, calculations by the authors

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5The sample can be found in the Annex of this paper.
b) **Manufactures remain the most important products in the international trade of goods:** Global exports show that from 1990 to 2011 the manufacturing sector remains the leader in value in the international trade of goods. In terms of exports, manufactured goods answered for 74.4% of the world’s 1991-1995 exports in US Dollars, and dropped to 70.5% in 2006-2010, due basically to the recent increase in fuel prices. Second come fuels exports (which maintained a growing share, rising from 7.8% to 12.1% in the period at hand), foods (share dropped from 9.7% to 7.5%), minerals (up from 3.3% to 4.2%) and agricultural raw materials (from 2.6% to 1.6%). Taking exports as a share of the world’ output, manufactures exports dropped from 21.1% in 1990-1995 to 17.1% in 2006-2010. The world’s manufactures exports by worker have been estimated at USD 3,117 in 2006-2010, six times more than that for fuels (USD 537) and ten times as much as for food products (USD 322), according to data from the World Development Indicators.

c) **What you export really does matter.** That phrase that became popular in Development Economics still holds (Hausmann, Hwange &Rodrik, 2006). A comparison of the various countries’ export profiles with their per capita GDP clearly shows that manufactures exports still prevail among the countries that have the world’s highest per capita GDPS. There are a couple of exceptions, mostly of natural resources abundant high-income countries - such as Australia, Norway and the Arab Emirates. Generally, a high correlation can be found between countries characterized as high-income (regardless of whether they have been characterized as such for a long time, as have been the United States, Germany and Japan, or more recently, such as South Korea, Singapore and Hong Kong) and the biggest manufactures exporters; as opposed to natural-resource exporting lagging countries (African and Latin-American).

Graphs 3 and 4 show that in high-income countries the share of manufactured goods in exports and the share of manufactures foreign sales in value added are far greater than those observed in other groups of countries.\(^6\)

Graph 3

Percentage share of manufactures exports in value added, based on amounts estimated in US Dollars at constant 2005 prices. Average for each group of countries categorized by income level.

Source: World Development Indicators

\(^6\)Recently, the share of manufactures in exports has got closer in the three lower per capita income groups, possibly due to the growing participation of Asian countries in the trade of these commodities, as part of their catching-up strategy.
That collection of data seem to indicate that upper-middle-income countries, which are still catching-up and must reinforce their industrial structure to further its development path, have assigned greater importance to manufacturing in their productive structure (as well as have displayed greater investment relatively to value added). High-income countries, in their turn, have been attempting to recover manufacturing sector’s share in total value added. In the 2000s, this share only dropped in lower-middle-income countries, what may be worsening their status of less-developed countries. In addition, manufactures exports seem to be significantly correlated with the level of per capita income, justifying this paper’s emphasis on this variable to explain the economic development process. In the next section, the theoretical arguments that attempt to explain the importance of the manufacturing sector in the development process are discussed, as well as that of manufactures exports and of the foreign exchange rate.

Section 2. Theoretical discussion about the relevance of manufacturing and its exports in the economic development process

The literature contains an extensive debate on the connections between international trade and economic development. The topic dates back to classical political economics. It was consolidated as a central theorem in neoclassical economics – the Heckscher-Ohlin-Samuelson model of comparative advantages\(^7\), which remains prevalent. At the same time it received many

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\(^7\)The Heckscher-Ohlin-Samuelson (HOS) neoclassical comparative advantages model includes rather restrictive assumptions, such as perfect factor mobility and technology transfer, assuming an exogenous nature of endowments and the availability of multiple production methods with constant returns to scale. These assumptions imply that the economy produces at decreasing marginal outputs relative to each production factor. Factor prices are proportional to...
criticisms from the 1950s until the present day, especially from the structuralist approach - which in privileged here. The structuralist view enables greater emphasis on demand as a determinant of the growth path of a country and at the same time allows (and prefers) sectorial analysis.

Structural change is a key concept in structuralist economic development literature: it is “a process that reconfigures the productive structure of a country, supported by technological, institutional and political transformations such as land, trade and industrial reforms, as well as by the macroeconomic regime” (Reis, 2012). The core of technological structural change lies in the creation and dissemination of innovations in certain industries, which then implement new and more productive production processes that may lead to linkage effects and learning processes that add momentum to the rest of the production structure. The linkage effect is defined as the development of specialized goods and services supply chains, market channels, organizations, and institutions that disseminate information and enable inter-player communication – leading to production increases in other parts of the economy (Ocampo, 2007, p. 19).  

In this sense, for development theorists like Prebisch (2000[1949]) and Hirschman (1958), exports specialization on primary goods may be harmful to economic development, depending: a) on the commodities market’s characteristics; b) on the intensity of linkage effects in the exports sector; c) on the application of export revenues. They believed that, in general, primary goods are weak generators of spillovers (incentives to other economic activities), and unable to add significant dynamic to trigger economic development. In addition, specialization in primary goods exports might compromise medium- and long-term development due to decreasing terms of exchange relative to manufactures imports. As a result, development theorists regarded industrialization as the principal means to obtaining a share of the benefits of technological progress and gradually improve the national living standards of peoples.

Nonetheless the operation of linkage effects is no trivial matter, given mainly financial and technological hurdles. In this sense, imports, too, play an important role in sustaining development. However, the dynamics are generally limited by external balance-of-payments constraints, that is, by the generation of funds (whether by means of exports or the financial account) that determine the ability to import. Another constraint is associated with factor restrictions, in particular rising real wages in the exporting sector. As industrialization advances and the effects arising from factor-supply restrictions become magnified, the pace of economic growth slows down. In some cases, this leads middle-income economies to the trap of external constraints or of the loss of competitiveness (BIRD, 2008). These limitations may be mitigated or even resolved via technological deepening (whether through improving quality of existing technology and products, or through a shift from low to high technological intensity activities), thereby supporting exports growth (Lall, 2000). Therefore, industrial diversification must move toward upgrading or increased sophistication, understood as a process in which nations, business firms and players move from low value-added activities to high value-added ones – or, more specifically, to high technology and knowledge content activities – on global productive networks and chains (Gereffi, 1999).

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their marginal productivity and there is a tendency toward full use of endowments. The general conclusion of HOS is that efficient equilibrium arises when players (regions/countries) specialized in the activity in which they enjoy relative comparative advantages in terms of production-factor costs (Reis, 2012).

3There are four classes of productive linkage relative to the remainder of the economy (Cicantell & Smith, 2005): 1) forward linkage, which relates to the use of the output of a certain sector as input for other sectors; 2) backward linkage, which relates to the demand for inputs; 3) fiscal - through taxes and subsequent public expenditures; 4) final demand – through the multiplier effect.


5For a review of the literature on balance-of-payments constrained growth (BPG), see Setterfield (2002). It is worth noting that the Kaldor (1966) paper is one of the starting points for this literature.

6Technology-intensive structures offer the best prospects for future growth because their output tends to grow faster on international trade: their demand tends to be highly elastic, they create new demands and substitutes for older products more quickly” (Lall, 2000, p. 5).
Chenery (1980) argues that, after the exhaustion of the imports substitution process in countries that were industrializing in the second half of the 20th century, manufactures exports became a necessary strategy to keep manufacturing growth at a higher level than that of domestic demand, and played a relevant role in the subsequent development of manufacturing. This argument implies two things. First, the need for an autonomous source of demand (public investment or exports) to stimulate the share of manufacturing in value added. Second, that the induced demand – resulting from rising income – is not enough.12 Exporting manufacturing stimulates domestic demand, the process of learning-by-doing, productivity rise (as per Verdoorn’s law) and the development of new comparative advantages. In addition the sector that produces goods with greater technology contents may strengthen, engendering a process of cumulative growth. In addition, manufacturing exports in general have greater value added than primary goods, so the first may reduce constraints against growth arising from the balance of payments.

Hausmann, Rodrik & Hwang (2006) showed that the level of specialization in exporting sophisticated products is correlated with the per capita income of a nation. Furthermore, the sophistication of a country’s exports influences the growth rate of both exports and per capita GDP. More sophisticated goods are those with greater productivity, as measured by the quantity of output generated from a certain volume of investment. Increased productivity would emerge from innovative projects, from which society as a whole would benefit.13

The processes of exports diversification and, eventually, exports industrial sophistication, as well as of structure change in production also realign institutions in the economy and in society in general. At the same time, structural changes are driven by institutions – the macroeconomic regime in particular (Ocampo, 2007) and, specially, the foreign exchange rate (Furtado 1957; Medeiros & Serrano 2001; Haussman, Pritchett & Rodrik 2005; Frenkel & Ros 2006; Rodrik 2008; Bresser-Pereira, 2011).

The exchange rate directly impacts net export balance, what have consequences for aggregate demand and growth, and individuals’ wage, employment and wealth levels. Therefore the exchange rate might be capable of changing long-term development paths. For example, exchange rate appreciation in developing countries may undermine the competitive of exports and, depending on the level of openness, lead to a loss of domestic market share to imports as well. A notorious case of this type is the “Dutch disease” (DD) –under which sustained primary goods exports may create, on the one hand, current account surpluses (or balances), and a systematic appreciation of the foreign exchange rate on the other. As Bresser-Pereira (2012) notes, this chronic over-appreciation shackles the exporting competitiveness of other domestic tradable goods industries and may even condemn the maintenance of the production structure (due to competition from imports), triggering deindustrialization. In economies that already show a certain level of diversification, the speed and scope of the deindustrialization caused by the Dutch disease depend on how macroeconomic policy reacts. Thus, trade balance results may affect export and productive structures to a greater or lesser degree, depending on the macroeconomic regime (Palma, 2005).

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12Public investment is a component of autonomous demand, but total investment exerts a multiplier effect on aggregate demand by means of expanded production capacity and multiplier. For this reason, analysis of its evolution was included in the previous section, but the demand component that we intend to discuss in greater detail is manufactures exports, once it raises antagonistic theoretical positions and economic policy choices.

13Razni & Blecker (2006) analyze the argument of the fallacy of composition, which would reduce the impact of manufactures exportson the growth process. According to this hypothesis, developing countries would engage in domestic trade of manufactured goods, increasing the competition among them, bringing down foreign demand for each country and the international prices of those products. The authors counter this argument based on a panel analysis of eighteen developing countries. They first demonstrate that the income-elasticity of manufactures exports is significant for those countries and that countries that export low-technology-content goods compete with other developing countries, whereas those that produce goods with high technology content compete with developed ones. The results of their model go against the argument of the fallacy of composition for more sophisticated products, indicating that exporting them would be a strategy that contributes to the growth of middle-income countries.
Traditional literature on the determination of the exchange rate regards it as an exogenous variable resulting from purchasing power parity (Razmi et al, 2009). However, as noted by development economists, neoclassical models’ assumptions not only fail to apply to the real world, thereby empirically invalidating its conclusions, but also the exchange rate is largely the result of economic policy\textsuperscript{14} that significantly affects economic growth. In fact, there is evidence that effective policies to maintain a devalued real exchange rate, such as recently adopted in East Asian countries (Medeiros, 2006), are significantly correlated with economic growth. As Rodrik (2008) \textit{apud} Razmi et al (2009) put it, the level of the exchange rate is correlated with the size and share of tradable goods industry, which may create multiplier effects for the other activities of a developing economy that has not yet attained full employment.

In that sense, Bresser-Pereira, Oreiro and Marconi (2012) argue that the exchange rate influences the production structure by stimulating manufactures exports. The argument is based on the structuralist paradigm that an important condition for the current account balance not to restrict growth is the relation involving the income-elasticity of exports, of imports, and of the world’s income. Structuralist tradition ever since Prebisch (2000[1949]) takes the income-elasticity of countries whose exports as markedly concentrated on primary goods and being lower than one, given their essential nature, while the income-elasticity of their imports is greater than one. Therefore, an increase in aggregate demand, even if stimulated by primary goods exports, would lead to balance of payments disequilibrium and to constraints against a higher rate of economic growth. Thirwall (2002) formalized this constraint:

The rate of growth of exports (x) depends on the growth of world demand (\(\dot{y}\)) and on the income-elasticity of the demand for exports (\(\pi\)):

\[
\dot{x} = (2.1)^{15}
\]

In order to the current account remains balanced, imports must grow at the same rate as exports. Demand for imports (m) depends on the domestic income (y) and on the income-elasticity of imports (\(\pi\)), which is greater than 1 and greater than the income-elasticity of exports. So:

\[
\dot{m} = \dot{x} = \pi \cdot \dot{y} \quad (2.2)
\]

Replacing (2.1) in (2.2), the rate of growth that guarantees the current account equilibrium depends on the income-elasticity of imports and of exports, and on the rate of growth of world demand:

\[
\dot{y}^* = \frac{\dot{x}}{\pi} = \frac{\xi}{\pi} \cdot \dot{y}_m \quad (2.3)
\]

Where \(\dot{y}^*\) is the growth rate consistent with the intertemporal equilibrium of the current account. If income-elasticity of imports is larger than 1 and of exports is smaller, the growth rate consistent with the current account equilibrium will be smaller.

Thus, in order to achieve greater growth rates without incurring current account deficits, a country must change the ratio of the income-elasticity exports to that of imports. Such a change is enabled by a change in productive structure caused by manufactures exports, which can be stimulated by keeping the real foreign exchange rate at a competitive level for their producers. Hence exports and imports income-elasticities are not exogenous variables, determined only by the country’s level of technological knowledge, but they are \textit{endogenous} variables that depend on the real exchange rate.

\textsuperscript{14} “Governments have a variety of policy options including monetary and fiscal policy, saving incentives, capital controls, and reserve management, and the evidence suggests that governments do indeed use several tools at their disposal to target exchange rates” (Razmi \textit{et al}, 2009, p. 2).

\textsuperscript{15} At first, it is assumed that the share of the country in world exports and the real exchange rate are constant.
Bresser-Pereira et al (2012) calls this level as the "industrial equilibrium exchange rate", as it enables efficient companies making manufactured goods domestically to compete on the international market. The industrial equilibrium exchange rate will contribute for a process of industrialization in which the country manages to continuously increase the generation of value-added in the productive process. In turn, the exchange rate depreciation (or the overvaluation) affects the country's productive structure, by increasing or decreasing the participation in the value-added of the tradable goods and services that are not the commodities giving rise to the Dutch disease. Consequently, exports and imports income-elasticity of increases (or decreases) and the external constraint disappears or is strengthened.

Thus, changes in the relation between the income-elasticity of imports and the income-elasticity of exports will depend on the variations in the difference between the observed exchange rate and the industrial equilibrium exchange rate:

\[
\frac{\partial (\xi)}{\partial t} = \beta(\theta - \theta_{\text{ind}}) \tag{2.4}
\]

Where is a positive constant; is the industrial equilibrium exchange rate; and is the nominal or market price exchange rate.

Considering equations (2.3) and (2.4) it may be derived that the growth rate compatible to equilibrium in the current account will be adjusting over time, depending on the relation between actual and industrial equilibrium exchange rates. Consequently, in the long term, there is no balance of payments constraint to growth if the exchange rate is duly aligned, that is, at the level compatible with the industrial equilibrium. Industrialization eliminated that constraint. This means that the foreign exchange rate has a relevant impact on economic growth, insofar as it stimulates change in the productive structure, via raising manufactures exports and the consequent change in the exports and imports income elasticity.

At this point, it is worth returning to Kaldor (1966), which tangents several issues raised here on the relation between growth and manufactures exports. Next sections attempts to rebuild first and second Kaldor laws in connection with the role of the manufacturing sector as the driving force of a developing economy’s dynamics. In addition it will be tested the hypotheses raised by Kaldor himself on the importance of manufactures exports and of investment in growth dynamics, as well as the importance of investment in this process. Kaldor, however, does not include the. The following section introduces Kaldor’s equations, which will drive subsequent econometric tests.

Section 3.A Kaldorian model to determine the importance of the manufacturing sector and its exports in the economic development

The first of Kaldor’s laws, shown in equation (3.1),relates the growth rates of the aggregate output(measured by GDP) and of the manufacturing sector’s output. It defines the latter as the “engine of growth”. For the countries and period at Kaldor's hand, the parameter associated with the explanatory variable “m” (industrial output growth rate) and dependent variable “q” (GDP growth rate) was approximately 0.6.16

16 Tests were performed using simple regressions in data series of twelve industrial nations (Japan, Italy, Federal Republic of Germany, Austria, France, the Netherlands, Belgium, Denmark, Norway, Canada, United Kingdom and United States) between 1953 and 1964. It is worth emphasizing that, when the text was drafted, the National Accounts Systems of several countries had been recently grouped together, as the author stresses. Therefore, their empirical analysis was relatively novel, as were econometric estimation techniques.
\[ q_i = b_0 + b_1m_i + \epsilon_i \] (3.1)

Kaldor argued that a positive correlation was evident because the manufacturing sector itself answered for 25% to 40% of the output, but emphasized that the results reveal a relation that is not limited to this fact. That is, the fact that there is a positive relation between the total output growth rate and the excess growth of manufacturing relative to other economic activities. So the first law can be re-written to take this fact into consideration; in it, “nm” is the growth rate of the economy’s non-manufacturing sectors:

\[ q_i = b_2 + b_3(m_i - nm_i) + \epsilon_i \] (3.2)

The relation is interpreted as follows: having stipulated the argument that different growth rates across activity sectors derive from differences in productivity, the manufacturing sector’s productivity gains would be more expressive (increasing returns to scale) because it can more easily incorporate technical advances (Pons-Novell & Viladecans-Marsal, 1999, p. 445). As Kaldor argues, classical economists already recognized increasing returns in manufacturing, but neoclassical economics neglected them so that the static equilibrium determination framework could work.\(^{17}\) Consideration of increasing returns to scale privileges a “static-dynamic” analysis where the productive process is associated to learning by doing, which brings about innovations and overall technical progress. In other words, productivity gains tend to accelerate the more the production increases.

This is precisely the starting point from which Kaldor invoked Verdoon’s law, a dynamic relation between the productivity growth rate “\(pt\)” (dependent variable, output by worker) and the manufacturing output growth rate “\(m\)” (explanatory variable). The author applies the law in two different and equivalent ways.\(^{18}\) Firstly, using the manufacturing output growth rate “\(m\)” as explanatory variable. Secondly, regressing the rate of growth of total employment “\(e\)” against “\(m\)”:

\[ pt_i = b_4 + b_5m_i + \epsilon_i \] (3.3)
\[ e_i = -b_4 + (1 - b_5)m_i + \epsilon_i \] (3.4)

The results of Kaldor’s estimations also indicate positive coefficients for the regressors, leading him to argue that manufacturing productivity or employment are mainly associated with increase in manufacturing output growth. It is worth pointing out that Kaldor himself notes that this adaptation does not mean that Verdoon’s law should apply to manufacturing only, or to every manufacturing activity individually. His point is that the industrial output growth rate (as well as that of ancillary activities such as utilities and construction) stands a better chance of exercising principal influence on output growth, due to its impacts on productivity growth in manufacturing itself and indirectly in other sectors (Kaldor, 1978[1966], p. 112). Libanio & Moro (2009) clarify that Kaldor’s interpretation of Verdoon’s law is a technical relation (Dixon & Thirlwall, 1975),

\(^{17}\)As Kaldor wrote: “One finds the origin of this doctrine [increasing returns to scale] in the first three chapters of The Wealth of the Nations. Here Adam Smith argued that the return per unit of labour – what we now call productivity – depends on the division of production into so many different process, as exemplified by his famous example of pin-making. As Smith explains, the division of labour depends on the extent of the market: the greater the market, the greater the extent to which differentiation and specialization is carried, the higher the productivity. Neo-classical writers, with one or two famous exceptions, like Marshall and Allyn Young, tended to ignore or to underplay this phenomenon” (Kaldor, 1978[1966], p. 105, our emphasis).

\(^{18}\)By definition, productivity “\(pt\)” equals the difference between the manufacturing output growth rate and the growth rate of employment (\(pt = m - e\)). Substituting this in the formula, we find that \(e = -b_4 + (1-b_5)m\)

12
intended to emphasize his criticism of perfect factors substitution in the production function and his belief in increasing returns to scale to explain international differences in growth rates.\textsuperscript{19}

The second law, from now on referred to as the Kaldor-Verdoorn law, was object of criticisms for two main issues: the omission of capital stock as a control variable and the possible endogeneity of output and/or employment growth rate of, as suggested by Libanio & Moro (2009). Wolfe (1968) was one of the first, if not the very first, to argue against omitting capital stock, as it is logically reasonable to assume that capital accumulation also impacts labour productivity. The absence of the variable is justified for its theoretically constancy in post-war period in advanced economies (for example, in Fingleton & McCombie, 1998, p. 91), what would not skew the estimation’s results. However, even if the justification were true for that period and in specific economies, ideally, from the angle of scientific investigation, it should be tested in different case studies.

As for the endogenous or exogenous nature of growth rates, Kaldor originally establishes that output growth rate is exogenous, while that of employment is endogenous. Therefore, as Libanio & Moro (2009) explain, although the two equations above are equivalent to Verdoorn’s law, Kaldor prefers (3.4), because (3.3) correlates productivity and industrial output. Libanio & Moro also argue that, more probably, both variables are endogenous in reality.\textsuperscript{20} This makes problematic the estimation of the model. In an attempt to avoid this issue, several studies focus only on countries with the same productivity growth rate, or use regions within a single country, assuming homogeneous intra-border productivity. Another interesting possibility would be using additional control variables for technological development, such as the rate of accumulation (as is the case of this paper).

Back to the paper of 1966, Kaldor suggests several other variables from the perspectives of both demand and supply that might explain some countries’ different industrial output growth rates:

“Economic growth is the result of a complex process of action between rises in demand brought about by increases in supply, and by increases in the supply generated as a result of increases in demand. (…) The nature of this interplay will be conditioned both by demand elasticities and by supply constraints; by individual preferences and by technological factors” (Kaldor, 1978[1966], p. 112).

From the demand standpoint, Kaldor highlights three main sources of growth: consumption, domestic investment and net exports. In the case of consumption, a high income-elasticity for manufactured goods is typical of an intermediate income zone, so that growth tends to be greater because the manufacturing sector’s expansion leverages the real income growth rate, which raises the demand for manufactures in general. Investment, however, is the most crucial variable in the author’s opinion. Developed countries have a better consolidated capital goods industry, generating demand for their own goods during the process of supply increase through investment. That is, expansion of the productive capacity in the investment goods sector feeds into the demand for the sector’s own products, establishing a feedback cycle. In the end, the capital assets industry accelerates the output growth rate until it hits a technological threshold. As for net exports, Kaldor lists four development stages of industrial structure and exports. They start with light

\textsuperscript{19} “It is worth to note also that this interpretation is related to Kaldor’s perception that economic growth is demand-determined rather than resource-constrained. In other words, Kaldor argues that output growth is determined by the exogenous growth of effective demand, while both productivity growth and employment growth are endogenous” (Libanio & Moro, 2009, p. 5).

\textsuperscript{20} “According to cumulative causation mechanisms (Kaldor, 1970; Dixon and Thirlwall, 1975), the growth of productivity may exert a feedback effect on output through changes in relative prices, and therefore in international competitiveness, leading to higher exports. McCombie (1983) points out an additional source of simultaneity, or reverse causation from employment to output: “since the Verdoorn Law is a production relation, it is plausible to argue that the growth of the inputs (in other words, employment and capital) causes the growth of output in a technological sense” (McCombie, 1983, p. 416-7)” (Libanio & Moro, 2009, p. 6).
industrialization, involving imports of capital goods and exports of commodities and low value-added manufactured goods. The industrialization process only evolves if the country substitutes imports (ISI) and becomes a net exporter of increasingly sophisticated manufactured goods, until it is able to form a domestic capital goods industry (by means of ISI, which would stand as the third stage) and then export these products (fourth stage). In all cases, when investment, consumption and net manufactured goods exports have reached maturity, demand growth tends to slow down.\textsuperscript{21}

On the supply side, Kaldor notes that over the course of the industrialization process, the pace of economic growth may drop due to shortages in the supply of goods, usually remedied with imports. This movement may lead to external constraints in the balance of payments (which occurs often in countries at the initial development stage). Other supply-side constraint is related with the workforce. According to the author, the employment rate empirically rises as a country industrialize, an increase usually met by the contingent of reserve labour coming from the low-productivity agricultural sector, up until this reserve is depleted.\textsuperscript{22}

Therefore, in order to re-estimate Kaldor’s laws within today’s context, using the most up-to-date method possible and incorporating the relevant criticisms noted before, here it is adopted a criterion similar to that developed by Libanio & Moro (2009) to test the first two laws of Kaldor in Latin America from 1980 to 2006. For the first law, (3.1) and (3.2) are estimated adding a vector of control variables that includes terms associated with demand and supply, many of which Kaldor himself suggested. Thus, the panel specification is as follows:

\begin{align}
q_{it} &= \beta_0 + \beta_1 m_{it} + \beta_2 c_t + \varepsilon_t \\
q_{it} &= \beta_3 + \beta_4 (m_{it} - \text{nm}_{it}) + \beta_5 c_t + \varepsilon_t
\end{align}

where the subscripts i and t correspond to the country and year of observation respectively; q\(_{it}\) is the total output growth rate. It is worth noting that every output-related variable in this model is presented in terms of value added to prevent the distortions that taxes and subsidies might generate in estimating the importance of the manufacturing sector for economic growth; m\(_{it}\) is the manufacturing sector’s output growth rate, nm\(_{it}\) is the growth rate of the other economic sectors, \(\varepsilon_t\) is the vector of all random errors, and \(c_t\) is a control-variables vector that includes proxies such as the change of the investment share of total value added, a proxy for workforce growth, another for capital stock growth, one for the cost of labour, one for human capital and, finally, one for the price of capital. Two other proxies representing a contribution from this paper are the introduction of manufactures exports and exchange rate.

It is expected a positive relation between q and m, with \(\beta_1\) and \(\beta_4\) coefficients between 0 and 1, indicating increasing returns to scale. The magnitude of the coefficient is associated with the manufacturing sector’s contribution to value-added growth. In addition, we expect \(\beta_2\) and \(\beta_5\) to be smaller for high-income countries, whose manufacturing structure is already mature.

\textsuperscript{21}There are two other “Kaldor laws”, created with the contribution of Thirwall, that are not covered in this analysis and should be revisited as an extension of this study. According to the third law, “the faster industry grows, the more labour it will absorb from agriculture and other activities where the marginal product is below the average product (because of diminishing returns), so that as labour transference takes place, labour productivity outside the industrial sector increases and raises the growth of labour productivity in the economy as a whole (and therefore GDP growth)” (Wells & Thirwall, 2003). The fourth law, originally stated by Thirwall (1979), postulates that “given the rate of growth of world income, the long run equilibrium rate of growth in any individual economy depends on the ratio of the income elasticities of exports and imports” (Setterfield, 2011). Although we did not test this final law, we will include net manufactures exports as an explanatory variable, which is compatible with Kaldor’s notions of stages of economic development.

\textsuperscript{22}However, as Libanio & Moro (2009) clarify, faced with Rowthorn’s (1975) criticism that this would mean that the mayor constraint against output growth comes from the supply side, Kaldor (1975) corrects himself by affirming that demand has prevalence in determining output. This constraint, therefore, is not that relevant to his argument and, furthermore, it is output rather than employment that should be the preferred regressor for the second law.
In the Kaldor-Verdoorn law, the capital stock growth rate is considered exogenous:

\[ p_t = \beta_0 + \beta_1 m_{at} + \beta_8 k_{it} + \beta_9 c_{it} + \varepsilon_t \]  

(3.7)

where the subscripts i and t correspond to the observed country and year, respectively. \( p_t \) is the manufacturing growth rate and \( k_t \) is the capital stock growth rate.\(^{25}\) It is expected a positive ratio of \( p_t \) to \( m_{at} \), as well as of \( p_t \) to \( k_t \). In addition, the \((1-\beta_8)/\beta_9\) ratio concerns returns to scale. There is also a way to endogenize the capital stock in the model\(^{24}\), but the estimation is not presented in this paper because the results have not been robust. Still, the estimation of (3.7) is an important advance for the model, and regarding capital stock as exogenous is a reasonable assumption when the sample is split between high- and middle-income countries.

Therefore, the econometric model presented next estimates equations (3.5) to (3.7). Finally, it is worth noting that Kaldor’s laws are intrinsically empirical propositions, that is, “only empirically can one truly determine the actual ratio of productivity growth to output growth” (Marinho et al., 2002, p. 464).

**Section 4. A dynamic panel for high- and middle-income countries from 1990 to 2011**

Sample selection counted initially on the 80 countries with the highest GDP, considering the average in US Dollars for the 2005-2011 period. Subsequently, countries whose fuels sales exceeded 70% of foreign sales were removed, as income generation in such cases is very dependent on such products, which may act as a significant negative incentive for industrialization while, at the same time, enables high per capita income. Out of the remaining countries, 63 composed the final sample, because they had enough data for the variables included in the model, taking the period between 1990 and 2011. Those countries were sub-divided into two samples, one for high-income countries (per capita income over US$ 4,085), and another for middle-income countries (between US$ 1,036 and US$ 4,085), according to the World Bank categorization criteria, for the 2005-2011 period. Countries included in the sample are shown in the Annex.

The data panel is therefore made up of 63 countries (n) over 22 years (t). Please note that the absence of observations for some of the selected countries over the period required unbalanced panels, that allow variable time dimension.

Given the discussions throughout the text, the annual data series used in the tests are:

- **Vatot**: is the economy’s total value added, at constant 2005 prices. Because the comparison is of growth rates and not income levels, it seems more appropriate using constant values in the domestic currency to avoid distortions caused by conversion into different currencies. Source: *National Accounts Estimates of Main Aggregates - United Nations Statistics Division*.

- **Vad**: is the manufacturing sector’s value added, using the same criterion and source as above.

- **Mit_nnit**: is the difference between the manufacturing sector’s value-added growth rate and that of other economic sectors. The criterion and source are the same as above.

- **Pit1**: corresponds to the estimated value of the manufacturing sector’s workforce’s productivity. Calculated by dividing the manufacturing sector’s value added (at constant 2005

\(^{24}\)If the specification does not include the term \( k \), it “does not consider the influence of the growth of capital stock on labour productivity, and can only be used under one of the following assumptions: (i) a constant capital-output ratio, justified by Kaldor as a ‘stylized fact’ of industrial countries in the postwar period; (ii) a constant and exogenous growth rate of the capital stock over time; (iii) a constant ratio between the growth rates of capital and employment, as in steady-state growth. If none of these conditions are met, the above specification will yield a biased measure of returns to scale” (Libanio & Moro, 2009, p. 7).

\(^{25}\)Anticipating the criticism that capital stock is endogenous to the model and, therefore, cannot be included, Libanio & Moro (2009) endogenize it as follows: \( tf_t = \delta_0 + \omega_1 m_{at} \), where \( tf_t = \omega_1 c_{at} + (1 - \omega_0)k_{at} \). \( tf_t \) is total factors productivity growth, where \( \omega_0 \) is the share of wages in national income, causing the level of returns to scale to be given by \( 1/\sigma \).
prices in local currency, corresponding to Vad) by employment in the sector as number of individuals. Employment level was estimated based on the amount of people hired to work (not just employees, but also the self-employed, who amount to a relevant group in agriculture, for example). It was calculated by the chaining, based on variation, of three distinct datasets on employment by sector, as a complete time series is not available: EU KLEMS Growth and Productivity Accounts and World Input-Output Database (number of working individuals) and GGDC 10 Sector Database, Groningen Growth and Development Centre (number of employed individuals).

**Labourforce:** Corresponds to the total population between ages of 15 and 64 (usually defined as able to work), calculated based on information available from United Nations, Department of Economic and Social Affairs, Population Division.

**Fkfv:** the gross fixed capital formation-to-value added ratio (it differs from the rate of investment because the latter is calculated relative to GDP). The criteria and source are the same as used for value added.

**Hc:** Index of human capital per person, based on years of schooling (Barro &Lee, 2012) and returns to education (Psacharopoulos, 1994), included in Penn World Table 8.0.

**Lab_avgd:** Index for the real compensation of labour per hour of manufacturing work. Used as proxy for the cost of labour. Calculated by the chaining(based on variations) of the series from EU KLEMS Growth and Productivity Accounts and World Input-Output Database. In the former database, the series was already calculated, but in nominal values; it was deflated by the industrial value-added price index (implied deflator); for the latter, firstly the total compensation for work (compensation mass) was divided by the number of work hours of people hired. Aggregation of information from the various industries that form the manufacturing sector was weighted by the industrial value added obtained from the same source.

**Exp:** corresponds to the value of manufactures exports at constant 2005 prices. Calculated based on the total exports of commodities and on manufactured goods as share of total exports. The information was obtained from World Development Indicators, in current dollars. Because no information at constant values was available, it had to be estimated by adopting the price index for US exports of Industrial supplies and materials as a deflator, as calculated by the Bureau of Economic Analysis, U.S. Department of Commerce.

**K:** Estimated capital stock of the economy, converted in 2005 US Dollars according to purchasing power parity. Amounts calculated in thousands of US Dollars. The source is PennWorld Table, version 8.0.

**Pid:** Index for the evolution of prices in gross manufacturing fixed capital formation, used as a proxy for the cost of capital. The source is World Input-Output Database. Aggregation of the various industries that make up the manufacturing sector was weighted by the industrial value-added obtained from the same source.

**Pl_gdpo:** Index for the real exchange rate, deflated by purchasing power parity. The source is PennWorld Table, version 8.0.

Regressions will preferably include logarithmic derivatives of these variables, once the structure of Kaldor model is based on growth rates. In some cases, the level variable produced better results and was therefore maintained. Specifically for Mit_nmit, the variable is not in logarithmic form because the series includes some negative values.

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25Methodological details about the series of this database can be found in Timmer (2012), “The World Input-Output Database (WIOD): Contents, Sources and Methods”.

26Methodological details about the calculation of this variable and others from this database can be found in Feenstra, Inklaar & Timmer (2013), "The Next Generation of the Penn World Table".
Theoretical model

Based on the previous discussion, the equations for the first and second laws of Kaldor incorporate manufactures exports, exchange rate and other controls on the dependent variables (value added and productivity) as noted throughout the text, would be:

\[ q_{it} = \beta_0 + \beta_1 m_{it} + \beta_n c_i + \epsilon_i \]  \hspace{1cm} (4.1)

where:
- \( q = \text{d.log}(Vatot) \)
- \( m = \text{d.log}(Vad) \)
- \( c = \text{vector of other explanatory variables: } \text{log}(Vatot_{t-1}), \text{d.log}(Labourforce), \text{d.log}(Fkfva), \text{d.log}(hc), \text{d.log}(Lab\_avgd), \text{d.log}(expc), \text{log}(pl\_gdpo), \text{log}(Pid), \text{d.log}(K) \)

A positive relation between Vatot and Vad is expected, indicating that the growth of manufacturing value-added (m) stimulates total aggregate value-added growth (q). The same signal is expected for the share of investments in value added, for manufactures exports and for exchange rate, for the reasons discussed previously.

\[ q_{it} = \beta_2 + \beta_3 (m_{it} - nm_{it}) + \beta_n c_i + \epsilon_i \]  \hspace{1cm} (4.2)

where:
- \( q = \text{d.log}(Vatot) \)
- \( m_{it} - nm_{it} = \text{difference between the manufacturing value-added growth rate and that of the other economic sectors.} \)

All other variables are the same as in equation 4.1.

A positive relation between Vatot and \( m - nm \) is expected, indicating that a superior value-added growth rate in manufacturing in comparison to the other economic sectors tends to stimulate the growth of total value added.

\[ p_{it} = \beta_4 + \beta_5 m_{it} + \beta_n c_i + \epsilon_i \]  \hspace{1cm} (4.3)

where:
- \( p = \text{d.log}(Pit1) \)
- \( m = \text{d.log}(Vad) \)

All other explanatory variables are the same as in equation A, except for \( \text{log}(Vatot_{t-1}) \), which has been replaced by \( \text{log}(Pit1_{t-1}) \).

Finally, a positive relation between Pit1 and Vad is expected, so as to validate the Verdoorn’s law, in which the growth of manufacturing output (in value added) stimulates its productivity, implying increasing returns to scale.

Estimation methodology

The renewed interest in long-term economic growth and the availability of macroeconomic data for a vast universe of countries have been generating interest among macroeconomists in estimating panel data models combining time series and cross-section data.

The analysis of panel, or longitudinal, data is one of the most active and innovative topics in econometrics literature. This is due to the fact that this type of data provides an extremely rich environment for the development of estimation techniques and theoretical results. And, in practical terms, researchers can use them to examine issues that cannot be individually investigated at the time level or in terms of cross-section data.
The basic structure of such models is as follows:\(^{27}\)

\[
Y_{it} = \alpha_i + \beta' X_{it} + \varepsilon_{it}
\]  

(4.4)

where \(Y\) is the dependent variable; \(X\) is the explanatory variable; \(\beta\) is a parameter; \(\varepsilon\) is the error term; \(i\) represents the studied unit (countries, business firms); \(t\) represents the year; and \(\alpha_i\) is the individual effect.

This individual effect may be interpreted as a fixed or random effect. While, in the former case, \(\alpha_i\) is a specific group of constant terms, in the latter it stands for a specific group of random effects for each period.

A dynamic model has its dependent variable lagged against the set of explanatory variables, as in equation (4.5):

\[
Y_{it} = \alpha_i + \delta Y_{it-1} + \beta' X_{it} + \varepsilon_{it}
\]  

(4.5)

When fixed-effect estimators are applied in dynamic models they tend to be skewed because of the assumption of an exogenous independent variable. Likewise, the least-squares estimator is skewed due to the correlation between the lagged dependent variable and the individual specific effect, even in the absence of correlation between residuals.

These problems can be addressed by the dynamic-model approach, based on the generalized method of moments (GMM) as proposed by Arellano and Bond (1991),\(^{28}\) which is consistent when applied to dynamic models.

In order to eliminate the specific effect, the first difference of equation (4.5) is taken, generating (4.6):

\[
\Delta Y_{it} = \Delta \alpha_i + \delta \Delta Y_{it-1} + \beta' \Delta X_{it} + \Delta \varepsilon_{it}
\]  

(4.6)

Then the strategy is to use GMM to estimate the model in first-differences, taking all possible lags as an instrument of the lagged variable. In case of endogenous variables, their lagged levels are used as instrumental variables; and in case of pre-determined ones, their levels are lagged once. This method attempts to use all information of the sample to build the instrumental variables set; at the same time, this eliminates the unobserved specific effect, thereby enabling estimation.

In equation 3, the term \(\Delta \varepsilon_{it}\) is correlated with the lagged variable \(\Delta Y_{it-1}\). However, Arellano and Bond (1991) point out that, when error \(\varepsilon_{it}\) is not auto-correlated, two or more lags of \(Y_{it}\) are valid instruments for \(\Delta Y_{it-1}\). Moreover, the other explanatory variables are assumed to strictly be exogenous and that their instruments shall be their own lags. Therefore, the first-difference GMM estimator has the following linear moment condition:

\[
E[Y_{it-1} \Delta \varepsilon_{it}] = 0 \text{ for } s \geq 2, \ t = 3, \ldots, T
\]  

(4.7)

The instruments of the model must be valid in order to get a consistent GMM estimator. In this sense, Arellano and Bond (1991) suggests two tests: \(i\) Sargan test, whose null hypothesis is that where instruments are uncorrelated with residuals, and \(ii\) autocorrelation test to check if the difference error is second-order auto-correlated.

\(^{27}\)For additional details on the econometric methodology, see Cameron & Trivedi (2005), Greene (2003) and Wooldridge (2000).

\(^{28}\)This overall approach has been developed at various stages in the literature. See, for example, Ahn & Schmidt (1995), Arellano & Bover (1995), Blundell & Bond (1998).
Section 5. Estimation results and interpretation

Before presenting our results, note again that estimations are crucially dependent on the validity of the instruments used to identify endogenous variables. In order to check this possibility, Sargan test was ran. Failure in rejecting the null hypothesis indicates that the instruments are robust. Tests for first and second law models suggest that the chosen instruments are valid. Furthermore, the serial correlation test examines whether the error term is not serially correlated. More specifically, it tests for whether the differentiated error term is second-order serially correlated (by design, the differentiated error term is probably first-order serially correlated, even if the original error term is not). Tests for the models indicate that the null hypothesis of absent second-order serial correlation for the differentiated error term cannot be rejected. Thus, the estimations passed the validity tests for the instruments.

Table 1 below shows the estimation results. The first two equations test for the validity of the first Kaldor’s law, while the third equation tests the second law. All tests were run for two samples, one for middle- and another for high-income countries.

In first law estimations the coefficients of the main variables of the test were positive and significant; therefore, for the chosen sample of countries and period, both manufacturing output growth (see equation one) and the positive difference between the manufacturing output growth rate and the growth rate of the other sectors (see equation two) appear to have stimulated the economy’s aggregate growth rate. The coefficient is bigger in the case of the ratio of manufacturing output to the overall economy for middle-income countries, indicating the sector’s importance for countries that are at an intermediate stage of development. As for the tests where the dependent variable is the difference between the manufacturing sector’s growth rates and those of the other sectors, the impact on overall output is also greater in middle-income countries, but at a very similar magnitude.

Control variables associated with investment and labour supply were relevant for both equations and both samples. This shows that labour (one of the supply-side constraints listed by Kaldor) and investment (one of the most relevant demand-side components according to the same author) apparently positively impact the economic growth. In addition, the coefficients of the variable associated with investment are greater in middle-income countries, supporting the data descriptive statistics provided in section 1. This variable may play a very important role in intermediate development stages because economies that are not yet mature depend on the expansion of the production capacity and its multiplier effect to grow at significant rates. Investment also stimulates the demand for intermediate inputs and inter-industrial demand itself.

The variable associated with human capital proved itself relevant in middle-income countries, but not in high-income ones, possibly due to the scarcity of skilled labour in the former, making for a relevant marginal contribution of skill-building, particularly because the activities carried out in middle-income countries should be more labour-intensive. As for the capital stock variable, in its turn, the behavior was the opposite, possibly because work processes in wealthy countries are more capital-intensive. What may make a difference (in fact, this is a hypothesis that should be tested) are technology gains and expansion of the share of capital in the production process, as labour availability is probably lower.

The real wage variable, in its turn, was proved to be relevant in high-income countries (with inconclusive results for middle-income ones), possibly because their wage levels are higher and tend to have greater impact on aggregate demand. This is also compatible with demand-driven development theories (and with Kaldor (1966)), according to which early development stages require autonomous spending (after the Keynesian definition) for the economy to advance toward more advanced stages, at which growth becomes more self-sustainable. In this case, the impact of wages on aggregate demand would be more significant than the negative impact on costs.
Also in connection with our results for middle-income countries, the variable associated with manufactures exports at constant prices had the expected positive signal in both equations, indicating their relevance as a determinant of aggregate demand and, as a consequence, their direct association with the economic growth. Furthermore, the magnitude of its coefficient in the second equation proves the effects of favorable spillovers from manufactures exportson the growth of other sectors’ output. The coefficient is greater for middle-income countries, indicating that manufacturing export sector’s role of supplementing and even stimulating growth is greater in countries at intermediate development stages, which confirms the theoretical discussion. The relation between the real exchange rate and output growth, in its turn, had a positive coefficient in the first law for middle-income countries, indicating that devalued rates may be associated with greater economic growth there, like the theoretical section had discussed. Its smaller influence in high-income countries, which have possibly reached a higher level of competitiveness and became less dependent on this relative price, is compatible with the findings of Razmi, Rapetti & Skott.

Table 1 –Regression results

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<td>p_{it} = \beta_4 + \beta_5 m_{it} + \epsilon_i</td>
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<td>.000 .000 .200 .155 .015</td>
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Middle-income countries appear to have greater need to keep their exchange rates at a competitive level in order to consolidate their industry and sophisticate their productive structure.

Therefore, it appears that the postulate of Kaldor’s first law is confirmed, and that the impacts of other control variables on growth, including manufactures exports and real exchange rate, are different for middle- and high-income countries, which may reflect the two groups’ different development stages.

The third equation shows the estimations, for high- and middle-income countries, of Verdoorn’s law, that is, the positive relation between output (measured as value added in this study) and productivity, in this causal direction. The results show that changes in value added positively contribute to the evolution of manufacturing productivity, which confirms the assumption found in the Kaldor-Verdoorn law about increasing returns to scale in manufacturing, considering all of the controls included in the equations. This is one of the most important result of this paper. The coefficient of the variable associated with value added is, again, more relevant in middle-income countries, showing that gains obtained from the presence of increasing returns to scale are greater in economies at intermediate development stages. One possible explanation might lie in the high inter-industrial demand at such stages, as Chenery, Sherman & Moshe (1986) argues.

Analyzing the controls, variables associated with labour and human capital stock were negative and significant for high-income countries, perhaps due to the exhaustion of their influence on productivity growth in countries with higher schooling achievement and, as noted earlier, more capital-intensive working processes. The variables were not relevant for middle-income countries. Manufacturing wages growth had a positive and significant signal for middle-income countries only. One possible explanation lies in the fact that manufacturing wage gains in such countries have greater influence on productivity than in societies where the wage level is higher.

As for investment, results remain positive and significant for middle-income countries, but lose significance among high-income ones, maybe because of their greater capital stock. Actually, Graph 2 has shown that the investment rate is lower in wealthier economies. And about the control most emphatically discussed in this paper, manufactures exports make a positive contribution to labour productivity in both middle- and high-income countries, as expected. One possible explanation is the need to be highly competitive on the international marketplace, creating externalities on the domestic market. Such as for the first law, the variable associated with the real exchange rate, in its turn, displayed a positive signal for middle-income countries and was not significant for high-income ones, indicating that, in developing countries, more devalued rates are associated with increasing productivity, whereas the variable lacks the same importance in developed countries. The reasons discussed previously may be one explanation for this.

Thus the general conclusion is that Kaldor’s first and second laws hold for the sample of 63 countries for the recent period between 1990 and 2011. This suggests that manufacturing sector growth is fundamental for economic development and productivity rise, particularly in middle-income countries. Furthermore, the inclusion of capital stock as a variable improves the results of Kaldor’s laws, given its high explanatory power for output and productivity growth in more developed countries, which enjoy higher levels of it. In particular, estimations of the influence of investments share and of manufactures exports growths appear to indicate that they are relevant variables for total output growth and for manufacturing productivity increases too, especially in middle-income countries. In addition, the model suggests that the evolution of the exchange rate toward more competitive levels also plays a positive role, particularly – once again – in middle-income countries. Finally, the estimates also allowed the confirmation of the different impacts that the selected variables may exert on a country depending on the level of per capita income and period at hand, showing that distinct economic growth stages require equally distinct development strategies. In addition, it was found that exports composition is an important factor for economic growth, and so is the exchange rate.
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ANEXX I – Value of Industrial transformation as share of total value added, 1990-2011 average (%) of high and middle-income countries included in the sample.

<table>
<thead>
<tr>
<th>High Income Countries</th>
<th>VIT/ total (average 1990-2011)</th>
<th>Middle Income Countries</th>
<th>VIT/ total (average 1990-2011)</th>
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| Total HIGH INCOME     | 17.0                            | Total DEVELOPING        | 18.4                           |