MANUFACTURING INDUSTRY AND ECONOMIC GROWTH IN LATIN AMERICA: A KALDORIAN APPROACH

Gilberto Libanio[1]

ABSTRACT

This paper discusses the importance of manufacturing industry for the growth trajectories of developing countries from a Kaldorian perspective, with particular emphasis on the case of Latin America. After three decades of expressive growth rates in the postwar period, the region has experienced twenty years of very low growth. Most of the countries in the region have since the late eighties undertaken important processes of trade and financial liberalization, but this has not yet been effective in delivering the high growth rates observed in the "golden age". This essay intends to address the growth performance of Latin America during the period of reforms by discussing and testing Kaldor's first and second "growth laws". The first law states that "manufacturing is the engine of growth", whereas the second law (also known as Verdoorn's Law) asserts that there is a positive causal relationship between output and labor productivity in manufacturing, derived from static and dynamic increasing returns to scale. This paper provides estimations of the first and second of Kaldor's laws using panel data for a sample of the seven largest economies in Latin America during the period 1985-2001. Our estimation results appear to support Kaldor's views on the importance of manufacturing industry for economic growth.

Keywords:

Economic growth; returns to scale; Latin America

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[1]Professor of Economics at CEDEPLAR / Federal University of Minas Gerais, Brazil (gilberto@cedeplar.ufmg.br).
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1 Introduction

Economists have for a long time discussed the causes of economic growth and the mechanisms behind it. In the last two decades, in particular, a revived interest on this topic arose with the upsurge of 'new growth' (or 'endogenous' growth) models, after Romer (1986, 1990) and Lucas (1988). Broadly speaking, one of the features of this 'new' approach, as compared with neoclassical growth models *a la* Solow and Swan, is the importance of increasing returns to scale.

Nicholas Kaldor was one of the first to consider the role of increasing returns in economic growth. Contrarily to endogenous growth theory and its focus on supply-side issues, however, Kaldor's perspective emphasized the importance of the exogenous components of demand in explaining economic growth in the long run.

In this paper, Kaldor's insights on economic growth will be used to discuss the case of Latin America. After three decades of significant growth rates in the postwar period, the region has experienced twenty years of very low growth. Most of the countries in the region have since the late eighties undertaken an important process of trade and financial liberalization, but this has not yet been effective in delivering the high growth rates observed in the "golden age".

In particular, this essay intends to discuss and test Kaldor's first and second "growth laws" for the case of Latin America during the period of reforms. The first law states that "manufacturing is the engine of growth", whereas the second law (also known as Verdoorn's Law) asserts that there is a positive causal relationship between output and labor productivity in manufacturing, derived from static and dynamic increasing returns to scale. This paper will provide estimations of the first and second of Kaldor's laws using panel data for a sample of the seven largest economies in Latin America during the period 1985-2001.

In the next sections, I will discuss some of the theoretical and empirical controversies related to the estimation and interpretation of Kaldor's growth laws. Then a specification for estimating Kaldor's first and second growth laws for Latin America will be outlined, and some empirical evidence will be presented and discussed.

2 Kaldor's First Law

According to Kaldor (1966), an important stylized fact in the growth trajectory of developed economies in the postwar period is the relationship between industrial growth and the performance of the economy as a whole. This observation is the origin of Kaldor's first law, which states that there is a close relation between the growth of manufacturing output and the growth of GDP. Kaldor's first law can be summed up in the expression "manufacturing is the engine of growth", and was first estimated by Kaldor in a cross section of developed countries over the period 1952-54 to 1963-64. The law can be represented by following regression:

$$q_i = a_i + b_i m_i \qquad (1)$$

where q and m refers to growth of total output and manufacturing output, respectively.

It is important to note that the correlation between the two variables is not only due to the fact that industrial output represents a large component of total output. The regression coefficient is expected to be positive and less than unity, which means that the overall growth rate of the economy is associated with the excess of the growth rate of manufacturing output over the growth rate of non-manufacturing output. This proposition implies that high growth rates are usually found in cases where the share of manufacturing industry in GDP is increasing, and it can be tested using the equation:

$$q_i = c_i + d_i \,.\, (m_i - nm_i) \qquad (2)$$

where nm refers to the growth of non-manufacturing output.

As additional evidence supporting the statement that "manufacturing is the engine of growth", Kaldor has argued that the growth is non-manufacturing output also responds positively to the growth of manufacturing, as described in the following equation:

$$nm_i = u_i + v_i \,.\, m_i \qquad (3)$$

The explanation for the correlation between the growth of manufacturing output and the overall performance of the economy is to be found on the impact of the former on the growth of

productivity in the economy. There are two possible reasons for such effect. The first relates to the fact that the expansion of manufacturing output and employment leads to the transfer of labor from low productivity sectors (or disguised unemployment) to industrial activities (that present higher productivity levels). The outcome is an increasing overall productivity in the economy and little or no negative impact on the output of the traditional sectors, given the existence of surplus labor. According to Kaldor, this process is characteristic of the transition from "immaturity" to "maturity", where an "immature" economy is defined as one in which there is a large amount of labor available in low productivity sectors that can be transferred to industry. For the purposes of this paper, it is worth noting the importance of informal sectors with low levels of productivity in Latin American economies.

The second reason for the relation between manufacturing growth and productivity relates to the existence of static and dynamic increasing returns in the industrial sector. Static returns relate mainly to economies of scale internal to the firm, whereas dynamic returns refer to increasing productivity derived from learning by doing, 'induced' technological change, external economies in production, *et cetera*. In this case, Kaldor's interpretation is influenced by the work of Allyn Young (1928) who conceives increasing returns as a macroeconomic phenomenon based on the interaction between activities in the process of general economic expansion. Also, it echoes Adam Smith's idea that increasing productivity is based on the division of labor, which in turn depends on the extension of the market.

The relation between output growth and productivity growth in manufacturing is the basis of Kaldor's second growth law, also known as Verdoorn's Law, which is discussed in the next section.

3 Kaldor's Second Law (Verdoorn's Law)

The term Verdoorn's Law refers to the statistical relation between the growth of manufacturing output and the growth of labor productivity in manufacturing, where causality runs primarily from the former to the latter. This relationship is named after the Dutch economist P.J. Verdoorn, who was among the first to find such empirical regularity in a cross section of industries (Verdoorn, 1949). Verdoorn's work did not achieve immediate attention in the economics profession. It was quoted by Arrow in his classic 1962 paper on 'learning by doing' (Arrow,

1962), but did not receive widespread recognition until 1966, when Nicholas Kaldor explicitly referred to it and coined the term Verdoorn's Law in his Cambridge Inaugural Lecture (Kaldor, 1966).

Verdoorn's Law is usually interpreted to provide evidence of the existence of static and dynamic increasing returns within industry, and it is often pointed out as a key player in models of circular and cumulative causation in the Kaldorian tradition (Kaldor, 1970; Dixon and Thirlwall, 1975). The basic argument is that an initial growth in output induces productivity gains that allow for reduction of unit labor costs and, given a mark-up pricing rule, for fall in prices, increasing the competitiveness of a country or region. These gains, in turn, allow for further output expansion through increasing exports, which reinitiate the cycle. In conclusion, once a country or region acquires a growth advantage, it will tend to keep it through the process of increasing returns and consequent competitive gains that growth itself induces.

Verdoorn's Law has generated a large secondary literature, both theoretical and empirical[2]. The theoretical research has ever been surrounded by controversy. The main issue here is the definition of the theoretical structure underlying Verdoorn's Law or, in other words, the theoretical explanation for the link between output growth and productivity growth. The question can also be enunciated as: what is the correct interpretation of the empirical relation captured by Verdoorn's coefficient?

In Verdoorn's original works, the theoretical justification is based on some form of learning function, in which output growth allows for a greater division of labor and this, in turn, gives scope for improving labor skills:

> "One could have expected *a priori* to find a correlation between labor productivity and output, given that the division of labor only comes about through increases in the volume of production; therefore the expansion of production creates the possibility of further rationalization which has the same effects as mechanization". (Verdoorn, 1949, p.3)[3,4]

[2] For reviews of the literature, see Bairam (1987), McCombie and Thirlwall (1994, chapters 2 and 8), McCombie, Pugno and Soro (2002).

[3] Quoted from the English translation by A.P. Thirlwall, published in McCombie, Pugno and Soro (2002, chapter 2).

Following Verdoorn's (1949) model, two alternative underlying theoretical structures for the relation between labor productivity and output may be derived (Rowthorn, 1979). The first one relates to the conditions of labor supply and can be expressed as:

$$p = \frac{\mu}{1+\rho} + \frac{\rho}{1+\rho}.q \qquad (4)$$

where μ and ρ are constants, and 1/ρ is the wage-elasticity of the labor supply. It should be noticed that this relationship is determined by labor market variables and is independent of the conditions of production. This arises because output growth requires increasing utilization of labor and labor supply may be seen as a function of wages which, in turn, depend on productivity (via the marginal productivity condition).

The second relationship implicit in Verdoorn's model can be derived from a static Cobb-Douglas production function such as $Q = E^{\alpha}.K^{\beta}$, and is given by:

$$p = \frac{\beta}{\alpha}.\gamma + \frac{\alpha - 1}{\alpha}.q \qquad (5)$$

where γ represent the rate of growth of the capital stock. In this case, the relation depends on the technology and the conditions of production, and is associated with the (Kaldorian) interpretation of Verdoorn's law as reflecting the presence of economies of scale.

However, as a consequence of this 'dual' relationship between productivity and growth, Rowthorn (1979) argues that it is impossible to interpret the Verdoorn coefficient as an accurate indication of returns to scale[5].

It should be noticed that the difference between the two relationships is associated with different assumptions about the production process. The first interpretation considers a static Cobb-Douglas production function with no first-degree homogeneity constraint imposed on the degree of returns to scale, and therefore assumes substitutability between labor and capital. The second

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[4] Note that this is also the interpretation made by Arrow (1962) when he refers to Verdoorn's work.

[5] See also McCombie (1986) for a demonstration of how Verdoorn's Law can be expressed as a production relationship and as a labor supply relationship.

one is based on a fixed-coefficients production function and, therefore, on the assumed 'complementarity' of factors of production. According to Soro (2002), it is impossible to discriminate between the two approaches at an empirical level, given that the usual formulation of Verdoorn's Law in empirical studies is compatible with both interpretations. This helps to explain why this issue is still not resolved in the literature.

Ros (2000) provides a concise discussion on how the Verdoorn coefficient can be interpreted under different specifications. As a general case, a CES production function extended to allow for technological externalities is considered:

$$Q = A.[aK^{\psi} + (1-a).E^{\psi}]^{\frac{1}{\psi}} \qquad (6)$$

For such specification, Ros shows that the Verdoorn coefficient depends on a number of variables and parameters, namely: 'the profit share, which depends on the capital-labor ratio; returns to scale; and parameters of both the labor demand function (elasticity of substitution in particular) and the labor supply function' (Ros, 2000, p. 133). Two special cases are of interest here, and somehow correspond to the approaches considered by Verdoorn. In the first one, in which we have the elasticity of factor substitution equal to one (capital-labor substitutability)[6], it is shown that the Verdoorn coefficient depends entirely on the elasticity of labor supply, and turns out to be independent of the nature of returns to scale. The second special case considers a fixed-coefficients technology (setting the elasticity of factor substitution equal to zero). In this case, the Verdoorn coefficient is a pure technology parameter, which is not affected by the parameters of the labor supply function, and depends only on the extent of increasing returns, given by the productivity effects of capital accumulation. In sum, this example illustrates the difficulties of interpreting the estimated Verdoorn coefficients, and of deriving information on returns to scale from empirical results.

However, it should be noted that Kaldor (1966) interprets Verdoorn's Law mainly as a technical relationship, which provides clear evidence of increasing returns to scale in manufacturing. This relates to his criticism of the use of production functions with "perfect" substitutability of factors of production, and to his emphasis on increasing returns as an explanatory factor in international

[6] In this case, we have a Cobb-Douglas technology extended to allow for technological externalities.

differences in growth rates. In addition, interpreting the Verdoorn coefficient as a labor supply relationship is not acceptable from a Kaldorian perspective because it depends on the assumption that the supply of labor is responsive to the wage level. And, as McCombie (1983, p. 420) points out, "a central tenet of the demand-orientated approach is that there is no systematic relationship between the growth of manufacturing wages and the supply of labor to that sector".

Although Kaldor did not develop a detailed rationale for Verdoorn's law, it is clear that he regarded it as a form of technical progress function, which can be expressed as:

$$p = f(k - e) \qquad (7)$$

with $f' > 0$ and $f'' < 0$, and where lower case letters correspond to the growth rates of labor productivity, capital and labor, respectively. In other words, the technical progress function states that the rate of productivity growth is a result of capital accumulation, and increases with the rate of growth of capital per worker but at a diminishing rate.[7]

Kaldor not only considers that some sort of learning function underlies Verdoorn's Law (as Verdoorn himself pointed out), but he also believes that it is a macroeconomic phenomenon. In addition, Kaldor views the relationship as a 'dynamic' one, between the *growth rates* (as opposed to *levels*) of output and productivity, and may be explained by factors such as increasing specialization among firms, positive externalities, induced technical progress, and greater scope for product differentiation. Dixon and Thirlwall (1975), who have a Kaldorian interpretation of Verdoorn's Law, identify the main determinants of the Verdoorn coefficient as being "the rate of induced disembodied technical progress, the degree to which capital accumulation is induced by growth and the extent to which technical progress is embodied in capital accumulation" (Dixon and Thirlwall, 1975, p. 209).

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. The sources of growth of the

[7] Kaldor (1957) used a linear version of the technical progress function such as $p = a + b(k-e)$. However, this specification can be derived (as demonstrated by Black [1962]) from a static Cobb-Douglas production function. It implies that the Verdoorn's Law may also be specified in *levels* of the variables. I will return to this point later.

manufacturing sector are particularly relevant for the discussion on Verdoorn's Law and in this case Kaldor (1966, 1975) points out to two fundamental sources of autonomous demand, namely, agriculture in early stages of development and exports in later stages. In sum, Kaldor suggests that aggregate demand determines output growth which, in turn, affects labor productivity due to increasing returns, learning by doing, induced technological change, and so on.

The proper specification of Verdoorn's Law for empirical estimation, on the other hand, has also been subject to extensive debate in the literature. The first problem with Kaldor's (1966) specification is that it excludes the contribution of the stock of capital. Intuitively, one could expect the growth of capital stock to be an important influence on the growth of labor productivity. If capital is not included in the regression equation, we could expect the Verdoorn coefficient to be biased (Wolfe, 1968).

The usual justification for excluding the growth of capital stock derives from one of Kaldor's 'stylized facts' of economic growth in postwar advanced economies, namely, the constancy of capital-output ratio. However, even if this assumption is accepted, and an unbiased regression coefficient can be obtained, it does not provide a measure of economies of scale, unless the output elasticities of the production function are known. In sum, if the Verdoorn's Law is based on some sort of production function, the contribution of the growth of the capital stock need to be considered in order to measure the degree of returns to scale. Indeed, most of the recent estimates of the Law include a variable representing the growth of capital (*e.g.* Harris and Lau, 1998; Harris and Liu, 1999; Leon-Ledesma, 2000; Bianchi, 2002).

The second problem in estimating Verdoorn's Law refers to whether output or employment should be endogenously determined. In Kaldor's original specification, output growth is exogenous, whereas productivity growth is the dependent variable:

$$p_i = a + b.m_i \qquad (8)$$

where p and m are the growth rates of labor productivity and output in manufacturing, respectively. Let e be the rate of growth of employment in manufacturing. In this case, $p \equiv m - e$ (by definition). Substituting in (8) and rearranging yields:

$$e_i = -a + (1-b).m_i \qquad (9)$$

Equations (8) and (9) are equivalent descriptions of Verdoorn's Law, according to Kaldor, but the latter is more appropriate for estimation purposes due to the correlation between *p* and *q*. In this case, it is clear that Kaldor takes output growth as exogenous, and employment growth as endogenous. However, Rowthorn (1975) argues that such specification is inconsistent with Kaldor's (1966) explanations for the slow growth rates of UK, based on the exhaustion of labor surplus from the agricultural sector: "Kaldor concluded that the potential growth of industrial productivity is limited by the supply of labor" (Rowthorn, 1975, p. 10). Rowthorn then suggests that employment growth, and not output growth, should be the regressor, *i.e*: $m = c + d.e$. He estimates Verdoorn's Law using this alternative specification and, after excluding Japan as an outlier, finds that the hypothesis of constant returns to scale could not be rejected for OECD countries in the postwar period[8]. In response to Rowthorn, Kaldor (1975) changed his mind regarding the importance of labor shortage in explaining UK's growth rates and reaffirmed the view that output is demand rather than supply constrained and, as a consequence, output not employment should be the regressor in the estimation of Verdoorn's law.

In any case, an important issue regarding the correct specification of Verdoorn's equation is the fact that neither output nor employment is likely to be exogenous, but they may be jointly determined. 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).

In this case, the Verdoorn coefficient will be subject to simultaneous equation bias, in both Kaldor's and Rowthorn's specifications. As pointed out by McCombie (1983), the estimate of returns to scale under Rowthorn's specification ($\hat{d}$) will usually be lower than the one under

[8] This issue is known in the literature as 'Rowthorn critique', and generated a well-known debate between Kaldor and Rowthorn in the 1975 volume of the *Economic Journal*.

Kaldor's specification $\left(\frac{1}{1-\hat{b}}\right)$, except in case the regression has a perfect statistical fit ($R^2 = 1$), when both specifications would yield the same result. This is because the relationship between the two estimates is given by $(1-\hat{b}).\hat{d} = R^2$ and, therefore, $\hat{d} < \left(\frac{1}{1-\hat{b}}\right)$ if $R^2 < 1$. Given these problems, the "true" estimate of returns to scale will fall between the two alternative estimates, i.e., $\hat{d} < \hat{\lambda} < \left(\frac{1}{1-\hat{b}}\right)$.[9]

A necessary condition for the correct estimation of Verdoorn's Law using cross-country data is that all countries in the sample need to have the same rate of 'exogenous' productivity growth, i.e. growth of productivity which is not induced by the growth of output. This assumption gives rise to another empirical difficulty in estimating the law. If 'exogenous' productivity growth varies between countries, due for example to the diffusion of technology from the more advanced to the backward countries ('catching-up'), then a spurious Verdoorn relation can be generated. This occurs because the countries with the highest growth of productivity may be the ones with highest output growth rates, due to a feedback effect from the former to the latter through improved price competitiveness. In this case, even if constant returns prevail in each individual country, the cross-country regression of productivity growth on output growth may show a positive relation and spuriously suggest the existence of increasing returns to scale. A number of alternatives have been advanced in the literature in order to circumvent this problem, including: (i) the use of additional variables to account for the level of technological development (Gomulka, 1983); (ii) the analysis of individual countries using time-series data (Chatterji and Wickens, 1981; McCombie and De Rider, 1983; Atesoglu, 1993; Bianchi, 2002); (iii) the use of cross-regional data, under the assumption that regions of a single country do not present significant disparities in terms of their level of technology (McCombie and De Rider, 1983; Bernat, 1996; Hansen and Zhang, 1996; Fingleton and McCombie, 1998; Leon-Ledesma, 2000).

[9] Parikh (1978) used a simultaneous equation model in the estimation of Verdoorn's law, in order to circumvent this problem, but his procedures have also been subject to criticism (see McCombie, 1983). McCombie (1981) also attempted to resolve the issue by using an instrumental variable approach, but his results were sensitive to the method of normalization and did not resolve the controversy.

4 Empirical estimation of Kaldor's First and Second Growth Laws in Latin America

In the past three decades, studies to assess the validity of the Kaldor's growth laws used diverse specifications, econometric techniques and datasets. In very general terms, it is possible to say that Kaldor's Laws has been confirmed by empirical evidence. That is to say, the various results in the literature suggest that the manufacturing sector has an important role in the growth performance of the economy, and that it is characterized by the existence of increasing returns to scale.

This paper intends to provide estimations of Kaldor's Laws using a panel of selected Latin American economies for the period 1985-2001. Kaldor's first growth law ("manufacturing is the engine of growth") can be tested using the following equation:

$$q_i = a_i + b_i m_i \qquad (1)$$

where q and m refers to growth of total output and manufacturing output, respectively. As discussed in section 2, equations (2) and (3) provide additional support to the first law, and for this reason they will also be estimated in this study.

In addition, the paper will provide estimations of Verdoorn's Law in the manufacturing sector. As mentioned before, the traditional specification proposed by Kaldor (1966)[10] is:

$$e_i = c + d.m_i \qquad (9)$$

where e and m are the growth rates of employment and output in manufacturing, respectively. This specification does not consider the influence of the growth of capital stock on labor 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. For

[10] I will use this modified version, instead of regressing productivity on output growth, in order to avoid spurious correlations due to the fact that these two variables are correlated (by definition).

this reason, this study will estimate an extended version of equation (9), including the growth of the capital stock:

$$e_i = \pi + \gamma.q_i + \phi.k_i \qquad (10)$$

where k represents the growth of the capital stock, and the degree of returns to scale is given by $(1 - \phi)/\gamma$. In this case, Kaldor's specification (and not Rowthorn's) will be used because Latin American countries generally have large informal sectors with a significant amount of unemployed or underemployed labor that could be transferred to manufacturing sector as this sector grows. Therefore, the problems of labor shortage pointed out by Rowthorn (1975) do not seem to apply to the case of Latin America.

It should be noted that in order to include the growth of the capital stock as a regressor in equation (10), we need to assume that it is exogenously determined. However, one could argue that the growth of capital is endogenous to the model, and is a function of output growth. As Kaldor (1970, p. 339) points out: "It is sensible – or perhaps more sensible – to say that capital accumulation results from economic development as that it is a cause of development. Anyhow the two proceed side by side". In this case, equation (10) would not be correctly specified, and a better specification of Verdoorn's Law would be:

$$tf_i = \delta_i + \sigma_1 q_i \qquad (11)$$

where tf_i is the growth rate of total factor input, defined as $tf_i = \omega_i e_i + (1 - \omega_i)k_i$., and ω_i is the employment share in national income. Under this specification, the degree of the returns to scale is measured by $1/\sigma_1$.

In this study, Kaldor's growth laws as specified in equations (1) to (3), (10) and (11) will be estimated using panel data for the seven largest economies in Latin America (Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela) during the period 1985-2001. The choice of countries has been restricted in order to increase the homogeneity of the sample and minimize the bias caused by different 'exogenous' productivity growth rates across countries (as discussed in section 3). The period of analysis is delimited by data availability. All data come from World Development Indicators. Employment in the manufacturing sector was calculated by using total

labor force discounted by unemployment rates, multiplied by the percentage of total employment in industry. The output series corresponds to the growth rates of GDP, of manufacturing output, agriculture and services. Direct estimates of the stock of capital in the manufacturing sector are not available from WDI for the countries in the sample; in the estimations of equations (10) and (11) I used changes in electricity consumption as a proxy for the growth of capital stock in manufacturing. Finally, the estimation of total factor productivity (equation 11) was based on $\omega_i = 0.4$ (exercises with alternative values of ω_i do not show significant changes in the results). All estimations were made using Stata 8.2.

The results of the estimations of Kaldor's first law are provided in tables 1 to 3. The estimations are in line with other studies in the literature (e.g. Kaldor, 1966; Cripps and Tarling, 1973; Thirlwall and Vines, 1982; Drakopoulos and Theodossiou, 1991); Hansen and Zhang, 1996) and suggest that the manufacturing sector has performed an important role in the growth trajectory of the largest Latin American economies during the period 1985-2001. The regressions were estimated using fixed effects and random effects models; in all cases, the Hausman test indicates preference for the random effects model.

As mentioned before, the positive impact of manufacturing growth on the overall performance of the economy may be related to the transfer of labor from low productivity sectors to the industrial sector. If this is so, the results presented here are not surprising, since Latin American economies are usually characterized by high levels of employment in informal sectors (or disguised unemployment) and surplus labor. Therefore, there is scope for transferring labor to manufacturing when this sector grows, with little or no negative impact on the output of the traditional (or informal) sectors.

However, tests for autocorrelation and groupwise heteroskedasticity suggested the need to correct the estimation of equations (1) to (3) (see appendix). Therefore the model was estimated by Feasible Generalized Least Squares with correction for heteroskedastic panels. The results are provided in table 4 and confirm the estimations provided in tables (1) to (3).

TABLE 1

KALDOR'S FIRST LAW (EQUATION 1)

SELECTED LATIN AMERICAN COUNTRIES

1985-2001

n = 119		
Fixed Effects:	$q = 2.033 + 0.545\ m$ (8.31)* (15.40)*	$R^2 = 0.666$ F = 237.26
Random Effects:	$q = 2.028 + 0.547\ m$ (4.72)* (15.63)*	$R^2 = 0.666$ Wald = 244.39
Hausman test:	$\chi^2(1) = 0.29$	

Source: World Bank – WDI

Note: t-statistics in parenthesis; * = significant at 95%.

TABLE 2

KALDOR'S FIRST LAW (EQUATION 2)

SELECTED LATIN AMERICAN COUNTRIES

1985-2001

n = 119		
Fixed Effects:	$q = 3.502 + 0.521\ (m\text{-}nm)$ (9.74)* (6.58)*	$R^2 = 0.239$ F = 43.35
Random Effects:	$q = 3.492 + 0.509\ (m\text{-}nm)$ (5.45)* (6.52)*	$R^2 = 0.239$ Wald = 42.56
Hausman test:	$\chi^2(1) = 0.81$	

Source: World Bank – WDI

Note: t-statistics in parenthesis; * = significant at 95%.

TABLE 3

KALDOR'S FIRST LAW (EQUATION 3)

SELECTED LATIN AMERICAN COUNTRIES

1985-2001

n = 119		
Fixed Effects:	*nm = 1.912 + 0.430 m* (8.19)* (12.75)*	R^2 = 0.571 F = 162.50
Random Effects:	*nm = 1.913 + 0.430 m* (4.63)* (12.89)*	R^2 = 0.571 Wald = 166.17
Hausman test:	$\chi^2(1) = 0.00$	

Source: World Bank – WDI
Note: t-statistics in parenthesis; * = significant at 95%.

TABLE 4

KALDOR'S LAW (CORRECTED FOR HETEROSKEDASTICITY)

SELECTED LATIN AMERICAN COUNTRIES

1985-2001

Method: FGLS (heteroskedastic panel)		
n = 119		
Equation (1):	*q = 1.739 + 0.614 m* (8.75)* (20.76)*	Wald = 431.03
Equation (2):	*q = 3.450 + 0.466 (m – nm)* (10.93)* (6.80)*	Wald = 46.26
Equation (3):	*nm = 1.846 + 0.432 m* (9.40)* (14.83)*	Wald = 219.95

Source: World Bank – WDI
Note: z-statistics in parenthesis; * = significant at 95%.

Kaldor's second growth law (Verdoorn's Law) was estimated using equations (10) and (11), and the results are provided in tables 5 and 6, respectively. All estimations confirm the Verdoorn's Law, i.e. show the existence of significant increasing returns to scale in manufacturing. The regression using exogenous growth of capital stock provides an estimate of returns to scale around 1.4, and shows low significance of the variable *k.* When the capital stock is treated as endogenous to output (table 6), the estimate of the Verdoorn coefficient is around 0.42 and the degree of returns to scale is around 2.3. In both cases, the Hausman test indicates a preference for the random effects model.

Also in this case, tests for autocorrelation and groupwise heteroskedasticity suggested the need to correct the estimation of equations (10) and (11) (see appendix). For this reason the model was estimated by Feasible Generalized Least Squares with correction for heteroskedastic panels. The results are provided in table 7 and also confirm the hypothesis of increasing returns to scale using both specifications.

TABLE 5
VERDOORN'S LAW (EQUATION 10)
SELECTED LATIN AMERICAN COUNTRIES
1985-2001

n = 90		
Fixed Effects:	$e = -0.81 + 0.654q + 0.087k$ (-1.06) (6.29)* (0.69)	$R^2 = 0.346$ F = 23.23
		Returns to scale = 1.397
Random Effects:	$e = -0.915 + 0.659q + 0.082k$ (-0.81) (6.42)* (0.66)	$R^2 = 0.346$ Wald = 48.38
		Returns to scale = 1.394
Hausman test:	$\chi^2(2) = 0.15$	

Source: World Bank – WDI

Note: t-statistics in parenthesis; * = significant at 95%; all estimations of returns to scale are greater than unity at 95%.

TABLE 6

VERDOORN'S LAW, ENDOGENOUS K (EQUATION 11)

SELECTED LATIN AMERICAN COUNTRIES

1985-2001

n = 90		
Fixed Effects:	$tfi = 2.063 + 0.413q$ (5.06)* (6.09)*	Adj R^2 = 0.325 F = 37.11 Returns to scale = 2.419
Random Effects:	$tfi = 2.001 + 0.432q$ (4.84)* (6.50)*	Adj R^2 = 0.325 Wald = 42.25 Returns to scale = 2.316
Hausman test:	$\chi^2(2) = 1.78$	

Source: World Bank – WDI

Note: t-statistics in parenthesis; * = significant at 95%; all estimations of returns to scale are greater than unity at 95%.

TABLE 7

VERDOORN'S LAW (CORRECTED FOR HETEROSKEDASTICITY)

SELECTED LATIN AMERICAN COUNTRIES

1985-2001

Method: FGLS (heteroskedastic panel)		
n = 90		
Equation (10):	$e = -0.26 + 0.655q + 0.155k$ (-0.40) (6.99)* (1.24)	Wald = 73.95 Returns to scale = 1.291
Equation (11):	$tfi = 2.166 + 0.476q$ (6.59)* (8.79)*	Wald = 77.20 Returns to scale = 2.103

Source: World Bank – WDI

Note: t-statistics in parenthesis; * = significant at 95%; all estimations of returns to scale are greater than unity at 95%.

Finally, an additional estimation was performed using an instrumental variable procedure in order to account for the problem of simultaneity (as discussed in section 3). In this case, Verdoorn's law was estimated by pooled two-stage least squares (G2SLS), using lagged values of *q* and *k* as instruments. The results are reported in table 8 below.

TABLE 8
VERDOORN'S LAW (IV ESTIMATION)
SELECTED LATIN AMERICAN COUNTRIES
1985-2001

Method: G2SLS Random-Effects IV Regression		
n = 90		
Equation (10):	$e = -0.908 + 0.659q + 0.081k$ (-0.85) (6.41)* (0.65)	$R^2 = 0.346$ Wald = 48.19
		Returns to scale = 1.394
Equation (11):	$tfi = 2.001 + 0.433q$ (4.92)* (6.51)*	$R^2 = 0.325$ Wald = 42.44
		Returns to scale = 2.309

Source: World Bank - WDI

Note: instruments used in the IV regression: q, k, q_{t-1}, k_{t-1}, k_{t-2} in equation (10); q, q_{t-1} in equation (11).

The use of instrumental variables estimation has not changed significantly the estimated parameters in both specifications. This result is in line with other studies where IV techniques were attempted in order to deal with simultaneous equation bias in the estimation of Verdoorn's law[11].

[11] I also performed fixed-effects IV regression for equations (10) and (11). The results were also similar to the ones in tables (5) and (6). Since the Hausman test indicated preference for the random effects model, the results of the fixed effects estimation are not presented here, but can be made available upon request.

6 Conclusion

This paper analyzed the relation between manufacturing output growth and economic performance from a Kaldorian perspective by estimating Kaldor's first and second growth laws for a sample of seven Latin American economies during the period 1985-2001. As discussed in the text, the relation between industrial growth and GDP growth can be explained by the effects of manufacturing on productivity levels in the whole economy. Such effects are due to transfer of labor from low productivity sectors to the industrial sector and to the existence of static and dynamic economies of scale in manufacturing.

The results presented here confirm the "manufacturing is the engine of growth" hypothesis, and suggest the existence of significant increasing returns in the manufacturing sector in the largest Latin American economies. In estimating Verdoorn's Law, I used different specifications in order to deal with some of the most important theoretical and empirical issues discussed in the literature. This includes the use of a proxy for the growth of the capital stock, and its inclusion as an endogenous variable in the regression, as well as the use of instrumental variable techniques in order to deal with simultaneity problems. Verdoorn's Law was confirmed in all exercises, with the estimated Verdoorn coefficient ranging from 0.41 to 0.66. So we can conclude that productivity growth seemed to respond positively to output growth in the manufacturing sector in the period of analysis.

Despite the fact that the estimations presented here seem to confirm several other studies in the literature, the results deserve some qualification. First, it should be noted that the period under scrutiny is characterized by widespread trade and financial reforms in Latin America, to which the manufacturing sector responded by promoting cost reduction strategies in order to maintain some degree of competitiveness. These strategies in most cases involved cuts in employment levels, and this can cause an upward bias in the levels of labor productivity. Second, it is important to stress that there is a large degree of heterogeneity in the national experiences across the countries in the sample. In most of the cases, the shares of manufactures in GDP and exports have declined over the last two decades, in favor of agriculture (Argentina) or mining/oil (Venezuela). In some countries the patterns of specialization remained fairly stable, whereas in the case of Mexico there was a significant expansion of manufacturing production and exports, particularly due to the expansion of maquila industries.

Overall, the results confirm the existence of increasing returns in the manufacturing sector, and the possibility of cumulative growth cycles in the region, based on the expansion of industrial activities. This relates to the fact that Latin American economies have not attained a high level of "maturity", in terms of the exhaustion of surplus labor in low productivity sectors, given the existence of large informal sectors, and implies that the development of industrial activities represent an important source of potential economic growth in the region.

In terms of economic policy implications, the analysis presented here can serve as a warning concerning some of the specialization trends within the region, where we observe an increasing participation of commodities and intermediate goods in exports from most of the countries in Latin America, and a concomitant decline in manufacturing exports. Given the importance of increasing returns to scale at a theoretical level – both in cumulative causation models and endogenous growth theory – one should view with caution policies that would promote further de-industrialization in the region, due to its potential negative effects to economic growth in the long run.

APPENDIX:

WOOLDRIDGE TEST FOR AUTOCORRELATION IN PANEL DATA
SELECTED LATIN AMERICAN COUNTRIES / 1985-2001

Ho: no first-order autocorrelation

Equation (1):	*F (1,6) = 1.107* *Prob > F = 0.333*
Equation (2):	*F (1,6) = 4.087* *Prob > F = 0.090*
Equation (3):	*F (1,6) = 0.548* *Prob > F = 0.487*
Equation (10):	*F (1,6) = 1.996* *Prob > F = 0.207*
Equation (11):	*F(1,6) = 0.194* *Prob > F = 0.675*

LIKELIHOOD-RATIO TEST FOR GROUPWISE HETEROSKEDASTICITY
SELECTED LATIN AMERICAN COUNTRIES / 1985-2001

Ho: no heteroskedasticity

Equation (1):	*LR* $\chi^2(6) = 33.83$ *Prob* $> \chi^2 = 0.00$
Equation (2):	*LR* $\chi^2(6) = 19.01$ *Prob* $> \chi^2 = 0.004$
Equation (3):	*LR* $\chi^2(6) = 23.52$ *Prob* $> \chi^2 = 0.001$
Equation (10):	*LR* $\chi^2(6) = 13.81$ *Prob* $> \chi^2 = 0.032$
Equation (11):	*LR* $\chi^2(6) = 20.20$ *Prob* $> \chi^2 = 0.003$

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