UNEVEN DEVELOPMENT IN GROWTH MODELS OF KEYNESIAN INSPIRATION [1?]

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ABSTRACT

This article aims to make a systematic presentation of Keynesian-inspired growth models (Neo-Keynesian and Kaldorian Models), focusing on the role of aggregate demand in the analysis of the determinants of uneven development, which means that the focus of the article will be *the proximate causes* of economic growth in Maddison´s sense (1988) from the perspective of Keynesian Economics. These growth models will be classified into two groups, namely: *growth models with limited labor supply*, more directly applicable *to mature economies*; and *growth models led by aggregate demand*, in which labor supply can be regarded as unlimited or perfectly elastic, thus being more applicable to the case of dual economies in Lewis's sense or in the process of Industrialization. In the case of models with limited supply of labor, the growth rate compatible with a balanced growth path is determined by the natural growth rate, consisting of the sum between the growth of the workforce and the growth of labor productivity. As technological progress is largely embedded in new machinery and equipment, the pace of growth of labor productivity depends critically on the pace of capital accumulation; but the extent to which technical progress is incorporated into the economy depends on the level of the technological gap, which expresses the *technological asymmetries* between the various economies. In this setting, different levels of *technological gap* are compatible with different rates of growth of labor productivity along the balanced growth trajectory, thus generating divergences between the growth rates of the countries.

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1. INTRODUCTION

Modern growth theory makes the distinction between the proximate and the ultimate causes of economic development (Maddison, 1988). The proximate causes are those immediately responsible for the object in question; while the ultimate causes are the ones distant in time and are the base causes, that is, the background determinants or the origin of the phenomena. In the context of growth theory, the proximate causes are those directly related to the level of income *per capita,* the existing quantity of physical and human capital, the availability of natural resources, the efficiency in the use of productive resources and the level of technical and scientific knowledge existent at a point in time. On the other hand, the ultimate causes refer to the reasons why countries have distinct availabilities of productive factors and, therefore, different levels on income per capita. Among the ultimate causes are geography, institutions, income distribution and macroeconomic policy regimes (Ros, 2013, p. 15-17).

Regarding the proximate causes, the different theories of economic growth can be separated in two large groups. The first consists of the set of theories developed from the seminal works of Solow (1956; 1957), which can be referred to as the *neoclassical approach*[2]. This approach argues that the fundamental limit for long term economic growth is given by supply side constraints. Specifically, these models consider that the long-term real growth is determined by the rate of accumulation of factors of production and by the rate of technical progress. Demand is only relevant to explain the level of capacity utilization but has no impact on the determination of the rate of its expansion. In the long run, Say's law is valid and supply (the availability of factors of production), determines aggregate demand.

In the neoclassical perspective, the supply side factors are the determinants of the long run growth tendency of capitalist economies. Aggregate demand is responsible only for the fluctuations around the long run tendency, which economists call the economic cycle. That is, the essence of the neoclassical approach is that the long run growth tendency is independent of aggregate demand, and only deviations occur during economic cycles.

2 In the neoclassical approach we also include the endogenous growth theories because in these theories the constraints to growth are determined in the supply side, which leaves no role for aggregate demand in determining the pace of economic growth.

The second group is formed by a set of theories developed from the extension of Keynes's principle of effective demand, presented in the General Theory of Employment, Interest and Money (Keynes, 1936). The effective demand principle, which states that the level of employment is determined by aggregate demand, was originally designed for an economy anchored in the Marshallian short run. It was up for Keynes's disciples, more specifically, Roy Harrod, Joan Robinson and Nicholas Kaldor, during the 1950 and 1960's, to extend this principle to the long run, in which the stock of capital, population and production techniques change over time. This generation of authors is referred to as the Post-Keynesian School, or the Cambridge School, as most of these scholars taught at Cambridge University in the United Kingdom.

The models built by these authors contain a common Keynesian idea: investment determine savings. Therefore, entrepreneurs' decisions to invest is fundamental in explaining the long-term economic growth.

In particular, these models point that in the long run, the paradox of thrift is valid. Therefore, an increase in the propensity to save, given an amount of investment, is followed by a fall in the level of economic activity. At the end of the multiplier process, the same level of aggregate savings prior to the change is maintained.

In Keynes's General Theory, the paradox of thrift is one of the fundamental results of the effective demand principle, which was designed for an economy operating in the Marshallian short run. The models developed by the Cambridge School extend these results for the context of a growing economy.

The theories developed by the Cambridge School were originally thought to explain the growth of developed or industrialized economies. These economies, on the other hand, have some fundamental characteristics.

The first is that these are *mature economies,* that is, economies that have already completed their industrialization processes in which all the labor force existing in the traditional or subsistence sector was transferred to the modern or capitalist sector. In this situation, labor supply is not perfectly elastic for the capitalist sector as in the initial stages of industrialization. The result is that real wages are not determined by the reproduction costs of labor force. In this sense, long term economic growth is bounded by *the natural rate of growth*, which consists in the sum of the rate of growth of labor force and the rate of growth of labor productivity.

The second fundamental characteristic of mature economies is that they operate with frontier technologies. Thus, their productive structure incorporates the most advanced, state-of-the-art, production techniques, resulting in products and services with the highest possible value added per-capita. In this sense, the growth of labor productivity results necessarily from technological progress - and from its incorporation in machines and equipments- instead of resulting from the process of imitation or importing of already existing technologies.

Focusing on mature economies and the absence of technological asymmetries in the structure of the growth models developed by the Cambridge School in the 1950 and 1960, rendered the Keynesian inspired growth models incapable of explaining the uneven economic *performance* existing between developed and developing economies.[3]

Indeed, economic growth during the last 200 years was extremely unequal. Different groups of countries experienced large and systemic differences in the rates of growth of labor productivity and income *per capita*.

Table 1 - Average growth rate of gross domestic product per capita of selected countries.

Country	Period	Initial Per Capita GDP (1985 US$)	Final Per Capita GDP (1985 US$)	Average Growth Rate (%)
Japan	1890-1990	842	16,144	3
Brazil	1900-1987	436	3,417	2.39
Canada	1870-1990	1,330	17,070	2.15
Germany	1870-1990	1,223	14,288	2.07
United States	1870-1990	2,244	18,258	1.76
China	1900-1987	401	1,748	1.71
Mexico	1900-1987	649	2,667	1.64
United Kingdom	1870-1990	2,693	13,589	1.36
Argentina	1900-1987	1,284	3,302	1.09
Indonesia	1900-1987	499	1,200	1.01
Pakistan	1900-1987	413	885	0.88
India	1900-1987	378	662	0.65
Bangladesh	1900-1987	349	375	0.08

Source: Barro e Sala-I-Martin (1995). Authors own presentation.

The differences in income per capita observed reflect, in the first place, the existence of technological asymmetries between countries, that is, the fact that countries find themselves in the technology frontier, while others are lagging behind, and some, far behind. Secondly, these differences reflect the existence of asymmetries in the in-

3 The neoclassical growth theory, either in the exogenous growth models such as in Solow (1956), or in the endogenous growth models for example in Romer (1990), are incapable of satisfactorily explaining the problem of uneven development precisely for not including asymmetries in technology and productive structure in the formal models. The Neoclassical growth models, by assuming that technology is a public good and that productive structure is irrelevant for economic growth, are incapable of explaining the long-term persistent differences in the rate of growth of income per capita between countries. See Ros (2013) and Oreiro (2016).

dustrialization process, i.e., the existence of industrialized, industrializing, and non-industrialized countries. These asymmetries in the industrialization process led some countries to have an economy specialized in the production and exporting of primary products, while others have a diversified economy- thus, capable of exporting a great variety of manufacture products with an elevated degree of technological intensity.

The recent developments in the Keynesian theory- notably originating from the works of Thirlwall (1979) and Verspagen (1993)- allowed to incorporate these asymmetries in technology and in the productive structure in the formal presentation of demand led growth models. These are models in which the growth rate of real output and labor productivity are determined by the rate of demand growth, in particular, the rate of growth of exports. Therefore, it is possible to deal with the question of uneven growth with a Keynesian theoretical background.

In line with it, the aim of this work is presenting a systematic view of the growth theories of Keynesian Inspiration, focusing on the role of aggregate demand as the determinant of uneven development. Therefore, focusing on the proximate causes of economic growth under a Keynesian referential.

2. GROWTH MODELS IN DEVELOPED ECONOMIES: THE KALDOR-PASINETTI-VERSPAGEN MODELS[4]

In this section, we analyze the determinants of growth in a developed economy, that is, an economy that has already gone through the process of industrialization and all the available labor force in the subsistence sector was transferred to the modern industrial sector. In this situation, labor supply for the capitalist sector is not unlimited, but it is constrained by the long-term population growth. In the short and medium run, labor force is capable of growing at a faster rate than the population growth if changes in labor's working time or in the participation rate. Nevertheless, in the long run both the working time and the participation rate are constant, in such way that the growth of labor supply is only determined by the rate of population growth.

The potential rate of growth in this economy is determined by the so-called natural rate of growth, which results from the sum of the growth rate of population and the growth rate of labor productivity. Technical progress is, broadly speaking, embodied in new machinery and capital equipment. Therefore, the growth rate of labor productivity is determined by the rate in which the capital stock per worker is growing, with this relation being expressed by the equation known as the technical progress function. This endogeneity of technical progress allows us to categorize this model as an endogenous growth model.

4 This section is based on Oreiro (2016, chapter. 3; 2018, chapter 3)

A developed economy is not necessarily at the technology frontier. Therefore, the technical progress function presented in this section considers the positive and negative effects of the technological gap in the rate of growth of labor productivity.

In the goods markets, we assume that supply is inelastic, thus, the income distribution between wages and profits would be the adjusting variable between the natural rate of growth and the rate of growth compatible with macroeconomic equilibrium between savings and investments, which is referred to in the literature as the warranted rate of growth.

The models presented in this section are developed from the pioneering contributions of Kaldor (1956;1957) and Pasinetti (1962) for solving the Harrod-Domar dilemma. Indeed, the fundamental conclusion of the Harrod-Domar growth model is showing that the achievement of a balanced growth trajectory with full employment of the labor force is possible but highly improbable. Therefore, capitalist economies should present an irregular growth path, alternating between periods of accelerated growth rates followed by sharp contractions in the level of economic activity and employment.

The incompatibility of these models with the historic experience of developed capitalist economies between 1950 and 1973 led Nicholas Kaldor and Luigi Pasinetti to formulate models in which the long run growth trajectories are stable and characterized by the full employment of the labor force. However, it required the development of a new theory of functional income distribution, in which the wage and profit shares are the adjusting variables between the decision to save and to invest.

The importance of this new theory of income distribution was to establish a second mechanism[5] by which investments can determine savings. Indeed, Keynes demonstrated in the General Theory that an exogenous increase in investment would generate an equivalent increase in savings via the multiplier effect. Kaldor and Pasinetti, on the other hand, argued that changes in investment always generate an equivalent increase in savings due to the effects on distribution between wages and profits. In this theory, profits and wages have different marginal propensities to save. Therefore, an increase in the level of investment results in an increase in the profit share of total income, which then causes an increase total savings due to the higher marginal propensity to save out of profits.

2.1 Production techniques and the natural rate of growth

We will consider an economy producing a single homogeneous good (for

5 The first mechanism consists of the investment multiplier presented in macroeconomics textbooks.

instance, wheat) that serves for consumption and investment. The production function is a fixed coefficients type. Regarding labor, we assume that it is a homogenous input- workers have the same skills and qualifications. Fixed capital, on the other hand, is constituted of machines and equipments produced at different points in time, thus embodying different levels of technical knowledge. In this sense, equipments and machines from different harvests have different levels of productivity. Aggregating different types of capital is a difficult task, for this reason we thus abstract the heterogeneity between capital goods, assuming a homogenous capital stock.

Output, at time *t,* is given by the Leontief production function:

$$Y = min(aL; uvK) \qquad (1)$$

In this setting, factors of production are complementary, with no possibility for substituting inputs because of changes in relative factor prices.

Where *Y* is output, $\bar{Y}$ is potential output[6], *L* is the labor force employed, *K* capital employed, *a* is the average labor productivity, $u = \frac{Y}{\bar{Y}}$ is the capacity utilization rate, $v = \frac{\bar{Y}}{K}$ is the potential output-capital relation.

Capital and labor inputs are used efficiently if the following condition is met:

$$Y = aL = uvK \qquad (2)$$

From equation (2), we can derive the amount of labor firms are willing to employ. Indeed, from the first part of equation (2) and solving for *L*, we find:

$$L = \frac{1}{a}Y \qquad (3)$$

Equation (3) shows that the quantity of labor that firms are willing to employ is proportional to the level production.

Applying the natural log in equation (3) and differentiating the expression with respect to time, we obtain:

$$\hat{L} = \hat{Y} - \hat{a} \qquad (4)$$

Where $\hat{L}$ is the growth rate of employment, $\hat{Y}$ is the growth rate of output and $\hat{a}$ is the rate of growth of labor productivity. In equation (4) employment will increase (decrease) in time if the growth rate of output is higher (lower) than the growth rate of labor productivity.

6 Potential output is represented by the maximum amount that can be produced when firms are operating with a degree of capacity utilization equal to the desired. It is important to note that this is not necessarily full capacity utilization, as firms ought to maintain some degree of idle capacity for strategic reasons.

As we are considering a developed economy, we assume that the growth rate of employment is equal to the growth rate of the labor supply.[7] If ? is the growth rate of the labor force, we have:

$$\hat{Y} = \eta + \hat{a} \qquad (5)$$

Equation (5) shows that the rate of output growth is equal to the sum of the rate of growth rate of labor force and the growth rate of labor productivity. The left side of the equation is an upper limit to the growth rate of output. If it deviates to a higher growth rate, employment will grow faster than the supply of labor, in such way that unemployment will converge to zero. In this sense, the economy will face a shortage of workers to sustain this rate of growth- therefore this is an unsustainable rate of growth in the long run. On the other hand, if the economy is growing at a lower rate, employment will increase at a lower rate than the supply of labor, thus unemployment will converge to 100%. Clearly, both trajectories are unsustainable.

For an economy to present a balanced growth rate, i.e., where the rate of employment remains constant over time, it is necessary that the economy grows at a rate given by equation (5). The rate of output growth that allows for a balanced trajectory is given by the natural growth rate g_N in equation (6).

$$g_N = \eta + \hat{a} \qquad (6)$$

2.2 Technical progress function

In the conventional or neoclassical growth theory, labor productivity growth can be separated into two parts. First, by an increase in the capital stock per worker, that is, in capital intensity; Secondly, from advances in the so-called state-of-the-art – the level of technical knowledge available in a given point in time. This distinction is possible in an economy which technical progress is disembodied from new machines and capital equipment. However, a large portion of technical progress is embodied in capital goods, thus, it is nearly impossible to distinct the growth of labor productivity attributed only to an increase in capital intensity or to improvements in the state-of-the-art technologies.

Expressing the growth rate of labor productivity as a function of the growth rate of the capital stock per worker, as in Kaldor (1957). We have:

$$\hat{a} = \alpha_0 + \alpha_1 \hat{k} \qquad (7)$$

7 This doesn't imply that the economy is operating in full employment, but only that the unemployment rate is constant over time. Indeed, the unemployment rate can be expressed by $U = \frac{N-L}{N} = 1 - \frac{L}{N}$, where *L* is the total labor employed and N is the size of the labor force. If labor force and employment grow at the same rate, *U* will be constant over time, but at a level which can be higher or lower than full employment scenario.

Where $\hat{k}$ is the growth rate of the capital stock per worker.

The technical progress function can be understood in two ways. The first one, an increase in capital intensity, which imply the introduction of more advanced technology, will increase labor productivity. The second way is that most of technical innovations which lead to productivity increases require a higher stock of capital per worker - for instance a more complex equipment or more mechanical power – which means that the most part of technical progress is embodied in new machines and equipment.

The term α_0 in equation (7) represents the share of technical progress that is autonomous in relation to the capital accumulation. This parameter represents the disembodied share of technical progress due to, for example, changes in organization which increases production without the need for additional investment.

The term $\alpha_1\hat{k}$, on the other hand represents the share of technical progress that is embodied in machines and equipments, induced thus by the capital accumulation. The coefficient α_1 represents the sensitivity of the growth rate of labor productivity to changes in the rate of growth of the stock of capital per worker. This coefficient captures the capacity of transforming a flow of new ideas and knowledge into productivity increases via investments.

This coefficient of induction from the productivity growth to the capital accumulation, depends on the technology gap- that is, the distance between the level of technological knowledge of an economy in relation to the technological frontier.[8]

What is the relation between the technology gap and the coefficient of induction of technical progress? At some degree, countries behind the technology frontier can rapidly increase productivity simply by means of imitating and by learning the methods of production employed in countries at the technology frontier. It means that, to a certain extent, presented in the next parts, the growth rate of labor productivity in an economy behind the frontier is a positive function with respect to the same frontier. As imitation involves, at least partially, in purchasing machines and equipment produced in countries which are at the technology frontier, the co-

8 This idea was inspired in Alexander Gerschenskron, which, in his classical work *Economic Backwardness in Historical Perspective,* argues that "Assuming an adequate endowment of usable resources, and assuming that the great blocks to industrialization had been removed, the opportunities inherent in industrialization may be said to vary directly with the backwardness of a country. Industrialization always seemed the more promising the greater the backlog of technological innovations which the backward country could take over from the more advanced country.". It is clear that the advantage of backward countries in industrialization from the possibility of using technological innovation already developed in advanced countries, clearly stating the existence of a technological gap between advanced economies and the ones behind. The use of these new technologies, on the other hand, is given by the possibility of "But all these superficialities tend to blur the basic fact that the contingency of large imports of foreign machinery and of foreign know-how, and the concomitant opportunities for rapid industrialization with the passage of time, increasingly widened the gulf between economic potentialities and economic actualities in backward countries (Gerschenskron, 1962, p.8).

efficient of induction of technical progress will depend on the size of the technology gap. In this sense, countries behind the technological frontier can benefit from positive leakages of knowledge from countries leading in technology.

A remark is that this positive coefficient of induction of technical progress and the technology gap depends on the learning and absorbing capacity in each country. The absorbing capacity, on the other hand, depends on the very distance a country is in relation to the technology frontier. For instance, if the distance is too far, the country will not be capable to benefit from the positive leakages from leading countries. In this case, the induction coefficient of the technical progress is a decreasing function of the technological gap.[9]

Defining $G = \frac{T_N}{T_S}$ as the technology gap,[10] where T_N is the level of knowledge at the technological frontier and T_S the level of technological knowledge of the lagging countries, we suppose, base in Verspagen (1993), that:

$$\alpha_1 = a_2 G e^{-\frac{G}{\delta}} \quad (8)$$

Where δ is a parameter representing the technological learning capacity of the economy in question (also referred as the absorption capacity).

In equation (8) if the technology gap equals one, the coefficient of induction of the technical progress will be constant and equal to $a_2 e^{-\frac{1}{\delta}}$. Differentiating equation (8) with respect to G, we obtain:

$$\frac{\partial \alpha_1}{\partial G} = a_2 e^{-\frac{G}{\delta}}\left(1 - \frac{1}{\delta}(G)^2\right) \quad (9)$$

In equation (9), it is clear that $\frac{\partial \alpha_1}{\partial G}$ is positive only if $\left(1 - \frac{1}{\delta}(G)^2\right) > 0$, that is, if $\delta > G^2$. This means that the coefficient of induction of the technical progress function will only be an increasing function of the technology gap if, and only if, the square of the technology gap is smaller than the parameter representing the absorbing capacity of the economy.

The growth rate of capital stock per worker is:

$$\hat{k} = \hat{K} - n \quad (10)$$

Where $\hat{K}$ is the growth rate of the capital stock (henceforth g_K).

Substituting (8) and (10) in (7), we have:

$$\hat{a} = \alpha_0 + \left(a_2 G e^{-\frac{G}{\delta}}\right)(g_k - n) \quad (11)$$

9 More information available in Verspagen (1993, p. 126-130).
10 The minimum value for the technological gap is G=1

Equation (11) is the technical progress function. We can observe that the growth rate of labor productivity depends on the rate of growth of the capital stock, on the growth rate of labor productivity and the technology gap.

2.3 Capital accumulation and balanced growth

Based on the economic efficiency condition (equation 2), output for a given point in time can be expressed as:

$$Y = uvK \qquad (12)$$

Equation (12) expresses output as a function of the existing capital stock, the level of capacity utilization and the potential output-capital relation.

Taking the logarithmic time derivatives, we arrive at the expression of output growth:

$$g_Y = g_u + g_v + g_K \qquad (13)$$

Where g_Y is the growth rate of output, g_u the growth rate of level of capacity utilization, and g_v the growth rate of the potential output-capital.

The term g_v in equation (13) is the rate of growth of capital productivity, which depends on the technological progress.[11] When capital productivity is increasing over time, technological progress is thus referred as capital saving. In the case where capital productivity is falling over time, technological progress is referred as capital intensive. Finally, in the case where capital productivity is constant over time, technical progress is thus called neutral.

Empirical evidence presented in Kaldor (1957) point to the stability of the capital-output over time, therefore, for a neutral technical progress.

The term g_u in equation (13) is the rate of change in the level of capacity utilization. In the long run, the only sustainable value for g_u is zero, meaning that the level of capacity utilization will be constant over the balanced growth trajectory. It does not imply full capacity utilization or that firms are operating with excess over planned capacity. In this case, the trajectory in which u is constant over time is compatible with underutilization of productive capacity.

Assuming that technical progress is neutral and that the economy is in balanced growth trajectory, we have:

$$g_Y = g_K \qquad (14)$$

Where the rate of growth of output is equal to the rate of growth of the capital stock.

11 A detailed explanation is available in Bresser-Pereira (1986)

In the long run balanced growth trajectory of this economy output must grow at a rate equal to the natural, given by the sum of the rate of growth of labor force and the rate of growth of labor productivity. Substituting (11) in (6), we find:

$$g_N = \left(1 - \left(a_2 G e^{-\frac{G}{\delta}}\right)\right) n + \alpha_0 + \left(a_2 G e^{-\frac{G}{\delta}}\right) g_K \qquad (15)$$

Finally, substituting (14) in (15) and solving for g_N, we arrive at:

$$g_N = n + \frac{\alpha_0}{\left(1 - \left(a_2 G e^{-\frac{G}{\delta}}\right)\right)} \qquad (16)$$

Equation (15) is the final expression where the natural rate of growth depends on the rate of growth of the labor force and on the technology gap. From (16), the natural rate of growth is an increasing function of the technology gap if $\delta > G^2$.

2.4 The macroeconomic equilibrium, investment and saving.

We now turn to the demand side of this economy. For simplicity, we assume a closed economy without government. The objectives of these assumptions are to make the model as simple as possible. This will allow us to devote our attention to the relations between aggregate supply and demand over a balanced growth trajectory.

A fundamental characteristic of Keynesian growth models is the assumption that planned investment spending is autonomous in relation to planned savings. This is based in an economy which the banking system is sufficiently developed and capable of providing the necessary liquidity for investments to take place[12]. Indeed, increasing investment can be performed prior to increases in saving, enabled by the expansion of credit.

Based on this reasoning, we assume that planned investment (*I*) is exogenous and given by:

$$I = \bar{I} \qquad (17)$$

Total savings (S) is the sum between savings of firms (S_F) and households (S_H). Most Keynesian growth models assume families as homogenous agents. Nevertheless, we can subdivide it into two: capitalists and workers.

12 A comprehensive explanation is provided in Paula (2014, p. 98-120).

Capitalists are households which income derives only from firms' shared profits (Pasinetti, 1962). These are, in Kaldor's (1966) terminology, hereditary barons, with very little relation with the traditional industrial capitalist that simultaneously managed and owned capital. Capitalists here are rentiers, that is, households for which income consists solely of the ownership of capital stock.

On the other hand, workers are households whose income originate from wages and salaries, as well as part of the firms' shared profits. This class includes not only blue-collar workers but also workers directly or indirectly related to management.

According to Pasinetti (1962), capitalists' propensity to save (s_c) is higher than of workers (s_w) propensity to save. The justification of this assumption is not sufficiently convincing. The difference between the propensity to save from both classes seems to be based on the old Ricardian conception according to which wages tend towards the labor force subsistence level. Under these conditions, capital accumulation by workers would be impossible. Therefore, it would be more appropriate to assume workers propensity to save as zero, but this is not what the author assumes. In fact, in his model, workers are capable of accumulating capital, because their propensity to save is larger than zero. Why would then the workers propensity to save be lower than the baron class? Pasinetti never provided a convincing explanation.

A more reasonable assumption is that the propensity to save depends on the type of income (Kaldor, 1966). Specifically, Kaldor (1966) assumes a propensity to save from profits higher than the propensity to save from wages. This difference does not depend on the preferences of individuals of each class, but on the very nature of entrepreneurial income. According to the author, in a world where economies of scale prevail, firms are force by competition to either expand or fail, as productivity increases are associated with cost reductions and increases in production over time. In this sense, an elevated coefficient of retained earnings is a necessary condition for the survival of firms in the long run, because retained earnings are an essential source of primary financing to the expansion of firms. Households, on the other hand, are not subject to this same competitive pressure and this is a reason for their slower pace of wealth accumulation.

According to the exposition above, we have the following set of equations:

$$S = S_F + S_H \qquad (18)$$

$$S_H = S_W + S_C \qquad (19)$$

$$S_W = s_w(W + P_w) \qquad (20)$$

$$S_C = s_c P_c \quad (21)$$

$$S_F = P_R \quad (22)$$

$$P_R = \varepsilon P \quad (23)$$

$$P = P_R + P_D \quad (24)$$

$$P_D = P_W + P_C \quad (25)$$

$$P_w = k_w P_D \quad (26)$$

$$P_C = (1 - k_w) P_D \quad (27)$$

Where W are wages, P_W the total profits distributed for the workers, P_C the amount of profits received by the capitalists, P_R the amount of earnings retained by firms, P_D the distributed earnings to capitalists and households, P is the total sum of profits, ε the coefficient of retained profits, k_w the share of the capital stock owned by the workers.

From the savings of firms, substituting (23) in (22), we have:

$$S_F = \varepsilon P = \varepsilon \frac{P}{K} K = \varepsilon r K \quad (28)$$

Where *r* is the profit rate, is given by:

$$r = \frac{P}{K} = \frac{P}{Y}\frac{Y}{\bar{Y}}\frac{\bar{Y}}{K} = huv \quad (28.1)$$

In Equation (28.1), the profit rate is expressed as the product between the profit share of income (*h*), the degree of productive capacity utilization (*u*) and the potential output-capital relation.

Substituting (26) in (20) and remembering that $P_D = (1 - \varepsilon)P$, we find:

$$S_W = s_w W + s_W k_w (1 - \varepsilon) r K \quad (29)$$

Finally, substituting (27) in (21):

$$S_C = s_c (1 - k_w)(1 - \varepsilon) r K \quad (30)$$

Adding equations (28), (29) and (30), we arrive at the aggregate savings function:

$$S = \{\varepsilon + (1 - \varepsilon)[s_w k_w + s_c (1 - k_w)]\} r K + s_w W \quad (31)$$

Equation (31) is the general expression for planned savings. Planned savings depends on i) the profit rate and the size of capital stock; ii) total wages; iii) distribution of capital stock between capitalists and workers; iv) the coefficient of retained earnings; v) the propensity to save of capitalists; and vi) the propensity to save of workers.

From equation (31) we can derive four particular cases of the savings function: the Ricardian, Harrodian, Pasinettian and Kaldorian.

The Ricardian savings function is derived from equation (31) by setting the propensity to save of workers equal to zero and that firms distribute all profits. In this case we have:

$$S = s_c rK \qquad (31.1)$$

The Harrodian savings function, on the other hand, is derived by setting the propensity to save of workers equal to the propensity to save of capitalists ($s_W = s_c = s)$, and that firms, as in the previous case, distribute all profits. Thus, we have:

$$S = s\,P + s\,W = s\,Y \qquad (31.2)$$

The Passinetian case is obtained when the propensity to save of capitalists is higher than the propensity to save of workers, and that firms distribute all profits. It can be observed in equation (31.3).

$$S = \{[s_W k_W + s_c(1 - k_W)]\} rK + s_W W \qquad (31.3)$$

Finally, the Kaldorian case refers to a situation where firms retain part of the profits, but the propensity to save of capitalists is equal to the propensity to save of workers. In this case we have:

$$S = \{\varepsilon + (1 - \varepsilon) s_F\} rK + s_F W \qquad (31.4)$$

In this last case, the propensity to save of profits is given by $(s_P = \{\varepsilon + (1 - \varepsilon) s_F\})$, which is larger than the propensity to save of households (s_F).

The equilibrium condition in the goods market is given by:

$$\bar{I} = S \qquad (32)$$

Dividing both sides of equation (32) by K, we have:

$$g_K = \sigma \qquad (33)$$

Where $\sigma = \frac{S}{K}$ is savings as a share of the capital stock.

In other words, the goods market is in equilibrium when the rate which entrepreneurs wish to increase the capital stock is equal to the desired savings as a share of the stock of capital.

2.5 Balanced growth in the Kaldorian Model

The fundamental characteristic of the growth models presented in this section is that the economy operates with in the level of capacity utilization desired by entrepreneurs over the balanced growth trajectory. It means that the idle capacity of the economy corresponds to the one planned by firms in the economy. We assume then, in this type of model:

$$u = u^n \qquad (34)$$

Where u^n is the normal degree of utilization of the productive capacity.

The reason for this assumption relies on the fact that fluctuations in sales are not perfectly predictable, with peaks at certain times. Therefore, this degree of excess capacity is necessary for firms to meet unanticipated demand peaks.

The level of capacity utilization is equal to the normal or desired level. Therefore, supply and demand adjust is performed not by changes in the variation of the level of capacity utilization, but by changes in the markup, that is, changes in the relation between costs of production and prices. Facing a fall in the expected demand, firms will reduce the markup, keeping the degree of capacity utilization equal to the normal. Similarly, when facing an anticipated increase in demand, profit margins will increase.

Considering labor cost as the only direct cost of production, the profit margin (*h*), can be expressed as:

$$h = \frac{p - c}{p} = \frac{p - wa_0}{p} = 1 - \frac{w}{p} a_0 \qquad (35)$$

Where *p* is the goods' price, *c* unit cost of production, *w* is the nominal wage rate, $a_0 = \frac{L}{Y}$ is the required unit labor cost, that is, the quantity of labor necessary to produce one unit of output.

Income in this economy is divided between wages and profits:

$$pY = wL + P \qquad (36)$$

Dividing equation (35) by *pY,* we obtain:

$$1 = \frac{w}{p} a_0 + \frac{P}{pY} \qquad (37)$$

The last term of the right side of the equation (37) is ratio between the number of profits and the monetary income of this economy. This ratio is denominated by the share of profits to income. Thus, the other term of the right side of the equation can only be the wage share.

Substituting (35) in (37), we conclude that:

$$h = \frac{P}{pY} \qquad (38)$$

Equation (38) shows that the profit margin of firms determines, on the aggregate, the profit share. Therefore, changes in the profit margin will result in changes in the profit share (and in the wage share) on the aggregate income.

In the Kaldorian growth model, there are no differences between the propensity to save of different households, but only between households (available income) and firms (profits). As presented in the last section, the distinction between propensities to save does not require the existence of a wealthy class of hereditary barons with high propensity to save. The truth is different propensities to save of firms and households depend on the competitive pressure firms face in a market with the presence of dynamics and static economies of scale.

In this sense, the Kaldorian model consists of the following system of equations:

$$g_N = n + \frac{\alpha_0}{\left(1 - \left(a_2 G e^{-\frac{G}{\delta}}\right)\right)} \qquad (16)$$

$$\sigma = \{\varepsilon + (1-\varepsilon)s_F\}huv + s_F(1-h)uv \qquad (31.1)$$

$$u = u^n \qquad (34)$$

$$g_K = g_Y \qquad (14)$$

$$g_Y = g_N \qquad (14.1)$$

$$g_K = \sigma \qquad (33)$$

Assuming, for simplification, that the coefficient of retained earnings is equal to one, the warranted rate of growth is given by:

$$g_w = u^n v(s_F + h(1 - s_F)) \qquad (39)$$

In equation (39), given the normal rate of capacity utilization, the relation of potential output-capital and the propensity to save of households, the warranted rate of growth is an increasing function of the profit share. This results from the fact that the aggregate propensity to save is given by the weighted average of the share of profits, the propensity to save of firms (equal to 1) and the households propensity to save. Therefore, an increase in the share of profits will redistribute income from the sector with a lower propensity to save (households) to the sector with the higher propensity to save (firms). The result is an aggregate increase in the propensity to save and, therefore, in the warranted rate of growth.

In the Kaldorian model, the functional income distribution is the adjustment mechanism between the warranted rate and the natural rate of growth. Substituting (16) in (39) and solving for *h*, we have:

$$h^* = \left(\frac{1}{1 - s_F}\right)\left\{\frac{n}{u^n v} + \frac{\alpha_0}{u^n v\left(1 - \alpha_2 G e^{-\frac{G}{\delta}}\right)}\right\} - \left(\frac{s_F}{1 - s_F}\right) \qquad (40)$$

Equation (40) determines the profit share for which the warranted rate of growth adjusts to the value of the natural rate of growth (figure 1).

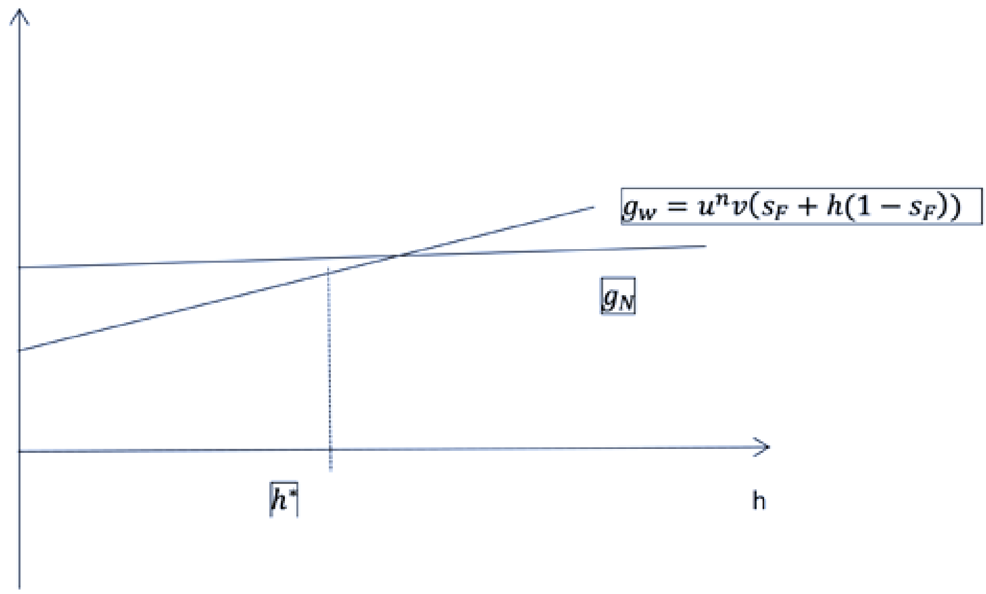

FIGURE 1 - Adjusting mechanism between the warranted rate of growth and the natural rate of growth
Source: Author’s own presentation

An important result of the Kaldorian model is that the functional distribution between wages and profits is a non-linear function of the technology gap. In this sense, it is possible to show that the profit share is an increasing function of the technology gap until it reaches the limit given by the learning capacity of the economy.

As an exemple, consider an economy which the labor force grows at 1.5% a year. Consider the coefficient α_0 which represents the disembodied part of technological progress equal to 0.015. Also suppose that $\alpha_2 = 0{,}9$ and that the parameter δ which represents the technological learning capacity (absorptive capacity) equals to 1,5. Supposing the normal rate of capacity utilization equals to 0.7, and that the potential output-capital is 0.5, and the propensity to save of households is 0.05.

The development of the profit share as a function of the technological gap is displayed in figure 2.

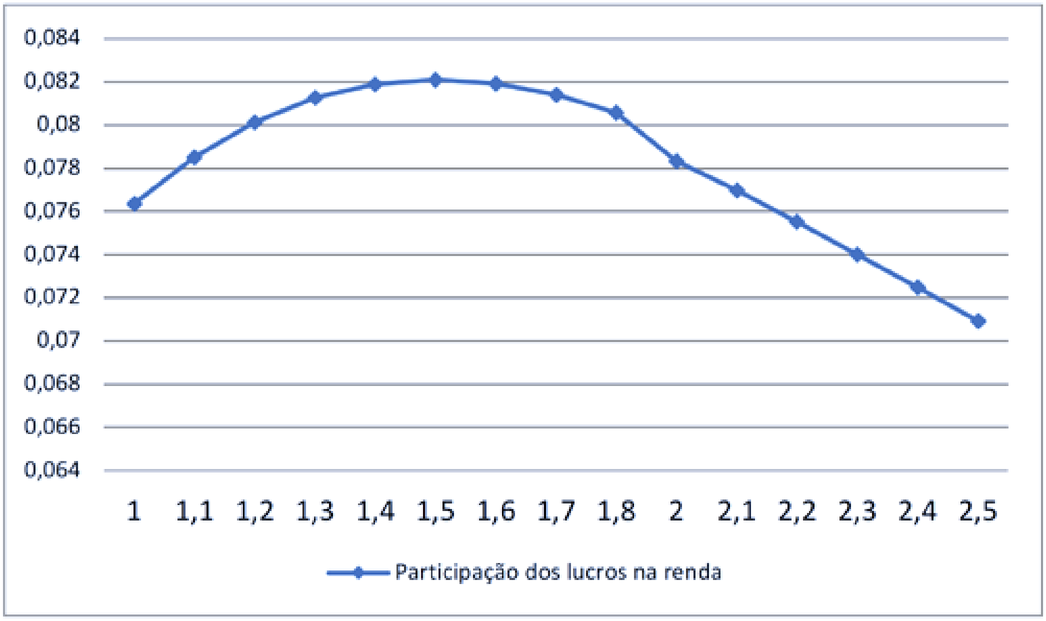

Figure 2 - Share of profits as a function of the technological gap
Source: Authors´ own elaboration

In figure 2, we observe that as the technology gap is reduced, the share of profits initially increases until it reaches a maximum level where the technological gap equals the learning capacity (G= 1,5). From this point the share of profit falls until the technological gap is completely eliminated. This behavior of the profit share is related to the behavior of the natural rate of growth.

In this sense, for values superior to the learning capacity, the natural rate of growth is decreasing function of the technological gap. Thus, a reduction in the gap will increase the natural rate of growth and the growth rate of the capital stock over a balanced growth trajectory. The equilibrium in the goods market requires an increase in savings as a ratio of capital stock which requires a redistribution of income towards the sector with higher propensity to save- that is, firms. For this reason, the profit share should increase in a way to generate the additional savings required for the acceleration of the growth rate.

2.6 Evaluation of the Kaldor-Pasinetti-Verspagen growth models

We proceed now to evaluate the ability of the growth models presented previously to explain the stylized facts observed in the historic development experience of capitalist economies. The essential point is to analyze the compatibility of the models presented and the divergence in the rates of growth of income per capita between countries.

In the models presented in this work, the long-term real rate of growth is determined by the natural rate of growth, which consists in the sum of the growth rate of the labor force and the growth rate of labor productivity. Labor productivity, on the other hand, is a function of the technology gap, that is, the distance between the level of technological knowledge of a country in relation to the technology frontier.

For levels of the technology gap below a certain threshold- which is determined by the capacity to absorb new technologies that the country has-, the rate of growth of labor productivity is a decreasing function of the technology gap, that is, countries relatively more distant from the technology frontier will present higher rates of productivity growth.

This result is compatible with the *catching-up* literature, where within certain limits, countries behind in technological development will present conditions to grow faster than those at the technology frontier. It is a result, up to a point, of the positive overflow of technical knowledge and scientific developments.

In the cases where a country is too distant from the technology frontier, i.e., beyond the threshold of the absorptive capacity of the economy, the country will not be able to benefit from the overflow of technological knowledge. In this scenario, the growth rate of labor productivity is less affected by knowledge overflows. Therefore, a large technology gap is associated with a reduction in the growth rate of productivity, and everything else constant, a reduction in the long-term real rate of output growth.

In this sense, the existence of different levels of technology gaps will lead countries to present different rates of natural growth- and, given the rate of population growth, the growth of output and income *per capita*. It thus follows that in this class of growth models, the divergence between the growth rates of income *per capita* results from technology asymmetries between countries.

3. DEMAND LED GROWTH MODELS WITH UNLIMITED LABOR SUPPLY.[13]

We now proceed to models with unlimited labor supply. Relaxing this assumption is important to reflect economies that have yet to finalize the industrialization process. Therefore, a substantial part of the labor force remains at the subsistence sector, where labor productivity is considerably lower than in the industrial or modern sectors of the economy (Lewis, 1954). In this sense, the subsistence (or traditional) sector works as a reservoir nearly inexhaustible of labor force to the modern industrial sector, which in this case does not face any supply side restriction regarding labor. This can be expanded even for economies which have already completed the industrialization process, but the supply of labor is relatively unlimited as a result of free emigration of workers from abroad.

In economies with unlimited labor supply, the fundamental restriction to long-term economic growth originates from the demand side of the economy. As it is presented throughout this section, investment and technical progress adapt, under certain conditions, to the pace of expansion of autonomous demand in the long term. Therefore, the supply side of the economy is never an obstacle to continuous economic growth.

In open economies, components of autonomous aggregate demand are two: exports and government spending. The long-term economic growth rate is then a weighted average between the growth rate of exports and the growth rate of government spending. In the case of a small open economy without a reserve currency, exports are the only true exogenous variable. In this sense, long term growth is export led.

Therefore per capita growth rate differences observed between economies are essentially a result of differences in the exporting dynamics of the economies. This dynamism depends on two factors related to the productive structure of the economy.

Firstly, the level of productive specialization of a country, that is, the degree in which the productive structure of the economy specializes in the production of few different types of goods. There are at least two distinctive types of productive specialization: economies specialized in exporting primary goods and industrialized or industrializing economies with a diversified productive structure and a complex export basket. Products exported by economies in the first group generally have a lower income elasticity of demand, resulting in non-dynamic exporting patterns. Manufactured products, on the other hand, have a higher income elasticity of demand, resulting in a more dynamic exporting pattern in industrialized countries.

13 This section is based on the presentation of chapter 4 in Oreiro (2016)

A relevant indicator of the level of specialization of an economy is the share of industry in GDP. In this sense, primary exporting economies have a small share of industry to output, with a share of industry usually below 15%. On the other hand, the share of industrial output in industrialized economies is usually between 15% to 40% of GDP. A positive result of industrialization in the long-term rate of growth is increasing the diversification of the productive structure of the economy, leading to a more diversified export basket as well as a more dynamic growth of exports.

The second factor is the technological content of exports, which fundamentally depends on the technology gap, as defined previously. Therefore, the smaller the technology gap, the more technological will the exports be, and in this sense, the higher the income elasticity of demand of its exports.

3.1 Endogeneity of the long-term availability of factors of production

The neoclassical development models assume that the fundamental limit to long term economic growth is the availability of factors of production. Aggregate demand is only relevant in explaining the level of capacity utilization but does not have a direct impact in determining the pace of productive capacity expansion. In the long run, Say's law is valid, and supply determines demand.

Is the availability of factors of production really independent of demand? This question was first put forward by Kaldor (1988) originated the theory of demand-led growth. The basic assumption of these models is that capital goods (factors of production) in modern capitalist economies are produced within the system, by the very own economy. In this sense, the availability of factors of production can never be considered independently of demand. The essential problem lies not on the allocation of given resources among alternative uses, but in the determination of the pace of expansion by which these resources are created.

To understand the endogeneity of the long-term availability of factors of production, we start by analyzing the availability of capital. A given amount of capital at a point in time- the existing productive capacity- is a result of past decision to invest in fixed capital. It follows that the stock of capital is not a constant determined by nature. It depends on the pace which entrepreneurs wish to expand the existing capital stock in the economy.

In this sense, what fundamentally conditions the stock of capital are investment decisions. Investment, on the other hand, depends on two different factors: i) the opportunity cost (largely influenced by central bank's interest rate), and ii) long-term expectations of demand growth. If entrepreneurs anticipate a strong and sustained growth in demand for goods and services- which is expected of an economy facing long term sustained growth- they will conduct large investments in expanding productive capacity.

In other words, investment adjusts to expected demand as long as an essential restriction is fulfilled: expected returns of a capital investment is greater than the cost of capital. Therefore, if the condition is fulfilled, capital availability should not be seen as an obstacle to long term growth.

In fact, the short- and medium-term economic growth cannot exceed the availability of physical capacity to produce. Nevertheless, in the long run, the production capacity can be expanded- by increases in fixed capital investments- to meet aggregate demand for goods and services (Kaldor, 1988, p.157)

A possible rebuttal to this argument is the requirement of prior savings to perform these investments. Meaning that any investment spending requires prior savings in this economy. Neoclassical economists would argue that the availability of capital is limited by the fraction which society is willing to postpone consumption. Savings in this context is defined by private savings (firms and households), government savings and foreign savings.

The relationship between savings and investment is the subject of great debates among Neoclassical and Keynesian economists since the publication of the General Theory of Employment, Interest and Money by John Maynard Keynes.[14] According to Keynes (1936) it is not true that investment requires prior saving. Investment requires only the creation of liquidity in the financial sector. This is referred in the literature as the *finance* motive of money demand (Carvalho, 1992, p.148-153). If banks are willing to extend credit lines- even if with short maturity- at favorable conditions, it will be possible then for firms to initiate implementing investment projects, purchasing machines and equipments. Once investment is performed, new aggregate income will be created in such magnitude, that, at the end of the process, aggregate savings will adjust to the value of investment in fixed capital. Savings thus created can be used for the *funding* of short-term debt of firms and banks. That is, firms will be able to liquidate- by retained earnings, selling shares or bonds in the market- all debt contracted with commercial banks at the moment when they required liquidity to implement new investments. Savings always, in a way, adjust to the level of desired investments by entrepreneurs (Davidson, 1986)[15].

14 About the debate between Keynes and the classics regarding the relationship between saving and investment and the determination of the interest rate is available see Oreiro (2000)

15 It is important to mention that investment determines savings even under full employment. Kaldor (1956) argues that in an economy which operates with full capacity utilization over the long-term growth trajectory, increasing investments will result in higher profit margins, thus in a redistribution of income from workers to capitalists, and as the propensity to save of capitalists is higher than of workers, this will ultimately result in an increase in aggregate savings.

Obstacles for the expansion of the productive capacity are mainly financial. More specifically, they depend on the opportunity cost of capital. Firms will be willing to expand productive capacity according to the expected growth of demand, as long as the expected rate of return of these new investment projects are greater than the opportunity cost of capital. Broadly speaking, we can define the cost of capital as equal to the average interest rate companies pay for funds required to finance their own investment projects. There are three sources for this financing: retained earnings, debt, and equity. The cost of capital is the weighted average of each of these sources of financing.

Regarding the availability of labor force, can it be seen as an obstacle for the growth of production in the long-term? For a series of reasons, rarely the availability of workers can be considered as a limit for economic growth. In the first place, the number of working hours can increase to adjust to the level of production. Secondly, participation rates- defined as the ratio between the labor force and the total population in working age- can increase as a result of a strong labor demand (Thirlwall, 2002, p.86).

In boom periods, the growth rate of labor force participation increases as a result of incentives (higher opportunity cost of leisure) for those not working. Furthermore, population and the labor force are not a given endowment from the viewpoint of a national economy, because an eventual shortage of labor during a boom can be solved by immigration of workers from other regions. For instance, the emigration to France and Germany during the booming years of 1950 and 1960 from countries in the periphery of Europe (Greece, Spain, Portugal, Turkey, and the south of Italy).

The last element to be considered is technical progress. Can the pace of innovation in the economy be considered a restriction to long-term growth? If the rate of technical progress is exogenous, then growth will be constrained by the pace which technology expands. However, technological progress is not exogenous to the economic system. In first place, the pace of introduction of new innovations is largely determined by the pace of capital accumulation- where most of innovations are embodied in new machinery and equipments produced.[16] In this sense, a booming economy will accelerate its rate of capital accumulation, inducing a faster pace of technical progress, thus, a faster rate of growth of labor productivity.

16 This idea was pioneered by Kaldor (1957) through his function of technical progress, which establishes the existence of a structural relationship between the growth rate of output per worker and the growth rate of capital per worker. According to the author, it is not possible to separate the productivity growth that comes from the incorporation of new technologies from that part that results from an increase in capital per worker. This is because most technological innovations that increase labor productivity require the use of a larger volume of capital per worker because they are incorporated into new capital goods

Secondly, the disembodied part of technological progress is associated to the existence of dynamic economies of scale, such as *learning-by-doing*. As a result, this establishes a structural relation between the rate of growth of labor productivity and the rate of growth of production, referred in the literature as the Kaldor-Verdoorn law (León-Ladesma, 2002). An increase in aggregate demand induces an acceleration of growth, which positively affects the rate of growth labor productivity.

As a result, concepts such as potential output and full-employment output, essential parts of the neoclassical approach, are relevant only to the short-run. These concepts ignore the fact that the availability of factors of production and the very pace of technical progress are endogenous variables in the process of economic growth and development.

3.2 Determinants of the long-term economic growth

As described in the last section, if the availability of factors of production is not a long-term constraint on growth, what are the limiting factors? In the long run, the ultimate factor is aggregate demand. If there is demand, firms will respond by increasing production and productive capacity, as long as two conditions are fulfilled: *i)* a sufficiently high rate of return, allowing entrepreneurs to achieve the desired rate of return on capital; *ii)* an effective profit rate greater than the cost of capital. Under these conditions, the rate of real output growth will be determined by the growth rate of the autonomous demand. That is, the share of demand that is independent of the level or the variation of domestic income.

In open economies, the autonomous components of aggregate demand are two: exports and government spending.[17] Investments are not an autonomous component of demand, because the decision to invest in fixed capital is fundamentally determined by entrepreneurial expectations with respect to the level of production and sales, according to the principle of acceleration of investment theory (Harrod, 1939). In other words, investment is not an exogenous variable in the point of view of economic growth because it is induced by the level of growth of income and production. Therefore, long-term economic growth is the weighted average of the rate of growth of exports and the rate of growth of government spending.

17 Deve-se fazer aqui uma distinção importante entre os gastos de consumo corrente do governo e os gastos de investimento. Embora ambos os tipos de dispêndio governamental sejam autônomos com respeito ao nível e/ou a variação da renda corrente, os gastos de investimento do governo geram uma externalidade positiva sobre o investimento privado. Por essa razão, uma política de crescimento baseada na expansão fiscal deverá privilegiar o aumento dos gastos de investimento, em vez do aumento dos gastos de consumo corrente. Sobre os efeitos do investimento público sobre o crescimento de longo prazo, ver Oreiro, Silva e Fortunato (2008).

In a small open economy without a convertible currency, the rate of growth of exports is the only true exogenous source of demand. If the rate of growth of government spending is higher than that of exports, output and income will increase faster than exports. For an economy which the income elasticity of imports greater than one, imports will increase faster than exports, resulting in an increasing trade deficit – which is unsustainable in the long run.

3.2.1. A simple demand-led growth model

We consider now a small open economy producing a homogeneous good, an imperfect substitute for goods produced abroad. The availability of goods in the domestic economy is given by the sum of the local production and the real value of imports. The aggregate demand for goods and services can be divided into two: the first denominated by D, which is constituted by the components of demand which are induced by the level of economic activity. In the economy in question, induced demand is a result of the sum of consumption spending and investment; the second part, A, is composed by the autonomous spending, which independent of the level of economic activity.

The equilibrium condition in the goods market is given by:

$$Y + \theta M = D + A \qquad (41)$$

Where *Y* is the real value of domestic output, θM the real value of imports; $\theta = \frac{EP^*}{P}$ the real exchange rate; *E* the nominal exchange rate; P^* the price of imported goods expressed in currency of the exporter; *P* is the price of domestic goods and *M* the quantity imported.

For simplicity, we assume the validity of the purchasing power parity, where $\theta = 1$.

The source of consumption demand are wages- the propensity to consume out of profits is equal to zero. Income tax rate (τ) is imposed over wages, and income from capital is exempt from taxes. In this way, consumption demand is given by the following equation:

$$C = c_w(1 - \tau)(1 - \pi)Y \qquad (42)$$

Where c_w is the propensity to consume out of wages, π is the share of profits on income;[18]and C is the consumption demand.

18 We will assume that the share of wages (profits) in income is exogenous to the model, being determined at a microeconomic level from the mark-up rate set by companies over the unit cost of production, with a view to

According to Freitas e Serrano (2015), we assume that aggregate investment (*I*) is only performed by the private sector and induced by the level of economic activity.

$$I = hY \qquad (43)$$

Where h is the marginal/average propensity to invest.

Autonomous demand is given by:

$$A = \bar{G} + \bar{X} \qquad (44)$$

Where $\bar{G}$ is the government's real expenditure in consumption, $\bar{X}$ the real value of exports.

Finally, we assume that the quantity imported is entirely determined by the level of economic activity.

$$M = mY \qquad (45)$$

Substituting equation (42) and (45) in (41) and solving for output, we have:

$$Y = \sigma A \qquad (46)$$

Where $\sigma = \frac{1}{s+m-h}$ is the Hicksian Supermultiplier of autonomous spending:

$s = 1 - c_w(1-\tau)(1-\pi)$; $(s+m-h) > 0$.

Taking the differential of (46) and assuming σ constant, we have:

$$dY = \sigma(d\bar{G} + d\bar{X}) \qquad (46.1)$$

Dividing (46.1) by *Y*, we have:

$$g_Y = \alpha g_g + (1-\alpha) g_X \qquad (47)$$

Where $g_Y = \frac{dY}{Y}$ is the real output rate of growth; $\alpha = \frac{\bar{G}}{A}$ is the share of government spending of domestic demand; $g_g = \frac{dG}{G}$ is the growth rate of government spending; and g_X is the rate of growth of exports.

Equation (47) shows that the growth rate of output is the weighted average between the growth rate of government spending and of exports. Therefore, for equation (47) to be sustainable in the long term, it is necessary that the output rate of growth adjust to the level of autonomous demand expansion. The growth rate of capital stock is given by:

determining the sales price of their products. For more details, see chapter 5 of Oreiro's (2016).

$$g_K = \frac{h}{v}u - \delta \quad (48)$$

Where g_K is the rate of growth of capital stock; $v = \frac{K}{Y_p}$ is the ratio capital (*K*)/ potential output (Y_p);[19] $u = \frac{Y}{Y_p}$ is the degree of capacity utilization; and δ is the rate of capital depreciation.

Note that:

$$\dot{u} = u\left(g_y - g_K\right) \quad (49)$$

Substituting (47) and (48) in (49) we have:

$$\hat{u} = \frac{\dot{u}}{u} = \left(\alpha g_g + (1-\alpha)g_X + \delta - \frac{h}{v}u\right) \quad (50)$$

According to Skott (2010), we assume that the rate of growth of capital stock will accelerate (decelerate) if the degree of capacity utilization is above (below) the normal degree of capacity utilization, then we have:

$$\frac{dg_k}{dt} = \mu(u - u_n) \quad (51)$$

Finally, the dynamic of government spending in autonomous demand is given by:

$$\hat{\alpha} = (1-\alpha)\left[g_g - g_X\right] \quad (52)$$

The balanced growth trajectory of this economy requires that $\hat{\alpha} = \frac{dg_k}{dt} = \hat{u} = 0$. From equation (52) we then have:

$$g_g = g_X \quad (53)$$

In other words, a balanced growth trajectory requires the growth of exports to be equal to the growth rate of government spending. As exports is the only truly exogenous component of demand (Thirwall, 2002, p.53)[20], the growth rate of government spending must be taken as an endogenous variable over the balanced growth trajectory.

From equation (51) we have:

$$u = u_n \quad (54)$$

Substituting (52) and (54) in (50), and making $\hat{u} = 0$, we obtain:

$$h = \frac{(g_x + \delta)v}{u_n} \quad (55)$$

19 The potential product is defined as the level of production obtained when companies are operating with a degree of utilization of production capacity equal to normal. So, we get $Y_p = \frac{K}{v}$.
20 In the words of Thirwall (2002, p. 83): "Exports differ from other components of demand (...). Exports are the only true component of demand in an economic system, in the sense of demand emanating from outside the system. This is very important to bear in mind. The major part of consumption and investment demand is dependent on the growth of income itself" (Thirlwall, 2002, p. 83)".

Equation (55) determines the rate of investment compatible with a balanced growth trajectory. The growth rate of productive capacity adjusts to the growth rate of autonomous demand, which is determined by the rate of growth of exports. In this equation we have that an increase in the rate of growth of exports results in an increase in the rate of investment, which is compatible with a balanced growth trajectory.

What is the effect of an increase in the growth rate of exports in the good's market equilibrium? Dividing equation (46) by K. We have:

$$u^n = v\sigma a_K \qquad (56)$$

Where $a_K = \frac{A}{K}$ is the autonomous demand by unit of capital; and $\sigma = \frac{1}{s+m-h}$ is the Hicksian Supermultiplier.

In equation (46), we have that a_K is the only endogenous variable. We can then rewrite the original expression as:

$$a_K = \frac{u^n}{v\sigma} \qquad (57)$$

An increase in the growth rate of exports generates an increase in the rate of investment, as the result shown in equation (55). An increase in the rate of investment, on the other hand, will result in an increase in the Hicksian Supermultiplier, σ. In the transition to the new balanced growth trajectory, the stock of capital will increase faster than autonomous demand, therefore a_K will decrease in order to reach the new level compatible with the investment rate. Consequently, exports have a direct effect not only over aggregate demand, but an indirect effect over investment by allowing this component of demand to growth faster than otherwise possible (Thirwall, 2002, p. 54).

Adjustments in the goods market occur not by means of changes in the utilization capacity, neither by changes in income distribution, but by changes in ratio between autonomous demand and capital stock. This mechanism resembles the Sraffian Supermultiplier closing but relies on totally different hypotheses regarding the dynamics of capital accumulation, income distribution and the role of exports as the dominant element of autonomous demand.

3.3 Export-led growth: the Dixon-Thirlwall model.

The fundamental characteristic of Dixon-Thirlwall growth model is the role of exports for a country without internationally convertible currency. Originally designed to explain trade between regions of the same country and the differences in the rate of growth, it can easily be extended to explaining the differences observed in the growth rates of output among different countries.

The structure of the model consists of the following system of equations:

$$\hat{q}_{i,t} = r_t + \alpha_i \hat{Y}_{i,t-1} \quad (58)$$

$$\hat{p}_{i,t} = \hat{w}_{j,t} - \hat{q}_{i,t} \quad (59)$$

$$\hat{X}_{i,t} = \beta_j(\hat{p}_{w,t} + \hat{e}_t - \hat{p}_{i,t}) + \gamma_i \hat{Y}_{w,t} \quad (60)$$

$$\hat{Y}_{i,t} = \lambda_i \hat{X}_{i,t} \quad (61)$$

Where $\hat{q}_{i,t}$ is the growth rate of labor productivity of the country/region *i* in period *t*; $\hat{Y}_{i,t-1}$ is the rate of growth of real output in country/region *i* in period *t-1;* $\hat{p}_{i,t}$ the price changes in country *i* in period *t*; $\hat{w}_{j,t}$ the growth rate of nominal wages in country *i* in period *t.* $\hat{X}_{i,t}$ is the rate of growth of exports (in quantity) of country *i* in period *t;* $\hat{p}_{w,t}$ the rate of change of prices in the rest of the world; $\hat{e}_t$ is the rate of change of nominal exchange rate in period *t.* $\hat{Y}_{w,t}$ is the rate of output growth in the rest of the world; β_j is the price elasticity of exports; γ_i is the income elasticity of exports; λ_i is the export multiplier.

Equation (58) stablishes the existence of a causal relation between the growth rate of potential output and the growth rate of productivity, i.e., the Kaldor-Verdoorn law. According to the Kaldor-Verdoorn law, an increase in the pace of growth of production, specially of industrial production, is associated with an increase is the pace of growth of labor productivity. This is a result of dynamic economies of scale and the technological progress induced by the expansion of production (Setterfield, 1997, p. 48).

The first source of economies of scale can be traced back to Young (1928), which consists of a higher degree of specialization of workers inside the firm as a result of increases in the level of production, thus resulting in labor productivity increases. The second is pointed by Kaldor (1957), which points to productivity gains resulting from investment in new machinery and equipment, which incorporate new production technologies. In this case the increase in production and sales can induce firms to invest in modernizing of the capital equipment, therefore increasing labor productivity. A third source is emphasized by Schmookler (1966) and refers to the induction of demand to technological innovation, in this sense, an expansion of the level of production and sales results in an increase of labor productivity via incentivizing technological innovation. Finally, Arrow (1962) emphasized the role of dynamic economies of scale, which can result from *learning-by-doing*- by repeating the production process over time, workers gain more knowledge of the production process, which lead to improvements productivity-. In this sense, the faster the pace of expansion of production, the faster the *learning-by-doing* can operate, and the faster will be the increase in labor productivity.

Equation (59) establishes that the rate of change in domestic prices is equal to the rate of growth of nominal wages and the growth rate of labor productivity. This equation, on the other hand, is derived from a mark-up price setting:

$$p_{i,t} = \left(\frac{w_{i,t}}{q_{i,t}}\right)\tau \qquad (62)$$

Where $p_{i,t}$ is the price in country/region *i* in period *t;* $w_{i,t}$ is the nominal wage in country/region *i* in period *t*; $q_{i,t}$ is the labor productivity in country/region *i* at time *t* ; and τ is the mark-up.

In equation (62) we consider that domestic firms operate in markets where monopolist or imperfect competition is present. This means that firms can set prices at a rate which exceeds by a certain margin the direct unitary costs of production- here only the unitary labor cost. The mark-up depends on structural factors, for instance market concentration; barriers to entry of new competition; the degree of differentiation of products- which can be perceived as exogenous to the growth process-. Thus, the mark-up is an exogenous constant.

Equation (60) presents the rate of growth of exports as a function of the change in the real exchange rate $(\hat{p}_{w,t} + \hat{e}_t - \hat{p}_{i,t})$ and of the growth rate in the rest of the world ($\hat{Y}_{w,t}$). This equation comes from the following export function:

$$X_{i,t} = \left(\frac{e_t p_{w,t}}{p_{i,t}}\right)^{\beta_i} \left(Y_{w,t}\right)^{\gamma} \qquad (63)$$

Where $X_{i,t}$ is the quantity exported by country/region *i* in period *t*; e_t is the nominal exchange rate at period *t*; $p_{w,t}$ is the price of goods produced in the rest of the world, measured in local currency in the period *t*; and $Y_{w,t}$ the income of the rest of the world.

Equation (63) tells us that the quantity exported is a function of the real exchange rate $\theta_t = \frac{e_t p_{w,t}}{p_{i,t}}$, of prices of goods produced in the rest of the world in terms of domestic goods, and of the income of the rest of the world.

Equation (61) establishes that the growth rate of output is determined by the rate of growth of autonomous demand, constituted only by exports.

Solving the model, we initially substitute equation (58) in (59), obtaining then:

$$\hat{p}_{i,t} = \widehat{w}_{j,t} - r_t - \alpha_i \hat{Y}_{i,t-1} \qquad (59.1)$$

We follow by substituting equation (59.1) in (60) and obtaining:

$$\hat{X}_{i,t} = \beta_j\left(\hat{p}_{w,t} + \hat{e}_t - \widehat{w}_{j,t} + r_t + \alpha \hat{Y}_{i,t-1}\right) + \gamma_i \hat{Y}_{w,t} \qquad (60.1)$$

Finally, we substitute (60.1) in (61) and after some calculation, we have:

$$\hat{Y}_{i,t} = \lambda_i\beta_i\alpha_i\hat{Y}_{i,t-1} + \lambda_i\beta_i\left(\hat{p}_{w,t} + \hat{e}_t - \widehat{w}_{j,t} + r_t\right) + \lambda_i\gamma_i\hat{Y}_{w,t} \qquad (61.1)$$

Equation (61.1) tells us that the growth rate of output in country/region *i* at time *t* depends on: i) the growth rate observed in the past period; ii) the change in real exchange rate; and iii) the growth rate of income in the rest of the world.

The inflation rate in the rest of the world is determined as a result of the difference between the rate of change of wages and the rate of growth of labor productivity. Assuming a Kaldor-Verdoorn coefficient for the rest of the world as equal to the domestic economy coefficient, we have:

$$\hat{q}_w = r_t + \alpha_w \hat{Y}_{w,t-1} \quad (64)$$

$$\hat{p}_{w,t} = \hat{w}_{w,t} - \hat{q}_{w,t} \quad (65)$$

Substituting (64) in (65), we arrive at the final expression for inflation in the rest of the world:

$$\hat{p}_{w,t} = \hat{w}_{w,t} - r_t - \alpha_w \hat{Y}_{w,t-1} \quad (65.1)$$

Now we substitute (65.1) in (61.1) and obtain the following:

$$\hat{Y}_{i,t} = \lambda_i \beta_i \alpha_i \hat{Y}_{i,t-1} + \lambda_i \beta_i \left(\left(\hat{w}_{w,t} - \hat{w}_{j,t} \right) + \hat{e}_t - \alpha_w \hat{Y}_{w,t-1} \right) + \lambda_i \gamma_i \hat{Y}_{w,t} \quad (61.2)$$

With equation (61.2) we arrive in a conclusion that the growth rate of output of country/region *i* is negatively affected by the wage inflation differential between domestic and foreign inflation, $\left[-\left(\hat{w}_{j,t} - \hat{w}_{w,t} \right) \right] = \left(\hat{w}_{w,t} - \hat{w}_{j,t} \right)$. In other words, if nominal wages are growing faster in the domestic economy than in the rest of the world, the result is the loss of competitivity of the domestic economy. This results from the appreciation of the real exchange rate, which results in a decrease in the growth rate of exports, reducing autonomous demand growth and domestic output.

As argued previously, one of the ways which labor supply can be expanded is by allowing the flow of immigrants. Therefore, it is reasonable to assume that there are no obstacles to the international mobility of labor force. The differential of inflation between the rest of the world and the local economy should equal to zero-that is, wages should grow at the same pace in every country.

According to the original Dixon-Thirlwall model, we assume that the nominal exchange rate is constant over time. The economy operates under a fixed exchange rate. In this way, we arrive at:

$$\hat{Y}_{i,t} = \lambda_i \beta_i \alpha_i \hat{Y}_{i,t-1} + \lambda_i (\gamma_i - \beta_i \alpha_w) \hat{Y}_{w,t} \quad (61.3)$$

Equation (61.3) tells us that the rate of growth of output in country *i* at period *t* depends on the growth rate of previous periods and the growth rate of income in the rest of the world.

In the steady state growth trajectory, growth rates should be constant over time. Therefore, we have $\hat{Y}_{i,t} = \hat{Y}_{i,t-1} = g$ e $\hat{Y}_{w,t} = g_w$. The final equation for the rate of output growth in country/region *I* over the long-term trajectory of stable growth is given by:

$$g = \frac{\lambda_i[\gamma_i - \beta_i\alpha_w]}{(1 - \lambda_i\beta_i\alpha_i)} g_w \qquad (66)$$

Equation (66) shows us that the growth rate of output over the stable trajectory depends on the growth rate of the rest of the world and of the structural parameters of the economy.

For catching-up to happen, it is necessary that $\left(\frac{\lambda_i[\gamma_i - \beta_i\alpha_w]}{(1 - \lambda_i\beta_i\alpha_i)}\right) > 1$. In this way, the following condition should be fulfilled:

$$\gamma_i + \beta_i(\alpha_i - \alpha_w) > \frac{1}{\lambda_i} \qquad (67)$$

Expression (67) shows that the necessary and sufficient condition for the catching-up to happen is that the sum of the price elasticity of exports and the income elasticity of exports, multiplied by the difference between the Kaldor-Verdoorn coefficients of the domestic and rest of the world economies, be higher than the export multiplier.

The degree of productive specialization and technological intensity will be determined if the condition described in (67) is fulfilled or not. As a result, primary exporting economies should present lower values for the income elasticity of exports and the Kaldor-Verdoorn coefficients than in industrialized economies. Therefore, these economies have a higher propensity to show slower economic growth and lagging behind in economic development. On the other hand, industrialized economies that export goods with higher technological intensity will present higher than average economic growth.

An important variable for the long-term economic growth is the Kaldor-Verdoorn coefficient. In equation (66) we find that the higher α_i , the higher will be the growth rate. This results from the fact that a α_i will induce a faster labor productivity growth rate from the output growth rate. Therefore, the higher will be the competitivity of this economy due to dynamic economies of scale.

This induction coefficient depends on the share of industry to output, because manufacturing industry is the core of increasing returns to scale (Thirwall, 2002, p. 41), and the share of industry to output will determine the capacity to generate dynamic and static economies of scale- which are the basis of the Kaldor-Verdoorn law. In this sense, following Botta (2009) and Gabriel, Jayme Júnior e Oreiro (2016), we assume:

$$\alpha_i = \alpha\sigma_i \qquad (68)$$

Where σ_i is the share of manufacturing industry in the output of country *i.*

Substituting (68) in (67) and assuming $\alpha_w = \alpha\sigma_w$, we arrive at following expression:

$$\sigma_i > \sigma_w + \frac{1}{\alpha\beta_i}\left(\frac{1}{\lambda_i} - \gamma_i\right) = \sigma_i^c \qquad (69)$$

Where σ_i^c is the critical value of the share of industry to output of country *i* above which the economy can perform the catching-up with the rest of the world. This critical value may be higher or lower than the share of manufacturing industry in the rest of the world, depending on the term $\left(\frac{1}{\lambda_i} - \gamma_i\right)$ and $\left(\frac{1}{\lambda_i} - \gamma_i\right) > 0$. For catching-up to happen, it is necessary that country *i* has a higher share of industry than the rest of the world, $\sigma_i > \sigma_w$. On the contrary, it is possible for the catching-up to happen even if $\sigma_i < \sigma_w$.

We can conclude then, from the analysis of the Dixit-Thirlwall model, that the long-term growth, although demand-led, its capacity to generate own supply- understood as the principle of effective demand- depends on the structure of the economy. In particular, the share of manufacturing industry to output (which determines the Kaldor-Verdoorn coefficients) and the composition of exports (which determined the income elasticity of exports) are structural parameters and are vital for the viability of a catching-up trajectory. Therefore, the composition of exports is fundamental to establishing the pace of economic growth in demand-led growth models.

4. CONCLUSIONS

In this article were presented the main growth models of Keynesian inspiration to evaluate to which extent these are capable to explain the observed uneven development. These models were classified into two categories: i) growth models with limited supply of labor – more adequate for mature economies and ii) models in which growth is led by aggregate demand – and labor supply can be considered unlimited or perfectly elastic – which are more adequate for dual (in the sense of Lewis, 1954) or industrializing economies.

In the case of economies with a limited labor supply, the growth rate compatible with a balanced growth path is determined by the natural rate. This rate is the sum between the growth rates of labor supply and labor productivity. As technical progress is, to a large extent, embedded in new machinery and equipment, the growth of productivity largely depends upon capital accumulation. Yet, the extent to which a given economy incorporates technical progress is dependent upon the technology gap, which expresses the technology asymmetries between different economies. In this context, different technology gaps are compatible with different rates of productivity growth and, therefore, different balanced growth paths. Which, in turn, reflect in different growth rates between countries.

In the models with unlimited supply of labor, economic growth is, by its turn, determined by the growth of the autonomous component of aggregate demand. More specifically, growth in these economies is determined by the dominant component of autonomous demand, that is, exports. In this context, the investment rate adjusts itself to the growth rate of exports, making that the equilibrium in the goods market is maintained by variations in the ratio between autonomous demand and the capital stock. This adjustment mechanism makes that a normal utilization rate of productive capacity and a functional distribution of income is determined at the micro level by price making decisions and are compatible with the role that aggregate demand has as the engine of long-term economic growth. In this context, uneven development is the result of asymmetries in the productive structure of countries, which are accounted by different shares of manufacture industry in GDP.

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