Determinants of capital accumulation in Latin America

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Abstract

The theoretical model of Bhaduri and Marglin (1990) is one of the most discussed works regarding capital accumulation and functional income distribution. However, their analysis does not include the effects of an economy with government. The aim here is to identify the relationships between capital accumulation, the real exchange rate and the debt-to-GDP ratio, using a modified version of that model. The results of the theoretical model showed that an increase in the debt-to-GDP ratio contributes to a regime of conflict between capitalists and workers. The empirical results for a group of countries in Latin America are consistent with this. Undervaluation of the real exchange rate has a positive influence on capital accumulation. A higher debt-to-GDP ratio has a negative effect.

Keywords

Capital, capital formation, foreign exchange rates, public debt, gross domestic product, income distribution, economic growth, econometric models, Latin America

JEL classification

E12, F31, F43

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[1] The author gratefully acknowledges the financial support received from the National Council for Scientific and Technological Development (CNPq) through a PQ-2 research productivity grant.

I. Introduction

The relationship between capital accumulation and functional income distribution has been studied by several authors, such as Bhaduri and Marglin (1990), Bowles and Boyer (1990), Lima, Sicsú and de Paula (1999), Uemura (2000), Stockhammer and Onaran (2004), Naastepad (2006), Hein and Vogel (2008) and Stockhammer, Onaran and Ederer (2009). "The relationship between growth and income distribution enables identifying economic growth patterns. Thus, if aggregate demand responds positively to a profit share increase in income, it is said that the economy is characterized by a profit-led regime. In situations where aggregate demand responds negatively to a profit share increase in income, the economic growth regime can be characterized as wage-led" (Araújo and Gala, 2012, p. 41).

Depending on the prevailing regime of accumulation, a greater share of wages in income can increase or decrease capital accumulation. Thus, wage variations have a complex and ambiguous influence on the level of production and employment. Wage increases can drive up production costs, causing a decrease in capital accumulation, but they can also expand the purchasing power of workers, leading to an increase in effective demand (Bhaduri and Marglin, 1990; Bowles and Boyer, 1990; Lima, Sicsú and de Paula, 1999; Uemura, 2000; Stockhammer and Onaran, 2004; Naastepad, 2006; Hein and Vogel, 2008; Stockhammer, Onaran and Ederer, 2009).

Bhaduri and Marglin (1990) developed a theoretical model in which capital accumulation is explained by the profit share in income and the level of capacity utilization. This model is usually applied in the context of "neo-Kaleckian" models of growth and functional income distribution, in which the level of the real exchange rate can affect long-term economic growth, owing to the impact this variable has on the functional distribution of income. In fact, if a profit-led accumulation regime prevails, an undervalued real exchange rate causes higher inflation, which in turn leads to a reduction in real wages. This exponentially increases firms' profit margins, encouraging them to increase productive capacity utilization and, consequently, levels of investment (Bhaduri and Marglin, 1990; Blecker, 2011).

Empirical data accumulated in recent years suggests that maintaining the real exchange rate at a competitive and stable level can directly stimulate capital accumulation, mainly in developing countries (Oreiro and de Paula, 2007; Gala, 2008; Razmi, Rapetti and Skott, 2009; Missio, 2012; Rapetti, Skott and Razmi, 2012; Oreiro and Araújo, 2013; Oreiro, Missio and Jayme, 2015). To study the relationship between economic growth, income distribution and the real exchange rate, Missio (2012) and Oreiro and Araújo (2013) developed a non-linear macrodynamic model for an open economy in which investment in fixed capital is assumed to be a function of the profit share of income and the level of capacity utilization, as in Bhaduri and Marglin (1990), but also as a quadratic function of the real exchange rate.

This article aims to contribute to the relevant literature by expanding on the theoretical model of Bhaduri and Marglin (1990) to include the variables "real exchange rate"[2] and "debt-to-GDP ratio" as determinants of capital accumulation. Another intended contribution to the literature is the use of the expanded theoretical model for empirical analysis, based on econometric estimation of the model from data on a group of Latin American countries for the 1990–2014 period.[3]

In this article, the inclusion of the debt-to-GDP ratio is based on the history of the Latin American countries analysed, which tend to face recurrent economic instability, with undesirable political and social repercussions. In some cases, the instability is related to the productive structure and external

[2] Real exchange rate misalignment refers to a situation in which a country's real exchange rate deviates from the notion of an "equilibrium" real exchange rate. The exchange rate is said to be "undervalued" when it is depreciated with respect to the equilibrium and "overvalued" when it is appreciated with respect to the equilibrium. These misalignments are considered to influence economic performance (Razin and Collins, 1997).

[3] Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Mexico, Panama, Paraguay, Peru, the Plurinational State of Bolivia and Uruguay. The selected countries account for around 94% of the GDP of Latin American countries.

economic relations of these countries. Given the constant variations in the prices of primary products on the international market and the inelasticity of demand for those products, countries' capacity to service debts is compromised, giving rise to imbalances and a need for external financing (Munhoz, 2002).

With high levels of public debt, Latin American governments are constrained in terms of monetary policy, leading to higher inflation, lower real wages and, consequently, a smaller share of wages in income. The need to maintain high interest rates creates a situation of macroeconomic instability in the countries, which translates into low rates of capital accumulation and economic growth (Oreiro, Sicsú and de Paula, 2003).

Government financing difficulties increase expectations of default and countries lose the political capacity to make internal economic and financial decisions, leaving them at the mercy of the market and unable to invest or accumulate capital (Hermann, 2002). The reduction in public resources for investment also affects the confidence of private investors, and they are left to hope that at some point governments will increase the tax burden to pay their debts. As a result, private investors do not invest either, which reduces capital accumulation and, consequently, growth of countries' economies.

Regarding the relationship between public debt and the exchange rate, in some cases, the former is linked to the latter. Exchange rate fluctuations will influence the volume and risk of debt and public sector financing needs. Initially, a pattern of exchange rate undervaluation increases the cost of external debt, which is often dollar-denominated (Meurer, Moura and Nunes, 2007).

The theoretical results show that a higher debt-to-GDP ratio contributes to a regime of conflict between capitalists and workers. The empirical results were consistent with the adapted theoretical model. Specifically, it can be observed that greater undervaluation of the real exchange rate, of the profit share in income and of capacity utilization has a positive influence on capital accumulation. A higher debt-to-GDP ratio also has a negative effect on investment.

This article is divided into six sections, including this introduction. The second section describes the basic structure of the theoretical model adapted from that of Bhaduri and Marglin (1990). The third section outlines the development of the adapted model, its implications and theoretical results, and the fourth section details the methodology for the empirical analysis of the adapted model. The fifth section presents and analyses the empirical results obtained, and the sixth section provides the conclusions of the work.

II. Adapting the theoretical model to the determinants of capital accumulation

This section presents the structure of the theoretical model adapted from the original study by Bhaduri and Marglin (1990). The model developed by these authors is based on an economy without government Therefore, in this section, an adapted model will be structured that aims to describe the relationship between real wages and effective demand in a context of distributional conflict for an economy with government.

Aggregate savings (S) are given by:

$$S = S_P + S_G + S_E \tag{1}$$

where S_P is private savings, S_G is government savings and S_E is external savings.

It is assumed that workers consume all their income and that capitalists save a portion s of their untaxed profits. Thus, it is possible to describe the private savings function S_P as follows:

$$S_P = s(1 - \tau)R \tag{2}$$

where s is the propensity to save of capitalists $(0 < s < 1)$, R is the profit of capitalists, and τ is the tax rate on profit $(0 < \tau < 1)$.

Government savings (S_G) are the difference between tax revenues (T) and government expenditure (G):

$$S_G = T - G \tag{3}$$

The government only taxes capitalists by means of a tax rate on profits (τ):

$$T = \tau R \tag{4}$$

In the interest of simplification, government expenditure is assumed to be composed only of amortization of public debt and interest on that debt:

$$G = (\alpha + i)D \tag{5}$$

where α is the amortization rate for public debt $(0 < \alpha < 1)$, i is the interest rate of public debt $(0 < i < 1)$, and D is public debt.

External savings can be written as given by:

$$S_E = \varphi_0 Y - \varphi_1 \theta \tag{6}$$

where Y is national income and θ is the real exchange rate of the economy. Consider that $\varphi_0 > 0$ and $\varphi_1 > 0$.

Substituting equations (2) to (6) in (1) and making some adaptations, the new aggregate savings equation is obtained:

$$S = \Gamma h z - (\alpha + i)\mathcal{S} z + \varphi_0 z - \varphi_1 \theta \tag{7}$$

where $\Gamma = \left[s(1-\tau) + \tau\right]$; $h = R/Y*$ is the share of profits in income; $z = Y/Y*$ is capacity utilization and $\mathcal{S} = D/Y$ is public debt as a proportion of income.[4]

As in Bhaduri and Marglin (1990), the investment function is inferred from the savings function. Thus, the new version of the investment function is:

$$I = I(h, z, \mathcal{S}, \theta) \tag{8}$$

where $I_h > 0$, $I_z > 0$, $I_{\mathcal{S}} < 0$ and $I_\theta > 0$.

A country's debt is generally divided into capital expenditure, interest payments and primary current expenditure. Capital expenditure is considered productive debt and primary current expenditure unproductive debt. Capital expenditure, such as infrastructure investment, increases productivity and promotes economic growth. Unproductive debt, in contrast, does not stimulate a country's growth, and is strictly financial. Throughout the history of Latin American countries, productive debt has represented a small part (around 20%) of total public debt as a proportion of income. Most debt is unproductive and corresponds to primary current expenditure (ECLAC, 2018).

[4] Here, the potential output is normalized, without loss of generality, to make it equal to 1.

The justification for including public debt as a proportion of income in the original investment function is that that the higher debt-to-GDP ratios in Latin American countries tend to reduce capital accumulation (investment) through several channels: they reduce governments' investment capacity and therefore decrease total investment; they increase expectations that tax burdens will increase (to finance the rise in debt), thus discouraging private investors and in turn reducing total investment; they increase perceived country risk among foreign investors, which is detrimental to capital accumulation and economic growth (Meurer, Moura and Nunes, 2007; Oreiro, Sicsú and de Paula, 2003).

With a high debt-to-GDP ratio, monetary policy is dominated by fiscal policy. As a result, inflation tends to remain higher, affecting real wages and reducing the share of wages in income.

Undervaluation of the real exchange rate stimulates net exports, which eases the external constraint and allows countries to benefit from static and dynamic economies of scale (owing to the larger market). These effects increase effective demand and intensify economic growth.

The macroeconomic equilibrium is given by:

$$S = I \tag{9}$$

where aggregate saving *(S)* is equal to the aggregate investment *(I)* of the economy. Based on this equilibrium, the adapted theoretical model can be developed, on the basis of the original model of Bhaduri and Marglin (1990).

III. Developing the adapted theoretical model on the determinants of capital accumulation

This section outlines the development of the theoretical model adapted from the original study by Bhaduri and Marglin (1990) and the results obtained.

Substituting (7) and (8) into (9), it follows that $\Gamma h z - (\alpha + i)\mathcal{S} z + \varphi_0 z - \varphi_1 \theta = I = I(h, z, \mathcal{S}, \theta)$. Therefore, the slope of the IS (investment-saving) curve is:

$$\frac{dz}{dh} = \frac{I_h - \Gamma z}{\Gamma h + \varphi_0 - (\alpha - i)\mathcal{S} - I_z} \lessgtr 0 \tag{10}$$

Analysing the slope of the IS curve, some possible results can be obtained, which are summarized in table 1.

Table 1
Possible slopes of the IS (investment-saving) curve and their conditions

Cases	Slope	Conditions
A	$dz/dh > 0$	$(I_h - sz) > (1 - s)\tau z$ $sh + (1 - s)\tau h + \varphi_0 > (\alpha + i)\mathcal{S} + I_z$
B	$dz/dh > 0$	$(I_h - sz) < (1 - s)\tau z$ $sh + (1 - s)\tau h + \varphi_0 < (\alpha + i)\mathcal{S} + I_z$
C	$dz/dh < 0$	$(I_h - sz) > (1 - s)\tau z$ $sh + (1 - s)\tau h + \varphi_0 < (\alpha + i)\mathcal{S} + I_z$
D	$dz/dh < 0$	$(I_h - sz) < (1 - s)\tau z$ $sh + (1 - s)\tau h + \varphi_0 > (\alpha + i)\mathcal{S} + I_z$

Source: Prepared by the authors, on the basis of the results of this research.

For a positive IS curve as in case A, the sensitivity of investment with respect to the share of profits in income minus aggregate savings relative to potential output, has to be greater than the propensity to consume multiplied by the amount collected as a proportion of potential output; marginal propensity to consume measures how much a person's consumption increases when there is an increase in their disposable income. In addition, the savings of capitalists added to the marginal propensity to consume multiplied by the tax that affects the share of profits in income plus the income elasticity of imports $(sh + (1 - s)\tau h + \varphi_0)$ must be greater than the financial costs of public debt plus the sensitivity of investment to capacity utilization (accelerator effect).

If the sensitivity of investment to the share of profits in income is less than the propensity to consume multiplied by the amount raised as a share of potential output, for the IS curve to maintain a positive slope, the denominator of equation (10) must also change. The expression $sh + (1 - s)\tau h + \varphi_0$ must be less than the financial costs of public debt in relation to GDP plus the sensitivity of investment to the level of capacity utilization, case B.

Cases C and D correspond to a negative IS curve slope. In these cases, the signs of the expressions in the numerator and denominator must be opposite, as shown in table 1.

Also as shown in table 1, the condition for the tax on profit $(0 < \tau < 1)$ to always remain positive is that:

$$\tau^c = \frac{I_h - sz}{(1 - s)z} > 0 \tag{10.1}$$

Upon observing the denominator of equation (10.1), it can be seen that the denominator will always be positive. Thus, for τ^c to be positive, it is necessary that $I_h - s.z > 0$. This expression states that investments should be more sensitive than savings. Investments are assumed to respond relatively more strongly to a change in the profit share than to savings.

Capitalists' profit can be defined as follows: $R/Y* = hz$ It follows that:

$$d\left(R/Y*\right) = dhz + hdz$$

Let it be assumed that profit as a proportion of potential output is constant. Hence:

$$\varepsilon_{zh} = -1 \tag{11}$$

where ε_{zh} is the elasticity of capacity utilization with respect to the share of profits in income.

From the income perspective, the output is given by the sum of capitalists' profit and workers' wages. This means that workers' wages are equal to the total output minus capitalists' profit. It is also known that the share of profits in income equals capitalists' profit divided by the total output. Thus, the profit of capitalists is given by the share of profits in income multiplied by the output. Therefore, workers' wages are given by:

$$W = (1 - h)Y \tag{12}$$

Dividing both sides by $Y*$ and deriving, it follows that:

$$d\left(W/Y*\right) = (1 - h)dz - zdh \tag{13}$$

or equally:

$$\frac{d\left(W/Y*\right)}{dh} = (1 - h)\frac{dz}{dh} - z \tag{13.1}$$

Equation (13.1) can be used to analyse whether the increase in the profit share of income results in a rise or fall in wages as a proportion of potential income. This will depend on the sign of equation (13.1).

There are two possible outcomes: first, if $\left(dz/dh\right) < 0$ occurs, it means that the sensitivity of capacity utilization with respect to the share of profits in income must be negative, which characterizes an accumulation regime of stagnation. With this first possibility, the sensitivity of wages with respect to the share of profits in income is negative, which characterizes a regime of conflict between capitalists and workers.

There is also a second possibility: if the sensitivity of the level of capacity utilization with respect to the share of profits in income is positive $\left(dz/dh\right) > 0$, characterizing an accumulation regime of acceleration. Two cases may arise.

The first case results in a regime of cooperation between capitalists and workers, which occurs when the increase in the share of profits in income causes wages as a proportion of income to rise $\left(\frac{d\left(W/Y*\right)}{dh} > 0\right)$. For this to occur, $dz/dh > z/(1-h)$, which means that the sensitivity of capacity utilization to the share of profits in income has to be greater than the ratio of capacity utilization to the share of wages in income.

If $\left(dz/dh\right) > 0$ occurs, a second case may occur. The result is that the rise in the share of profits in income leads to a decline in wages as a proportion of income $\left(\frac{d\left(W/Y*\right)}{dh} < 0\right)$, which characterizes a regime of conflict between workers and capitalists. For this to happen, it is necessary that $dz/dh < z/(1-h)$. This means that the sensitivity of capacity utilization to the share of profits in income has to be lower than that of capacity utilization to the share of wages in income.

A summary of the possible results is presented in table 2.

Table 2
Possible accumulation regimes

Accumulation regime \ Social regime	Cooperation	Conflict
Acceleration	$\frac{d\left(W/Y*\right)}{dh} > 0$ $\left(dz/dh\right) > 0$	$\frac{d\left(W/Y*\right)}{dh} < 0$ $\left(dz/dh\right) > 0$
Stagnation	$\frac{d\left(W/Y*\right)}{dh} > 0$ $\left(dz/dh\right) < 0$	$\frac{d\left(W/Y*\right)}{dh} < 0$ $\left(dz/dh\right) < 0$

Source: Prepared by the authors, on the basis of the results of this research.

As table 2 shows, in a regime of acceleration, a higher share of profits in income positively affects capacity utilization, this being a profit-led regime (in this case the slope of the IS curve is positive). If in a regime of acceleration, a positive share of profits in income increases the share of wages in income, the social regime is said to be one of cooperation between capitalists and workers. If a higher share of profits in income negatively affects the share of wages in income, the social regime is one of conflict.

When the economy is in an accumulation regime of stagnation, it is understood that a higher share of profits in income negatively affects capacity utilization, as it is a wage-led regime (the slope of the IS curve is negative). In this case, as it is a social regime of cooperation, an increase in the profit share of income positively affects the wage share of income, but in a social regime of conflict, an increase in the profit share of income negatively affects the wage share of income.

1. Equal functional distribution of income

Suppose that capitalists and workers divide income into equal parts. Therefore:

$$h = (1-h) \Rightarrow \frac{h}{(1-h)} = 1$$

As $\frac{dz}{dh} \cdot \frac{h}{z} = -1$, then:

$$-\frac{dz}{dh}\frac{h}{z} = \frac{h}{(1-h)} = 1 \tag{14}$$

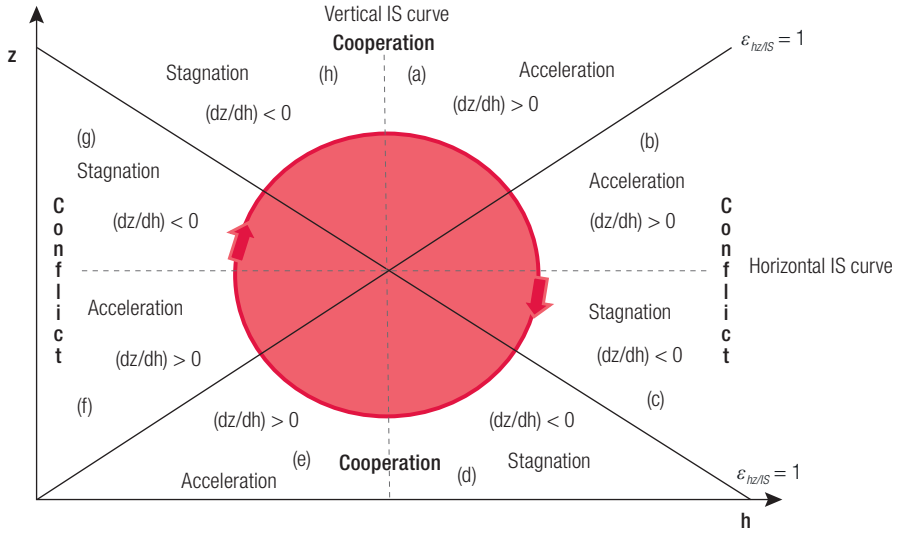
or

$$-\frac{dz}{dh} = \frac{z}{(1-h)} = 1 \tag{14.1}$$

If $\frac{dz}{dh}\frac{h}{z} > \frac{h}{(1-h)}$ occurs, it is a regime of cooperation between capitalists and workers. If $\frac{dz}{dh}\frac{h}{z} < \frac{h}{(1-h)}$ occurs, it is a regime of conflict between capitalists and workers. Under condition (14), a given decrease (increase) in the wage share (profit share) of income sufficiently stimulates demand and capacity utilization to increase aggregate employment and the wage bill. This provides a landscape that favours cooperation between the two classes in the regime of acceleration.

Figure 1 summarizes and presents the possible results of the model, with h on the horizontal scale and z on the vertical scale. For a vertical IS curve, it is necessary that the numerator of equation (10) tends to infinity or that the denominator tends to 0. For a horizontal IS curve, it is necessary that the numerator of equation (10) tends to 0 or that the denominator tends to infinity. A positive slope occurs when elasticity is 1, where an increase of 1 in the wage share of income increases the level of capacity utilization by the same amount. A negative slope occurs when the elasticity of capacity utilization with respect to the share of profits in income is -1, as shown in equation (11).

Figure 1
Zones of cooperation and conflict in the two accumulation regimes



Source: Prepared by the authors, on the basis of A. Bhaduri and S. Marglin "Unemployment and the real wage: the economic basis for contesting political ideologies", *Cambridge Journal of Economics*, vol. 14, No. 4, December, 1990 and adapted to the results of this research.

Equation (13), which provides the necessary support for the conclusions of the model, explains some of the points in figure 1. In zones (a) and (b), there is a regime of acceleration. When approaching an infinite slope of the IS curve, as in (a), $\frac{dz}{dh}$ is very large and greater than $\frac{z}{(1-h)}$. Thus, the derivative $\frac{d\left(W/Y^*\right)}{dh}$ is positive, which characterizes a regime of cooperation, because when the share of profits in income increases, the share of wages in income also increases.

In zone (b), the slope is already close to zero. Thus, while $\frac{dz}{dh}$ is still positive, it is small; thus, it is less than $\frac{z}{(1-h)}$ $\frac{d\left(W/Y^*\right)}{dh}$ and is less than zero and the conflict zone is identified. In zone (c), $\frac{dz}{dh}$ is negative, which leads to the derivative $\frac{d\left(W/Y^*\right)}{dh}$ also being negative.

In zone (e), $\frac{dz}{dh}$ is positive and large, as it is close to the slope of the infinite IS curve. Thus, it can be understood that $\frac{dz}{dh} > \frac{z}{(1-h)}$, which leads to $\frac{d\left(W/Y^*\right)}{dh} > 0$. If the increase in the share of profits in income also increases the share of wages in income, the regime is one of cooperation between capitalists and workers. In zone (f), although it is positive, $\frac{dz}{dh}$ is small, and less than $\frac{z}{(1-h)}$, and thus, $\frac{d\left(W/Y^*\right)}{dh} < 0$, meaning that it is a regime of conflict. Zone (g) has a small negative $\frac{dz}{dh}$, as it is in the stagnation zone and close to the zero slope of the IS curve. Thus, $\frac{d\left(W/Y^*\right)}{dh} < 0$ and the regime is one of conflict.

Another exercise that can be performed using the adapted model is determining the effect of the debt-to-GDP ratio variable on the slope of the IS curve. To do this, it follows that:

$$\frac{\left(dz/dh\right)}{d\mathcal{S}} = \frac{\left(I_h - \Gamma z\right)\left(\alpha + i\right)}{\left[\Gamma h + \varphi_0 - \left(\alpha + i\right)\mathcal{S} - I_z\right]^2} \lesseqgtr 0 \tag{15}$$

It is known that $\Gamma = \left[s\left(1-\tau\right)+\tau\right]$. Thus, if $\left(I_h - \Gamma z\right) > 0$, the derivative $\frac{\left(dz/dh\right)}{d\mathcal{S}} > 0$ and the IS curve become more vertical. If $\left(I_h - \Gamma z\right) < 0$, the derivative $\frac{\left(dz/dh\right)}{d\mathcal{S}} < 0$ and the IS curve become more horizontal. Thus, in an economy with high levels of taxation and capacity utilization, the resulting sign of equation (15) is negative. Indeed, the slope of the IS curve flattens, making it more horizontal and putting the economy closer to a zone of conflict between capitalists and workers (see figure 1).

IV. Methodology

1. Effects of the real exchange rate and public debt on income distribution and economic growth

The core argument of the theoretical model developed in this article is that the exchange rate and the debt-to-GDP ratio are important in explaining capital accumulation, in addition to the variables included in the original theoretical model (the share of profits in income and productive capacity utilization). The empirical model is used to test this argument. Thus, in this section the aim is to empirically test the effect of the real exchange rate and the debt-to-GDP ratio on the new investment function presented in section II that gave rise to equation (8). The function obtained is estimated as:

$$\begin{aligned} g_{it} = \frac{1}{K} = \alpha_0 + \alpha_1 g_{it-1} + \alpha_2 \ln h_{it} + \alpha_3 \ln z_{it} + \alpha_4 \ln \varphi_{it} \\ + \alpha_5 \ln \varphi_{it-1} + \alpha_6 \ln Debt_{it} + \alpha_7 \sum_{j=5}^{K} \beta_j X_{it} + f_i + u_{it} \end{aligned} \tag{16}$$

where $i = 1, ..., 15$ is the number of Latin American countries analysed and $t = 1990, ..., 2014$ the time period analysed; g is a proxy for the rate of capital accumulation; I is gross investment; K is the capital stock; h is the share of profits in income; z is productive capacity utilization; φ is the real exchange rate according to the methodology of Rodrik (2008);[5] $Debt$ is the debt-to-GDP ratio of each country, and u_{it} is the random error term. According to theory, the coefficient of the share of profit in income (α_2) can be positive or negative depending on the prevailing accumulation regime. The productive capacity utilization (α_3) and real exchange rate $(\alpha_4$ and $\alpha_5)$ coefficients should be positive, while the coefficient for the debt-to-GDP ratio (α_6) should be negative.

The dependent variable was included in the empirical model as also determined by its past value in a period. Thus, it is possible to consider the persistence of the dependent variable over time. The same procedure was used by Rapetti, Skott and Razmi (2012), Razmi, Rapetti and Skott (2009), Missio and others (2015) and Gabriel (2016), which characterizes a dynamic panel model.

The vector *"X"* is composed of three control variables, namely: average years of schooling of the population, inflation (annual percentage, based on consumer prices) and government consumption (final consumption expenditure of the public administration as a proportion of GDP).[6] The β_j's are the parameters to be estimated and f_i is a variable that captures the unobserved and fixed characteristics of each country over time.

The definition of the control variables contained in X_{it} was based on the empirical studies on economic growth and the exchange rate by Gala (2008); Rapetti, Skott and Razmi, (2012); Razmi, Rapetti and Skott (2009) and Gabriel (2016).

The control variables can be divided into two groups: structural and macroeconomic. The first group corresponds to variables known in the literature on economic growth and includes proxies for human capital. The second group comprises variables from the more recent literature, which seeks to correlate short-term variables with long-term economic performance, such as inflation and government consumption.

This article uses annual data from 15 countries, relating to the 1990–2014 period, i.e., a total of 375 observations. However, some data are not available for debt-to-GDP ratios and average years of schooling, which makes the panel unbalanced. Two models are estimated in this article. The first contains only the variables of the theoretical model discussed in sections II and III, while the second includes some control variables.

2. Econometric procedures used to analyse the determinants of capital accumulation

The systems of Arellano and Bond (1991) ("Difference GMM"), Arellano and Bover (1995) and Blundell and Bond (1998) ("System GMM") are the most appropriate for estimating the adapted equation in this analysis (equation (8)). The reason for this is the treatment of certain issues inherent to the data, such as the use of the lagged dependent variable as the explanatory variable of the model —as is the case of the capital accumulation rate variable (g_{it-1})— which characterizes a dynamic panel. Another justification for the use of dynamic panel systems is the presence of explanatory variables that are not strictly exogenous or have endogenous characteristics. The variable representing the real exchange

[5] Presented in section IV.3.

[6] The Bhaduri-Marglin model was developed at a stage in the world economy when financialization was in its infancy. Thus, to make the empirical model more current, an indicator of financialization of the economy (constructed using the ratio between total non-monetary financial assets through a proxy of the difference between monetary aggregates M3 and M1 (in dollars) and GDP in constant dollars (2010=100), as suggested by Bruno and others (2011)) was tested as a control variable. However, the results were neither robust nor significant.

rate, φ_{it}, has this characteristic. Theory on the relationship between economic growth and the real exchange rate (Razmi, Rapetti and Skott, 2009; Gala, 2008; Loayza and Fajnzylber, 2005; Missio, 2012; Gabriel, 2016) has shown that the latter variable is contemporaneously associated with the former. In addition, there is a feedback effect, which characterizes simultaneity and, as a result, endogeneity.

To control for endogeneity, the generalized method of moments (GMM) panel methodology needs valid instruments. Otherwise, the efficiency of the estimators may be reduced, the standard errors become larger, and the number of statistically significant coefficients is smaller. As is often the case in empirical macroeconomic research, there are difficulties in obtaining good exogenous regressors. Thus, the chosen methodology will take the lagged in-level and first-difference regressors as instruments for the cases linked to the real exchange rate, as suggested by Arellano and Bover (1995) in another context. Razmi, Rapetti and Skott (2009), Missio (2012) and Gabriel (2016) have used this procedure in matters related to this research.

In the estimator of Arellano and Bond (1991), the "Difference GMM", is used instead of GMM. However, assuming the first differences are uncorrelated with fixed effects allows the introduction of more instruments, improving the efficiency of the estimators, a method called "System GMM", an estimator of Arellano and Bover (1995) and Blundell and Bond (1998), which is an extension of the original model (Roodman, 2009; Gabriel, 2016). As the first differences of the variables may reduce the time period in relation to the number of cross-sectional observations, the system used in this article is that of Arellano and Bover (1995) and Blundell and Bond (1998), which is to say the "System GMM".

3. Construction of the index of undervaluation of Rodrik (2008)

The real exchange rate undervaluation or overvaluation index was constructed following the methodology proposed by Rodrik (2008), which has been frequently used by authors dealing with the subject, such as Araújo (2010), Razmi, Rapetti and Skott (2009), Missio (2012), Missio and others (2015) and Gabriel (2016). Using data from the Penn World Table 9.0, the real exchange rate (RER) with respect to the nominal exchange rate $(XRAT)$ and the purchasing power parity conversion factor (PPP) were constructed. The real exchange rate and the nominal exchange rate are expressed in local currency units per United States dollar.[7]

The exchange rate undervaluation index is essentially a measurement of the misalignment of the real exchange rate with respect to an equilibrium exchange rate, corrected for the Balassa-Samuelson effect, adjusting a real exchange rate to a country's development process. The rapid increase in productivity and the growth of the tradable goods sector, whose prices are determined on the international market, lead to a rise in wages. When this rise spreads throughout the economy, the prices of non-tradable goods also climb, owing to the greater purchasing power of individuals and greater demand for services. Thus, this measure of the real exchange rate adjusts the relative price of tradable goods to that of non-tradable goods.

The real exchange rate undervaluation indicator (φ_{it}) is calculated using three steps. The first step uses countries' nominal exchange rate data $(XRAT_{it})$ and purchasing power parity conversion factors (PPP_{it}) to calculate the real exchange rate (RER_{it}):

$$ln\, RER_{it} = ln\left(XRAT_{it}/PPP_{it}\right) \tag{17}$$

[7] Penn World Table 9.0 provides the variable "nominal exchange rate" (xr, in local currency per dollar) and the variable "GDP price level" (pl_gdpo), which is given by (PPP/XR). Purchasing power parity is the ratio of nominal GDP in local currency to real GDP in constant 2011 dollars. This variable shows how prices differ between countries when converted at the nominal exchange rate (Feenstra, Inklaar and Timmer, 2015).

where index i is the 15 countries in the sample and t is the unit of time, which in this article is 24 years (1990–2014). RER values of more than 1 indicate that the national currency is undervalued with respect to what the purchasing power parity (PPP) suggests.

In the second step, the equilibrium real exchange rate is adjusted for the Balassa-Samuelson effect. Equation (17) must be corrected for differences in factor endowments, with per capita GDP in dollars $(pcGDP)$ as a proxy for this endowment. Thus, in the second step, this effect is taken into account by regressing RER with respect to pcGDP, as given by:

$$ln\, RER_{it} = \alpha + \beta\, ln\left(pcGDP_{it}\right) + f_t + \epsilon_{it} \tag{18}$$

where f_t is the fixed effect per time period and ϵ_{it} is the error term.

When estimating (18) with robust standard errors and correcting for the verified problems of heteroskedastic structure and autocorrelation, the β result is -0.86 $(t = -4.24)$, with a statistically significant p-value of 0.00. This value is different from those found by Razmi, Rapetti and Skott (2009), Missio (2012), Missio and others (2015) and Gabriel (2016). However, all of them worked with advanced, emerging and developing economies, which differs from this analysis, whose data relates to Latin American countries.

In the third step, to determine the φ_{it} indicator of Rodrik (2008), the following equation is used:

$$ln\left(\varphi_{it}\right) = ln\, RER_{it} - ln\, \widehat{RER}_{it} \tag{19}$$

where RER is the real exchange rate constructed in equation (17) and $\widehat{RER}$ is the equilibrium real exchange rate, given by equation (18). When φ_{it} is greater than 1, the real exchange rate means that goods produced in the country are relatively cheaper in dollar terms, which is to say that the exchange rate is undervalued. Conversely, when φ_{it} is less than 1, the real exchange rate is overvalued.

4. Description and sources of data

The data used in this article are from the database of the World Bank (n/d), the world development indicators (WDI) and the Penn World Table (PWT 9.0), in addition to the *Statistical Yearbook for Latin America and the Caribbean* (ECLAC, 2016). The Latin American countries for which the largest possible database existed for the 1990–2014 period were selected. The period ends in 2014 because the data available for construction of the real exchange rate undervaluation index ends in that year.[8]

The countries selected for analysis account for around 94% of the total GDP of Latin America.[9] They are: Argentina (7.7% of GDP), the Bolivarian Republic of Venezuela (7.4%), Brazil (40.9%), Chile (4.3%), Colombia (5.6%), Costa Rica (0.70%), Ecuador (1.4%), El Salvador (0.38%), Honduras (0.29%), Mexico (19.5%), Panama (0.63%), Paraguay (0.39%), Peru (2.9%), the Plurinational State of Bolivia (0.39%) and Uruguay (0.77%). Thus, the panels formed have 15 countries (i) over 25 years (t). Some data, such as those related to the average years of study of the population, are not complete, so the panel is not balanced. Variables with negative values had their values added to a positive constant, so that it was possible to apply the natural logarithm.

Table 3 provide the symbols, descriptions and sources of the variables.

[8] Penn World Table 9.0 data.

[9] Considering the years from 2010 to 2016 and values in constant 2010 dollars.

Table 3
Descriptions and sources of variables used in model estimation

Symbol	Variable description	Source
I	Gross fixed capital formation as a percentage of GDP	World development indicators (WDI)
K	Productive fixed capital endowment. Corresponds to the sum of the endowment in machinery and equipment plus the endowment in non-residential buildings	PWT 9.0
G	Rate of accumulation of productive fixed capital. Corresponds to the proportion of gross fixed capital formation and fixed capital production endowment available in the economy of each country	Prepared by the authors
ϕ	Metric of exchange rate undervaluation or overvaluation according to the methodology of Rodrik (2008)	Prepared by the authors on the basis of PWT 9.0 data
$xrat$	Nominal exchange rate by country measured in United States dollars	PWT 9.0
ppp	Purchasing power parity in relation to each country's GDP (2011=100)	PWT 9.0
rer	Real exchange rate adjusted for purchasing power parity. Based on the methodology of Rodrik (2008)	Prepared by the authors on the basis of PWT 9.0 data
h	Share of profit in income	Tosoni (2017)
Y	Gross domestic product (GDP) in constant dollars (2010=100)	WDI
Y^P	Potential output. Defined as the actual level of output that the economy could generate if it operated at high rates of resource utilization	Aravena (2010)
z	Productive capacity utilization, constructed as Y/Y^P	Prepared by the authors on the basis of data from Aravena (2010) and WDIs
$Debt$	Total central government public debt (domestic and external) as a proportion of GDP of the countries (as a percentage)	CEPALSTAT
$YrsSch$	Average years of schooling of the population	IDB
$GovCons$	Government consumption (general government final consumption expenditure as a proportion of GDP, in percentages)	WDI
$Infla$	Annual inflation rate (based on consumer prices)	WDI

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en; World Bank, World Development Indicators (WDI) [online database] https://datatopics.worldbank.org/world-development-indicators/; University of Groningen, Penn World Table [online database] www.ggdc.net/pwt; Inter-American Development Bank (IDB) [online database] https://data.iadb.org/; C. Aravena, "Estimación del crecimiento potencial de América Latina", *Macroeconomics of Development series*, No. 106 (LC/L.3269-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), December, 2010; D. Rodrik, "The real exchange rate and economic growth", *Brookings Papers on Economic Activity*, vol. 2008, No. 2, 2008 [online] http://muse.jhu.edu/journals/eca/summary/v2008/2008.2.rodrik.html; A. Tosoni, "Distributional Cycles and Economic Growth in Latin America", *Cuadernos de Economía*, vol. 36, No. 72, 2017 [online] http://fce.unal.edu.co/media/files/v36n72a01_Alarco.pdf.

V. Results and analysis

1. Im-Pesaran-Shin and Fisher-ADF (Augmented Dickey-Fuller) unit root tests

The unit root tests of Im, Pesaran and Shin (1997) and the Fisher-ADF version proposed by Maddala and Wu (1999) for panel data were applied in this analysis. These tests are the most commonly used in the literature, with unbalanced panels, as in the case of this article. Table 4 shows the results of the tests performed. All variables were stationary at 1% and 5% significance levels and, thus, all were used in level.

Table 4
Unit root tests (Im-Pesaran-Shin and Fisher-ADF) for panel data, 1990–2014

Variable	Method	Statistic	p-value
lng	Im-Pesaran-Shin -W - stat	-2.7023***	0.0034
	Fisher-ADF χ^2	112.0772***	0.0000
lnφ	Im-Pesaran-Shin -W - stat	-5.4250***	0.0000
	Fisher-ADF χ^2	119.8972***	0.0000
lnh	Im-Pesaran-Shin -W - stat	-2.4594***	0.0070
	Fisher-ADF χ^2	86.2619***	0.0000
lnz	Im-Pesaran-Shin -W - stat	-9.31750***	0.0000
	Fisher-ADF χ^2	282.7014***	0.0000
lnDebt	Im-Pesaran-Shin -W - stat	-2.2287**	0.0409
	Fisher-ADF χ^2	93.7748***	0.0000
lnYrsSch	Im-Pesaran-Shin -W - stat	-1.7862**	0.0370
	Fisher-ADF χ^2	127.9773***	0.0000
lnGovCons	Im-Pesaran-Shin -W - stat	-1.6853**	0.0460
	Fisher-ADF χ^2	123.2229***	0.0000
lnlnfla	Im-Pesaran-Shin -W - stat	-2.2923**	0.0109
	Fisher-ADF χ^2	161.7077***	0.0000

Source: Prepared by the authors, on the basis of the results of this research.
Note: ** Significant at 5% and *** significant at 1%. Tests with time trend and intercept. The lags of the tests were selected according to the Akaike information criterion. The null hypothesis of the Im-Pesaran-Shim and Fisher-ADF χ^2 tests is that the variable contains unit root and the alternative hypothesis is that the variable is stationary.

2. The effects of real exchange rates and public debt on capital accumulation

Section II of this paper presented an adaptation of the original model of Bhaduri and Marglin (1990), addressing the determinants of capital accumulation. This section presents the estimates of this model adapted to a sample of 15 Latin American countries, the results of which are shown in table 5.

Applying the first- and second-order serial correlation test of Arellano and Bond (1991), the null hypothesis of no first-order serial correlation is rejected. However, the hypothesis of no second-order serial correlation is not rejected. The Sargan-Hansen test was applied and the null hypothesis of joint validity of the moment conditions was not rejected. Estimates were performed using system GMM with the robust covariance matrix (*robust vce*).

The coefficient of the lagged capital accumulation rate (g_{t-1}) was positive and significant for the estimates for both model (1) and model (2). Thus, it can be concluded that there is a persistence of capital accumulation over time in the case studied in this paper, as confirmed by previous studies (Rapetti, Skott and Razmi, 2012; Razmi, Rapetti and Skott, 2009; Missio and others 2015; Gabriel, 2016).

The contemporaneous effect of the coefficient of the exchange rate undervaluation or overvaluation variable (φ) was negative and significant for the first estimation. Razmi, Rapetti and Skott (2009) and Gabriel (2016) obtained a similar result. The justification may lie in the fact that, according to Rodrik (2008), undervaluation of the real exchange rate leads to a decline in the share of agriculture in GDP. The countries studied in this study are agro-exporters. Initially, exchange rate undervaluation may cause a decline in the share of agriculture in GDP, hindering the growth of these economies.

Table 5
Dynamic panel estimates of the capital accumulation determination model, system GMM

g	(1)	(2)
lng_{t-1}	0.359***	0.357***
	(0.010)	(0.013)
lnh	0.035*	0.043
	(0.020)	(0.050)
lnz	0.166***	0.205***
	(0.013)	(0.017)
$ln\varphi$	-0.210**	-0.133
	(0.082)	(0.099)
$ln\varphi_{t-1}$	0.224***	0.153*
	(0.076)	(0.090)
$lnDebt$	-0.052***	-0.054**
	(0.169)	(0.023)
$lnYrsSch$		0.194**
		(0.081)
$lnGovCons$		-0.191***
		(0.040)
$lnlnfla$		-0.014*
		(0.007)
Number of observations	324	250
Arellano-Bond test for AR(1) - A	z= -2.805 Prob>z 0.005	z= -2.657 Prob>z 0.007
Arellano-Bond test for AR(2) - A	z= -1.080 Prob>z 0.279	z= -0.672 Prob>z 0.501
Sargan-Hansen test - B	chi2(324)=78.05 Prob>chi2=0.5048	chi2(245)=69.65 Prob>chi2=0.5900

Source: Prepared by the authors, on the basis of the results of this research.
Notes: Terms in parentheses are standard errors; *** significant at 1%. In A, the null hypothesis is that there is no correlation of order "n" in the residuals. In B, the Sargan–Hansen test verifies the validity of the instruments used. The null hypothesis: the instruments are jointly valid.

The effect of real exchange rate undervaluation with a lag was positive and significant for both estimations. This suggests that it takes some time for currency undervaluation to stimulate capital accumulation and, consequently, economic growth in developing countries, a result also found by Razmi, Rapetti and Skott (2009) and Gabriel (2016).[10]

According to Razmi, Rapetti and Skott (2009), with the aforementioned result, "the real exchange rate becomes a critical element of successful development". The authors provide empirical data showing that the effect of exchange rate undervaluation on investment growth is particularly meaningful for developing countries, as can be confirmed in the case of this paper for the Latin American countries analysed.

Based on the relationship between growth and income distribution, it is possible to define patterns of economic growth (Bhaduri and Marglin, 1990; Bowles and Boyer, 1990; Lima, Sicsú and de Paula, 1999). Thus, the results show that the coefficient of the share in profits variable (h) is positive and significant in the estimation performed in model (1). In this case, the economy is said to be characterized by a profit-led accumulation regime (Araújo and Gala, 2012; Oreiro and Araújo, 2013). Thus, a greater share of wages in income tends to decrease capital accumulation. In effect, the increase in wages generates an increase in production costs, which causes a decline in capital accumulation.

[10] The effects of the J-curve indicate that, in the short term, in the event of exchange rate undervaluation, the trade balance deteriorates with respect to the period prior to the shock. However, given the rigidity of the contracts signed by economic agents in foreign trade, the trade balance tends to return to equilibrium in the periods following changes in the exchange rate, which can subsequently lead to economic growth.

However, profit-led accumulation regimes cannot be guaranteed to promote economic growth because, even if profit rates grow, they may not stimulate investment, given other more profitable and low-risk alternatives, such as financial assets.[11] In this article it was not possible to consider the effect of the financialization of Latin American economies on the variable "profit share in income", whose series of values was provided by Tosoni (2017). Nor was it possible to break it down into operating and non-operating profits obtained in the financial market.

The coefficient of capacity utilization (z) was significant and positive in the estimations performed, a result expected based on theory. This occurs when a rise in the ratio of actual output to potential output exerts a positive influence on capital accumulation (Bhaduri and Marglin, 1990; Oreiro and Araújo, 2013).

If the sensitivity of investment to changes in profit margins is high, and if the difference between the propensity to consume of wages and profits is small, the contraction in consumer demand induced by a decline in real wages will be more than offset by the increase in investment demand. This leads to an increase in productive capacity utilization (Oreiro and Araújo, 2013), and as in this article productive capacity utilization is found to have positive effects on capital accumulation, there is a feedback cycle.

The coefficient of the debt-to-GDP ratio variable $(Debt)$ was negative and significant for the cases presented. This shows that the rise in public debt in Latin American countries has hindered capital accumulation and, consequently, economic growth. This is because the pattern of public indebtedness in Latin American countries is largely made up of unproductive and current expenditure (ECLAC, 2018).

The result can also be explained by the fact that with a high debt-to-GDP ratio governments are constrained in conducting monetary policy (Oreiro, Sicsú and de Paula, 2003). The external financing difficulties encountered by governments also increase expectations of debt default (Hermann, 2002), which generates a situation of insecurity. The need to maintain high interest rates and the reduction in public resources for investment also erode the confidence of private investors.

Upon including the control variables, the coefficients of the base model variables remained significant and maintained the same signs as in model (1). The results showed that the coefficient of the average years of schooling $(YrsSch)$ exerts a positive and significant influence on capital accumulation.

The coefficient of the government consumption variable $(GovCons)$ was significant and had a negative sign. This suggests that countries with higher shares of government consumption relative to output have lower rates of growth in capital accumulation and, consequently, lower rates of economic growth.

The coefficient of the inflation variable $(Infla)$, which represents a proxy for economic stability and monetary policy (Gala, 2008), was significant.

VI. Conclusions

The main objective of this study was to add theoretical and empirical elements to the literature that studies the effects of exchange rates and public debt on the growth of economies. To do this, the capital accumulation function commonly used in studies on the relationship between economic growth and income distribution was modified by including the undervaluation index for the real exchange rate and the debt-to-GDP ratio in the investment function.

The conclusion that can be drawn from the adapted theoretical model is that, in an economy with high levels of taxation and capacity utilization, higher debt-to-GDP ratios tend to make the relationship between workers and capitalists more conflictive. Thus, it should be in the interest of governments to reduce debt-to-GDP ratios so that rises in the profit share of income have a less negative influence on the wage share of income. Thus, relations between capitalists and workers would be more amicable.

[11] The authors thank an anonymous consultant for commenting.

Based on the empirical results, it can be concluded that the adapted theoretical model fits well with the reality of Latin American countries for the period from 1990 to 2014. An undervalued real exchange rate exerts a direct and positive influence on capital accumulation. Thus, it is concluded that an undervalued real exchange rate causes a change in the pattern of international insertion, increasing a country's competitiveness. This occurs because a real exchange rate that is undervalued with respect to its equilibrium enables a country to produce new goods or compete in markets that were previously inaccessible for its products.

Since investments are sensitive to increases in the share of profits in income, Latin American economies are in a profit-led regime of accumulation. Thus, a given fall (or rise) in the wage share of income (profit share of income) sufficiently stimulates demand and capacity utilization to increase aggregate employment and the wage bill. Therefore, incentive policies to increase the share of profits in income, such as reducing taxes on profits, should be considered in the pursuit of increasing capital accumulation.

Thus, if a profit-led accumulation regime prevails, an undervalued real exchange rate will lead to a reduction in real wages, which will increasingly push up firms' profit margins, encouraging them to increase productive capacity utilization, and resulting in investment.

It is also concluded that the governments of Latin American countries should attempt to rein in growth in debt-to-GDP ratios. This will result in more freedom to conduct monetary policies and less difficulty in obtaining external financing, meaning that they will be able to improve investors' expectations.

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