Received: August 2019 | Revised: August 2020

DOI: 10.1111/meca.12316

ORIGINAL ARTICLE

METROECONOMICA
INTERNATIONAL REVIEW OF ECONOMICS

WILEY

The La Marca model revisited: Structuralist goodwin cycles with evolutionary supply side and balance of payments constraints

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Abstract

This research is aimed at investigating the causes of volatility that affect middle-income countries by studying the La Marca model. Drawing from the open-economy Goodwin tradition, this model demonstrates that economic activity, income distribution and accumulation of foreign assets dynamically interact, resulting in a pattern of dampened cycles. The study consists in analyzing the characteristics of the model by initially imposing: (I) a constant real exchange rate; (II) a constant net external asset to capital ratio, which is in line with the balance of payments dominance theory and (III) a fixed income distribution. We then (IV) expand the original model by adding an evolutionary supply-side in which productivity is at the center of the economic dynamic through international technology transfer and the Kaldor-Verdoorn effect. The results show that (1) the model always converges. (2) The restrictions (I) and (II) remove the cyclical component of the model, which highlights a central difference between La Marca and the original Goodwin model. (3) Fixed income distribution leads to a monotonic trajectory that reduces oscillations. (4) The inclusion of productivity dynamics generates new sources of volatility in the relationship between productivity, capacity utilization and net external assets and is in line with the structuralist argument of structural fragility.

KEYWORDS
growth cycles, Kaldor-Verdoorn, macroeconomic dynamics, structuralism

JEL CLASSIFICATION
E32; F44; O11; O30

1 | INTRODUCTION

The recurrence of boom-and-bust dynamics in some key economic variables, such as GDP growth, is a persistent problem for many economies, especially developing countries (Koren & Tenreyro, 2007). This volatility has strong impacts on the economic structure, raising uncertainty, fostering productive specialization and increasing the fragility of the economic system (Lavopa & Szirmai, 2018). Stylized facts show that economic volatility has an important regular component in which the literature explains using cycle theories (Korotayev & Tsirel, 2010).

Cliometrics has a long tradition in economic theory. Yet, the existence and determinants of cycles for many economic variables are still open to academic debate. Econometric evidence points to the existence of these cycles in key macroeconomic variables (Korotayev & Tsirel, 2010). The debate surrounding growth cycles is especially important for low- and medium-income countries, in which volatility tends to be higher (Malik & Temple, 2009). Poor countries tend to have repetitive short periods of growth that are succeeded by strong crisis and followed by adjustment periods that *weaken the structure of the economy* (Foster-McGregor, Kaba, & Szirmai, 2015).

There are many economic traditions focusing on discussing, modeling and explaining economic cycles. Schumpeter (1939) worked on technology cycle theory and Goodwin (1967) focused on the growth and distribution cycle model. Both of them proposed to investigate the causes of endogenous volatility. Real business cycle theorists have also been leading the discussion about cycles in a neoclassical perspective (Hartley, Hoover, & Salyer, 1998).

In the Structuralist theory, the role of economic structures is the main underlying aspect that defines the behavior of an economic system (Prebisch, 1950). Productive structure, labor markets, external sectors and institutions define the real economic and development possibilities of a country (Cimoli & Porcile, 2014). The presence of weak economic structures is a central problem in the Latin American Structuralist tradition (Taylor, 1983). This weakness leads to the emergence of high amplitude short-growth cycles and inherent instability (Dutt, 2019).

This paper follows the growth model tradition started by Goodwin (1967), who designed a closed model in which the structure behind the economy defines a growth and distribution pattern that interacts in a cyclical predator-prey dynamic. This model was later developed in a structuralist version by Barbosa-Filho and Taylor (2006). The open economy version of the Goodwin model has been a matter recently brought back to the debate by Pugno (1998), Nishi (2019), Dávila-Fernández and Sordi (2019) and Spinola (2020). La Marca (2010) gave a further contribution, combining the Structuralist Goodwin model with a stock-flow framework by Foley and Taylor (2004).

In this paper, we propose to analyze and expand the La Marca model, observing the growth-cyclical pattern of countries who find themselves in the middle-income trap (Lavopa & Szirmai, 2018). The flexibility of this model allows us to relate economic cycles, external sector and structural elements in an oligopolistic economy and is the reason we selected this specific model. The La Marca

(2010) model can be easily related to the structuralist framework and raises important insights in the debate about structural elements/failures behind developing countries' high economic volatility.

In order to further study this model, we impose some assumptions based on the structuralist theory. We expand the La Marca (2010) model in the following ways:

1. *Study the structure of the La Marca original system*:
   i. Impose a constant real exchange rate.
   ii. Impose constant net foreign assets to capital ratio, which is in line with the balance of payments dominance theory.
   iii. Assume the case in which income distribution is constant. The profit share follows a fixed mark-up level and the wage share is fixed. We analyze the relationship between the evolution of the external account and capacity utilization.
2. *Model a Supply Side structure*
   iv. Define *productivity dynamics* by adding the Kaldor-Verdoorn effect (Kaldor, 1975). Through the learning processes, investments lead to quantitative improvements in the productive structure thereby raising productivity.
   v. Consider the world north-south technology gap dynamic using a center-periphery framework. The north is technologically dynamic while the south lags behind. Internationalized firms from the south that owns external assets (foreign direct investments) have more learning opportunities, adopting technology from abroad, which raises their domestic productivity.

2 | LITERATURE REVIEW

2.1 | Demand side cycles: Richard Goodwin and the Lotka–Volterra cycles

The Lotka–Volterra (LV) is a specific type of dynamic model in which its peculiar specification results in the formation of cyclical solutions. This model creates a Predator-Prey dynamic, which is often applied in ecological studies. It follows a specification in which one variable is the predator and the other is the prey. The LV model can be generalized for n variables (Kolgomorov model) (Gandolfo, 1971). In this case it is possible to have deterministic cycles that fluctuate around the long-run equilibria.

The use of the Lotka–Volterra system in economics can be traced back to the work of Goodwin (1967), who established a model in which economic activity and income distribution interact dynamically. The Goodwin model creates endogenous cycles between the wage share (predator) and employment (prey) and reproduces predator-prey dynamics in a growing closed saving-determined economy. This framework gives rise to many models in which economic activity (effective demand) and income distribution interact.

The Structuralist tradition, which accounts for the role of structural elements underlying the economic system, has made efforts to expand the Goodwin model. Taylor (1983) has formalized and modeled many concepts in Structuralist theory from the Goodwin model. Barbosa-Filho and Taylor (2006) expanded the Goodwin model with Structuralist features by including a dynamic relationship in their model between the wage share and capacity utilization in a demand-driven economy.

More recently, there have been efforts to expand the Goodwin model from a closed economy to an open economy by merging the Goodwin cyclical dynamics with the Balance of Payments Constrained Model (BPCM), which was started by Thirlwall (1979). Pugno (1998) was a pioneer in this debate, even though his model is unable to generate permanent cyclical fluctuations. More recently, Dávila-Fernández and Sordi (2019) and Nishi (2019) have succeeded to extend and empirically test Goodwin's growth cycle to an open economy framework in which the economy fluctuates around the balance of payments constrained equilibrium rate of growth (Dávila-Fernández, 2020).

In a similar tradition, La Marca (2010) developed a model that merges the Structuralist Goodwin system with the Foley and Taylor (2004) model. The latter suggests that heterodox models should use social accounting matrices in order to derive its causal relationship in a stock-flow consistent manner. The Foley and Taylor (2004) model works for an open economy and adds financial elements (equities) to the debate. La Marca (2010) then used the Foley and Taylor (2004) framework to develop an open economy version of the Goodwin model.

2.2 | Supply-side cycles: productivity, Schumpeterian cycles, structural change and catching up

The seminal Goodwin (1967) model traces back to the relationship between income distribution and economic activity, but the supply side plays a passive role. It assumes a Phillips curve to define the relationship between employment and real wages and a Leontief production function with fixed coefficients. Demand determines the adjustment of employment and economic activity through income distribution effects. There are also supply side theories that address economic cycles, including some expansions of the Goodwin model. Some are presented here in this section that are part of the theoretical foundation in our expansion of the La Marca (2010) model.

In mainstream growth theories, there is a central role for productivity in a supply-side driven economic system using the concept of Total Factor Productivity (TFP), which is associated with technological change. Real business cycles considers technological shocks as exogenous and the system reacts by readjusting itself toward the equilibrium point (Plosser, 1989). Business cycles are created by stochastic shocks that converge to a long run equilibrium trajectory. The system dynamic derives its cyclical behavior from these stochastic shocks.

The Evolutionary tradition offers a supply-side perspective focused on the presence of deterministic endogenous cycles. Schumpeter (1939) offered an implicit explanation for the existence of endogenous business cycles focusing on the role of technology, which changes the industrial paradigm through an endogenous mechanism of innovation (Perez, 2010). The economic structures adjust to the new conditions (Nelson & Winter, 1977) and the constant flow of innovation gives rise to cyclical behavior (Silverberg & Verspagen, 1995). This competitive process constantly changes the characteristic of the economic system resulting in big productivity changes.

Shah and Desai (1981) is the most notable model that includes technical change into the Goodwin model, but this has been more recently developed by van der Ploeg (1987), Foley (2003), and Tavani and Zamparelli (2017). Within the Evolutionary economics tradition, a variety of distributive cycle models that includes dynamics of innovation creation and diffusion were developed by Goodwin (1991), Englmann (1994), Silverberg and Verspagen (1995), Fatás-Villafranca, Jarne, and Sánchez-Chóliz (2012), Dosi, Sodini, and Virgillito (2015), among other relevant contributions in this field.

Fragility in terms of a specialized structure and a peripheral external sector position of a developing economy also plays a central role in terms of supply side cyclical behavior. Krugman and Venables (1995) show that multi-sector models in open economies define specialization patterns and fragility of an economic structure. Koren and Tenreyro (2007), Frenkel and Rapetti (2012) and Kaltenbrunner and Painceira (2015) link this external fragility to volatility. Each sector has a different productivity level and the reallocation of resources plays a central role in defining the position of an economy in the international division of labor. The discussion about the emergence of new sectors and reallocation between sectors is also a relevant source of volatility. The Structuralist Theory has important contributions in this regard. Botta (2009) and more recently Cimoli and Porcile (2014) and Porcile and Yajima (2019) develop a toolbox linking a north-south framework, structural change, balance of payments constraints and the technological gap within one model.

The Kaldor-Verdoorn effect (Kaldor, 1975), in which learning-by-doing generates increasing returns (Verdoorn, 2002), is a central concept in this discussion whereby it links economic activity to productivity. This concept has been recently brought back in the literature by numerous authors such as Marconi, de Reis, & de Araújo (2016); Magacho and McCombie (2017) and Romero and Britto (2017).

Another important point in this literature is international technology transfer that contributes to the catching up process (Lee, 2013; Lorentz, Ciarli, Savona, & Valente, 2016). Countries that technologically lag behind have more potential to catch-up to the technology frontier. Nevertheless the learning process is not natural. Technologically backward countries need to build a certain level of domestic capabilities that allow them to learn from abroad (Verspagen, 1991). In this way, they are only able to reach a virtuous catch-up process after creating some baseline conditions to learn and develop.

2.3 | The Thirlwall model and balance of payments dominance

An important source of volatility is related to the role of the external sector in the economic system. In this sense, the nominal exchange rate plays a central role. In this section, we highlight the framework of the Balance of Payments Constrained Model (BPCM).

The Thirlwall (1979) model is, on the one hand, a demand-led model as it ultimately depends on the current account to define long-run growth possibilities. On the other hand, it has a supply side element, as the dynamic behavior of the current account depends on income and price elasticities of imports and exports, which are directly related to the condition of the productive structure and technology. The elasticities have been endogenized by many authors such as Cimoli (1988) and Cimoli and Porcile (2014).

A more radical version of the BPCM is the balance of payments dominance theory (Ocampo, 2011). In this version, countries have their economic growth adjusted by the external sector conditions even in the short-run. The nominal exchange rate adjusts to the level that turns net exports equal to zero (so growth of exports and imports can be the same afterward). The theory is based on the historical observation that the external sector has constrained short-run economic growth in Latin American economies (Bertola & Ocampo, 2012).

3 | THE ORIGINAL LA MARCA (2010) MODEL

3.1 | Wage share distributive equation

Output (X) in this model is divided into the profit share (π), wage share (ψ) and the share of imported intermediate inputs (a) in domestic currency (multiplied by the real exchange rate ξ). In this sense, the sum of the shares is equal to one $\psi + \pi + \xi a = 1$.

From La Marca (2010), the motion equation of the wage share ($\dot{\psi}$) has the following specification:

$$\dot{\psi} = \tau (\psi^* - \psi) \tag{1}$$

In Equation (1), τ represents the speed of adjustment between the equilibrium value of the wage share (ψ^*) and the actual wage share (ψ). The model assumes a linear adjustment process toward the equilibrium point. The equilibrium value of the wage share is defined by a labor discipline real wage (Bowles & Boyer, 1988). The motion equation of the wage share is then:

$$\dot{\psi} = \tau \left[l \exp(1 + ulk) - \psi \right] \tag{2}$$

In which $l = L/X$, where l is the fixed amount of effective labor (L) per unit of product (X). $u = X/K$, in which u is the output (X) to capital (K) ratio used as an index of capacity utilization. $k = K/N$, where k is a constant for the relationship between capital (K) and the employable working population (N).

The equilibrium value of the wage share follows a Phillips curve, in which the employment rate h has a positive relationship to wages. $h = \frac{ulk}{\varepsilon}$ in which ε captures the degree of effort exerted by workers. The wage share equilibrium value (ψ^*) comes from a labor discipline real wage Phillips curve theory. It links the employment and the capacity utilization rate to be consistent with the labor market equilibrium wage share. The profit share and the share of intermediate inputs adjust to the wage share: $\xi = \frac{1-\psi}{a\left(1+\frac{1}{\eta}\right)}$ and $\pi = \frac{1-\psi}{\eta\left(1+\frac{1}{\eta}\right)}$ in which η is the price elasticity of domestic output in the world market.

3.2 | Capacity utilization equation

The capacity utilization moving equation adjusts the goods market through the identity between domestic investment (g), domestic savings (σ) and the sum of those components of the current account that respond to the real exchange rate (z):

$$\dot{u} = \lambda (g + z - \sigma) \tag{3}$$

In Equation (3) λ is the adjustment coefficient of the capacity utilization. g is the domestic investment. According to La Marca (2010), it follows a Keynesian investment function[1] ($g = \alpha\pi u + \gamma$). α is the imported input to output ratio and γ is the exogenous investment component that represent the 'animal spirit' of the capitalists. The variable z is the sum of all of the components of the current account that depend on the exchange rate and σ is the total national savings. The values of z and σ are the exchange rate sensitive elements of the external sector and the total national savings, respectively.[2] A substitution of the variables that define the values of g, z and σ in Equation (3), as originally in La Marca (2010) results in the following equation:

$$\dot{u} = \lambda \left\{ \left[\left(\alpha - s_p\right) \pi - s_h \psi - \xi a \right] u + \gamma + \xi^\eta x + \left(1 - s_p\right) j \xi b \right\} \tag{4}$$

[1]This is one of the most common version of the Keynesian investment function (Bhaduri & Marglin, 1990). We understand that the autonomous component of the animal spirit may raise important remarks, as firms would continue to accumulate capital if utilization is equal to zero ($u = 0$). A non-linear convex function passing from the origin would be the same but would not add much to the model that is not considering extreme low levels of u, which is the case for most middle-income economies.

[2]We have $\sigma = s_h \left[\left(1 - s_b\right) (\pi u + j\xi b) + \psi u \right] - \upsilon (\pi u + j\xi b) + s_b (\pi u + j\xi b)$ and $z = \xi^\eta x + j\xi b - \xi a u$. In which υ is the propensity to consume out of capital gains.

In this equation s_h is the propensity to save of households and s_p is the aggregated weighted propensity to save. x is the export-capital ratio, j is the interest rate and $b = B/K$ is the net foreign assets to capital ratio or the value of foreign assets (B) per unit of capital (K). Capacity utilization evolves consistently with the level of savings, investment, interest payments and net exports. Capacity utilization then adjusts itself to the value that balances the product market.

3.3 | External asset equation

The third dynamic equation relates to the movement in the net foreign assets to capital ratio (b), which comes from the relationship between current account surplus and an increase of claims on the foreign sector:

$$\dot{b} = \frac{1}{\xi}(\sigma - g) - gb \tag{5}$$

Foreign net asset to capital growth depends positively on domestic savings but negatively on the domestic and foreign investments. When substituting σ and g:

$$\dot{b} = \frac{\left(s_p - \alpha\right)\pi u + s_h \psi u - \gamma}{\xi} - \left(g - s_p j\right) b \tag{6}$$

The three motion Equations (2), (4) and (6) form a system of dynamic equations which are the basis of the La Marca baseline model. The trajectory and stability conditions of the system depend on the assumptions regarding the parameter values. La Marca extensively discuss each of the values one by one. The stability conditions are possible to observe through an analysis of the Jacobian (J) of the system in its steady state.

$$J = \begin{bmatrix} \partial\dot{\psi}/\partial\psi & \partial\dot{\psi}/\partial u & 0 \\ \partial\dot{u}/\partial\psi & \partial\dot{u}/\partial u & \partial\dot{u}/\partial b \\ \partial\dot{b}/\partial\psi & \partial\dot{b}/\partial u & \partial\dot{b}/\partial b \end{bmatrix} \tag{7}$$

The motion equation of the wage share does not depend on the net external assets, so $\frac{\partial\dot{\psi}}{\partial b} = 0$. A stable system must have negative eigenvalues in their real part, as we analyze in the next section.

3.4 | Consolidated model, steady state and Jacobian

The La Marca model consists of a system of three dynamic equations. We calculate the steady state and the Jacobian to understand the structural characteristics of the model. In the steady state, we have that $\dot{\psi} = \dot{u} = \dot{b} = 0$. In this sense, the steady state conditions are:

$$\psi^* = l\exp\left(1 + u^* lk\right)$$

$$u^* = -\frac{\left[\gamma + \xi^{*\eta} x + \left(1 - s_p\right) j\xi^* b^*\right]}{\left[\left(\alpha - s_p\right)\pi^* - s_h\psi^* - \xi^* a\right]}$$

$$b^* = \frac{\left(s_p - \alpha\right)\pi^* u^* + s_h \psi^* u^* - \gamma}{\xi^*\left(g^* - s_p j\right)}$$

Being $\xi^* = \frac{1-\psi^*}{a\left(1+\frac{1}{\eta}\right)}$, $\pi^* = \frac{1-\psi^*}{\eta\left(1+\frac{1}{\eta}\right)}$ and $g^* = \alpha\pi u^* + \gamma$. It is possible to prove that the unique equilibrium point is defined and given by $\left(\psi^*, u^*, b^*\right)$. Calculating the Jacobian matrix eq.(7):

$$J = \begin{bmatrix} -\tau & \tau l k \psi & 0 \\ \lambda\left[\frac{\partial \xi}{\partial \psi}\left(\eta \xi^{\eta-1} x - a u\right) - \left(s_p - \alpha\right)\left(\frac{\partial \pi}{\partial \psi}\right) u + \frac{\partial \xi}{\partial \psi}\left(1 - s_p\right) j b - s_h u\right] & -\lambda\left[\left(s_p - \alpha\right)\pi + s_h \psi + \xi a\right] & \lambda\left(1 - s_p\right) j \xi \\ \frac{1}{\xi}\left(\frac{\partial \sigma}{\partial \psi} - \frac{\partial g}{\partial \psi}\right) - \frac{\partial \xi}{\partial \psi}\frac{(\sigma - g)}{\xi^2} - \frac{\partial g}{\partial \psi} b & \frac{1}{\xi}\left[\frac{\partial \sigma}{\partial u} - \frac{\partial g}{\partial u}(1 + \xi b)\right] & -\left(g - s_p j\right) \end{bmatrix}$$

Using the study of the variable signs from the La Marca (2010) model, we end up with the Jacobian results,[3] which would give us the following signs:

$$J = \begin{bmatrix} - & + & 0 \\ - & - & + \\ + & + & - \end{bmatrix}$$

This type of Jacobian gives negative eigenvalues in the real part and a pair of conjugate complex numbers for two eigenvalues showing a cyclical dampened pattern around a stable point. The result is a dynamic adjustment in which there are dampened cycles between capacity utilization and income distribution, as we can see in the simulation in the next section.

3.5 | Calibrations of the La Marca (2010) model

The original model in La Marca (2010) results in a small oscillation dampened cycle configuration. Using the same model structure, we test different parameters to observe how their changes would affect the evolution of the distinct variables of the system. As an exercise, we impose changes in specific variables to observe different adjustments, some with higher cyclical oscillations, as the case below, in which we change the values of l, x, j and s_h:

In the top left of Figure 1, we show the behavior of the wage share over time. The top center of Figure 1 is the capacity utilization rate over time, while the top right is the net external assets to capital ratio over time. Bottom left is the dynamic behavior of the real exchange rate over time. In the bottom center, we see the relationship between the wage share and capacity utilization. Finally, the bottom right is the relationship between net foreign assets to capital ratio and the wage share.

The results show a much stronger oscillation when compared to the original calibration of La Marca (2010), showing clearly the cyclical relationships between (1) wage share and capacity utilization and (2) between wage share and net external assets. The net assets show a peak in the first cycle, but then smooth toward its steady state (which is negative in this case) and also shows cyclical

[3] In which $\frac{\partial \xi}{\partial \psi} = \left[-\frac{1}{a\left(1+\frac{1}{\eta}\right)}\right]$; $\frac{\partial \pi}{\partial \psi} = \left[-\frac{1}{\eta\left(1+\frac{1}{\eta}\right)}\right]$; $\frac{\partial \sigma}{\partial \psi} = \left[s_h u - s_p u \frac{1}{\eta\left(1+\frac{1}{\eta}\right)} - s_p j b \frac{1}{a\left(1+\frac{1}{\eta}\right)}\right]$; $\frac{\partial \sigma}{\partial u} = \left[s_p \frac{1-\psi}{\eta\left(1+\frac{1}{\eta}\right)} + s_h \psi\right]$; and $\frac{\partial g}{\partial \psi} = \left[\frac{-\alpha u}{\eta\left(1+\frac{1}{\eta}\right)}\right]$

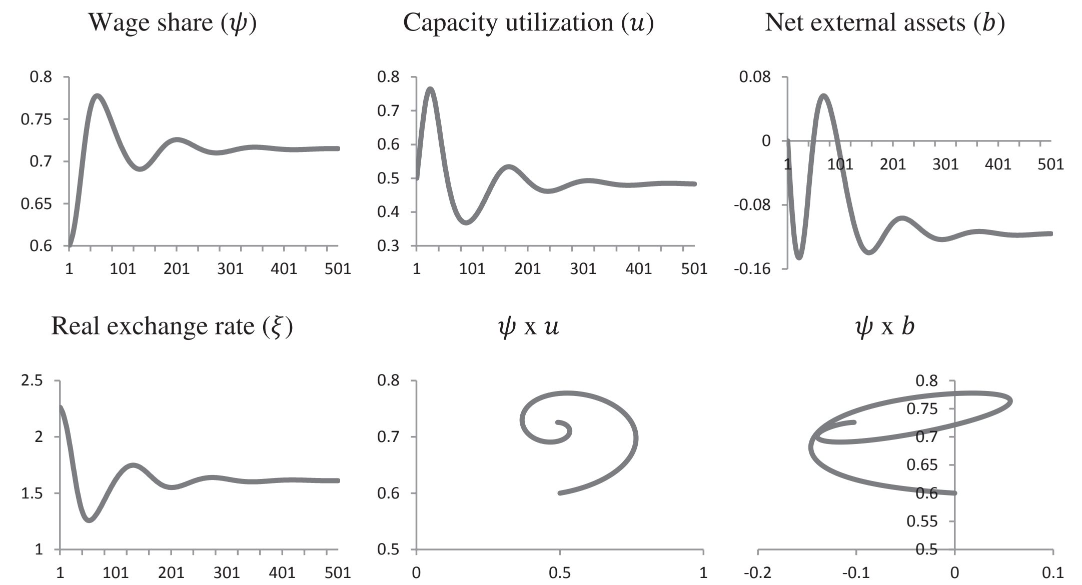

FIGURE 1 Alternative calibration of the La Marca (2010) original model. Parameter Values: $\tau=0.1$, $\lambda=1$, $k=20$, $l=0.01$, $\gamma=0.05$, $\alpha=5$, $\eta=1.3$, $a=0.1$, $x=0.01$, $j=0.1$, $s_b=0.5$, $s_h=0.6$. Initial conditions: $\psi_0=0.6$, $u_0=0.5$, $b_0=0$. Steady state: $\psi=0.71$, $u=0.48$, $b=-0.12$. Eigenvalues: $\lambda_1=-0.12+0.44i$, $\lambda_2=-0.12-0.44i$, $\lambda_3=-0.34 J=\begin{bmatrix} -0.1 & 0.14 & 0 \\ -1.34 & -0.12 & 0.01 \\ 0.91 & 0.09 & -0.33 \end{bmatrix}$

dynamics with the wage share. The real exchange rate follows the opposite of the wage share with an interesting cyclical behavior. Considering the current specification of the model, it is possible to define a dynamic pattern with dampened cycles.

The adjustment process, based on La Marca (2010), can be summarized in the following terms:

3.5.1 | Stagflationary phase

An initial negative shock shifts the variables away from their equilibrium values. There is an excess supply which results in "forced exports." Output and capacity utilization fall to balance supply and demand (domestic plus foreign) at the current real exchange rate. Wage share grows, squeezing profits and appreciating the real exchange rate. The economy slows down and domestic prices increase relative to foreign prices. Competitive exports and net assets revenue decreases, which leads demand to reduce more than supply. Employment then reduces more than its equilibrium value—starting a reversal of wage dynamics.

3.5.2 | Stagnationary phase

Prices slow down, the real exchange rate depreciates, and profits and competitive exports start recovering. Output and wage contraction balances production and demand. Further wage reduction brings the economy to a recovery phase.

3.5.3 | Recovery phase

There is growth in output and capacity utilization. “Forced imports” fill the gap between fast-growth demand and lagged supply. Wages still decline.

3.5.4 | Inflationary boom

Costs raising wages and prices lead to a reduction in profits. The role of the net asset-capital ratio (b) feeds back into the aggregate demand equilibrium as a response to the output-distribution dynamic.

These cyclical dynamics arise from the complex relationships in the model. The growth-distribution dynamic feeds into the evolution of the real exchange rate, international competitiveness and factor payments that combine to generate oscillations in the current account and trade balance.

The adjustment mechanism occurs in many rounds with every round weaker than the previous one. The economy under these conditions suffers from higher volatility and has less capacity to adjust itself from shocks (e.g., external price changes), which is a similar pattern of behavior in a less developed economy. It is relevant to mention that La Marca initially thought the model was applicable for a rapid developing Asian country such as Korea.

The alternative calibration described in Figure 1 generates some interesting dynamics in the model. Despite being an interesting exercise, it uses overly strong assumptions: an unrealistic low labor-output ratio ($l=0.01$), a lower export coefficient ($x=0.01$), a very high return on net foreign assets ($j=0.1$) and higher household savings ($s_H=0.6$). In order to be consistent with the La Marca original model (aimed at a medium income economy) and for the sake of comparison, we return to the original La Marca calibration for the rest of this article. However, the dynamic, despite more graphically visible with the alternative calibration, has the same analytical behavior in terms of dynamic adjustment.

4 | MODEL ANALYSIS AND INITIAL MODIFICATIONS

4.1 | Fixed real exchange rate and fixed net foreign assets to capital ratio

For the case of developing countries, such as Latin America, the external constraint historically played a central role in its economic process. The La Marca (2010) model assumes a constant nominal exchange rate (fixed e). The real exchange rate fluctuates according to the behavior of the terms of trade. In the original La Marca model, the real exchange rate is defined as: $\xi=\frac{e\overline{P}}{P}$. P is the domestic good price, $\overline{P}$ the foreign good price and e the constant nominal exchange rate.

In the Balance of Payments dominance of Ocampo (2011), the equilibrium in the balance of payments should also be valid for the short-run. In this way, the real exchange rate is constant and the nominal one fluctuates in order to create a trajectory in which the net foreign assets to capital ratio[4] (b) tend to a steady state equilibrium in which the growth of exports is equal to the growth of imports. This discussion can be summarized in the assumption that the real exchange rate is constant.[5]

[4]We assume, as implicit in La Marca (2010), p. 142, that under this scenario the value of foreign assets (B) will grow at the same rate as the capital stock (K), so that $\dot{b}=0$.

[5]We would like to keep η exogenous, so we drop the ξ equation. A constant ξ implies that, when $\xi=\frac{1-\psi}{a\left(1+\frac{1}{n}\right)}$, η becomes endogenous if the wage share is allowed to vary which would change the interpretation of the price elasticity, which is not our objective here.

$$\xi = \bar{\xi} \tag{8}$$

$$b = \bar{b} = 0 \tag{9}$$

When considering the Balance of Payments Dominance of Ocampo (2011) in the case of middle-income trapped countries, the balance of payments needs to be balanced even in the short-run.

When adding these elements to the La Marca model, we reach a simpler 2-dimensional system in which growth and distribution variates with a constant real exchange rate.

$$\dot{\psi} = \tau \left[\left(l \exp\left(1 + ulk\right) - \psi \right) \right]$$

$$\dot{u} = \lambda \left\{ \left[\left(\alpha - s_p\right) \pi - s_h \psi - \bar{\xi} a \right] u + \gamma + \bar{\xi}^{\eta} x + \left(1 - s_p\right) j \overline{\xi b} \right\}$$

This completely changes the characteristics and the structure of the model and result in a relationship that is in principle very similar to the one described by Goodwin (1967) between growth and distribution. We can analytically check the impact on the trajectory by looking at the steady state and the Jacobian:

Steady State ($\dot{\psi} = 0$ and $\dot{u} = 0$):

$$\psi^* = \tau \left[\left(l \exp\left(1 + u^* lk\right) \right) \right]$$

$$u^* = \frac{-\left[\gamma + \bar{\xi}^{\eta} x + \left(1 - s_p\right) j \overline{\xi b} \right]}{\lambda \left[\left(\alpha - s_p\right) \pi^* - s_h \psi^* - \bar{\xi} a \right]}$$

For the Jacobian of partial derivatives:

$$J = \begin{bmatrix} -\tau & \tau l^2 k \psi \\ \lambda \left[-\left(s_p - \alpha\right) \left(\frac{\partial \pi}{\partial \psi} \right) u - s_h u \right] & -\lambda \left[\left(s_p - \alpha\right) \pi + s_h \psi + \bar{\xi} a \right] \end{bmatrix}$$

Considering the positive values of τ, l, k, ψ, λ, s_p, s_h, α, u, π, a, $\bar{\xi}$, and $\frac{\partial \pi}{\partial \psi}$, we have the following jacobian:

$$J = \begin{bmatrix} - & + \\ - & - \end{bmatrix}$$

The matrix shows a negative trace and a positive determinant: $Tr\left(J_{\bar{b}}\right) < 0$ and $Det\left(J_{\bar{b}}\right) > 0$. This results in a pair of conjugate eigenvalues with negative real parts and no imaginary parts (monotonic convergence). This shows that the external dynamics is central to explain the presence of cycles in the model, which differentiate La Marca to the closed economy Goodwin seminal model.

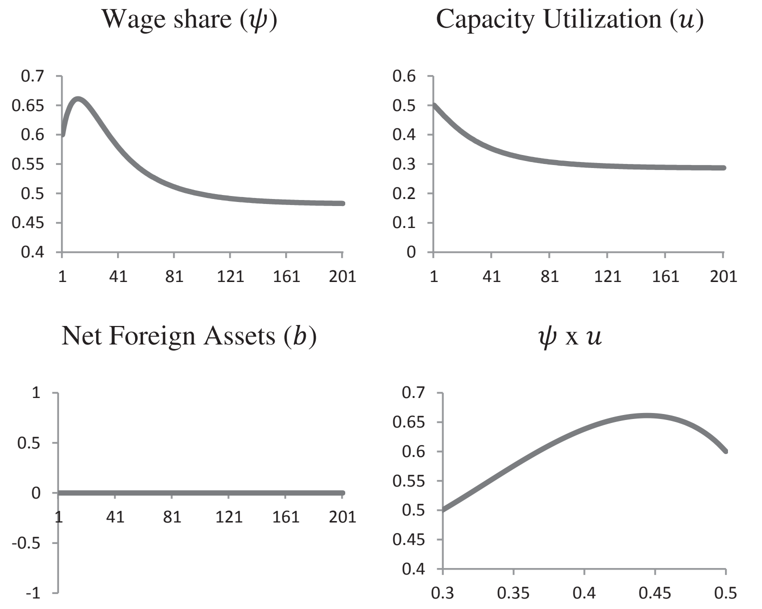

FIGURE 2 Modified La Marca model with $\xi = \overline{\xi}$ and $b = \overline{b}$. Parameter values: $\tau = 1$, $\lambda = 1$, $k = 20$, $l = 0.1$, $\gamma = 0.05$, $\alpha = 0.5$, $\eta = 1.3$, $a = 0.1$, $x = 0.05$, $j = 0.03$, $s_b = 0.5$, $s_h = 0.3$. Initial conditions: $\psi_0 = 0.6$, $u_0 = 0.5$, $b_0 = 0$, $\xi_0 = 0.01$. Steady state: $\psi = 0.47$, $u = 0.28$, b = 0, $\xi = 0.01$. Eigenvalues: $\lambda_1 = -0.91$, $\lambda_2 = -0.26$. $J = \begin{bmatrix} -1.00 & 0.96 \\ -0.06 & -0.18 \end{bmatrix}$

We can simulate the new system using the same values of the original La Marca model in order to show differences in adjustment dynamics when adopting both assumptions, so that the net foreign assets grow at zero rates in the long-run.

The top figures represent the evolution of the wage share and capacity utilization, while the bottom left represents the net exports/capital, respectively, over time. The bottom right figure shows the real the relationship between capacity utilization and the wage share. Figure 2 shows that when we change the exchange rate regime to a flexible nominal exchange rate, this affects the dynamics of the system.

In Figure 2, we use the same calibration values of the original La Marca (2010) model. The system converges (negative eigenvalues in the real part) and shows a small oscillation, but it does not generate cycles anymore (there are no complex eigenvalues). They follow a monotonic convergence to a stable equilibrium point. Variables such as the wage share and the net assets initially increase. Then, they start converging to the steady state. The capacity utilization converges monotonically to the steady state.

The trajectory to the steady state changes from dampened cycles to a monotonic trajectory. This implies that changes in the exchange rate regime remove endogenous oscillations. An external sector policy aimed at avoiding external debt reduces the endogenous pattern of volatility. This result is very much in line with the BPCM and the Balance of Payments Dominance (Ocampo, 2011) theories. A middle-income economy that cannot hold foreign debt in its own currency has its growth constrained by the behavior of its external sector. A direct adjustment to the external sector reduces the endogenous volatility. However, the cost is high in terms of economic activity and distribution. Changes in the exchange rate regime, from fixed to flexible, reduce economic activity and reduces the part of income that goes to wages (the wage share).

This situation is similar to that of many Latin American countries in the 1990s. Taking the case of Brazil as an example, the transition to a fixed nominal exchange rate regime in 1994 resulted in increased real wages, higher wage share and capacity utilization rate. However, the country suffered from pressure from its Balance of Payments (BP) with the fixed nominal exchange rate regime. After the crisis of 1998 and a return to the flexible nominal exchange rate, economic activity and real wages (rise in internal prices and major nominal exchange rate devaluation) were strongly reduced (Carneiro, 2002). The exchange rate regime changes led to lower volatility at the cost of higher inequality and lower growth. This result indicates that the exchange rate policy was not the best development strategy to reduce endogenous volatility.

4.2 | Fixed income distribution

Distribution is a central aspect in the Goodwin tradition of growth models. In this case, we fix the income distribution between profits and wages, removing the Goodwin growth-distribution dynamics, and study the relationship between capacity utilization (economic activity) and the external sector. Considering a monopolistic economy, the profit share of the economy is a function of the mark-up (z), so $\pi = \frac{z}{z+1}$. In this sense, we may fix the profit share ($\pi = \overline{\pi}$) and the wage share ($\psi = \overline{\psi}$).

That would imply that the equations for ψ, π and ξ would completely change, and the fixed income distribution would help us understand the relationship between capacity utilization (u) and balance of payments (b), a central discussion in the BPCM framework.

$$\dot{u} = \lambda \left\{ \left[\left(\alpha - s_p \right) \pi - s_h \psi - \xi a \right] u + \gamma + \xi^{\eta} x + \left(1 - s_p \right) j \xi b \right\}$$

$$\dot{b} = \frac{\left(s_p - \alpha \right) \pi u + s_h \psi u - \gamma}{\xi} - \left(g - s_p j \right) b.$$

When defining the equilibrium conditions ($\dot{u} = \dot{b} = 0$), we then have:

$$u^* = -\frac{\left[\gamma + \xi^{\eta} x + \left(1 - s_p \right) j \xi b^* \right]}{\left[\left(\alpha - s_p \right) \pi - s_h \psi - \xi a \right]}$$

$$b^* = \frac{\left(s_p - \alpha \right) \pi u + s_h \psi u^* - \gamma}{\xi \left(g - s_p j \right)}$$

The Jacobian of partial derivatives is the following:

$$J = \begin{bmatrix} \lambda \left[\left(\alpha - s_p \right) \pi - s_h \psi - \xi a \right] & \lambda \left(1 - s_p \right) j \xi \\ \frac{\left(s_p - \alpha \right) \pi + s_h \psi}{\xi} - b \alpha \pi & s_p j - \alpha \pi u - \gamma \end{bmatrix}$$

Considering the sign value study of the La Marca model, this results in:

$$J = \begin{bmatrix} - & - \\ + & + \end{bmatrix}$$

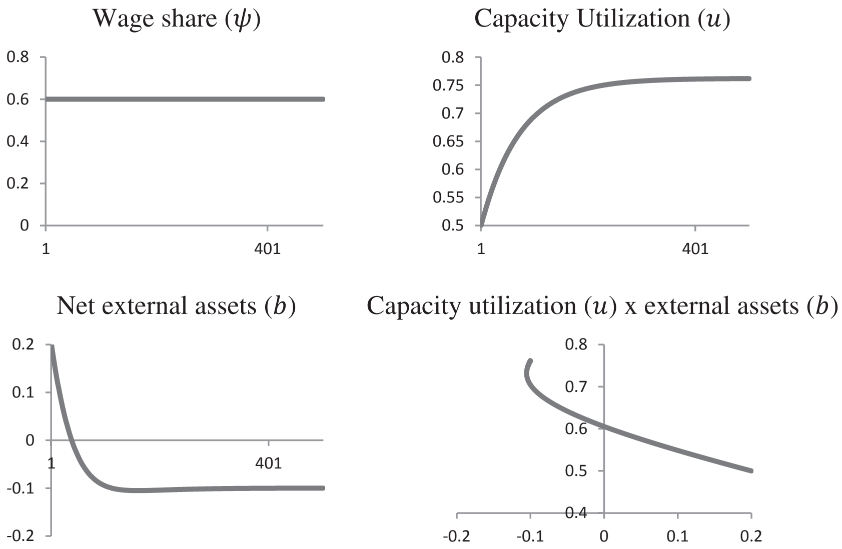

FIGURE 3 Simulation for fixed income distribution ($\dot{\psi} = 0$). Parameter values: $\tau = 1$, $\lambda = 1$, $k = 20$, $l = 0.1$, $\gamma = 0.05$, $\alpha = 1.2$, $\eta = 1.3$, $a = 0.1$, $x = 0.05$, $j = 0.01$, $s_b = 0.5$, $s_h = 0.3$. Initial conditions: $\psi_0 = 0.6$, $u_0 = 0.5$, $b_0 = 0.2$, $\xi_0 = 0.01$. Steady state: $\psi = 0.60$, $u = 0.76$, $b = -0.1$, $\xi = 0.01$. Eigenvalues: $\lambda_1 = -0.31$, $\lambda_2 = -0.13$. $J = \begin{bmatrix} -0.38 & -0.13 \\ 0.32 & 0.05 \end{bmatrix}$

The magnitude of the absolute values of the Jacobian elements defines if the model converges or diverges from the steady state (there is a possibility of divergence), as well as if there is a presence of cycles. Using the original calibration values:

The adjustment process converges to the equilibrium (negative eigenvalues), but it loses cyclical dynamics. The wage share is constant, keeping its initial value and the growth of the net external asset reduces initially, followed by increases when there are changes in the capacity utilization. We observe a monotonic convergence between growth and balance of payments, in which an increase in growth shows a negative correlation with accumulation of external assets.

The presence of fixed income distribution removes the cyclical component from the model. The source of endogenous oscillation disappears when we fix income distribution (which is a strong assumption). Without any expansion to the system, changes in the income distribution are shown as a central element in structural volatility.

In this section, we analyzed the structure of the original La Marca (2010) model and observed how it may lose its cyclical dynamics under specific restrictions. In the following section, we expand the original model and add a supply side dynamic in a similar spirit as in the literature presented in Sections 2.2 and 2.3 (Figure 3).

5 | MODEL EXPANSION

The scope of this model expansion is to change the focus of the original model to the behavior of economies trapped in the middle income. The middle-income trap (Lavopa & Szirmai, 2018) is a concept that highlights how countries may not advance economically above certain levels because their competitiveness in manufactured export goods is reduced by rising wages (Glawe & Wagner, 2016). The idea of the existence of a middle-income trap has been debated in the literature (Felipe, Kumar, &

Galope, 2017). We understand the development trap in the context of Latin America, in which stagnation has been the norm in the past few decades.

5.1 | Productivity dynamics

Following the theoretical debate in the literature review, we expand the La Marca (2010) model by adding productivity dynamics that incorporates the role of the supply side as a central aspect of the model. We implement this using the Kaldor-Verdoorn effect (Kaldor, 1975). This effect incorporates learning by doing, which allows the occurrence of increasing returns to scale. In this sense, an increase in demand, either by a growth in output ($\dot{X}$) or in investment (g), results in a rise in productivity. It is important to mention that the lack of investment in manufacturing tends to reduce innovation, technological progress and diversification, negatively affecting long-run development.

Productivity (δ) is given by $\delta = \varepsilon / l$. The work effort (ε) will be kept stable, but the effective labor per unit of product (l) is endogenized. The Kaldor-Verdoorn effect relates investment and productivity, so:$\delta = f(g)$, $d\delta / dg > 0$ and $dl/dg < 0$. In this sense, investment growth leads to a reduction of the effective labor per product (L/X) and increases productivity. This is a central element in the Kaldorian literature, in which higher demand creates learning opportunities, resulting in higher productivity, which has been empirically studied and tested for many developing countries (Marconi et al., 2016; Romero & Britto, 2017).

In addition to that, we consider an additional assumption—foreign investments in the form of foreign bonds are related to productive assets and investments in foreign companies (foreign direct investment). The accumulation of external assets generates positive technological spillovers (θ) in terms of productivity to domestic firms as a result of the internationalization of domestic firms (Merino, 2012) that generate higher learning opportunities. Technology transfer is a fundamental aspect to understand the relationship between developed north and developing south and is marked by the presence of a technology gap (Cimoli, 1988; Cimoli & Porcile, 2014; Verspagen, 1991). Domestic firms become more competitive as they learn from the activities of their subsidiaries located abroad. Technology transfer to the domestic economy has a positive effect on domestic firms' productivity. We assume this also raises average country productivity. Considering this assumption and using a linear equation for the variation of the labor-output ratio (l), we have:

$$\dot{l} = \rho g + \theta b + \phi l \tag{10}$$

ρ represents the learning-by-doing Kaldor-Verdoorn effect, and θ captures the technological transfer from foreign firms to domestic firms. ϕ is the decreasing effect of the level of labor output. Because l is seen as inverse productivity, we have that $\rho = d\dot{l}/dg < 0$. Increases in demand generate investments in the sectors an economy currently produces, leading to learning by doing and increases in labor productivity (reducing the labor-output ratio). Also, $\theta = d\dot{l}/db < 0$, which is generated by the positive effects of firm internationalization in productivity (Merino, 2012); and $\phi = d\dot{l}/dl < 0$, since there is a decreasing return to increases in productivity. The option for a linear equation is a matter of simplification.

After implementing this addition, the new dynamic system can be presented as the following:

$$\dot{\psi} = \tau \left[(l \ \exp(1 + ulk) - \psi) \right]$$

$$\dot{u} = \lambda \left\{ \left[\left(\alpha - s_p \right) \pi - s_h \psi - \xi a \right] u + \gamma + \xi^{\eta} x + \left(1 - s_p \right) j \xi b \right\}$$

$$\dot{b} = \frac{\left(s_p - \alpha\right)\pi u + s_h \psi u - \gamma}{\xi} - \left(g - s_p j\right) b$$

$$\dot{l} = \rho g + \theta b + \phi l$$

In the steady state ($\dot{\psi} = \dot{u} = \dot{b} = \dot{l} = 0$), we have:

$$\psi^* = l^* \exp\left(1 + u^* l^* k\right)$$

$$u^* = -\frac{\left[\gamma + \xi^{*\eta} x + \left(1 - s_p\right) j \xi^* b^*\right]}{\left[\left(\alpha - s_p\right)\pi^* - s_h \psi^* - \xi^* a\right]}$$

$$b^* = \frac{\left(s_p - \alpha\right)\pi u^* + s_h \psi u^* - \gamma}{\xi^* \left(g^* - s_p j\right)}$$

$$l^* = -\frac{\theta b^* + \rho g^*}{\phi}$$

Considering the derivatives in the original La Marca defining the first three rows and three columns, the expansion of the Jacobian adds the partial derivatives for l:

$$J = \begin{bmatrix} \partial\dot{\psi}/\partial\psi & \partial\dot{\psi}/\partial u & \partial\dot{\psi}/\partial b & \partial\dot{\psi}/\partial l \\ \partial\dot{u}/\partial\psi & \partial\dot{u}/\partial u & \partial\dot{u}/\partial b & \partial\dot{u}/\partial l \\ \partial\dot{b}/\partial\psi & \partial\dot{b}/\partial u & \partial\dot{b}/\partial b & \partial\dot{b}/\partial l \\ \partial\dot{l}/\partial\psi & \partial\dot{l}/\partial u & \partial\dot{l}/\partial b & \partial\dot{l}/\partial l \end{bmatrix}$$

Observing the signs, based on the La Marca (2010) and on our expansion, gives us the following Jacobian:

$$J = \begin{bmatrix} - & + & 0 & + \\ - & - & + & 0 \\ + & + & - & 0 \\ - & + & - & - \end{bmatrix}$$

The stability conditions (Gandolfo, 1971) can be observed using the Routh–Hurwitz condition. Applying the Routh–Hurwitz condition, we can our model converges or not. Using the Lyapunov coefficient, we see the presence of dampened cycles in the model. We can also observe these same results using the simulations below, in which we find eigenvalues with a negative real part and a pair of conjugate imaginary values.

The addition of productivity dynamics, which is a structural element of an economic system, results in the emergence of other sources of oscillatory behavior. All variables in the system have cycles, not only the ones related to growth and distribution, as in the original Goodwin model. We can analyze this observing the pairwise relationship between the variables. This situation brings another element to discuss the role of foreign sector adjustments. Balance of payments adjustments now cyclically converge to a stable point. This expansion opens the door to debate how cyclical aspects are related to economic structures and advances the structural cycles that Taylor (1983) initially developed.

Decomposing the system in pairwise effects results in the following structure[6]:

$J_{\psi,u} = \begin{bmatrix} - & + \\ - & - \end{bmatrix}$ Cycles (Goodwin)	$J_{u,b} = \begin{bmatrix} - & + \\ + & - \end{bmatrix}$ Monotonic convergence
$J_{\psi b} = \begin{bmatrix} - & 0 \\ + & - \end{bmatrix}$ Cycles (conditional)	$J_{u,l} = \begin{bmatrix} - & 0 \\ + & - \end{bmatrix}$ Cycles (conditional)
$J_{\psi l} = \begin{bmatrix} - & + \\ + & - \end{bmatrix}$ Monotonic Convergence	$J_{b,l} = \begin{bmatrix} - & 0 \\ - & - \end{bmatrix}$ Cycles (conditional)

We observe the possibility of cycles emerging from the following relationships: (1) wage share and capacity utilization (Goodwin); (2) wage share and net foreign assets; (3) capacity utilization and productivity; (4) net foreign assets and productivity. The first two effects have already been discussed in the original model, so we briefly focus on the latter two cyclical elements.

5.1.1 | Capacity utilization and productivity

Initially, this relationship is thought in terms of increasing returns brought by the Kaldor-Verdoorn law. Increases in economic activity have positive effects on productivity. What we observe in our dynamic system is that the relationship between capacity utilization and productivity has a cyclical aspect.

Higher productivity counter-balances the effects of capacity utilization in the sense that the same output can be produced with a smaller rate of capacity. We initially observe an increase in output that raises productivity. This rise in productivity pressures a virtuous reduction of capacity as output increases given higher labor productivity. This behavior ends ups resulting in a cyclical adjustment toward the equilibrium value. This mechanism has been explained in detail by Rezai (2012).

5.1.2 | Net foreign assets and productivity

A second element of the expansion is the relationship between the accumulation of net foreign assets and productivity. As discussed in eq.(10), the accumulation of external assets through FDI

[6]In this part, we assume that all variables are constant, but the pairwise ones studied. We can then find the Jacobian related only to the two variables in question, which are represented as the subscript of *J*

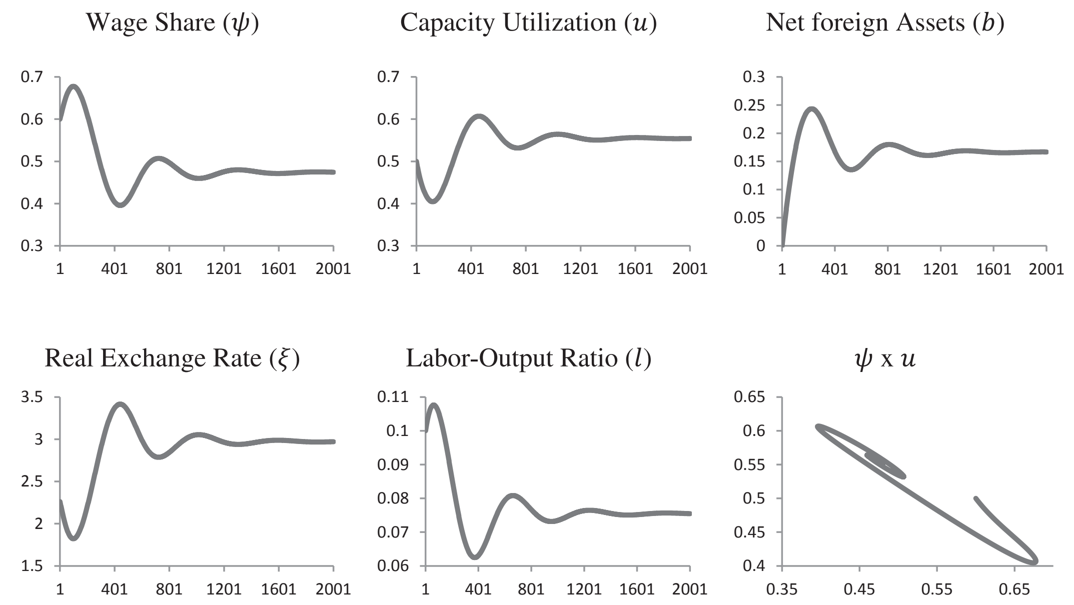

FIGURE 4 Simulation 1 - Modified model with productivity dynamics, original calibration. Parameter values: $\tau = 0.1$, $\lambda = 1$, $k = 20$, $l = 0.1$, $\gamma = 0.05$, $\alpha = 0.5$, $\eta = 1.3$, $a = 0.1$, $x = 0.05$, $j = 0.03$, $s_b = 0.5$, $s_h = 0.3$, $\rho = -0.03$, $\theta = -0.02$, $\phi = -0.001$. Initial conditions: $\psi_0 = 0.6$, $u_0 = 0.5$, $b_0 = 0$, $l = 0.1$. Steady state: $\psi = 0.47$, $u = 0.55$, $b = 0.16, l = 0.09$. Eigenvalues: $\lambda_1 = -0.029 + 0.108i$, $\lambda_2 = -0.029 - 0.108i$, $\lambda_3 = -0.413$, $\lambda_4 = -0.029 - 0108i$.

$$J = \begin{bmatrix} -0.100 & 0.071 & 0 & 1.153 \\ -0.338 & -0.471 & 0.032 & 0 \\ 0.094 & 0.04 & -0.094 & 0 \\ -0.003 & 0.003 & -0.02 & -0.001 \end{bmatrix}$$

internationalization lets domestic firms learn from foreign activities (Merino, 2012), which raises their productivity. This is related to the positive effects of internationalization. In dynamic terms, we see that a *cyclical aspect emerges from a counterbalancing effect* to this productivity increase process. One way to explain this cyclical behavior is related to two possible counterbalancing effects to the aforementioned internationalization process. First, more productive firms from developing countries, which consist of those that implement foreign FDI (the internationalized ones), become more attractive to be acquired by large companies in the developed world—this is also called denationalization, which was a very common process during the 1990s in Latin America (Bertola & Ocampo, 2012; Carneiro, 2002). Second, firms in developing countries find a barrier to their growth in productivity from technology transfer (Bell & Pavitt, 1992; Cimoli & Porcile, 2014; Verspagen, 1991). As this transfer is not an automatic movement, these companies manage to catch-up until a certain point in which they stagnate, as companies in the developed world continue with their innovative virtuous strategies at the global level, which increases the technology gap. These two elements result in the oscillatory dynamic between productivity and the accumulation of foreign assets. Firms in developing economies grow and internationalize, which increases learning and productivity. However, the most productive developing firms become more interesting to be acquired by big transnational companies and the learning process has its limits.

These elements dynamically counterbalance dynamically the effects of increases in productivity that generates this oscillatory behavior.

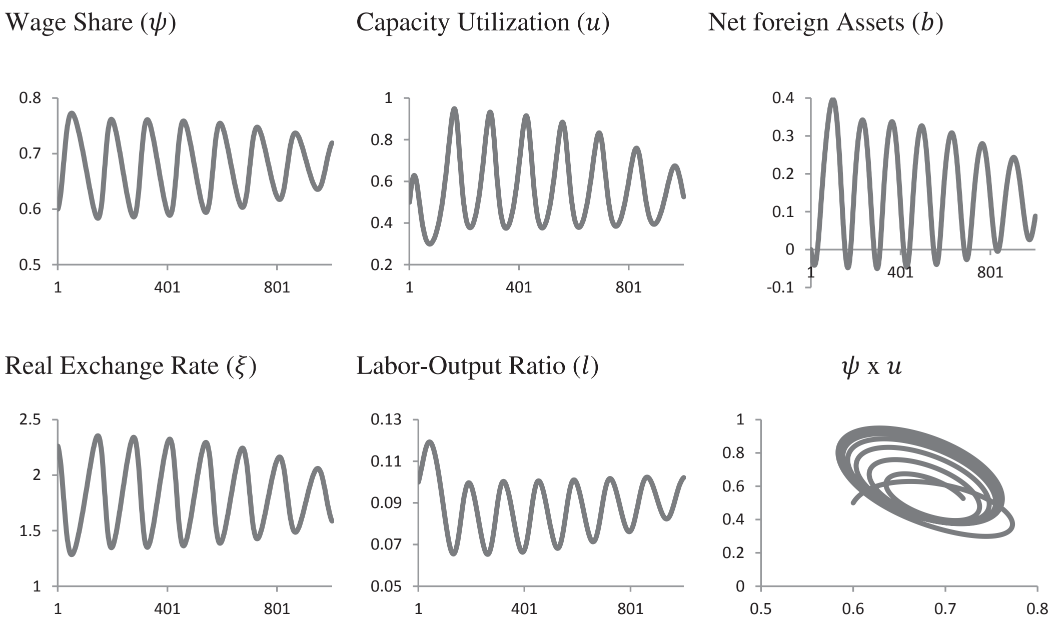

FIGURE 5 Simulation 2 - Modified La Marca results with productivity dynamics. Parameter values: $\tau = 0.1$, $\lambda = 1$, $k = 20$, $l = 0.01$, $\gamma = 0.05$, $\alpha = 5$, $\eta = 1.3$, $a = 0.1$, $x = 0.05$, $j = 0.3$, $s_b = 0.4$, $s_h = 1$. $\rho = -0.01$, $\theta = -0.03$. Initial conditions: $\psi_0 = 0.6$, $u_0 = 0.5$, $b_0 = 0$, $l = 0.1$. Steady state: $\psi = 0.69$, $u = 0.49$, $b = 013$, $l = 0.1$ Eigenvalues: $\lambda_1 = -0.037 + 0.41i$, $\lambda_2 = -0.037 - 0.41i$, $\lambda_3 = -0.214 + 0.198i$, $\lambda_4 = -0.214 - 0.198i$. $J = \begin{bmatrix} -0.1 & 0.13 & 0 & 1.38 \\ -1.50 & -0.32 & 0.01 & 0 \\ 0.92 & -0.01 & -0.09 & 0 \\ -0.01 & 0.01 & -0.03 & 0 \end{bmatrix}$

The first five figures from top to bottom and left to right of Figure 4 represent the evolution of the wage share, capacity utilization, net external asset/capital, real exchange rate and effective labor per unit of product in time. The last figure shows how growth and distribution evolve between themselves. We see that the oscillatory pattern with dampened cycles exists for all variables. All of them stabilize in an equilibrium point (a negative real part in the eigenvalues).

In order to illustrate the possibilities of the model as an exercise, we may use a different calibration that is able to reproduce many rounds of oscillation as seen in Figure 5.

This is an interesting representation of the model despite being unrealistic in economic terms. Our analytical study of the model clearly shows that our model is able to reproduce stable dampened cycles, but not the ones with neutral stability—which would require a zero value on the real part of their eigenvalues and a conjugate pair of imaginary values.

With our current specification, which considers the effects of the Kaldor-Verdoorn effect and technology transfer, a pattern which is closer to stable cycles emerges. However, neutral cycles (neither converges nor diverges from the equilibrium value in the long run) cannot be reproduced. The model, however, shows an interesting dampened cyclical relationship between productivity and economic activity, and between productivity and the accumulation of net external assets.

The calibration we used was aimed to test values for a middle-income economy. One in which the behavior of the real exchange rate is endogenously oscillatory. The endogeneity of productivity is central to explain this behavior. An increase in the wage share has negative effects on productivity itself, but in a wage-led economy it boosts growth, which through an increase in the capacity utilization affects investment. The rise in productivity occurs with the Kaldor-Verdoorn effect. This compensatory dynamics gives rise to cycles of decreasing amplitude.

6 | CONCLUSION

This paper proposed to study and expand the La Marca (2010) model in two different fronts: (1) initially, we observed the characteristics of the original model when adopting (a) a fixed real exchange rate, (b) constant net foreign assets to capital ratio and (c) a constant income distribution between wages and profits; and (2) we added productivity dynamics and technology transfer to the model. This work offers a small contribution that adds a jigsaw to a puzzle that is still open in the Structuralist literature on understanding what is behind the 'chicken flights' growth pattern, in which countries have their growth processes interrupted after a small virtuous period. This is one of the biggest challenges for low- and middle-income countries to sustain growth and overcome the medium-income trap. In other terms, how should we think about endogenous deterministic cycles that are characteristic of middle-income countries in a center-periphery framework?

Based on previous literature, this paper offers a simple solution to the inclusion of productivity in the Goodwin model by taking into account a learning by doing Kaldor-Verdoorn element and a technology transfer/learning from domestic firms that have assets abroad (increasing the average productivity of the economy). The results indicate that even the simple inclusion of productivity dynamics is able to produce cycles under specific conditions. This is of fundamental importance, because it shows that even in the presence of no shocks, the system still oscillates.

The results show that (1) in all cases the model converges. (2) The constant exchange rate and external sector stability turns the model into monotonic convergence. This reinforces the BPCM argument and may imply a reduction in endogenous volatility. (3) The fixed income distribution leads to a monotonic trajectory and reduces volatility. (4) The inclusion of productivity dynamics generates new sources of volatility in the relationship between productivity, capacity utilization and net external assets, and is in line with the Structuralist argument of structural fragility.

In order to interpret these relationships, new sources of volatility can be explained by (1) a higher productivity that counter-balances the effects of a rise in capacity utilization. The rise in productivity pressures a virtuous reduction of capacity as output increases given higher labor productivity. This behavior results in a cyclical adjustment toward the equilibrium value. (2) Highly productive firms from developing countries are more likely to be acquired by big companies in the developed world, and firms in developing countries find a barrier to their growth in productivity from technology transfer. In this sense, these elements dynamically counterbalance the effects of increases in productivity thereby generating oscillatory behavior.

Moreover, a flexible nominal exchange rate focused on balancing the external sector changes the dynamic properties of the model. The convergence trajectory to the steady state does not generate cycles. This is an important finding. The Thirlwall model and the Balance of Payments Dominance of Ocampo (2011) state the relevance of the external constraints in the long- and short-run, respectively. An exchange rate mechanism that is able to adjust the external sector automatically (no debt accumulation) results in the La Marca (2010) model in a pattern that reduces the endogenous instability in the adjustment mechanism. Despite the flexibility that the nominal exchange rate offers when it keeps the real exchange rate constant, it reduces volatility. There are costs, however, in terms of the steady state. It reduces the equilibrium values of the wage share and the capacity utilization. Achieving less volatility involves a trade-off, a reduction in the economic activity and income concentration on profits.

Finally, this paper offers an invitation to expand new contributions in the Structuralist Kaldor-Thirlwall framework of La Marca (2010) exploring even further the Schumpeterian aspects of economic cycles. The cyclical aspect of middle-income trapped economies could be further analyzed with other model expansions: adding a multi-sector model, further exploring the technological dynamic or increasing the heterogeneity of agents (with the use of Agent-based models). The Structuralist literature on cycles is still scarce in modeling techniques related to cliometric studies and the addition of new theoretical approaches and new models to observe specific aspects related to low- and middle-income countries offers an open space for a new road of research opportunities.

ACKNOWLEDGMENTS

I would like to acknowledge Bart Verspagen, Mary Kaltenberg, two anonymous referees and the editors of Metroeconomica for their fundamental inputs, that very much improved the quality of this manuscript. I thank UNU-Merit and the CatChain project for the institutional and financial support. I bear full responsibility for all opinions and any eventual inaccuracies presented in this paper.

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How to cite this article: Spinola D. The La Marca model revisited: Structuralist goodwin cycles with evolutionary supply side and balance of payments constraints. *Metroeconomica*. 2020;00:1–24. https://doi.org/10.1111/meca.12316

APPENDIX 1

Variable list, including all variables of the model

X	**Aggregate production**	r	**Profit rate**
K_i	Capital stock	g	Domestic investment rate
x	Export coefficient	m	Mark-up over costs
L	Labor	P	Prices
l	Labor-output ratio	p_e	Equities unit price
B	Value of foreign assets	σ	Domestic savings
b	Net foreign assets to capital ratio	γ	Animal spirit
D_i	Dividends	α	Investment sensitivity to profitability
N	Employable working population	ξ	Real exchange rate
H	Amount of hours worked	κ	Current account
h	employment rate (H/N)	τ	Wage share speed of adjustment.
η	Price-elasticity of domestic output in world market.	z	Sum of the current account components that respond to the real exchange rate
k	Capital-population ratio	s	Propensity to save
ε	effort exerted by workers	u	Capacity utilization
Λ	Exchange rate insensitive net imports	λ	Adjustment coefficient of the capacity utilization
a	Imported input to output ratio		
ψ	Wage share		*Subscripts*:
π	Profit share	b	Firms
j	Real return on net foreign assets	h	Households
E	Equities	g	Government
e	Nominal exchange rate	f	Foreign sector
ι	Constant for RER	$*$	Equilibrium value
ρ	Learning-by-doing (Kaldor-Verdoorn effect)	J	Jacobian
θ	Technological transfer from foreign firms to domestic firms	λ_i	Eigenvalues
ϕ	Decreasing effect of the level of labor-output	p	Index for private savings out of profits and interests
T_i	Taxes	Y_i	Income per social class
t_i	Tax rate	m	Mark-up
S	Savings	Ω	Net worth
C_o	Costs	w	Wage per worker