The Neokaleckian Model of Growth and Distribution Applied for Brazil.

Danilo Sartorello Spinola[1]

Summary

This study has as its main objective to analyze the relationship between structural change (measured as a productive structure that moves toward more productive sectors of an economy) and income distribution in Brazil. This work aims to simulate the Neokaleckian model of growth and distribution as designed by Cimoli, Lima & Porcile (2013) to the short run. This is a Post-Keynesian model with elements of the Schumpeterian theory and of Latin American Structuralism elements. Simulations are made in order to understand the impacts of structural change and wage level parameters of the model and to analyze the impact of exchange rate devaluations in the Brazilian economy. To accomplish these objectives, the model is calibrated with parameters as close as possible to Brazilian reality in the year of 2011. The results indicate the dynamics of the Neokaleckian model and analyze possible impacts of changes in the productive sector to growth and income distribution in Brazil.

1. Introduction

Since the foundation of Latin American structuralism in the 1950's and 1960's with Raul Prebish and Celso Furtado, the discussion of development in ECLAC[2] has been seen as a complex problem with multiple determinations. Prebish (1949) pointed out the existence of an international division of labor in which countries could stay in a central or a peripheral position in the international economic system. While countries in the center of the international economic system had a diversified production structure that gave them comparative advantages, the peripheral countries remained in a position of underdevelopment in which its specialized production structure put these countries in a disadvantageous situation in international commerce. This situation was created due the implications described in the deterioration of terms of trade hypothesis[3].In this perspective, industrialization and diversification of an economic

---

[1] PhD Candidate in Economics from United Nations University (UNU-Merit), Maastricht, The Netherlands. MA of Economics from the Universidade Estadual de Campinas (Unicamp). Campinas, Brazil.

[2] United Nations' Economic Commission for Latin America and the Caribbean (CEPAL).

[3] It is also known as *Prebish-Singer Hypothesis*. This theory postulates that the difference between products related to its income elasticity of demand creates a situation where countries with specialized production structures in products with low income elasticity of demand (primary products) have a declining tendency on the prices of exported products. This structure creates a situation of inequality increase between countries.

productive structure is the only way to overcome underdevelopment. Furtado (1959), when discussing the foundations of Brazilian economy, also defended the role of industrialization in peripheral economies as the way to internalize the Keynesian multiplier and create an endogenous and autonomous economic system that could bring up economic, social and cultural development.

ECLAC's perspective on the importance of the production structure is also related to the Latin American structuralist view on the role of income distribution. Di Filippo (2009) defines the structuralist view of income distribution as a result of three basic ideas: firstly the association between functional income distribution, institutional and industrial structure; secondly, the fact that personal income distribution directly affects the output of the economy by changing aggregate demand as defended by Keynes (1936). Thirdly, the role of Government as a strategic economic actor to change the income distribution pattern.

In order to give a small contribution to the Latin American structuralist perspective performed in ECLAC (2012), this paper aims to simulate and show the impacts of a structural change in growth and income distribution. This research is performed with the use of a demand-side *Kalecki-Steindl* model to the short run. The model was calibrated for Brazilian economy to the year 2011.

2. Neokaleckian Model

In order to comprehend how the relationship between functional income distribution, growth and structural changes occurs, it will be used the most recent demand-side theories based in the ideas of Kalecki (1968) and Steindl (1952).

The economic system is composed of agents that belong to a social class. The relationships between these classes are central and determine the functional income distribution. As a demand side theory, income distribution will affect the composition of demand and so the levels and patterns of Consumption and Investment. In this sense, income distribution will affect the level of final output, and growth. On the other hand, the ideas of Steindl (1952) related to the strategic decision of firms create a scenario where the rationality of the economic agents is not perfect, with existence of bounded rationality. The market structure is oligopolistic and firms will try to defend its markup by using market and non-market strategies. One of the main decisions of the firm is to fix a level of idle capacity as a competitive strategy to protect against new firms that wants to enter in the market.

The ideas of M. Kalecki and J. Steindl were central to heterodox models that try to explain the discussion to include variables such as social classes, production structure, economic growth and economic development. Blecker (2002) first formalized a Neokaleckian model to explain in a Post-keynesian perspective the relationship between variables cited above.

3. Specifications of the model

This model is briefly presented as it is defined by Cimoli, Lima & Porcile (2013), a Neokaleckian model based in Blecker (2002). The model consists of three agents representing social classes: capitalists, workers and government. The external sector plays a passive role, only supplying capital and intermediate goods. The assumptions are that capitalists earn profits and save all that they earn. The workers earn wages and spend all in consumption. The role of government is to set the nominal interest rate and the nominal exchange rate by buying or selling reserves. The model will discuss short and long run and the role of the distributive conflict to determine the share of each class in total output.

The firms have a Leontief function of production in which there is no substitution between the factors of production.

$$(1) \qquad Y = \min(aL, bM^m, vK)$$

About the variables: Y is the output, L the total labor, M^m is the amount of foreign intermediate goods, K is the capital stock and u is the level of capacity utilization in the economic system. About the parameters, a is the productivity of labor, b is the productivity of foreign intermediate goods and v is the productivity of capital. This model accepts existence of degrees of monopoly, where firms have a mark-up factor z. Because of imperfect competition, the prices are set over the marginal cost as presented in the following equation:

$$(2)\ P = z(\frac{W}{a} + \frac{P^*E}{Pb})$$

$$(3)\ Pk = kP + (1-k)P * E$$

Where P is the price level, W is the nominal wage level, P^* the foreign price level and E the nominal exchange rate. The prices are set over the costs of wages and intermediate goods. The costs are weighted by the mark-up factor z. For equation (3), it describes the composed level of prices determined by the weight of domestic supplied good plus domestic price level and external supplied good plus international price level.

In macroeconomic theory, the goods and labor markets equilibrium derives from the equation $Y= C+I+G+X-M$. The function *consumption of the government, G,* is thought as part of the *function of private consumption C*. From the vision of output from the demand side, the function that equilibrates the goods market will result in:

$$(4)\ P^{y}Y = PC + kPI + (1-k)P^{*}EI + PX - P^{*}EM$$

Where k is the domestic share in supply of capital goods, *C* is function of aggregate consumption, *I* is the function of investment, *X* is the amount of exports and *M* the amount of imports. P^{y} is a weighted price index related to the GDP.

Working with these macroeconomics variables, it is possible to find the following equations:

$$(5)\ C = \frac{WP}{L}$$

$$(6)\ I = gK$$

$$(7)\ X = xK$$

The variable *C* represents aggregate consumption, while *I* is the investment, and g the investment rate *I/K*. The parameter *x* represents the exports per unit of capital as *X/K*. Realizing algebraic manipulations that can be found in Cimoli, Lima & Porcile (2013), the expression for the goods market equilibrium is:

$$(8)\ uv = \sigma uv + kg + x - \frac{quv}{b}$$

The variables investment rate g and export per unit of capital x can be thought as functions of some parameters. The investment rate function depends on the interest rate and the decision of capitalists and its expectations over an uncertain future as defined by Keynes (1936). It also depends on the on the level of excess capacity, as described by Steindl (1952). The functions are thought as having a linear relationship.

$$(9)\ g = \alpha + \beta u - \tau r$$

$$(10)\quad x = hu^{*} + jq$$

In equation (9), α represents the animal spirit of the capitalists as defined by Keynes (1936). β is the response of the investment function to changes in the utilization rate, while τ is the response to the real interest rate *r*. In the equation (10), $u*$ is the rate of capacity utilization of

the stock of capital in global economy, h represents the non-price competitiveness and j is the response of exports to a rise in price of competitiveness.

Applying equation (9) and (10) in equation (8), it is possible to determine the level of equilibrium of the economy adjusted by the value of u:

$$(11) \quad u = \left[\frac{1}{v}\right] \frac{(k(\alpha - \tau r) + hu^* + jq)}{1 - \sigma - \left(\frac{k\beta}{v}\right) + \left(\frac{q}{b}\right)}$$

In the short run of this model it is adjusted in equilibrium by the excess capacity level as the variable E, nominal exchange rate is fixed and exogenous. In the end, when the excess capacity level is found, it is possible to determine the variables of investment level and imports.

$$(12) \quad I = (\alpha + \beta u - \tau r) * K$$

$$(13) \quad M = \left(\frac{uvk}{b} + (1 - k)I\right)$$

The functions of each macroeconomic variable are then defined. To finish the model, it is the relevant do show the functions that will determine the share of each class in the total real income:

$$(14) \quad \delta = \frac{P^* E M^m}{PY} = \frac{P^* E}{Pb} = \frac{q}{b}$$

$$(15) \quad \pi = \frac{PY - WP - P^* E}{PY} = \frac{z - 1}{z}$$

$$(16) \quad \sigma = 1 - \delta - \pi$$

In the share of each class, σ represents the share of the workers in total output, δ the share of foreign intermediate inputs and π the share of capitalists. The variable q represents the real exchange rate. In equation (15), the second passage has not been explicit, but with algebraic

manipulation the result is that the share of capitalists in total output does not rely on the share of workers and imported intermediate goods. Actually the share of capitalists will depend on the distributive conflict that can affect the mark-up factor *z*.

4. Short Run equilibrium, devaluations and structural change

The fundamental message of this model is that capitalists decide their share in the final output by adjusting their mark-up to their desired level according to demand and their power relations over workers. The main relationship is then between the share of the workers and share of imported intermediate goods. The adjustment of this model is done in the capacity level utilization variable. The parameters of production and the macroeconomic variables then determine the level of capacity of the capital stock and income distribution in equilibrium.

With this model, is it possible to simulate static impacts of devaluations and changes in different parameters to the income distribution, to the level of the output, to level of internal prices and to excess capacity level.

Changes in some parameters related to productivity (*a*, *b* and *v*), the range of capital goods a country produces and the parameters *j* and *h* are strongly related to the production structure. *k* is related to the degree of diversification, complexity and technological density of the production, while *h* is related to the ability of a country to participate in fast growing markets.

"The parameter *j* have a higher level when a firm is knowledge intensive, as it can react swiftly and raise production when the exchange rate becomes more competitive" (Cimoli, Lima & Porcile, 2013)

The modification in the parameters of the model can be used as a proxy, in this model, to measure impacts of a structural change in growth and distribution of income in the short run. In this way, this model is linked with the works of ECLAC (2010), ECLAC (2012) and ECLAC (2014) in the way that it tries to analyze impacts of the productive structure over the income distribution and understand how the structure also can determine growth.

The parameter *a*, *b*, *v*, *j*, *h* and *k* will then be called structural change parameters, as they depend on the quality of the products, the level of production and the productivity of an economy.

In order to simulate this model, I execute some external shocks in the level of the parameters to measure impacts over Brazilian economy. I will apply some shocks over the parameters of structural change parameters, interest and exchange rate. I will also analyze the power distribution (conflicting claims), and nominal wages are simulated in order to observe impacts over the distribution of income and over the GDP. In the next section I analyze the results of the model for Brazilian economy to the short run model for the year 2011. The methodology used to calibrate the model is better explained in the appendix of this work.

5. Simulation and dynamics of the model

In order to simulate the data to Brazil, the model was calibrated with real data found in different sources. The following parameters were calculated from real values and can be used to determine the production structure of the economy. The data was calculated for year 2011. The following table shows the parameters for Brazilian economy.

Table 1. Parameters of the model*

L	101325000	z	1.7
DK	6493198000000	P*	100
i	11.67	E	1.67
a	135.33	u*	0.775
b	10.71	k	0.68
v	0.37	W	12881
g	0.06		
alf	0.20	x	0.0409
B	0.000026	h	0.0500
t	-0.000291	j	0.0024

*The calculus of the parameters can be found on the Statistical Appendix.

Brazil, in 2011, was a country with a labor force of around 101 million people. The value of capital stock (*DK*) measured by PWT was of US$ 6.4 trillion. The interest rate and exchange rate were calculated using central bank data. The productivities were calculated from real values of each demand side macroeconomic component. The mark-up was calculated as 1 plus prices over costs. For the parameters of *g* and *x*, an econometric work was done calculating a regression for 10 year monthly observations.

It is relevant to say that prices are indexes and the value of capital stock *DK* is measured in US dollars in 2005 prices as it is the quantity *K* times its related prices P^k. The share of capital stock supplied by domestic firms is *k*, and the share supplied by the external sector is 1-*k*. These parameters were calculated using real values. The level of Wages used were calculated from empirical levels for 2011 in BR$ but converted to US$ using the yearly average nominal exchange rate. For P^y, it was taken the level of prices found in the PWT table for the year 2011.

The results of the simulation of the parameters found for Brazilian economy in 2011 can be observed in the table 2, below:

Table 2. Results of the Model

K	41891600000	*u*	81.84%
P	188.32	σ	50.54%
Pk	181.50	*q/b*	8.28%
Y	16187539627	π	41.18%

For 2011 in the Brazilian economy, the output of the model shows that the share of profits in the Brazilian GDP represents around 41% and the share of wages represent 50.5%. These results are close to empirical values, as it is for the level of excess capacity. About 8% of the GDP is used to import intermediate goods.

The Price level is a very interesting variable as it shows how an economy with high mark-up, as the Brazilian economy, that has higher mark-up level than the world mean, shows a pattern of high prices compared to external ones multiplied by the exchange rate ($P*E$ = 167).

Simulation 1. Modifications in the level of the exchange Rate

Table 3. Exchange rate modifications

E	1.336	1.503	1.670	1.837	2.004	2.220
σ	52.01%	51.26%	50.54%	49.84%	49.16%	48.30%
q/b	6.82%	7.56%	8.28%	8.98%	9.67%	10.52%
π	41.18%	41.18%	41.18%	41.18%	41.18%	41.18%
P	183.02	185.67	188.32	190.97	193.63	197.06
u	86.01%	83.84%	81.84%	79.99%	78.27%	76.22%
Y	1.13%	0.56%	0.00%	-0.54%	-1.07%	-1.73%

The first effect simulated in the model created external shocks in the exchange rate. The shocks made used as nominal level values 80%, 90%, 110% and 120% of the exogenous level. It was also simulated the effect for the exchange rate level of October/2013 (E=2.22). The results show impact on the income distribution, on the level of production capacity and on prices.

Firstly, this simulation shows that a devaluation have impacts on prices. This relation happens because devaluation affects costs of intermediate imported goods. This increase in costs is affecting final prices weighted by the markup factor. The domestic prices then increase with the exchange rate devaluation. The increase in prices affects consumption, exports and domestic investment, reducing them, imports are not affected. The result is a decrease in the product, a

negative growth rate. This is not necessary and depends on the parameters. For Brazil, the devaluation affects the income distribution reducing consumption.

An increase in nominal exchange rate level affects the real exchange rate. However the price effect reduces the exchange rate. The final result depends then on the parameters. In the case of Brazilian economy, the final result of a nominal devaluation is a real devaluation. The real evaluation then increases the share of imported intermediate goods in the output. As the share of the capitalists is constant, depending only on the markup, this results in a loss in the workers' share.

Finally, all these changes affect the capacity utilization level in a way that devaluation reduces the level of utilization of the capital stock. This effect happens because demand reduces due to price and income distribution changes. The capitalists, when they see a reduction in demand, they lower the use of capacity utilization adjusting it to demand variations. In this way, this model is a demand-side model.

Simulation 2. Mark-up Modifications

The second simulation is related to changes in the power relation between classes. The changes in power affect the mark-up factor *z*. This factor is calculated as the markup relation that measure prices over costs plus 1.

Table 4. Mark-up modifications

z	1.445	1.530	1.615	1.700	1.870
σ	59.46%	56.16%	53.20%	50.54%	45.95%
q/b	9.74%	9.20%	8.72%	8.28%	7.53%
π	30.80%	34.64%	38.08%	41.18%	46.52%
P	160.07	169.49	178.91	188.32	207.16
u	94.07%	89.14%	85.14%	81.84%	76.70%
Y	7.57%	4.77%	2.26%	0.00%	-3.90%

Distinct decreases in the markup factor were calculated in order to show how the matter of class struggle and income distribution is central to determine growth and price level in the Neokaleckian model.

In this model, and increase in the power of capitalists represented by the markup factor have firstly an impact in increasing prices, as firms can increase prices in a more oligopolistic situation without affect it competitive position. The increases in prices and markup have as a

result an increase in the share of capitalists over GDP. The prices then affect the relation between share of workers and share of imported intermediate goods. The final result is a reduction in workers share.

A reduction in the share of workers reduces workers' consumption and final demand. The output is then reduced because of effects of income distribution over macroeconomic variables *C*, *I* and *X*, and effect of prices over imports through changes in the real exchange rate.

The adjustment effect over capacity utilization occurs when demand increases (or decreases). This happens because of a reduction (or increase) in the markup change the share of workers in the GDP through price modifications. Increasing in prices reduces the real wages, reducing consumption. An increase (reduction) in the capacity utilization level then affect investment through a defensive effect as described in Steindl (1952). The firms increase investment when there is high *u* to defend themselves from potential new entrees.

It is really interesting to observe how this model shows that the role of income distribution is central to discuss growth and even inflation. The influence of the demand side over the economic system gives very different ideas and proposals to think an economic system than the mainstream supply side economics. In this model, a higher level of participation of workers is fundamental to develop a stable pattern of growth. The workers must then organize themselves in a way that can require increases in wages compatible to their increase in productivity, reducing the markup of firms to a level where supply and demand can grow stable stimulating each other.

Simulation 3. Wage Modifications

This simulation show how impacts over wages affect growth, income distribution and other variables

.

Table 5. Wage Modifications

W	4671	10305	11593	12881	14169	15457
σ	40.51%	48.82%	49.76%	50.54%	51.20%	51.76%
q/b	18.31%	10.00%	9.06%	8.28%	7.63%	7.07%
π	41.18%	41.18%	41.18%	41.18%	41.18%	41.18%
P	85.19	155.96	172.14	188.32	204.50	220.68
u	61.13%	77.33%	79.73%	81.84%	83.71%	85.37%
Y	-8.38%	-1.44%	-0.65%	0.00%	0.55%	1.02%

In this simulation it is interesting to see how wage policies that affect the medium wage, like an increase in the minimum wage, can have impacts over income distribution, demand, growth and the use of excess capacity. It was simulated changes of 80%, 90%, 110% and 120% of the empirical value of *W*. We also simulated a case where the medium wage is equal to the minimum annual wage of Brazil.

The results show how increases in wages have positive impacts over growth, but also increase prices. As wages are costs, an increase in costs weighted by the markup results in a relevant increase in prices. The firms pass the increases of costs to prices.

When the wages are elevated, the share of workers in GDP increases. When *W* elevates, workers elevate their own consumption, stimulating demand. This demand stimulus then makes firms elevate their capacity utilization level, also stimulating investment. These demand stimulus impacts in firms with an increase in the capacity utilization level of the capital stock.

It is interesting to see how in the extreme case of a very low salary, the share of import of intermediate goods increase. As the real exchange rate evaluates with price increases, the result is an increase in imports due to the relative low prices of international goods and a decrease in exports. In this case also there is a strong decrease in the output and the capacity utilization level. This decrease is caused by a slower demand that reduces consumption and internal investment.

Simulation 4. Structural Change Parameters

In order to analyze how the production structure can affect the output, some simulations were done with some structural change parameters in the short run. The simulations analyzed changes in the domestic production of capital goods, the productivity of labor and capital, and the *Animal Spirit* of the capitalists.

Domestic Supply of Capital Goods

This simulation analyzes impacts of changes in the variable *k*. It is relevant to say that changes in this variable do not affect the income distribution, only output and capacity utilization level.

Table 6. Domestic Supply of K Goods Modification

k	0.00	0.61	0.68	0.75	1.00
u	19.05%	75.56%	81.84%	88.12%	98.23%
Y	-9.96%	-1.00%	0.00%	1.00%	4.69%

The values of *k* used for the simulations were 90% and 110% of the empirical value, the case when all capital goods are imported and when call capital goods are domestically supplied. Higher internal supply of capital goods affects positively product and utilization capacity level. When the supply of capital goods is all domestic, the capitalists' decision to make investments affects in 100% the internal production, stimulating investments and reducing imports. On the other side, when there are no domestic supplies of capital goods, the inversions are reduced while imports are elevated, affecting negatively the product. It is notable to see how a low domestic supply of capital goods reduces the level of capacity utilization.

Productivity Parameters

This simulation changes value of the productivity of labor and capital and see its impacts to the economy. An increase on the parameter of labor productivity *a* affects the income distribution, prices, capacity utilization level and product. However, changes in the productivity of capital only affect the level of capacity utilization.

Table 7 - Productivity Parameters

a	108.3	121.8	135.3	148.9	162.4
σ	52.01%	51.26%	50.54%	49.84%	49.16%
q/b	6.82%	7.56%	8.28%	8.98%	9.67%
π	41.18%	41.18%	41.18%	41.18%	41.18%
P	228.8	206.3	188.3	173.6	161.4
u	86.13%	83.90%	81.84%	79.93%	78.29%
Y	-7.58%	-3.74%	0.00%	3.64%	6.91%
v	0.297	0.335	0.372	0.409	0.446
u	91.44%	90.83%	81.79%	74.39%	68.22%

The simulation analyzed impacts of increases and decreases in the magnitude of 10% and 20% to both parameters. To the productivity of labor, its increase affects in a low magnitude the income distribution, increasing the share of imported intermediate goods and reducing the share of workers. These changes occur because of strong modifications in internal prices. As prices are determined by costs, an increase in the productivity of labor without changes in wages strongly reduce costs as all productivity increase goes to imports. In this way, can be seen a strong reduction in prices. The price reduction compensates partially the loss of wages in total GDP, and increases consumption. As the productivity increased, even with increase in consumption the capacity level needed to sustain a fall in the demand level. Capacity utilization level falls,

affecting negatively the investment, reducing it. The final result is increase in product due to increases in consumption but with less capacity utilization level. In the case the wages accompany the increases in the level of labor productivity; increases in product would be even higher.

To the simulation of the productivity of capital as it does not affect prices it does not modify the income distribution as the elasticity is too low. It affects the level of capacity utilization as less capacity is necessary to perform the same level of output.

Animal Spirit Modifications

This section simulates change in the level of the variable animal spirit α. As this variable represents a subjective expectation of capitalists and their disposition to perform investments, this value for itself does not have any meaning. In order to understand the values attributed to a, the Table 8 shows values for this variable that makes the capacity utilization level goes from 0% to 100%.

.

Table 8 - Investment Elasticity

α	-0.058	0.000	0.190	0.200	0.210	0.258
u	0.00%	18.47%	78.63%	81.84%	84.96%	100.00%
Y	-66.86%	-51.76%	-2.59%	0.00%	2.59%	14.88%

The variable animal spirit does not affect share of profits or share of imported goods, for this reason, it does not affect the income distribution. However, changes in this variable increase investment and so the final output. The animal spirit also affect the level of capacity utilization as the mood of the capitalists determine how they are disposed to invest, so the demand side of the economy continues determining the final result.

6. Conclusion

The main objective of this paper was to simulate a Neokaleckian model of growth and distribution applied to Brazilian economy for the short run. The results of the model, a demand-side model shows that an increase in demand determines growth and how income is distributed determine the demand pattern. Reductions in the mark-up of the firms increase in wages and increases in the productivity of labor are measures that stimulate consumption and elevate the aggregate demand. Increases in the “mood” of the capitalists, measured as animal spirit, improve

investment and increases in the elasticity of exports to the interest rate elevate exports, these measures also increase growth as increase in the productivity of imported intermediate goods. Modifications on the productivity of capital and on the share of domestic supply of capital goods do not interfere with income distribution, but also increase growth. The capacity utilization level variable is the adjustment for this model.

It is important to highlight the fact that this model is for the short run. In this model, the external balance is not in equilibrium. In a medium run it is impossible to a country to grow under restriction in the external sector, especially Latin American countries, that have historical problems with external constrains. In the long run model, the government adjusts the nominal exchange rate by intervening by buying or selling foreign reserves. This paper only discussed the short run. In future this work will be expanded in order to simulate dynamics impacts of a medium run adjustment.

The results showed to Brazilian economy also can be used to compare with other economies. With the future development of this model, it is possible to calibrate it to other Latin American economies, using data of the PWT tables. Some adjustments were necessary in order to calibrate this model to a more realistic view of Brazilian economy. These adjustments will be later discussed in the appendix.

Finally, this paper showed some possibilities of simulation on Neokaleckian models and proposes in the appendix a methodology to calibrate this model using the Penn World Tables. It is also possible to have an idea of how a demand-side macroeconomic model can be used in the ECLAC's discussion for Latin American economies. The model analyzes in a simple way some relations between income distribution, structural changes in production and growth for an economic system. In the end, it is possible to expand this work in a qualitative way by further defining some variables relating them to the ECLAC's discussion and simulating this model to other Latin American economies.

7. **Bibliography**

BHADURI, A.; MARGLIN, S. Unemployment and the real wage: the economic basis for contesting political ideologies. Cambridge journal of Economics, 1990, vol. 14, no 4, p. 375-93.

BLECKER, R. Distribution, demand and growth in Neokaleckian macro-models. The economics of demand-led growth. Cheltenham, UK: Edward Elgar, 2002.

CIMOLI, M.; LIMA, G.; PORCILE, G. The production structure, exchange rate preferences and the Short Run — Medium Run Macrodynamics, 2013. available in http://www.fea.usp.br/feaecon/RePEc/documentos/Cimoli_Lima_Porcile12WP.pdf

DAVIDSON, Paul (Ed.). Post-keynesian macroeconomic theory. Edward Elgar Publishing, 2011.

DEQUECH, David. Reflexões sobre a Teoria Geral depois de 60 anos. Ensaios FEE, v. 17, p. 116-139, 1996.

DI FILIPPO, A. Estructuralismo latinoamericano y teoría económica. Revista de la CEPAL, 2009.

DOSI, G.; FAGIOLO, G.; ROVENTINI, A. Schumpeter meeting Keynes: A policy-friendly model of endogenous growth and business cycles. Journal of Economic Dynamics and Control, v. 34, n. 9, p. 1748-1767, 2010.

ECLAC, U. N. The Time for Equality: Closing Gaps, Opening Trails. Santiago: UN ECLAC, 2010.

ECLAC, U. N. Structural Change for Equality. Santiago: UN ECLAC, 2012.

ECLAC, U. N. Pactos para la igualdad: Hacia un futuro sostenible. Santiago: UN ECLAC, 2014.

FURTADO, C. Formação econômica do Brasil. 1959.

GODLEY, Wynne; LAVOIE, Marc. Monetary Economics An Integrated Approach to Credit, Money, Income, Production and Wealth. 2007.

KALECKI, M. Class struggle and the distribution of national income. In: Michal Kalecki (eds), Selected Essays on the Dynamics of the Capitalist Economy, 1933–1970, (Cambridge University Press, Cambridge, UK 1970 [1971]) 156-164. 1970

KEYNES, J. M. The general theory of employment, interest and money. New York: Harcourt, Brace, 1936. Print.

KREGEL, Jan Allen. Rate of profit, distribution, and growth: two views. 1971.

MAZZUCATO, Mariana. Financing innovation: creative destruction vs. destructive creation. Industrial and Corporate Change, p. dtt025, 2013.

MARSHALL, Alfred. Principles of economics. Vol. 1. 1898.

MINSKY, Hyman P. John maynard keynes. New York: Columbia University Press, 1975.

MINSKY, Hyman P.; MINSKY, Hyman Philip. Can" it" happen again?: essays on instability and finance. Armonk, NY: ME Sharpe, 1984.

PREBISCH, Raúl. Estudio económico de América Latina. Cinqüenta anos de pensamento na CEPAL, Rio de Janeiro: Record, 2000a, 1949.

SCHUMPETER, J. A. Capitalism, socialism and democracy. New York: Harper & Row. 1962

SPINOLA, D. S. Estrutura produtiva no modelo Neokaleckiano de crescimento e distribuição: simulações para a economia brasileira. UNICAMP, Instituto de Economia, Campinas, SP. 2014 Available at:

<http://www.bibliotecadigital.unicamp.br/document/?code=000927424>

STEINDL, J. Maturity and stagnation in American capitalism. Oxford: Blackwell, 1952. Print.

8. Methodological Notes

Below it is possible to see how the parameters of the model for Brazilian economy were calculates. The calibration process required some adjustments in order to make the model more plausible, these adjustments are better described in the next section. Below is a list of parameters that have an empirical source.

Table. Empirical Parameters

DY	1,810,140,875,000	*E*	1.673
L	101,325,000	*i*	11.671
DK	6,493,198,000,000	*u*	0.824
DC	1,215,871,625,738	*u**	0.775
DI	379,767,555,575		
DG	318,403,779,913	*DMm*	158131554
DX	246,722,201,263	*DMbk*	74332348.9
DM	350,624,287,488	*DMbcons*	62060498.9
Pi	137.855	*DMpetr*	56099886
*P**	100		

(1) The variables preceded with a *D* means that they are calculated in their value in US$ dollars of 2005 prices to the year 2011.

(2) *DY, DK, DC, DI, DG, DX, DM, L, Pi* and *E* are variables found in the Penn World tables for Brazil in the year 2011. DY represents the value of the output; DK the value of capital stock; *DC* the value of consumption; *DI* the value of investment; *DG* the value of government consumption; *DX* the value of exports; *DM* the value of imports; *L* is the total labor force and P^i the index of internal prices, having external prices as the basis 100.

(3) *P*:* The international Prices are considered as 100 – based on the United States of America prices for 2011.

(4) *i*: The variable of nominal interest *i* was measured by the yearly mean to the year 2011. The data used was found in the Brazilian Central Bank (BCB)

(5) *u*: The variable capacity utilization level *u* used has its source in the State of Sao Paulo Industry Federation (FIESP) to the month of july of 2011.

(6) *u**: The source for variable of international capacity utilization level *u** is the website of the Federal Reserve (FED) for the month of July of 2011.

(7) *DMbk, DMm, DMbc & DMpetr* : The composition of each component of imports were find in the Brazilian ministry of economy website. Mbk is the import of capital good, Mm of intermediate goods, *Mbc* of consumption goods and *Mpetr* is the import of petroleum.

Calibration process

(1) Cimoli, Lima & Porcile (2013) model had as an assumption the fact that government spending was calculated as private spending. In this way, *DG* was aggregated to *DC*. The consumption variable received then the empirical values of consumption and of government spending. *DC*= 1534275405650.

Another assumption of the model Cimoli, Lima & Porcile (2013) is that there are only import of intermediate and capital goods. In order to make it plausible, first the value of *Mpetr* was aggregated in the value of intermediate goods. The participation of intemediate goods in the imports was then calculated. DM^m= 214231439.7. The rest of imports was calculated as capital goods DM^{bk}= 136392847.8.

(2) Were calculated the quantity of consumption and export. In order to do so, each value was divided by the internal prices. $C = \frac{DC}{P^i}$ and $X = \frac{DX}{P^i}$.

(3) The value of consumption is equal to the consumption of the workers. This happens because workers consumption all that they earn, and firms do not consumption. Having the empirical parameters, it is then possible to calculate the wage variable: $W = \frac{P^i C}{L}$.

(4) The quantity of capital stock was calculated as: $K = \frac{DK}{P^k}$.

(5) The quantity of imported goods can be calculated as $M = \frac{DM}{P*E}$. This function can be decomposed with a participation of intermediate and capital goods as: $M = M^m + M^{bk}$.

(6) The function of final goods can be written as $M^{bk} = (1-k) * I$

(7) The Investment function, written as $I = \frac{DI}{P^k}$ where $P^k = kP + (1-k)P * E$. Having the final goods function and Investment function it is then possible to find the values of *k* and *I*.

(8) Having *C, I, X* and *M*, it is then possible to find the quantity of *Y*. $Y = C + kI + (1-k)qI \mp X - qM$.

(9) The parameters of the Brazilian economy productivities of labor, imported intermediate goods and capital were then calculated by the production function as: $a = \frac{Y}{L}$, $b = \frac{Y}{M^m}$ and $v = \frac{Y}{uK}$. It was used to calculate *v* the empirical value of the capacity utilization variable *u*.

(10) Having the productivity parameters, the mark-up factor was calculated as $z = \frac{P}{\frac{W}{a} + \frac{P*E}{b}}$

(11) The value of the investment rate was calculated as $g = \frac{I}{K}$

(12) The export per capital was calculated as $x = \frac{X}{K}$

(13) In order to discover the parameters that involves the functions that determine the investment rate and export per capital units, $g = \alpha + \beta u - \tau r$ and $x = hu + jq$, it was used observances related to the 10 last years with data found in the PWT and a regression was done.

(14) To measure the parameter of the function *x*, it was used a regression.

In the case of the function *x*, the coefficients show significance, but the results showed a behavior seen on Brazilian economy, there is a conjuncture situation where the exchange rate evaluate at the same time of an increase in the exports. The situation where the prices of commodities highly increased gave pressure to the exchange rate at the same time that did not affect the quantity of exported goods.

(15) The final results of the parameters calculated for Brazilian economy with the methodology described above are:

Table. Parameters

C	11129659011	*a*	132.31152
I	2583111194	*b*	10.4682741
X	1789726903	*v*	0.36838605
M	2096032326		
Mm	1280675751	*g*	0.05848698
Mbk	815356574.8	*x*	0.04052312
Y	13406464783		
K	44165574956	*W*	15142.121
k	0.684	*q*	1.239
1-k	0.31145859	*r*	8.46616258

These results were used as parameters to calibrate the model. However, some adjustments were necessary in order to better understand the dynamics of the model.

(16) An important problem in the simulation of this model is related to the prices. As all macroeconomic variables are measured in value, the prices used to deflate the values are important. An important factor is that the price used to determine the value of the GDP was different than the one used to deflate the consumption, investment, export and import. The Macro equation was rewritten in order to solve this problem as

$$Y = C + Ik + I(1 - k)q + X - qM$$

The result of the prices calculated were:

Table. Prices

Pi	137.855
P*E	167.280
Pk	147.019

Adjustments

The results of the parameters measured in the methodology section gave relevant information for the calibration of the model. Still, the results and the dynamics of the model with these parameters show odd results. The value of the share of profits was higher than 80%, totally unreal to the Brazilian economy. This happened because we over-valuated consumption with low markup. In order to make more reality to the model, some parameters were recalculated.

Firstly, the nominal wage endogenously found in the methodology was substituted by an empirical value. In The Brazilian Institute of Geography and Statistics (IBGE), to the year 2011, the value of wages was of RS$ 1.792,61, about 3.3x the minimum Wage level. Using the nominal exchange rate level to 2011, E=1.67, the level of wages are W= 12881.03.

The mark-up found represent a very low level compared to the empirically measured to the Brazilian economy. The mark-up factor is fixed in the level of z=1.7, as the empirical level of profits in the Brazilian economy is about 41%. We can find the level of z using the equation: $\frac{z-1}{z} = \pi$. For the prices P, they were recalculated with the new Mark-up, the final result can be seen on the model.

A very important change was made with the parameters that result in the investment rate g. The parameter was adjusted in order to find the desired level of utilization capacity. As α is a variable that does not have a value on itself, changes in its value were made without loss to the comprehension of the model.

The empirical results showed an inverse relation between real exchange rate and export per unit of capital. This result is due to other factors that alter these variables, like commodity prices and Chinese demand. In order to solve these problems, as this relation could not be found in other papers, an elasticity level was exogenously given as an arbitrary level that could represent the impact of exchange rate devaluation on the exports *per* capital. The variables j and h were then adjusted.