Department of Economics- FEA/USP

The equalizing spiral in early 21st century Brazil: a Kaleckian model with sectoral heterogeneity

Clara Brenck
Laura Carvalho

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Clara Brenck (zanoc131@newschool.edu)

Laura Carvalho (lcarvalho@usp.br)

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The relative success of the Brazilian and other South American economies in combining higher growth rates with a reduction of income inequality in the 2000s can be better understood through the study of the relationship between wage distribution, consumption patterns and the composition of employment. By starting from the Neo-Kaleckian framework, this paper builds a two-sector open economy model with two types of workers. An unstable cumulative causation mechanism through which a reduction in wage inequality increases consumption of non-tradable goods, leading to higher demand for low-skilled labor and a further reduction in inequality may arise.

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1 INTRODUCTION

In standard Kaleckian models, the functional distribution of income affects aggregate demand through different propensities to save of capitalists and workers, as well as through the sensitivity of investment and/or net exports. The demand regime of an economy is considered wage-led when the positive effect on consumption of a higher wage share is strong enough to compensate for its negative effect on investment and net exports, being considered profit-led otherwise (TAYLOR, 1983; DUTT, 1984; BLECKER, 1989; BHADURI; MARGLIN, 1990). Extended versions of the model add a so-called distributive curve to deal with the other direction of causality, namely the response of the functional distribution of income to the level of economic activity (TAYLOR; TAYLOR, 2004; BARBOSA-FILHO; TAYLOR, 2006; NAASTEPAD; STORM, 2006). In particular, Goodwinian dynamics may arise in a profit-led economy when stronger aggregate demand strengthen the position of workers in the labor market, resulting in a so-called profit squeeze.

As made clear by the recent experience of several developing countries, a more complete understanding of the dynamic relationship between income distribution and aggregate demand – in both directions of causality – may require adding sectoral heterogeneity and wage inequality to the Kaleckian

approach. In the first decade of the twenty-first century, Brazil and other South American economies, such as Argentina, Bolivia, Ecuador, Uruguay, and Venezuela, were able to combine relatively high GDP growth rates, strong job creation and a fall in personal income inequality. The annual average growth rate of Brazil rose from 1.88 (in the period 1990-2003) to 4.43 (between the years 2004 and 2011), while the Gini index fell from 0.57 in 2003 to 0.52 in 2014, according to data from the Brazilian Institute of Geography and Statistics (IBGE).

While social transfers and minimum wage policies have played a large role in explaining real income gains at the bottom of the distribution, in several of these countries the reduction in wage inequality also resulted from the growth pattern itself, which by largely benefiting services and construction sectors, increased demand for low-skilled workers and strengthened their relative bargaining position.

Focusing on the Brazilian experience, Carvalho and Rugitsky (2015) and Rugitsky (2017) developed the following hypothesis: as lower income individuals experienced higher wage growth, the average consumption basket tilted towards higher demand for more technologically complex manufacturing goods as well as non-tradables (in line with Engel's law[1]), with the latter being relatively intensive in low skilled labor. In other words, the reduction in wage inequality could have helped increase demand for services, thus leading to a change in the composition of employment and a further reduction in wage inequality, in a cumulative causation mechanism (see Figure 1). Not surprisingly, the process of strong job creation and reduction in wage disparities in the 2000s was accompanied by accelerating services inflation, as higher wages were passed through higher prices (GIOVANNETTI, 2013). Given the overvaluation of the exchange rate and the structural deficiencies of the Brazilian productive structure, another side effect was an increase in the imports of manufacturing goods (CARVALHO, 2018; BRENCK; CARVALHO, 2019).

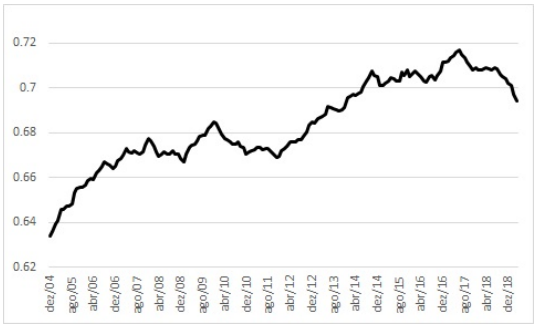
While the model presented in this paper is the first to incorporate this specific form of relationship between wage inequality, consumption patterns and the composition of employment in a Kaleckian framework, other efforts have been made to include wage inequality and/or sectoral heterogeneity into that approach. Carvalho and Rezai (2016) introduced the effect of wage inequality in the savings function in a standard Kalecki-Steindl framework and concluded that the reduction in wage inequality has a positive impact on aggregate demand, even when the demand regime of the country is profit-led. Additionally, higher inequality may push the demand regime towards more 'profit-ledness'. Taylor and Bacha (1976), Taylor (1989), Dutt (1990), Dutt (1997), Park (1997), Fujita (2015) and Nishi (2018) incorporate sectoral heterogeneity in the baseline model, with inequality being embodied in the productivity levels of the sectors. Taylor and Bacha (1976) also incorporate wage inequalities between skilled and unskilled workers. Taylor (1989) shows that changes in the demand for labor-intensive products affects the functional distribution of income in both the short- and long-run, and that the differences in distribution between wages and profits depend on the productivity difference between the two sectors. Taylor and Bacha (1976) conclude that the share of "luxury" goods (goods that use more skilled labor to be produced) in the productive structure tends to increase, reducing the share of wages over time.

[1] Carvalho *et al.* (2016) examines the share of specific products in total consumption based on the Brazilian household expenditure survey (POF) and find that for classes earning under two minimum wages, between 2003 and 2008, the participation in total consumption of fresh and industrialized food declined from 14.25 and 18.52 to 10.61 and 13.31, respectively, while electronic and communication equipment and other services, including maintenance and repair services, associative services and services provided for companies, increased from 1.45 and 1.12 to 3.04 and 1.39, respectively.

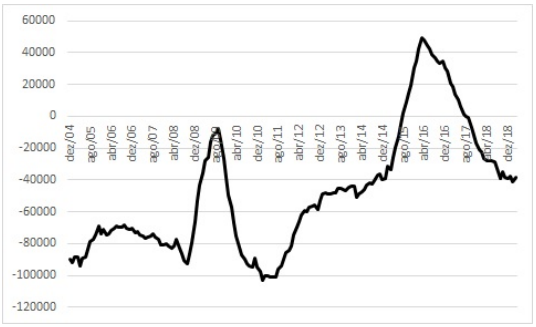
Drawing on these contributions and inspired by the Brazilian experience, we built a two-sector open economy Kaleckian model with two types of workers in which changes in the distribution of wages affects consumption patterns and the composition of employment. The next section presents the setup of the model and its main comparative static results. The third section analyzes the stability of the model under different conditions. The last section discusses the paper's main contributions and policy implications.

2 THE MODEL

Figure 1 – Evolution of relative wages and employment in selected sectors* in Brazil, between 2004 and 2019 – 12-month moving average
Source: General Register of Workers and Unemployed (CAGED)



(a) Ratio of the average wage of admitted workers in the selected sectors* to the average wage of admitted workers in the remaining sectors of the economy (12-month moving average)



(b) Difference in the net job creation between selected sectors* and the remaining sectors of the economy (12-month moving average)

*Selected sectors: Clothing, footwear and textiles; Construction; Furniture and products of various industries; Maintenance and repair services; Services provided to families and associations; Domestic services; Accommodation and Food Services.

We assume an open economy with only two sectors. Sector NT stands for labor-intensive non-tradable activities (e.g. construction, personal services)[2]. Sector T produces tradable essential goods (e.g. food, energy, clothing). Both consumption of more sophisticated goods and investment in new machinery and equipment will be fully supplied by imports, as we take the simplifying assumption that the domestic productive structure is not able to meet such demand.

The assumption that investment goods are imported in developing economies was also at the core of the so-called "gap models" in structuralist macroeconomics (BACHA, 1984; TAYLOR *et al.*, 1990). Even if Brazil is still competitive in a few non-basic manufacturing sectors, we have chosen to leave

[2] Sector NT is a stylized representation of selected sectors considered in Figure 1. Starting with data available in the Household Budget Surveys (POF) of 2002-03 and 2008-09 the National Account System (SCN), the sectors can be classified according to their import coefficients, productivity level, average wage, employment growth, and consumption growth of low income families – families whose income is lower than 3 minimum wages. Clothing, footwear and textiles; Construction; Furniture and products of various industries; Maintenance and repair services; Services provided to families and associations; Domestic services; Accommodation and Food Services were the sectors that had a positive consumption growth and positive employment growth in the period 2003-2008 in Brazil and were the ones whose import coefficient, wages and productivity levels were below average. The selected sectors corresponded to 30.3% of total employment, on average, between 2004 and 2015, and 13.7% of GDP, on average, during the same period, according to data from the National Accounts System (IBGE).

more technologically complex tradable activities out of our simplified domestic economy. Recalling the Brazilian experience in the 2000s, this assumption relates to what Bielschowsky (2012) calls "mass consumption in Brazil, mass production in China", that is, an increase in national income increases the consumption of sophisticated goods, but because the production of these products is mostly foreign, there is a "leakage of demand" reflected in rising imports.

As in Taylor (1989)[3], capital is pre-determined in each sector, which allows for different profit rates and degrees of capacity utilization. Each sector's productive function is of a Leontief fixed-coefficient form. The model assumes excess capacity in both capital and labor.

Each sector hires only one type of worker. Workers in sector NT have a lower skill level and make a lower relative wage. The level of output determines total employment in each sector:

$$L_j = Y_j a_j \tag{1}$$

where $a_j = \dfrac{L_j}{Y_j}$ is the labor-output ratio for each sector $j = NT, T$.

Total employment of the economy is $L = L_T + L_{NT}$ and the composition of employment will be measured by $l = L_T / L_{NT}$. Although we do not consider a situation of full employment, changes in the employment composition will have a different effect for each sector. Because labor productivity in the tradable sector is higher, the greater the l ratio, the harder it is for capitalists of the tradable sector to find qualified workers, that is, the "reserve army" is not proportionally equal in both sectors. Workers from the tradable sector can be hired in the non-tradable sector (with a smaller nominal wage), but workers of the non-tradable sector cannot move easily to the tradable sector without additional training. This assumption does not affect the results in this section, but will have an important role in the stability analysis to follow.

Prices are set by a mark-up rule, but follow different dynamics in each sector: the non-tradable sector sets flexibles prices at an exogenous markup, while the tradable sector faces internationally given prices and flexible markups. This assumption holds because sector T faces foreign competition, which prevents its capitalists from passing higher unit labor costs into prices. Here sector T's mark-up needs to adjust to keep the final price at the international level, while sector NT can adjust prices without changing its mark-up. For simplicity, the nominal exchange rate will be considered fixed and normalized to one.

$$P_j = (1 + \tau_j) W_j a_j \tag{2}$$

Here, τ_j is the markup of sector $j = NT, T$, with $\bar{\tau}_{NT}$ being fixed. Because of how sectors were defined, $a_{NT} > a_T$ and $W_{NT} < W_T$, where W_j is the nominal wage. Wage inequality will be measured by parameter $\omega = (W_T / W_{NT}) > 1$. For simplicity, we will normalize a_{NT} to one, so that $a_T = a < 1$.

The investment function is the same in both sectors and is of the Kalecki-Steindl type. We will express it in levels, instead of normalizing it by the capital stock as usually done in the Kaleckian literature.

[3] Taylor (1989) assumes that the capital stock in both sectors is pre-determined, does not depreciate and there is no mobility between sectors, so that profit rates will not necessarily equalize in the short run. In the steady state, however, the sectoral capital stock growth rates are equal, as well as other variables such as profit rates and the ratio between outputs of the two sectors. In our model, capital is pre-determined, even when the adjustment of quantities and prices is considered.

Investment then responds positively to the level of sectoral nominal output (P_jY_j) and to sectoral profits (Π_j), for $j = NT, T$, as well as to an exogenous term (g_{0j}) that reflects the animal spirits of firms or the expected sales' growth. A fraction $0 > \alpha > 1$ of total investment corresponds to the purchase of machinery and equipment, which as anticipated, will be fully imported. The remaining fraction $(1-\alpha)$ corresponds to non-residential investment in construction (e.g. building new factories, expansion of current plants) and will be supplied nationally by sector NT.

$$I = g_{0j} + g_{\pi}\Pi_j + g_y P_j Y_j \tag{3}$$

We have two classes in each sector, namely four different income groups in the model: (i) workers hired by sector NT, (ii) workers hired by sector T, (iii) capitalists of sector NT and (iv) capitalists of sector T. As conventionally assumed, workers do not save and capitalists save $1 > s_{\pi} > 0$ out of profits. The four classes consume an amount $0 < A < W_{NT}$ of the tradable good (from sector T), understood as subsistence consumption or the consumption of goods with low income-elasticity. The amount A grows with the exogenous growth rate of the population η. The remaining income will be, then, used for imports or consumption from sector NT. Engel's law inspires the following assumption: even though we don't have explicit income elasticities in the model, we consider that all remaining income will be spent on goods with higher income-elasticity, that is, on services and technologically complex goods.

The propensity to import out of income $0 < m < 1$ is equal for all four income groups. Total imports also have an exogenous term m_0. Exports will be considered exogenous ($X = x_0 > 0$), for it depends on demand from the rest of the world, and will grow at the same exogenous rate η as autonomous consumption A[4].

Hence, we do not take into account the exchange rate effect for both exports and imports. We are aware that this is an unrealistic assumption, but including its impact could compromise the understanding of aspects that we consider more relevant for our primary interest, namely the relationship between employment composition and relative wages. Besides, as already mentioned, essential tradable goods are sold at the internationally determined price, and technologically complex goods are imported for not being available domestically, thus leaving no role for price substitution in the model. That assumption can be supported empirically by Santos *et al.* (2015), who shows that the relative exchange rate-elasticity of the goods imported by Brazil was very low under the period analyzed (1996-2013), especially when compared to their income-elasticity.

Each group's income and its allocation is shown in Table 1, below, where expression (1) was used to determine the employment level, with labor productivity constant. P_TC_T and $P_{NT}C_{NT}$ stand for the level of consumption of the outputs of sectors T and NT, respectively.

where $\tau_j W_j a_j Y_j = \Pi_j$ is the profit in each sector $j = NT, T$.

[4] In order to simplify the analytical solution of the model, we assume that domestic and foreign population growth rates, which determine growth rates of consumption of essential tradable goods, are the same.

Table 1 – Income allocation

Class	Income	Savings	$P_T C_T$	$P_{NT} C_{NT}$	Imports
(i)	$W_{NT} Y_{NT}$	0	A	$(1-m)(W_{NT} Y_{NT} - A)$	$m(W_{NT} Y_{NT} - A)$
(ii)	$W_T a Y_T$	0	A	$(1-m)(W_T a Y_T - A)$	$m(W_T a Y_T - A)$
(iii)	$\tau_{NT} W_{NT} Y_{NT}$	$s_\pi(\tau_{NT} W_{NT} Y_{NT})$	A	$(1-m)(\tau_{NT} W_{NT} Y_{NT} - A - s_\pi \tau_{NT} W_{NT} Y_{NT})$	$m(\tau_{NT} W_{NT} Y_{NT} - A - s_\pi \tau_{NT} W_{NT} Y_{NT})$
(iv)	$\tau_T W_T a Y_T$	$s_\pi(\tau_T W_T a Y_T)$	A	$(1-m)(\tau_T W_T a Y_T - A - s_\pi \tau_T W_T a Y_T)$	$m(\tau_T W_T a Y_T - A - s_\pi \tau_T W_T a Y_T)$

Nominal output in the non-tradable sector is, then:

$$P_{NT} Y_{NT} = P_{NT} C_{NT} + (1-\alpha)(I_{NT} + I_T) \tag{4}$$

Substituting the investment function (3) and consumption in Table 1 into equation (4) above, we get:

$$\begin{aligned} P_{NT} Y_{NT} = Y_{NT}\{(1-m)[(1-s_\pi) P_{NT\, s\pi} W_{NT}] + (1-\alpha)[g_y P_{NT} + g_\pi (P_{NT} - W_{NT}]\} + \\ + Y_T\{(1-m)[(1-s_\pi) P_{T\, s\pi} W_T a] + (1-\alpha)[g_y P_T + g_\pi (P_T - W_T a]\} - (1-m)4A + (1-\alpha)(g_{0\,NT} + g_{0\,T}) \end{aligned} \tag{5}$$

For the tradable sector, we get:

$$P_T Y_T = P_T C_T + x_0 - m_0 = 4A + x_0 - m_0 \tag{6}$$

Total imports are:

$$\begin{aligned} M = m_0 + m\{(1-s_\pi) P_{NT\, s\pi} W_{NT} + (1-s_\pi) P_{T\, s\pi} W_T a - 4A\} + \\ + \alpha\{g_{0\,NT} + g_{0\,T} + g_\pi[(P_{NT} - W_{NT}) Y_{NT} + (P_T - W_T a) Y_T] + g_Y [P_{NT} Y_{NT} + P_T Y_T]\} \end{aligned} \tag{7}$$

Total nominal output of the economy is then given by

$$P_{NT} Y_{NT} + P_T Y_T = P_{NT} C_{NT} + P_T C_T + I_{NT} + I_T + X - M \tag{8}$$

The rate of accumulation (or growth) in each sector will be measured by the investment function normalized by capital stock. Since capital productivity is constant, the rate of accumulation of capital is equivalent to the rate of output growth. Thus, we will refer to g_j as the sector's growth rate.

$$g_j = \frac{I_j}{K_j} = \frac{1}{K_j}[g_{0j} + g_\pi \Pi_j + g_y P_j Y_j] \ , \quad j = NT, T \tag{9}$$

We will solve the model for the level of output of each sector. It is important to state that, because labor productivity is constant, output changes can be represented as employment changes. Dividing equation (6) by P_T yields the solution for the output of sector T:

$$Y_T^* = \frac{4A + x_0 - m_0}{P_T} \tag{10}$$

Now, by substituting (10) into (5) we get the solution for sector NT:

$$Y_{NT}^* = \frac{\{(4A + x_0 - m_0)/P_T\}\Delta_T - (1-m)4A + (1-\alpha)(g_{0\,NT} + g_{0\,T})}{P_{NT} - \Delta_{NT}} \tag{11}$$

Where

$$\Delta_T = \{(1-m)[(1-s_\pi)P_T s_\pi W_T a] + (1-\alpha)[g_y P_T + g_\pi(P_T - W_T a]\}$$

and

$$\Delta_{NT} = \{(1-m)[(1-s_\pi)P_{NT} s_\pi W_{NT}] + (1-\alpha)[g_y P_{NT} + g_\pi(P_{NT} - W_{NT}]\}$$

The goods market (Keynesian) stability condition is found by analyzing the conditions for output adjustment in the presence of excess demand (BLECKER, 2011). Total output of the economy is:

$$\begin{aligned} PY = (1-m)\{W_{NT}Y_{NT} + W_T a Y_T + (1-s_\pi)[(P_{NT} - W_{NT})Y_{NT} + (P_T - W_T a)Y_T]\} + \\ +4Am + (1-\alpha)\{g_{0\,NT} + g_{0\,T} + g_\pi[(P_{NT} - W_{NT})Y_{NT} + (P_T - W_T a)Y_T] + g_y[P_{NT}Y_{NT} + P_T Y_T]\} + x_0 - m_0 \end{aligned} \tag{12}$$

The Keynesian stability condition is, then, represented by the following relation: $\frac{\partial(RH-LH)}{\partial Y_j} < 0$, for $j = NT, T$, where RH and LH represent the "right-hand-side" and "left-hand-side" of equation (12), respectively. This provides us with the two inequalities below:

$$\frac{\partial(RH - LH)}{\partial Y_{NT}} = -[(P_{NT} - W_{NT})(s_\pi - s_\pi m - (1-\alpha)g_\pi) + mW_{NT} - (1-\alpha)g_y P_{NT}] < 0$$

$$\frac{\partial(RH - LH)}{\partial Y_T} = -[(P_T - W_T a)(s_\pi - s_\pi m - (1-\alpha)g_\pi)mW_T a - (1-\alpha)g_y P_T] < 0$$

The sufficient conditions for the Keynesian stability to hold are: $(1-m)s_\pi > (1-\alpha)g_\pi$ and $m > (1-\alpha)g_y$[5].

[5] For profits to be positive, $P_{NT} > W_{NT}$ so that we get the condition $m > (1-\alpha)g_y$ for $mW_{NT} - (1-\alpha)g_y P_{NT} > 0$. It is analogous for the tradable sector

Comparative statics

First, raising the autonomous component of investment ($g_{0\,NT} + g_{0\,T}$) or the trade balance ($x_0 - m_0$) will increase total output through higher demand in both sectors. Second, a change in the level of consumption of essential goods (A) has an ambiguous effect on the non tradable sector. Starting with sector NT:

$$\frac{\partial Y_{NT}}{\partial A} = 4(1-m)\left\{(1-s_\pi) + s_\pi \frac{W_T a}{P_T} - 1\right\} + 4(1-\alpha)\left[g_y + g_{pi}\left(1 - \frac{W_T a}{P_T}\right)\right]$$

For profits to be positive, $P_T > W_T a$, so that the second part of the derivative is positive. The effect may be negative if the sum of $(1-s_\pi) + s_\pi \frac{W_T a}{P_T}$ is greater than one, and high enough to overcome the second positive part of the equation. The reason for that is related to the investment and consumption functions. While the essential consumption A reduces the remaining income, so that there is less income available for consumption in the non-tradable sector, an increase in A increases output in the tradable sector, so that it increases investment, making a counter-force. The effect is more likely to be positive if m and α are relatively small, as they create a demand leakage.

Changes in wage inequality, which can be represented by changes in W_{NT}, with W_T constant, affects the output of the non-tradable sector and, thus, the output composition of the economy.

In order to verify how it affects production in the non tradable sector, we calculate the corresponding partial derivatives relative to W_{NT}.

$$\frac{\partial Y_{NT}}{\partial W_{NT}} = -\left\{-\frac{\partial \Delta_{NT}}{\partial W_{NT}}\right\} \frac{\{(4A + x_0 - m_0)/P_T\}\Delta_T - (1-m)4A + (1-\alpha)g_o}{(P_{NT} - \Delta_{NT})^2} \tag{13}$$

The sign will depend on $\frac{\partial \Delta_{NT}}{\partial W_{NT}}$:

$$\frac{\partial \Delta_{NT}}{\partial W_{NT}} = (1-m)s_\pi - (1-\alpha)g_\pi$$

The sign of the impact of W_{NT} in Y_{NT} is, at first, ambiguous and depends upon whether $(1-m)s_\pi - (1-\alpha)g_\pi$ is positive or negative[6]. Rising wages in the non-tradable sector increases consumption by workers in this sector, since all remaining income goes to the non-tradable sector. Increasing income in the non-tradable sector increases output in this sector and, even thought profits may fall, if the term related to them in the investment function (g_π) is sufficiently small, the overall effect may be positive. The Keynesian stability condition provides us with the sufficient relation that guarantee this result.

[6] Note that the ambiguity of this result is due to the Kalecki-Steindl investment function type. If we consider the "canonical" investment function, as defined by Lavoie (2014), that is, if $g_\pi = 0$, the derivative is undeniably positive since m is positive and smaller than the unity and s_π is positive.

The impact on growth, in turn, can be negative even if the sufficient conditions for the Keynesian stability are taken into account, due to the downward pressure on profits in the Kalecki-Steindl investment function.

$$\frac{\partial g_{NT}}{\partial W_{NT}} = -g_\pi Y_{NT} + [g_\pi (P_{NT} - W_{NT}) + g_y P_{NT}] \frac{\partial Y_{NT}}{\partial W_{NT}} \tag{14}$$

The effect on total output will be of the same sign of the effect on the non-tradable sector, as sector T only produces essential consumer goods. The output composition, then, will also move towards a larger share of sector NT in the economy.

Another important analytical dimension is the effect of the reduction in wage inequality on the average propensity to import. Souto (2015), by estimating income elasticities of demand for imports in Brazil, using data from POF 2002-03 and 2008-09, shows that the income elasticity for imports increased in the period, especially for more impoverished families, who benefited most from income redistribution. The average propensity to import out of income is:

$$\overline{m} = \frac{M}{PY} = \frac{m_0 + \alpha(g_{0\,NT} + g_{0\,T}) - 4A}{PY} + (ms_\pi - \alpha g_\pi)\left(\frac{W_{NT}Y_{NT} + W_T a Y_T}{PY}\right) + m(1 - s_\pi) + \alpha(g_y + g_\pi) \tag{15}$$

To see how the reduction in wage inequality affects the average propensity to import in our model we need, then, one last exercise:

$$\frac{\partial \overline{m}}{\partial W_{NT}} = -\frac{\partial Y_{NT}}{\partial W_{NT}} \frac{P_{NT}(m_0 + \alpha(g_{0\,NT} + g_{0\,T}) - 4A)}{(PY)^2} + (ms_\pi - \alpha g_\pi)\left\{\frac{Y_{NT}}{PY} + \frac{W_{NT}}{PY}\frac{\partial Y_{NT}}{\partial W_{NT}}\left(1 - \frac{Y_{NT}P_{NT}}{PY}\right)\right\}$$

The overall effect is ambiguous, even if the Keynesian Stability condition holds. The fist term of the derivative is negative, since the impact of rising wages in the non-tradable sector also leads to higher output in that sector. The sign of the second term depends on whether $ms_\pi - \alpha g_\pi$ is positive of negative. The higher the response of the investment to profits, the more likely it is for the effect of reducing wage inequality to reduce the average propensity to import. This happens because rising non-tradable wages can reduce profits and, thus, reduce investment, which is in part imported. Although it increases the income of workers in sector NT, who will consume more imported goods, reducing profits also lowers capitalists' consumption, creating a counter-force to the increase in imports. This counter-force will be the higher, the smaller the propensity to save out of profits. As in Blecker (2011), we can face a trade-off when reducing inequality in an open economy model. Even though it can be expansionary in the output level, it may have an adverse effect on the trade balance.

A summary of the comparative static results is reported in Table 2 below.

Table 2 – Comparative statics summary

Shock variable	Response variable	Sign	Condition
$g_{0\,NT} + g_{0\,T}$	Y_{NT}	+	
A	Y_{NT}	+ / -	
	Y_T	+	
W_{NT}	Y_{NT}	+	if Keynesian stability
	Y_T	0	
	$Y = Y_{NT} + Y_T$	+	if Keynesian stability
	Y_T/Y_{NT}	-	if Keynesian stability
	$\overline{m}$	+ / -	

3 STABILITY ANALYSIS

In the last section, we analyze how changes in wage inequality affect output (and employment) in both sectors. We will now examine whether the relationship between employment composition and wage inequality is stable over time. Productivity will still be exogenous and constant, so that output changes will be equivalent to employment changes. Hence, changes in employment composition $l = L_T/L_{NT}$ can be represented by the difference in growth rates of the two sectors.

Equation (16) formalizes this relation, where for any variable X, $\widehat{X} = \frac{\partial X}{\partial t}\frac{1}{X}$ stands for its growth rate. Parameter $0 < \beta \leq 1$ measures how fast changes in the labor market occur, which depends on the rigidity of employment contracts and the labor market. The higher the value of β[7], the easier it is for employers to hire new workers, but also to dismiss them in an unfavorable situation.

$$\widehat{l} = \beta(g_T - g_{NT}) \tag{16}$$

Substituting the investment equation (3) and assuming constant productivity (1), expression (16) gives:

$$\widehat{l} = \beta\{g_\pi[(P_T/a - W_T)L_T - (P_{NT} - W_{NT})L_{NT}] + g_y(P_T L_T/a - L_{NT}P_{NT})\} \tag{17}$$

As developed in the last section, employment composition responds to changes in wage inequality, which will be represented by the parameter θ:

$$\frac{\partial \widehat{l}}{\partial \omega} = \beta\theta \ \begin{matrix} \geq \\ < \end{matrix} 0$$

where θ is positive (negative) if $\dfrac{\partial \frac{\Delta_T}{\Delta_{NT}}}{\partial W_{NT}}$ is negative (positive), i.e. if a reduction in wage inequality changes employment composition so as to increase (reduce) the relative size of the non-tradable sector[8].

[7] When $\beta < 1$, productivity will not be constant in a very short run, that is the time period that takes until all workers are hired.

[8] In the last section we have shown that the Keynesian stability condition is a sufficient condition for θ to be positive, but it is not a necessary one.

Changes in employment composition l also affects $\widehat{l}$[9]:

$$\frac{\partial \widehat{l}}{\partial l} = \beta\{g_\pi[(P_T/a - W_T)L_{NT} + (P_{NT} - W_{NT})l^{-2}L_T] + g_y(P_T L_{NT}/a + l^{-2}L_T P_{NT})\} \\ = \beta\mu \ > 0 \tag{18}$$

where $\mu = g_\pi[(P_T/a - W_T)L_{NT} + (P_{NT} - W_{NT})l^{-2}L_T] + g_y(P_T L_{NT}/a + l^{-2}L_T P_{NT}) \ > 0$

We also expect prices and wages to change in response to variations in employment composition, bargaining powers of workers and employers, and international prices. We assume that nominal wages grow according to expressions (19) and (20) below. Parameters $\sigma_j > 0$, for $j = NT, T$, measure the bargaining power of workers in each sector, which can be affected by the degree of unionization or labor regulation in each sector. Greater formalization of services, for example, will affect the bargaining power positively in sector NT, but will not significantly change bargaining power in sector T.

$$\widehat{W}_{NT} = \sigma_{NT} l^{-1} \tag{19}$$

$$\widehat{W}_T = \sigma_T l - \phi_\pi[W_T - W_T^\pi(l)] \tag{20}$$

Following the post-Keynesian 'conflicting claims' approach, as called by Blecker (2011) and originally postulated by Weintraub (1958) and Rowthorn (1977), nominal wage growth in the tradable sector faces the resistance of capitalists, who cannot pass higher costs into prices such as in the non-tradable sector. As defined in the last section, the tradable sector has internationally given prices, so that its mark-up needs to adjust to any changes in unit labor costs, making capitalists in that sector more resistant to raising wages. As in Blecker (2011)[10]. Although workers are more concerned about real wages, the conflict with capitalists is usually over nominal wages. In that sense, capitalists in the tradable sector will set a desired (or target) nominal wage, represented by $W_T^\pi(l)$, that is the nominal wage compatible with their desired profit rate. If the nominal wage in the tradable sector (W_T) is higher than the desired one, wages in the tradable sector will grow slower since $(W_T - W_T^\pi) > 0$. On the other hand, if the current wage is lower than the capitalist's desired wage, that is if $(W_T - W_T^\pi) < 0$, nominal wages in the tradable sector can grow faster because capitalists will be less resistant to losing profit margins. The magnitude of this effect will depend on parameter ϕ_π (> 0).

[9] For this derivation, we divided and multiplied the employment level of one sector by the other in order to show the l ratio explicit, that is, $\widehat{l} = \beta\{g_\pi[(P_T/a - W_T)lL_{NT} - (P_{NT} - W_{NT})l^{-1}L_T] + g_y(P_T lL_{NT}/a - l^{-1}L_T P_{NT})\}$.

[10] In Blecker (2011) workers and capitalists bargain over the wage share, setting up their targets, which determine the trajectory of prices and wages. Here we consider that only wages of the tradable sector can be influenced by the conflict, due to the international competitive characteristic of the sector. Capitalists set their target, or their desired nominal wage, even though the target is influenced by the bargaining power of workers, as defined in (21).

The desired profit rate of tradable sector's capitalists will depend inversely on the composition of employment of the economy (the l ratio), that is:

$$\frac{\partial W_T^{\pi}(l)}{\partial l} = -\gamma < 0 \tag{21}$$

where $\gamma > 0$ represents the bargaining power of capitalists over their desired profit rate, as represented by their desired nominal wage. The reason for that formulation is related to the assumption about the difference in the supply of workers in both sectors. Because we assume that workers from T sector need more specialized training or higher skills, changes in the composition of employment will have a more substantial impact in this sector. The more sector T incorporates workers, the higher is the cost of hiring new workers in this sector, since less qualified workers will require for employers to cover an additional training cost. As a consequence, capitalists will bargain over lower nominal wages to compensate this additional cost and avoid reducing profit margins.

Combining equations (20) and (19), equation (22) shows how wage inequality will evolve over time:

$$\widehat{\omega} = \widehat{W}_T - \widehat{W}_{NT} = \sigma_T l - \phi_{\pi}[W_T - W_T^{\pi}(l)] - \sigma_{NT} l^{-1} \tag{22}$$

Wage inequality growth responds ambiguously to the employment composition and negatively to the inequality level[11]:

$$\frac{\partial \widehat{\omega}}{\partial l} = \sigma_T + \sigma_{NT} l^{-2} - \phi_{\pi}\gamma \quad \underset{<}{\overset{>}{}} \; 0 \tag{23}$$

$$\frac{\partial \widehat{\omega}}{\partial \omega} = -\phi_{\pi} W_{NT} \quad < 0 \tag{24}$$

Inspired by the dual adjustment process developed by Bruno (1999) and Bhaduri (2008), we will divide the stability analysis into two different processes before studying their combined effect for overall stability. We have, then, a system of differential equations regarding those adjustments:

$$\widehat{l} = f(l, \omega)$$
$$\widehat{\omega} = h(l, \omega)$$

To analyze stability we need to look at the Jacobian matrix related to equations (16) and (22):

$$J = \begin{bmatrix} \frac{\partial \widehat{l}}{\partial l} & \frac{\partial \widehat{l}}{\partial \omega} \\ \frac{\partial \widehat{\omega}}{\partial \omega} & \frac{\partial \widehat{\omega}}{\partial l} \end{bmatrix} = \begin{bmatrix} \beta\mu & \beta\theta \\ \sigma_T + \sigma_{NT} l^{-2} - \phi_{\pi}\gamma & -\phi_{\pi} W_{NT} \end{bmatrix}$$

where

[11] Here we also divided and multiplied equation (22) by W_{NT} in order to make parameter ω explicit.

$$Det(J) = -\beta\mu\phi_\pi W_{NT} - \beta\theta(\sigma_T + \sigma_{NT} l^{-2} - \gamma\phi_\pi)$$

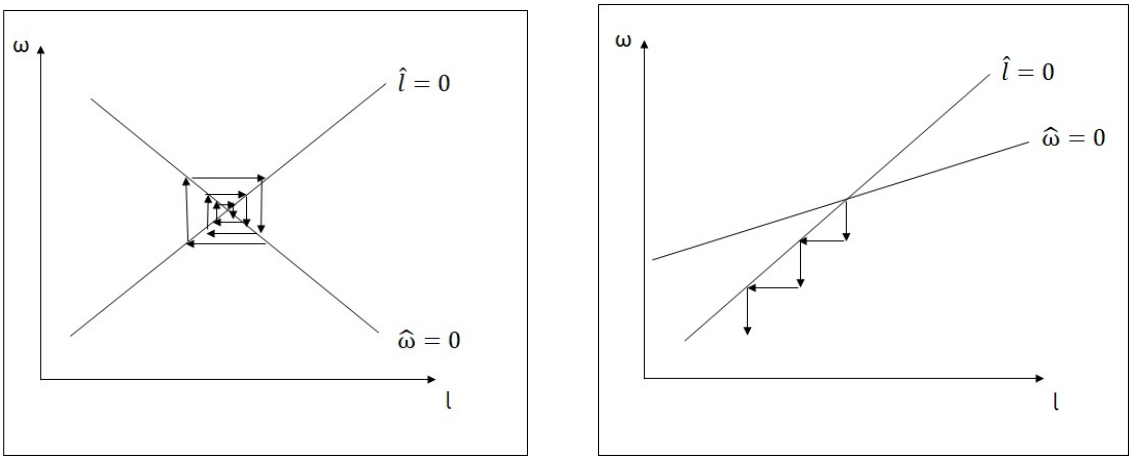
$$Tr(J) = \beta\mu - \phi_\pi W_{NT}$$

Stability results will depend on the sign of the determinant and the trace of matrix J. It leads us to six cases, shown in the Table 2.

Table 3 – Stability results

Det (J)	$-\beta[\mu\phi_\pi W_{NT} + \theta(\sigma_T + \sigma_{NT} l^{-2} - \gamma\phi_\pi)]$		
Tr (J)	$\beta\mu - \phi_\pi W_{NT}$		
	Conditions		**Overall Stability**
$\theta > 0$	Det(J) >0	Tr (J) <0 $\beta\mu < \phi_\pi W_{NT}$	(A) Stable
	$\sigma_T + \sigma_{NT} l^{-2} < \gamma\phi_\pi$	Tr (J) >0 $\beta\mu > \phi_\pi W_{NT}$	(B) Unstable
	Det (J) <0 $\sigma_T + \sigma_{NT} l^{-2} > \gamma\phi_\pi$		(C) Unstable
$\theta < 0$	Det (J) >0	Tr (J) <0 $\beta\mu < \phi_\pi W_{NT}$	(D) Stable
	$\sigma_T + \sigma_{NT} l^{-2} > \gamma\phi_\pi$	Tr (J) >0 $\beta\mu > \phi_\pi W_{NT}$	(E) Unstable
	Det (J) <0 $\sigma_T + \sigma_{NT} l^{-2} < \gamma\phi_\pi$		(F) Unstable

Figure 2 – Phase diagrams



(a) Stable case A

(b) Unstable case C

For each sign of θ we have a stable and two unstable situations, depending on the sign of $\sigma_T + \sigma_{NT} l^{-2} - \gamma\phi_\pi$ and on the sign of the trace ($\beta\mu - \phi_\pi W_{NT}$). As seen in the last section, the Keynesian stability condition is a sufficient condition for θ to be positive. To better understand this results it is interesting to look at the unstable situations. Because the markup in the non-tradable sector is exogenous and constant, prices and nominal wages in the non-tradable sector evolve according to ($\widehat{P}_{NT} = \widehat{W}_{NT}$).

The case where θ is positive represents the case where an increase in wages in the non-tradable sector increases the share of the same sector on total output (or employment). The instability of this case is, then, related to the presence of two forces operating in the same direction: an increase in wages in the non-tradable sector creates costs pressures and, at the same time, demand pressures (θ positive), making prices grow in an explosive way (Figure 2b). To stabilize the system, we need a weak bargaining power of workers, so as to reduce wage growth and the cost pressure on prices. Besides, a slow speed of adjustment of employment, that is, a lower β, also helps stabilize the economy. In other words, it increases the likelihood of condition (A) for the trace to be negative by reducing demand pressure (Figure 2a).

When θ is negative, on the other hand, reducing wage inequality increases the share of the tradable sector on total output. The last unstable situation (F) is exactly the one where workers have a reduced bargaining power. Because of that, capitalists from the tradable sector will be able to increase their desired profits, as represented by a reduction in the nominal wage paid by the tradable sector, possibly reducing even more wage inequality and creating a spiral toward the increase in the share of the tradable sector. This unstable process could reach a limit given by labor supply for instance. If the bargaining power of workers is strong enough so as to prevent tradable sector's wages to grow as slow as capitalists would desire, the pressure on the employment composition would be reduced and, then, the economy could achieve a stable path. Again, in this case, for the trace to be negative, it is important for parameter β to be small, that is, for changes in employment to occur slowly.

What is important to note is that, depending on the sign of θ, policy implications vary considerably. In the first situation, where θ is positive, stability requires the bargaining power of workers do be weak. When θ is negative, on the other hand, we need workers to have greater bargaining power to stabilize the economy. A common conclusion is that in both cases, β needs to be small for stability, meaning that the labor market needs to be regulated enough to avoid rapid hiring and dismissals. In the first case, however, it probably needs to be even smaller, as stability requires ϕ_π to be high enough for the bargaining power of capitalists to trump workers.

4 CONCLUDING REMARKS

This paper aimed to contribute to the Kaleckian literature by incorporating two other inequality dimensions into the relationship between aggregate demand and income distribution: sectoral heterogeneity and wage inequality. This extension was motivated by the recent experience of Brazil and other developing economies in combining higher growth rates and higher income growth at the bottom of the distribution through the reduction of wage disparities between low-skilled workers – mostly employed in services and construction – and medium-skilled workers – employed in basic manufacturing activities.

The open economy model we developed has two sectors and two types of workers. While the low-productivity non-tradable sector hires workers with lower wages and faces an income-elastic demand for its products (e.g. personal services, construction), the tradable sector pays higher wages and meets an entirely autonomous (domestic and foreign) consumption demand. Given the country's deficient

productive structure, we assume that more technologically complex consumption goods facing a higher income-elasticity, as well as capital goods (such as machinery and equipment), are imported.

Short-run equilibrium results suggest that a reduction in wage inequality, as represented by an increase in wages at the non-tradable sector, moves output (and employment) toward the non-tradable sector, as long as the Keynesian stability condition holds. Moreover, the higher the propensity to import out of income, the lower the multiplier effect of reducing wage inequality.

The average propensity to import, in its turn, will respond to wage inequality ambiguously, depending on the magnitude of the propensity to import out of income and on the sensibility of investment to profits. If this sensibility is high and profits fall when wages in the non-tradable sector increase, investment will fall, pushing down total imports. The total effect on the average propensity to import will be the smaller, the higher is the response of non-tradable output to the reduction in wage inequality (that is, the higher the multiplier).

Taking into account price dynamics and bargaining conflicts over wages, different stability results arise that temporally depend on the quantity and price adjustment processes. First, the Keynesian stability condition is a sufficient condition for the reduction in wage inequality to increase the share of the non-tradable sector in the economy. However, the system's overall stability is not guaranteed.

Unstable dynamics related to an explosive trajectory of non-tradable sector prices and wages may arise, thus mimicking the acceleration of services inflation observed in Brazil and other South American economies throughout the re-distributive process of the 2000's. This type of instability arises when two forces operate in the same direction: (i) demand pressures, as the increase in non-tradable sector's wages moves output toward the non-tradable sector, (ii) cost pressures, as higher bargaining power of workers prevent a reduction of the wage share. To stabilize the system in this case requires for the bargaining power of workers to be weaker, and for labor regulations to be strong enough to slow down the response of employment to changes in output.

If the Keynesian stability condition does not hold, a reduction in wage inequality increases the share of the tradable sector in total output. Instability in this case arises as a spiral in which the tradable sector increases its share in output while its nominal wage falls. For the economy to be stable in this scenario, the bargaining power of workers has to be higher than that of capitalists, and employment adjustment needs to be slower.

In general, our results show that the path to combine lower inequality and higher economic growth may face inherent difficulties that go beyond political disputes. By moving the economic structure towards non-tradable sectors, the redistribution of income towards workers at the bottom of the distribution may lead to deepening trade imbalances as well as inflationary pressures. Making the "equalizing spiral" sustainable in the long-run would thus require complementing the distributive effort with policies aimed at diversifying the industrial structure and boosting labor productivity. Incorporating such long-run aspects should be the subject of future developments in this research agenda.

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