Sectoral heterogeneity and wage inequality in Brazil: a Kaleckian-inspired model

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Abstract

The relative success of the Brazilian and other South American countries' economy in combining high growth rates with a reduction of wage inequality can be better understood by placing income distribution into the center of growth analysis. Basing such analysis in the Neo-Kaleckian framework, we intend to contribute to the theoretical literature by building a two-sector open economy model that incorporates wage inequality. In that context, the dynamics between wage inequality and employment composition are analyzed, in which different stability results arise depending on the speeds of adjustment of those two variables.

Keywords: growth, distribution, wage inequality, employment composition, Kaleckian model.

1 INTRODUCTION

Post-Keynesians have always attributed an important role to inequality and income distribution in their theory since it is directly related to aggregate demand. By stating that the propensity to save can differ among individuals, income distribution changes total consumption and impacts growth. The study of inequality, however, can be conducted along several dimensions of the economy, such as income or wealth inequality between countries, regions, workers or classes, and personal or functional inequality.

In the Kaleckian framework, the most common dimension of inequality analyzed is the functional inequality, where the saving rate out of wage income is assumed to be lower (or even null) than the saving rate out of profit income. Changes in the functional distribution of income are followed by changes in demand so that the countries' regimes of demand and growth are classified as wage- or profit-led. If the increase in the share of profits raises investment in a way that more than compensates the reduction in consumption, positively affecting the

degree of capacity utilization, the demand regime is profit-led and, hence, its growth regime is also profit-led, since the rate of accumulation of capital responds positively to increases in capacity utilization. On the other hand, if the share of profits in income reduces the degree of capacity utilization, that is, the sensitivity of consumption to the profit share is higher than that of investment, the demand regime of the country is called wage-led. The growth regime, in this case, can be either profit-led or wage-led, depending on the form of the investment function and the parameters of the economy.

Other inequality dimensions, however, are being incorporated into Kaleckian models. Carvalho and Rezai (2016) introduce personal inequality to the model and they conclude that the reduction in wage inequality has a positive impact on demand, even when the demand regime of the country is profit-led. Additionally, "changes in the saving rate [due to changes in personal distribution of income] also reduces the multiplier and capacity utilization with more subtle effects on investment and saving and, overall, ambiguous effects on the demand regime", that is, "higher inequality pushes the demand regime towards being more 'profit-ledness'."(CARVALHO; REZAI, 2016, p. 497-8).

Taylor and Bacha (1976), Taylor (1989), Dutt (1990), Dutt (1997), Park (1997), Fujita (2015) and Nishi (2018) incorporate sectoral heterogeneity in the baseline model, where inequality is 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, while growth depends on the response of investment function of each sector in relation to the rate of profit. 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.

These contributions have been especially significant for understanding specific economies or events. As argued by Rugitsky (2017), even though developed economies tend to be more homogeneous in terms of sectoral productivity, multi-sectoral models are still necessary for understanding developing economies. Leaving aside the single commodity assumption can also shed light on consumption patterns and behavior that are relevant for inequality results, as shown by Taylor and Bacha (1976).

The recent experience of South American countries is an example of how incorporating other inequality dimensions can help better understand their development trajectory. In the first decade of the twenty-first century, Brazil and other South American countries, such as Argentina, Bolivia, Ecuador, Uruguay, and Venezuela, were able to combine income distribution and growth. 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). Real GDP in

Argentina, Bolivia, Ecuador, Uruguay and Venezuela grew 6.2%, 4.6%, 4.8%, 5.9% and 6.5% between 2004 and 2011, respectively. During the same period, the GINI coefficient fell from 0.48 to 0.41 in Argentina; 0.56 (2005 value) to 0.44 in Bolivia; 0.52 to 0.44 in Ecuador; 0.45 (2006 value) to 0.41 in Uruguay; and in Venezuela it fell from 0.43 (2006 value) to 0.41, according to data from the World Bank (for Argentina), IMF (other countries) and Socio-Economic Database for Latin America and the Caribbean (for the GINI coefficients).

Some recent studies that use Brazilian tax data, however, have shown that the reduction in inequality was confined to the base of the income distribution, with the reduction of the wage disparity, but the share appropriated by the richest remained stable (Gobetti, Orair *et al.* (2015), Medeiros, Souza and Castro (2015), Medeiros and Castro (2018) and Souza and Medeiros (2015)). Medeiros, Souza and Castro (2015) show that the inequality was higher than that when calculated from household survey data, given that the latter tends to underestimate income at the top of the distribution. They found that between 2006 and 2015 the portion of income appropriated by the richest 1% in Brazil was just under 25% of total income and the richest 0.1% held 11%. In addition, they concluded that there has been no downward trend in recent years, i.e. they were not influenced by the reduction of inequality evidenced in the household surveys. Even though the reduction in inequality was restricted to wage income, this was still relevant, since it affects consumption composition and changes the output (and employment) composition, as it will be shown in the theoretical model later on.

The first and second Lula government period, from 2003 to 2010, were based on two main strategies: the expansion of mass consumption through policies of economic inclusion of the less favored and increases in household credit, and the rise in public investment in social infrastructure[1] (CARVALHO; RUGITSKY, 2015).

The expansion of consumption, if accompanied by changes in consumption patterns, together with technical progress, constitutes a fundamental vector of the process of structural change that characterizes economic development (MEDEIROS, 2015). As lower income individuals have a higher propensity to consume out of income increasing their income increases consumption, but not in a homogeneous way. “Income distribution, in addition to its impact on effective demand, may have an impact on demand composition, if the consumption baskets of households from different income groups differ significantly” (RUGITSKY, 2017). That can be theoretically understood with Engel’s law. As an individual income rises, it increases the share of services and manufactured goods consumed, given that these goods have, characteristically, high income-elasticity. Carvalho *et al.* (2016) look at the participation of specific products in relation to total consumption, based on Household Budget Research (POF). The following process becomes evident: for classes earning under 2 minimum wages, between 2003 and 2008, the participation in total consumption of fresh and industrialized food declined from 14.25 and

[1] Public investments grew, on average and real terms, 27.6% per year between 2006 and 2010, according to Brazilian Institute of Geography and Statistics (IBGE) data.

18.52 to 10.61 and 13.31, respectively, while electronic and communication equipment and other services[2] increased from 1.45 and 1.12 to 3.04 and 1.39, respectively. Additionally, according to data from the Central Bank of Brazil, the share of services in household consumption increased substantially on the base of income distribution, increasing less and less as the income scale rises (CARVALHO; RUGITSKY, 2015).

This change in demand composition impacts prices and production, but it had a particular effect on the composition of Brazilian employment structure since part of the new products consumed by the families, or part of their production process, were fulfilled by imports, given the overvaluation of Real and the characteristics of the Brazilian productive structure. Nominal exchange rate started at 2.89 R$/US$ in 2003, achieving its lowest value (in the period analyzed) of 1.67 R$/US$ in 2010. Santos *et al.* (2015) analyze the relative income- and exchange rate-elasticity of goods and services imported by Brazil, and conclude, that given the Brazilian productive structure, the evolution of imports in the last decade counted on an indirect effect of the increase in household income (LOUREIRO, 2018).

The goods whose internal production grew relatively more were, then, the non-tradable goods, such as services, construction, transports and recreation activities. These sectors had their capacity expanded, boosting employment demand and affecting employment composition. The rise in demand of the sectors from which families increased their consumption, coupled with the greater formalization of employment and the minimum wage hikes, made the average wage in this sectors grow faster than in the others that had their relative participation in employment reduced. Figure (1), shows the evolution of the employment and the average wage in some selected sectors[3] - construction, furniture, and products of various industries, maintenance and repair services, services provided to families and associations and domestic services - over the remaining sectors of the economy.

Medeiros (2015) argues that "[e]conomicaly, [...] the main movement [for the increase in the formalization of employment] was the increase in demand, due to a rise in domestic consumption and changes in consumption patterns associated with both income growth and credit diffusion. Consumption was displaced for goods and services regularly offered in cities markets, leading to an increase in employment in larger establishments."[4].

The difference in the growth rate of minimum and average wage was also crucial for the reduction in wage inequality and ensures an increase in income at the base of the distribution, given that these sectors are characteristically labor-intensive, that is, the jobs created

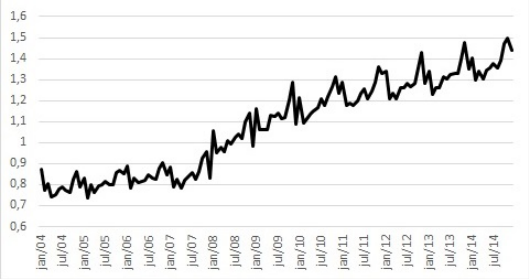
[2] Other services include maintenance and repair services, associative services and services provided for companies.

[3] To select these sectors we used data from Family Budget Surveys (POF) of 2002-03 and 2007-08 for consumption and of National Account System (SCN) for employment, aggregate value and imports, during the years of 2003 and 2008 - we selected these years to ensure compatibility with the two POF's available. At first, we eliminated the intermediate sectors and those with an import coefficient above the average. After doing that, the remaining sectors had to meet three requirements to be selected: consumption growth above average, employment growth above average and productivity level under the average.

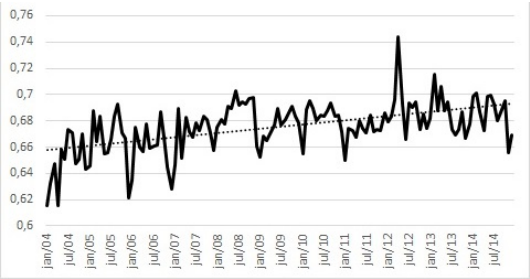
[4] Translated from the original by the author.

Figure 1 – Employment composition and relative wages
Source: Employee and Unemployed Register (CAGED)

(a) Relation between employment composition and relative wages



(b) Employment composition



(c) Relative wages

are mainly filled by more impoverished and low-skilled workers. Rugitsky (2017) summarizes this mechanism by arguing that increasing the income of the poorest populations, - as a consequence of the extension of state pensions, the government income transfer program and minimum wage hikes -, along with the formalization of the labor market, impacts the economy in a way to create a positive feedback mechanism in which income distribution, changes in consumption patterns and changes in the composition of the productive structure (and employment) are circularly related and reinforceing each other.

To better understand how the employment (and output) composition and the wage inequality are related, we built a two-sector Kaleckian model in which we analyze some static dynamics and stability results regarding different adjustment processes. Although the recent Brazilian experience inspired us, the very nature of constructing a model prevents us from being too ambitious in representing it in every detail. We will, however, build on the Brazil experience to characterize the structure of the model in a stylized way. The next section presents the developed theoretical model and some comparative static dynamics. The third section analyzes the stability of the economy taking into account different adjustment processes of the employment composition and of the relative wages. Finally, a summary and the main conclusions are presented in the last section.

2 MODEL

We assume an open economy with two sectors simplified as follows: sector NT produces non-tradable goods with a lower productivity (related both to capital and labor). Compared to the tradable one the NT sector is labor-intensive, e.g., services and construction. The second sector (T) produces tradable goods that can be used both for investment and consumption, that are thought of as essential commodities, such as food, energy, and clothes. Technological change is not considered so that productivity is constant. The consumption of sophisticated and technological goods will be supplied by imports, given that we consider a time period in the model where it is impossible to have a structural change in the economy so that the national productive structure is not able to meet such demand. Recalling the Brazilian experience, that specification can represent 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 external, there is a "leakage of demand" represented by rising imports.

Similar to Taylor (1989)[5], capital is pre-determined in each sector, allowing them to have different profit rates and capacity utilization. A sector's productive function is of Leontief fixed-coefficient form, there is excess capacity and labor force grows at the same rate as the capital stock so that labor and capital do not impose supply constraints. Each sector hires only one kind of worker and pays different wages so that wage inequality between sectors is incorporated. Production determines the employment level 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, changing employment composition will have a different effect for each sector. Because 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" of the sectors is not proportionally equal. 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 some training. This assumption does not affect the results in this section but will have an important role in the stability analyses.

[5] Taylor (1989) assumes that the capital stock in both sectors is pre-determined, does not depreciate and there is no mobility between the 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, such as other variables like profit rates and the ratio of the output of the two sectors. In our model, capital will be pre-determined, even when the adjustment of quantities and prices is considered.

Prices are set by a markup rule, but they have a different dynamic in each sector: the non-tradable sector has flex prices and an exogenous markup while the tradable one has internationally given prices and flexible markups. This assumption holds because sector T faces foreign competition and the international market determines its prices. Here the sector T markup needs to adjust to any cost changes, while sector NT can adjust prices without changing its markup. For simplicity, the 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 $j = NT, T$ - $\bar{\tau}_{NT}$ fixed. Because of how the sectors were characterized, $a_{NT} > a_T$ and $W_{NT} < W_T$, where W_j is the nominal wage. Wage inequality will be measured by the 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 (but in terms of the level of output, instead of normalized by the capital stock). It depends, then, on the sectoral nominal output ($P_j Y_j$), sectoral profits (Π_j), for $j = NT, T$, and on an exogenous term ($\frac{g_0}{2}$) that reflects the animal spirits of firms or the expected sales' growth.

$$I = \frac{g_0}{2} + g_\pi \Pi_j + g_y P_j Y_j \tag{3}$$

Two classes are considered (workers and capitalists) in each sector, so that we have four income groups: (i) workers hired by NT sector, (ii) workers employed by T sector, (iii) capitalists of sector NT and (iv) capitalists of sector T. As traditionally assumed in Kaleckian models, workers do not save and capitalists save $1 > s_\pi > 0$ of profits. The four classes consume an amount $0 < A < W_{NT}$ of the tradable good (from sector T), understood as subsistence consumption. The remaining income will be, then, used for imports or consumption from the NT sector. 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 services and in "luxury goods", that is, technological and sophisticated goods.

The propensity to import out of income $0 < m < 1$ is equal for all four groups and total imports also have an exogenous term m_0. Exports will be considered exogenous ($X = x_0 > 0$) since they depend on income from the rest of the world. In our model, we do not take into account the exchange rate effect on the trade balance. We are aware that this is a simplification, but including its impact would make the analyses too complicated and could compromise some aspects of the model that we consider more relevant for our primary interest, that is the relation between employment composition and relative wages. Besides, we defined the sectors in a way that the four income groups import technological goods because they are not available internally so that there is no substitution by prices. 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, especially when comparing to their income-elasticity, concluding that the main reason for rising imports in the last decade was the income increase of families.

Each group's income and its allocation is shown in Table (1), below, where we used equation (1) to substitute the employment level given that productivity is considered constant. $P_T C_T$ and $P_{NT} C_{NT}$ are the consumption in sectors T and NT, respectively.

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 each sector is, then:

$$P_{NT} Y_{NT} = P_{NT} C_{NT} \tag{4}$$

$$P_T Y_T = P_T C_T + I_T + I_{NT} + x_0 - m_0 \tag{5}$$

The total nominal output of the economy is

$$P_{NT} Y_{NT} + P_T Y_T = P_{NT} C_{NT} + P_T C_T + I_{NT} + I_T + X - M \tag{6}$$

The rate of accumulation (or growth) in each sector will be measured by the investment function normalized by the capital stock. Since 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 growth rate.

$$g_j = \frac{I_j}{K_j} = \frac{1}{K_j}[\frac{g_0}{2} + g_\pi R_j + g_y P_j Y_j] \ , \quad j = NT, T \tag{7}$$

We will solve the model for the level of output of each sector. It is important to state that, because productivity is constant, output changes can also be represented as employment changes. Substituting (3) and using the consumption functions shown in Table (1) into (4) and (5) we get the following system:

$$\begin{bmatrix} P_{NT}(s_\pi + m - s_\pi m) - (1-m)s_\pi W_{NT} & -(1-m)[W_T a s_\pi + (1-s_\pi)P_T \\ -[P_{NT}(g_y + g_\pi) - g_\pi W_{NT}] & P_T(1 - g_y - g_\pi) + g_\pi W_T a \end{bmatrix} \begin{bmatrix} Y_{NT} \\ Y_T \end{bmatrix} =$$

$$= \begin{bmatrix} -(1-m)4A \\ 4A + g_0 + (x_0 - m_0) \end{bmatrix}$$

Solving the system by Cramer's rule, we get the solution:

$$Y_{NT}^* = \frac{\Delta_{NT}}{\Delta} \tag{8}$$

$$Y_T^* = \frac{\Delta_T}{\Delta} \tag{9}$$

where Δ represents the determinant of the coefficient matrix and Δ_j is the determinant of the matrix obtained by replacing one column with the column vector of the right-hand side:

$$\Delta = P_{NT}P_T(s_\pi + m - s_\pi m - g_y - g_\pi) - P_{NT}W_T a[mg_\pi - s_\pi g_y(1-m)] + \\ + W_{NT}P_T(1-m)[s_\pi(g_y - 1) + g_\pi]$$

$$\Delta_{NT} = (1-m)\{P_T[4A(g_\pi + g_y - s_\pi) + (1-s_\pi)(g_o + x_0 - m_0)] + W_T a[4A(s_\pi - g_\pi) + s_\pi(g_0 + x_0 - m_0)]\}$$

$$\Delta_T = P_{NT}[(4A + g_0 + x_0 - m_0)(s_\pi + m - s_\pi m) - 4A(1-m)(g_\pi + g_y)] - \\ - W_{NT}(1-m)[4A(s_\pi - g_\pi) + s_\pi(g_o + x_0 - m_0)]$$

2.1 Comparative static exercises

By first analyzing this result some comparative statistical analysis can be done. Raising the autonomous component of investment (g_0) or the trade balance ($x_0 - m_0$) will increase the total output of the economy through a greater aggregate demand in both sectors. For the tradable sector, there is at first a direct effect since they are elements from the definition of that sector output. The effect on the non-tradable sector originates from the demand spillover of rising output (and employment) in the tradable sector, which leads to an increase in consumption in the non-tradable sector. However, the effect does not stop there. Rising income increases investment and the multiplier effect occurs. The effect will be smaller the higher the propensity to save out of profits and the propensity to import out of income due to the demand leakage that they represent. A less obvious effect is a change in the subsistence consumption (A). For the non-tradable sector, the effect is ambiguous:

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

For profits to be positive, $P_T > W_T a$, so that the effect will be negative if $s_\pi > g_\pi$ and $P_T g_y < (s_\pi - g_\pi)(P_T - W_T a)$. The Keynesian stability condition will give us $s_\pi > g_\pi$, but the ambiguity remains. The reason for that ambiguity is also related to the multiplier effect: even if the increase in the subsistence consumption (A) means lower remaining income and, consequently, lower consumption in the non-tradable sector, it can raise the tradable output and, then, have a positive counter effect. The effect on the tradable output will also be ambiguous due to the possible negative effect on the non-tradable output, which can lower investment.

$$\frac{\partial Y_T}{\partial A} = \frac{4}{\Delta}\{(1-m)[(s_\pi - g_\pi)(P_{NT} - W_{NT}) - g_y P_{NT}] + mP_{NT}\}$$

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

$$\begin{aligned} PY = (1-m)\{W_{NT}Y_{NT} + W_T a Y_T + (1-s_\pi)[(P_{NT} - W_{NT})Y_{NT} + (P_T - W_T a)Y_T]\} + \\ +4Am + g_0 g_\pi[(P_{NT} - W_{NT})Y_{NT} + (P_T - W_T a)Y_T] + g_y[P_{NT}Y_{NT} + P_T Y_T] + x_0 - m_0 \end{aligned} \tag{10}$$

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 (10), respectively. This provides us with the two inequalities below:

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

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

The sufficient conditions for the Keynesian stability to hold are: $s_\pi > g_\pi + s_\pi m$ and $m > g_y$.

Changes in wage inequality, that can be represented by changes in W_{NT}, if W_T remains constant, impacts both sectors, but in different ways since consumption patterns are different and investments are made with sector T goods. To see how it affects the production of each sector we calculate the respective derivatives relative to W_{NT}. Comparative statics regarding changes in the tradable sector wages can be found in the Appendix.

$$\frac{\partial Y_{NT}}{\partial W_{NT}} = -\Delta_{NT}\frac{P_T(1-m)[s_\pi(g_y - 1) + g_\pi]}{\Delta^2} \tag{11}$$

The sign of the impact of W_{NT} in Y_{NT} is, at first, ambiguous and depends upon whether $s_\pi(g_y - 1) + g_\pi$ is positive or negative. Since $1 > g_y > 0$, the first term is negative. The derivative

will be positive if $s_\pi > g_\pi + s_\pi g_y$[6]. Rising wages in the non-tradable sector increases consumption by workers, since all remaining income goes to the non-tradable sector, but the final effect will depend on what happens with profits on both sectors. If profits in the non-tradable sector falls not only the consumption over profits will be reduced, but it also causes a downturn pressure on investment and, consequently, profits of the tradable sector can be reduced, so that the overall effect in the non-tradable sector is not obvious. The Keynesian stability condition, however, provides us with two sufficient relations that guarantee this result. Since it gives us $s_\pi > g_\pi + s_\pi m$ and $m > g_y$, it follows that $s_\pi > g_\pi + s_\pi g_y$. The impact on growth, in turn, can be negative even if the sufficient conditions for the Keynesian stability are considered, due to the downturn pressure on profits in a Kalecki-Steindl investment function.

$$\frac{\partial g_{NT}}{\partial W_{NT}} = -g_\pi Y_{NT} + [g_\pi(P_{NT} - W_{NT}) + g_y P_{NT}]\frac{\partial Y_{NT}}{\partial W_{NT}} \tag{12}$$

For the tradable sector, however, the sign of $\frac{\partial Y_T}{\partial W_{NT}}$ is ambiguous, even if Keynesian stability is assumed to hold:

$$\frac{\partial Y_T}{\partial W_{NT}} = -\frac{(1-m)\{4A(s_\pi - g_\pi) + s_\pi(g_0 + x_0 - m_0) + Y_T P_T[(g_y - 1)s_\pi + g_\pi]\}}{\Delta} \tag{13}$$

The effect will be positive, if $Y_T P_T[(1-g_y)s_\pi - g_\pi] > 4A(s_\pi - g_\pi) + s_\pi(g_0 + x_0 - m_0)$. Both sides of the inequality are positive, if the sufficient conditions for the Keynesian stability are assumed to hold[7]. Thus, the result will depend on the magnitude of the coefficients. Because consumption of the tradable sector is fixed, its output will change proportionally to changes in investment. Although an increase in the non-tradable wages means higher costs to this sector, it can increase total profits, since it increases the output, as seen before, so the final impact in investment will depend on the parameters g_π, g_y and s_π. Since productivity is constant, costs in the tradable sector, due to changes in employment, if W_T is considered fixed, will move in the same direction as the total output. Thus, the final impact on investment will also depend on the magnitude of the two parameters of the investment function (g_π and g_y). If capitalists save a large part of their profits, that is, if s_π is high, the effect is more likely to be negative, since profits will not be transformed into consumption and the multiplier will be smaller. Growth of the tradable sector, in this case, will follow the same direction of output[8].

[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 both s_π and g_y are smaller than the unity.

[7] The left-hand side of the inequality is exactly the result of $\frac{\partial Y_{NT}}{\partial W_{NT}}$, multiplied by Y_T. The right-hand side will be positive because all terms inside the bracket are positive since the Keynesian stability condition guarantees that $g_\pi < s_\pi$.

[8] Rising non-tradable wages does not affect the tradable sector profits directly, that is, $\frac{\partial g_T}{\partial W_{NT}} = g_y P_T \frac{\partial Y_T}{\partial W_{NT}}$, so that the effect on growth will be the same of the impact on output multiplied by g_y.

It is interesting to note that this ambiguity will also be valid for the total output (or employment), that is $Y = Y_{NT} + Y_T$. Even though the effect on non-tradable output is positive, the overall effect can be negative, depending on the size and magnitude of the effect on the tradable sector:

$$\frac{\partial Y}{\partial W_{NT}} = \frac{\partial Y_{NT}}{\partial W_{NT}} + \frac{\partial Y_T}{\partial W_{NT}} = -(1-m)\frac{P_T}{\Delta}\{Y[s_\pi(g_y - 1) + g_\pi] + 4A(s_\pi - g_\pi) + s_\pi(g_0 + x_0 - m_0)\}$$

The effect will be positive if $Y[s_\pi(1-g_y) + g_\pi] > 4A(s_\pi - g_\pi) + s_\pi(g_0 + x_0 - m_0)$. Evidently the possibility of the overall effect being positive is higher than the possibility of the effect in the tradable sector to be positive, but the ambiguity cannot be disregarded.

By building a two sector model, it becomes relevant to understand how changes in the parameters and in exogenous variables can affect the output (and employment) composition between the two sectors. A natural measure for this is given by the ratio between the two outputs $\frac{Y_T}{Y_{NT}} = \frac{\Delta_T}{\Delta_{NT}}$. An increase in the nominal wage of the non-tradable sector (or a reduction in wage inequality) has an ambiguous effect in this ratio:

$$\frac{\partial \frac{\Delta_T}{\Delta_{NT}}}{\partial W_{NT}} = \frac{\frac{\partial \Delta_T}{\partial W_{NT}}\Delta_{NT} - \frac{\partial \Delta_{NT}}{\partial W_{NT}}\Delta_T}{\Delta_{NT}^2}$$

$$\frac{\partial \frac{\Delta_T}{\Delta_{NT}}}{\partial W_{NT}} = \frac{-(1-m)[4A(s_\pi - g_\pi) + s_\pi(g_0 + x_0 - m_0)]}{\Delta_{NT}}$$

The effect will be negative if $4A(g_\pi - s_\pi) < s_\pi(g_0 + x_0 - m_0)$. The Keynesian stability condition guarantees a sufficient condition for that since it gives us that $g_\pi < s_\pi$. If the effect of a reduction in wage inequality decreases output in the tradable sector, this result is as a trivial conclusion. However, even if higher wages in the non-tradable sector has a positive impact on the tradable sector output, this impact is not as great as the one in the non-tradable sector, changing the output composition toward this last one. It is worth remembering that employment composition will change in the same direction, since productivity is constant. Figure (1(b)) illustrates this movement for Brazil, showing that the relative size of the non-tradable sector increased from 2004, when social policies started to take place.

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 the adopted social programs. Thus, the Brazilian industry faced a leakage of demand. The average propensity to import out of income is:

$$\overline{m} = m\left[1 - \frac{4A + s_\pi(\tau_T W_T a Y_T + \tau_{NT} W_{NT} Y_{NT})}{PY}\right] \tag{14}$$

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

$$\frac{\partial \overline{m}}{\partial W_{NT}} = \frac{m}{PY}\left\{-s_\pi\left(\tau_T W_T a\frac{\partial Y_T}{\partial W_{NT}} + \tau_{NT}Y_{NT} + \tau_{NT}W_{NT}\frac{\partial Y_{NT}}{\partial W_{NT}}\right)\right\} + \\ + \frac{m}{(PY)^2}\left\{\frac{\partial PY}{\partial W_{NT}}[4A + s_\pi(\tau_T W_T a Y_T + \tau_{NT}W_{NT}Y_{NT})]\right\}$$

The effect is ambiguous, and the reason for this is precisely the ambiguity of the impact of the reduction in wage inequality on the tradable sector and, consequently, on the overall output of the economy (PY). It is vital to remember that raising the NT wages increases the relative output of the non-tradable sector, so that the effect on the average propensity to import will depend on that. If raising NT wages reduces output in the tradable sector, but increases the total output of the economy, the effect on the average propensity to import is more likely to be positive. Even though the reduction of the income generated by the tradable sector, due to a decrease in its output, impacts imports negatively, the more than proportional increase in the non-tradable sector output, in a way to increase the total output of the economy, compensates the adverse effect on imports that arrived from the tradable sector.

If the effect of raising non-tradable sector wages on the tradable sector output is positive, the effect on the average propensity to import can still be positive, but smaller than the one when this effect is negative. The reason for that is, probably, a denominator effect: the rise in PY will be higher than before, so that the increase in $\overline{m}$ is smaller. The smaller the propensity to save, the more likely it is for that derivative to be positive. The reason for this is twofold: the lower the propensity to save, the higher the effect on rising total output of the economy; and the smaller the propensity to save the higher is the income spent on consumption, that is in part imported, by capitalists. As in Blecker (2011), we can face an ambiguity 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.

Finally, if the overall impact on the total output from rising wages on the non-tradable sector is negative, the effect on the average propensity to import will also be negative since income will be reduced so that imports will also decline.

3 STABILITY

In the last section, we analyzed how changes on wage inequality affect the output (and employment) in both sectors. We now need to evaluate if the relation between employment composition and wage inequality is stable over time. Productivity will still be exogenous and constant over time, so that output changes will be equivalent to employment changes. That said, employment composition $l = L_T/L_{NT}$ variations can be represented by the difference of

growth from both sectors. Equation (15) formalizes this relation, where the following variable is expressed as its growth rate, that is $\widehat{X} = \frac{\partial X}{\partial t}\frac{1}{X}$. The parameter $\beta > 0$ measures how fast changes in the labor market occurs, that can represent the bureaucracy or rigidity of employment contracts. The higher the value of β, the easier it is for employers to hire new workers, but also to dismiss them in an unfavorable situation.

$$\widehat{l} = \beta(g_T - g_{NT}) \tag{15}$$

Substituting the investment equation (3) and using the productivity constancy (1), expression (15) is:

$$\widehat{l} = \beta\{g_\pi[(P_T/a - W_T)L_T - (P_{NT} - W_{NT})L_{NT}] + g_y(P_T L_T/a - L_{NT}P_{NT})\} \tag{16}$$

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

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

Where θ will be positive (negative) if $\frac{\partial \frac{\Delta_T}{\Delta_{NT}}}{\partial W_{NT}}$ is negative (positive), i.e. if a reduction in wage inequality changes employment composition in a way to increase (reduce) the relative size of the non-tradable sector[9].

Changes in the employment composition l also affects $\widehat{l}$[10]:

$$\begin{aligned}\frac{\partial \widehat{l}}{\partial l} &= \beta\{g_\pi[(P_T/a - W_T)L_{NT} + (P_{NT} - W_{NT})l^{-2}L_T] + g_y(P_T L_{NT}/a + l^{-2}L_T P_{NT})\} \\ &= \beta\mu \quad > 0\end{aligned} \tag{17}$$

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 the employment composition, bargaining powers of workers and employers, and international prices. We assume that nominal wages grow as the equations (18) and (19) below. The parameters $\sigma_j > 0$, for $j = NT, T$, measures the bargaining power of workers in each sector, that can be affected by

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

[10] 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, $\widehat{l} = \beta\{g_\pi[(P_T/a - W_T)lL_{NT} - (P_{NT} - W_{NT})l^{-1}L_T] + g_y(P_T lL_{NT}/a - l^{-1}L_T P_{NT})\}$.

unions organizations or policies that change labor conditions in each sector. Greater formalization of services, for example, will affect the bargaining power positively in sector NT, but will not significantly change the bargaining power in sector T.

$$\widehat{W}_{NT} = \sigma_{NT} l^{-1} \tag{18}$$

$$\widehat{W}_{T} = \sigma_{T} l - \phi_{\pi}[W_T - W_T^{\pi}(l)] \tag{19}$$

Following the post-Keynesian 'conflicting claims' approach, as called by Blecker (2011) and originally postulated by Weintraub (1958) and Rowthorn (1977), the growth of nominal wages in the tradable sector faces the resistance of the capitalists since they cannot transfer costs to prices as in the non-tradable sector. As defined in the last section, the tradable sector has internationally given prices. Its mark-up needs to adjust to any cost changes, making capitalists in that sector more resistant to raising wages. As in Blecker (2011)[11], 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 about losing markup margin. How strong this effect is will depend on the parameter ϕ_{π} (> 0).

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

$$\frac{\partial W_T^{\pi}(l)}{\partial l} = \gamma < 0 \tag{20}$$

where $\gamma > 0$ represents the bargaining power of capitalists over their desired profit rate, 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 specialized training or ability, 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 demand employers to cover an additional charge of training them, so that capitalists will

[11] In Blecker (2011) workers and capitalists bargain over the wage share, setting up their targets that 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, and are the capitalists who set their target, or their desired nominal wage, even though that target is influenced by the bargaining power of workers, as defined in (20).

bargain over a smaller nominal wages to compensate this additional cost and avoid losing mark-up margin.

Combining equations (19) and (18), equation (21) shows how the wage inequality will evolve:

$$\widehat{\omega} = \widehat{W}_T - \widehat{W}_{NT} = \sigma_T l - \phi_\pi [W_T - W_T^\pi(l)] - \sigma_{NT} l^{-1} \tag{21}$$

Wage inequality growth responds ambiguously to the employment composition and negatively to the inequality level[12]:

$$\frac{\partial \widehat{\omega}}{\partial l} = \sigma_T + \sigma_{NT} l^{-2} - \phi_\pi \gamma \tag{22}$$

$$\frac{\partial \widehat{\omega}}{\partial \omega} = -\phi_\pi W_{NT} \tag{23}$$

Inspired on the dual adjustment process, as developed by Bruno (1999) and Bhaduri (2008), the stability analyses can be separated into two different processes and, depending on how they interact, the overall stability of the system can vary. 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 (15) and (21):

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

where

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

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).

[12] Here we also divided and multiplied equation (21) by W_{NT} in order to explicit the parameter ω.

Table 2 – 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

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 equally ($\widehat{P}_{NT} = \widehat{W}_{NT}$). The case where θ is positive represents the case that an increase in wages in the non-tradable sector increases the participation of the same sector on the 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 trajectory. To stabilize, then, we have to have a weak bargaining power of workers so that wages will not grow much, reducing the cost pressure. Besides, a slow speed of adjustment on the employment, that is, a lower β also helps the economy to be stable. It helps the condition (A) for the trace to be negative since the demand pressure would occur slower.

When θ is negative, on the other hand, reducing wage inequality increases the participation of the tradable sector relatively to the non-tradable sector. 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, represented by a reduction in the nominal wage of the tradable sector, possibly reducing even more wage inequality and creating a spiral toward the increase of the tradable sector, and possibly achieving some limitation (labor force limitations, for example). If the bargaining power of workers is strong enough so that they can prevent tradable wages to grow slow as capitalists would desire, the pressure on the employment composition would be reduced and, then, the economy can achieve a stable path.

Again, in this case, for the trace to be negative, it is important for the parameter β to be small, that is, for the employment changes 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, that is, to tighten the labor market in order to avoid rapid hiring and dismissals would help achieving stability in both scenarios. In the first case, however, it probably needs to be very small, because stability requires ϕ_π to be great enough for the bargaining power of capitalists to trump workers.

4 CONCLUDING REMARKS

This paper aimed to contribute to the Post-Keynesian literature by extending the Kaleckian model by incorporating two other inequality dimensions: sectoral heterogeneity and wage inequality. Including these heterogeneities are essential for a better understanding of the Brazilian and other South American countries' economic trajectories, since it sheds light on many internal relations of the economic dynamics.

By first analyzing some comparative dynamic statics, it was shown that a reduction in wage inequality, represented by an increase in lower wages of the non-tradable sector, in the model nomenclature, changes output (and employment) composition toward the non-tradable sector, if we consider that the Keynesian stability condition holds. Within the economic theory context, one could explain this movement to be in line with Engel's law, which argues that as an individual income rises, it increases the share of services and manufactured goods consumed, given that these goods have, characteristically, a high income-elasticity. The consumption of manufactured goods, however, is imported, since the national productive structure is unable to provide them, so that the higher the propensity to import over income, the lower the multiplier effect of reducing wage inequality. The average propensity to import, in its turn, will respond the wage inequality reduction ambiguously, depending on the overall impact on total output of the economy and on the tradable sector output. If the decrease on wage inequality increases total output of the economy, the effect can be either positive or negative, depending on the parameter s_π, that is, the propensity to save - due to the multiplier effect -, and on the magnitudes of the increase (or decrease) in the output of the two sectors (and, consequently, of total output). If total output responds negatively to the increase in the NT wages, the average propensity to import also responds negatively.

Taking into account price dynamics and bargaining conflicts over wages, different stability results arise that temporally depend on the quantity and price adjustment processes so that we are left with different policy recommendations depending on the situation. At first, the Keynesian

stability condition is a sufficient condition for θ to be positive, where the overall situation can be stable or unstable. The unstable situation we call "service inflation" once it is related to an explosive trajectory of the non-tradable sector prices (and wages), due to two forces operating in the same direction: demand pressures since the increase in the non-tradable wages changes the output composition toward the non-tradable sector, and cost pressures since the bargaining power of workers is higher than the one of capitalists, preventing wages cuts. To stabilize the system in this situation we need, then, for bargaining power of workers to be weaker than that of the capitalists, and for the bureaucracy to hiring or dismissal process to be high enough to slow down the response of the employment composition, so that demand pressures would be smaller.

The second situation analyzed was where θ is negative, that is if a reduction in wage inequality increases the relative participation of the tradable sector output. This case is represented with the situation where the instability is related to a spiral of increasing participation in the tradable sector and a reduction in its nominal wages. For the economy to be stable, the bargaining power of workers have to be higher than that of capitalists and the employment adjustment needs to be slower.

Still the recent Brazilian trajectory serves as a lesson, indicating that the path to income distribution and growth is not trivial and faces inherent difficulties beyond political disputes. Incorporating heterogeneities and other than the functional inequality dimensions in the analyses can help understand and think about ways to overcome these challenges and imagine sustainable ways to achieving a more equal income distribution and growth.

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A Effects of rising tradable wages

The effect in the non-tradable output of increasing wages in the tradable sector is ambiguous:

$$\frac{\partial Y_{NT}}{\partial W_T} = \frac{1}{\Delta} a[4A(s_\pi - g_\pi) + s_\pi(g_0 + x_0 - m_0)] - P_{NT} Y_{NT} a[m g_\pi - s_\pi(1-m) g_y]$$

The Keynesian stability condition guarantees that the fist term is positive, but the ambiguity remains with the second term since it gives us that $s_\pi(1-m) > g_\pi$ but $g_y < m$. The effect will be positive if $s_\pi(1-m)g_y > m g_\pi$.

The impact in the tradable output is also ambiguous, depending on the size of the term in the bracket:

$$\frac{\partial Y_T}{\partial W_T} = -\frac{Y_T}{\Delta} P_{NT} a[m g_\pi - s_\pi(1-m) g_y]$$

The investment function type is also crucial in this case: if $g_\pi = 0$ the effect would be positive. Like argued before, because consumption of its sector is constant, the effect is directly related to the investment function and the increase in the non-tradable product - if $m = 0$ we also get an unambiguous result of an increase in the tradable product.

Changes in the tradable sector wages also affect negatively the relative output, if the Keynesian stability condition is assumed:

$$\frac{\partial \Delta_T / \Delta_{NT}}{\partial W_T} = -\frac{\Delta_T}{\Delta_{NT}^2}(1-m)[4A(s_\pi - g_\pi) + s_\pi(g_0 + x_0 - m_0)]$$

Which effect - of rising non tradable wages or rising tradable wages - is higher depends, then, if $\frac{\Delta_T}{\Delta_{NT}} \gtreqless 1$.