# ASSESSING PENSION SYSTEM OUTCOMES IN BRAZIL: A STOCK-FLOW CONSISTENT ANALYSIS

Daniel Nogueira Silva[*]
Henrique Morrone[†]
Sylvio Kappes[‡]

## Abstract

The pension system serves as an important instrument to provide income for individuals who are incapacitated for work or achieve old age. Recently, Pension Systems worldwide have faced financial and actuarial difficulties, casting doubts about their sustainability. Arguably, the main reasons for the systemic unbalance are the aging population and the structure of benefits. The present article investigates the impacts of these two variables by means of simulation exercises. Specifically, this paper aims to analyze how a rise in formality and an increase in labor productivity affect the results for the Brazilian Pension System (deficit or surplus), the participation of the benefits in total GDP and economic growth, based on a stock-flow consistent model (SFC). The results reveal that increasing formalization (i.e., raising the number of taxpayers) reduces the pension system deficit and boost economic growth. But the system deficit persists somewhat. Allowing for productivity growth improves the results.

**Key-words:** Stock-Flow Consistent Models; Pension System; Economic Growth.

**JEL Code:** O1; R15; Z10

[*]Professor Adjunto da Universidade Federal do Sul e Sudeste do Pará (UNIFESSPA). Contato: daniel.nogueira@umifesspa.edu.br.
[†] Professor Adjunto C da Universidade Federal do Rio Grande do Sul (UFRGS). Contato: hmorrone@hotmail.com.
[‡] Professor Adjunto no Departamento de Teoria Econômica da Universidade Federal do Ceará (UFC). Contato: sylviokappes@gmail.com.

## 1. Introduction

A pension system is a key to the well-functioning of any economy. Besides its usual role in providing funds for the elderly, it can serve as an instrument to foster economic activity (through an improvement in the distribution of income that raises effective demand), alleviate poverty for the elderly, and fight interregional inequalities. Presenting a synthesis of the discussion, Ferreira (2007) argues that the existence of social security systems is generally based on three arguments: the first is because governments are benevolent and paternalistic (Dotsey et al., 2015); second, for governments to correct market inefficiencies (Feldstein, 1998); and, third, as a result of coalition pressures among voters, which arise amid broader social demands (Hill, 2006). These different ways of understanding pension systems also influence the way how financial and actuarial difficulties faced by them are interpreted (Rego, Paula, Brito, 2019).

In Brazil, the pension system has presented substantial and persistent deficits after 1996, which have raised concerns about the system's sustainability and its impact on the economy. In this context, there are two opposing viewpoints. One that highlights the system's unsustainability, pushing for reforms, which includes increasing the retirees' age and other restrictive rules (Giambiagi et al., 2004; Zilberstajn et al., 2017; Holand and Malaga, 2018). According to them, the pension system imbalance can halt economic growth. A second view claims that the system is only sustainable when the economic model encompasses both actuarial and dynamic elements and the pension system can contribute to economic growth (Gentil, 2006; Puty et al., 2017; Lavinas and Cordilha, 2019). For Puty Et Al. (2017), the fiscal and actuarial forecasts made by the Brazilian federal government's model present substantial discrepancies compared to the results that effectively occurred. They have suggested different policies to reform the system and stimulate the economy.

In the present article, we propose a third complementary view. In line with the contributions of Paley (1998), Rada (2012), Yasar (2013), and Melis and Truda (2020), we stress the importance to incorporate structural features of the economy in any analysis that assesses the sustainability of the system and its effect on growth.

Because of the size and role of the informal sector in Brazil, evaluation of its relationship with the rest of the economy becomes central. A broad view of the sustainability of the Brazilian system that accounts for its economic structural heterogeneity (and its labor productivity differences) is lacking in the literature.

This paper aims to shed some light on the Brazilian Pension System, employing a Stock-flow Consistent model (SFC). According to Godley and Lavoie (2007), SFC models are important tools for analyzing the macroeconomic dynamics of economies. This approach consists of two components: an accounting part, which guarantees the logical consistency of the system, and a set of equations that describe its laws of movement. Stock and transaction flow matrices guarantee accounting consistency. The behavioral equations exhibit the model's assumptions (Caverzasi and Godin, 2015).

The literature that discusses the causes of pension systems' financial and actuarial problems puts great emphasis on population aging (Morimoto et al., 2018). Using mainly Overlapping Generations model (OLG) developed by Samuelson (1958) and Diamond (1965), these works try to explore the impacts of demographic change on the sustainability of Pay-as-You-Go (PAYG) pension systems (Fanti and Gori, 2012; Cipriani, 2014; Dedry et al., 2018). It means that the current generation pays for the retired share of the population. The main results point to a worsening of the financial conditions of social security systems in contexts of population aging. More recently, some studies have emphasized the role played by two economic variables to understand social security dynamics, especially in developing countries: labor market conditions and productivity.

According to Song et al. (2012), informality, combined with other labor market imperfections, would also play a central role in explaining the successive deficits faced by the PAYG social security model. Yasar (2013), Dotsey et al. (2015), among others, follow this argument. Regarding productivity, Paley's (1998) seminal work is an important contribution to understand how productivity influences both the diagnosis of the real conditions of the social security system (Moreira et al., 2019) and the overcoming of its main challenge, which is the accelerated population aging process (Boulhol, 2019).

Based on this discussion, the SFC model developed here analyzes the dynamics of Brazilian social security in a context of informality, changes in labor productivity and demographic transition. We included innovative features to tackle those issues. Firstly, we included the retirees as an institutional sector that becomes part of the distributive conflict of the model. Secondly, we add the informal sector. For this, firms and workers were divided into two groups: one that contributes to the pension system and the other that does not. An increase in the ratio of retirees to the number of workers captures demographic dynamics. In this sense, our heterodox model can capture important interactions between stocks and flows, encompassing the whole economy. It gives a fresh perspective on the Brazilian pension system sustainability. Our thesis is that the degree of formality and labor productivity growth can help to balance the pension system in the long term. These variables, however, are absent in most of the models that explore the question of pension system sustainability in Brazil.

We perform three simulation exercises in our model: (i) an increase in formalization; (ii) a surge in the number of the system's beneficiaries, driven by demographic transition; and (iii) a rise in labor productivity. In all the experiments, we examined the behavior of three key variables: GDP growth, the pension system deficit to GDP ratio, and total benefits/GDP ratio. The model is calibrated for the Brazilian economy, which is another innovative feature of our work, given the relatively small number of empirical SFC models in general, and for Brazil in particular.

The rest of this article is structured as follows. First, we briefly overview key statistics for the Brazilian pension system in section 2. Then, we introduce an SFC model in section 3. In section 4, we discuss the parameters and model calibration. Section 5 explores the simulation results. Finally, section 6 concludes.

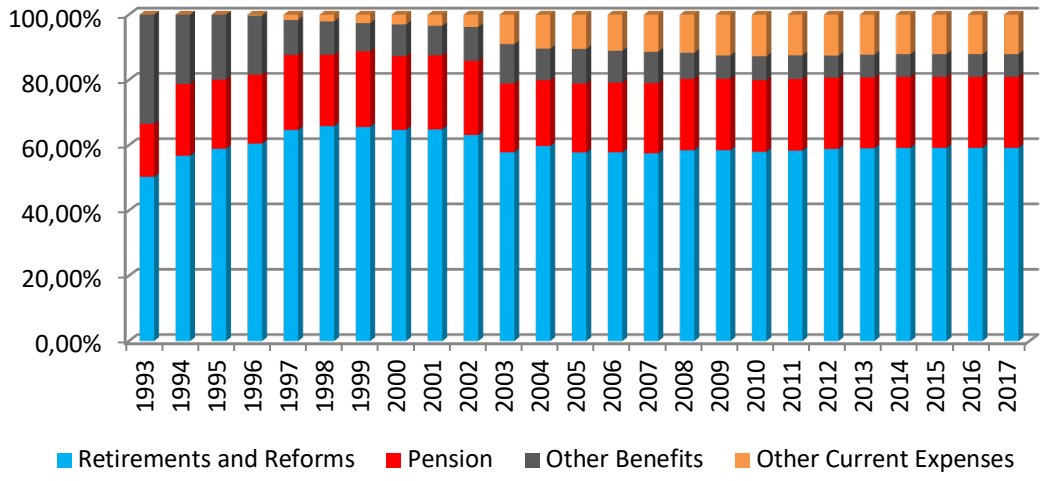
## 2. The key indicators of the Brazilian pension system: a brief review

The pension arrangement in Brazil functions as a pay-as-you-go (PAYG) system. The system was reformed at the end of the 1980s by the Federal Constitution

of 1988. Social justice and solidarity are two key elements of the Constitution. In this period, there was a mass of poor rural unemployed workers who could retire. It put pressure on the system. Since the Constitution of 1988, the system has depended on national government transfers to cover its deficits and reach a balance. It was a strategy to achieve social justice. Recently, the system presented a deficit of R$ 149 billion in 2016 and R$ 182,4 billion in 2017. Figures 1, 2, 3 and 4 exhibit the key statistics for the national pension system.

Figure 1 shows that the bulk of expenditures is payment of benefits, such as pensions for retirees, maternity leave and leave for sickness, among others. From 1994 to 2017, pensions grew 2,46%. Most of the pension growth in this period is due to rural pensions. In 2016, this segment contributed 2% to the system's revenues and their pensions comprised 22,2% of the total system's expenditure. Despite this source of unbalance, Arbex and Galiza (2017) argue that it is an instrument to guarantee a minimum income in rural areas.

Figure 1 – Current expenditures - 1993-2017 - (%)

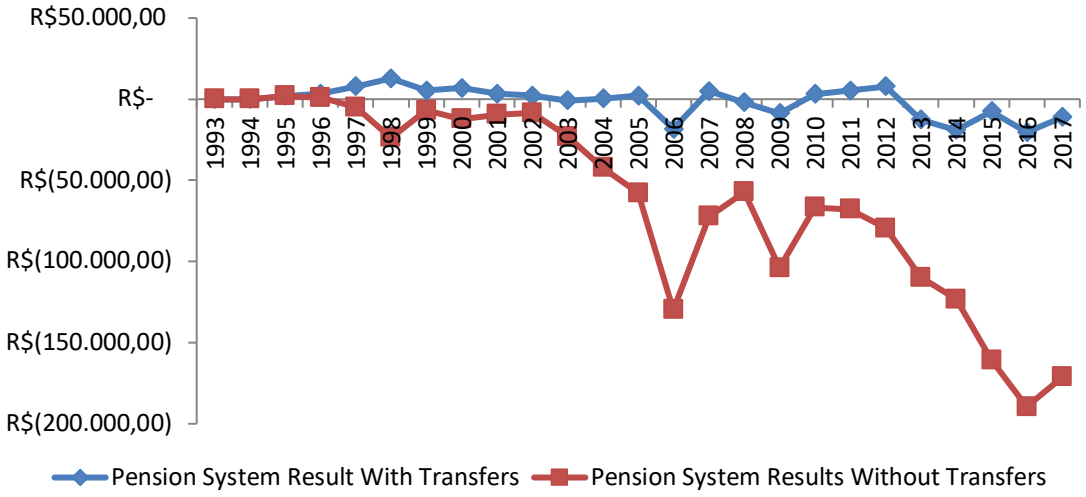



Source: Authors' calculations based on data from Brasil (2015) and Brasil (2016).

Figure 2 reports on the Brazilian pension system result. Between 1993 and 1996, the balance of the system was in equilibrium. Deficits emerged in 1997. The government transfers to fulfill the gap in the accounts markedly increased from 2011 to 2014. At least partially, the raising informality during the 1990s (but not in the 2000s) and the tax break policy that began in 2010 explains the pension system

deficits (Gentil, 2017). During the 2000s, the tax break policy did not boost formal activity (Neri, 2007). Demographic transition played a secondary role in explaining deficits since its effects usually appear in medium/long run statistics.

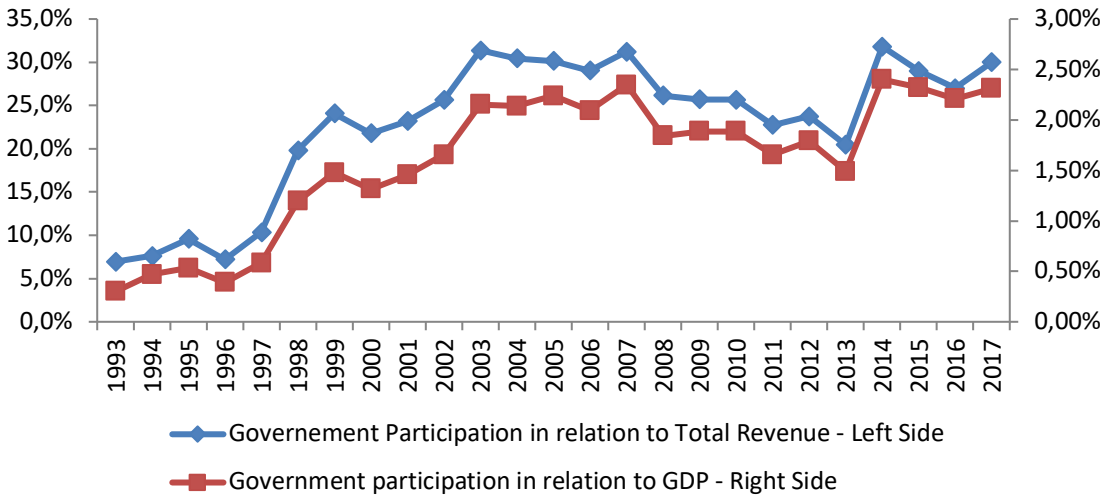
Figure 2 – Pension System results - 1993 - 2017 - (Millions (R$))




Source: Authors' computations based on data from Brasil (2015) and Brasil (2016).

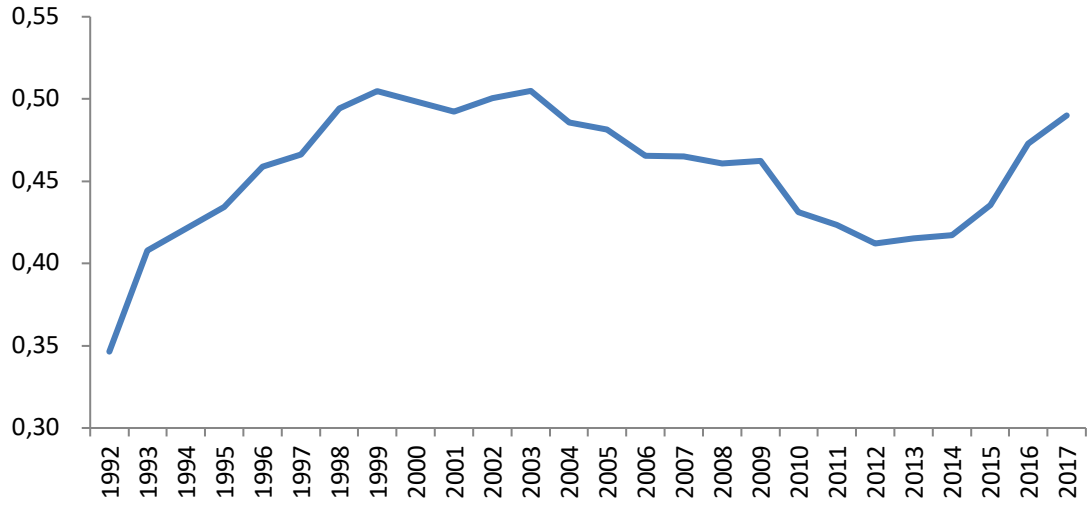
Figure 3 presents the evolution of government transfers in Brazil. Overall, transfers increased from 1997 to 2007 and then started to decline. They diminished up to 2013, then started to increase again. The rise in economy formalization seems to have positively impacted for the reduction in transfers from 2003 to 2013, except during the great recession (2007/2008).

Figure 3 – Government transfers toward the national pension system - 1993-2017




Source: Authors' computations based on data from Brasil (2015) and Brasil (2016).

Figure 4 – Dependency ratio- Brazil (1992-2017)




Source: Authors' computations based on data from IPEA (2011).

Another crucial statistic to access the pension system sustainability is the ratio of dependency, expressed in Figure 4. It is simply the beneficiaries-contributors ratio. From 1992 to 2000, this ratio rose markedly. However, this ratio declined persistently from 2003 to 2012, when it returned to grow. This growth is explained partially by the Brazilian tax break policy (Gentil, 2017; Silva, 2018). Despite this result, following Paley (1998) and Yasar (2013), if we allow for labor productivity and raising labor

formality, two factors not included in the dependency ratio, the sustainability of the pension system improves (Silva, 2018).

## 3. A Stock-Flow Consistent model of the Brazilian pension system

In this section, we will present a Stock-flow Consistent (SFC) model to analyze the Brazilian pension system. The main feature of the SFC methodology is, as its name suggests, consistently modeling economic stocks and flows. There are two basic matrices in every SFC model, one describing the balance sheets of the sectors modeled (accounting for the stocks) and another dealing with the real and financial transactions (accounting for the flows). An advantage of such action is that "[…] there are no black holes: every flow comes from somewhere and goes somewhere" (Godley, 1996, p. 7). According to Santos (2017, p.1), SFC models are "[…] crucial for sound macroeconomic reasoning in general and, therefore, its widespread adoption would increase both the transparency and the logical coherence of most macro models."

Lavoie and Godley (2001-2002, p.308) reinforce the message:

> In our methodology, we can justify every point by reference to a precise system of relationships. If others disagree, they can be challenged to say precisely what simplification or parameter is inappropriate. Every relationship can be changed, and one can find out whether the change makes any difference to the results. This method ought to be helpful to resolve some controversial issues.

The SFC methodology presents many other potentials. One is its capacity to predict crises. Bezemer (2010) and Galbraith (2012) argue that the 2008 financial crash was predicted by authors that used models based on a rigorous accounting, whereas models that rely upon notions of general equilibrium did not. Both the academy and central banks employ SFC models, like the Bank of England (Burgess *et al.*, 2016) and financial institutions, like Goldman Sachs (Hatzius and Stehn, 2012).

The model developed in this paper comprises seven institutional sectors: (i) workers, (ii) retirees, (iii) government, (iv) capitalists, (v) firms, (vi) Commercial banks, and (vii) the Central Bank. The structure of assets and liabilities is presented in Table 1, which shows the accounting balances of each sector. Assets are presented with a positive sign, while a negative sign denotes liabilities. We considered six types

of assets/liabilities: (i) banking deposits, an asset held by capitalists and firms and accounted as a liability for the commercial banks; (ii) tangible capital, an asset for firms whose accounting counterpart is an addition to this sector's net wealth; (iii) government bonds, held by commercial banks and central bank; (iv) high-powered money, emitted by the central bank and held by commercial banks; (v) central bank advances, a liability to commercial banks and an asset for the monetary authority; and (vi), banking loans, given by commercial banks to firms. Because of the model's accounting consistency, financial assets and liabilities cancel each other out, as shown in the last column of Table 1. The sum of the sector's column gives its net assets.

Table 1 – Balance Sheets

| | Workers | Retirees | Government | Capitalists | Firms | Commercial banks | Central bank | Σ |
|---|---|---|---|---|---|---|---|---|
| Deposits | | | | $+Dep_c$ | $+Dep_f$ | $-Dep_c$ , $-Dep_f$ | | 0 |
| Tangible Capital | | | | | +K | | | + K |
| Government bonds | | | -B | | | $+ B_b$ | $+ B_{cb}$ | 0 |
| High-powered money | | | | | | $+ H_b$ | - H | 0 |
| CB advances | | | | | | - A | + A | 0 |
| Loans | | | | | -L | + L | | 0 |
| Balance | | | $+V_{gov}$ | $-V_{cap}$ | $-V_f$ | $+V_b$ | $+V_{cb}$ | - K |
| **Σ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: author's computations.
Note: positive signs refer to assets, and negative signs refer to liabilities.

Table 2 presents intersectoral transaction flows between the sectors. A sector's use of funds receives a negative sign, while the source of funds takes a positive sign. The upper tier of the matrix exhibits the flow of goods, services and payments to factors of production. The middle tier brings the flow of financial payments. The last tier exhibits the sectors' changes in stocks. If receipts are larger than expenditures, the sector has a surplus allocated among the economy's assets. In the case of a deficit, this sector increases its liabilities. The results of this part of the table change the stocks in Table 1, which serve as a starting point for a next period. New transactions emerge in Table 2, which impact again stocks and so on. This link between stocks and flows generates the model's dynamics.

Table 2 – Transaction flow matrix

| | | | | | | Firms | | | Central bank | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Workers | Retirees | Government | Capitalists | Current | Capital | Commercial banks | Current | Capital | Σ |
| Consumption | | $-C_w$ | $-C_r$ | $-C_g$ | $-C_c$ | $+C$ | | | | | 0 |
| Investment | | | | | | $+I$ | $-I$ | | | | 0 |
| Firms profits | | | | | $+F_d$ | $-F_f$ | $+F_n$ | | | | 0 |
| Banks profits | | | | | $+F_b$ | | | $-F_b$ | | | 0 |
| Central bank profits | | | | $+F_{cb}$ | | | | | $-F_{cb}$ | | 0 |
| Taxes | | $-T_w$ | $-T_r$ | $+T$ | $-T_c$ | $-T_f$ | | | | | 0 |
| Wages | | $+WB$ | | | | $-WB$ | | | | | 0 |
| Pension contributions | | $-Z_w$ | | $+Z$ | | $-Z_f$ | | | | | |
| Retirees' payments | | | $+AN_r$ | $-AN_r$ | | | | | | | |
| *Interest on* | Deposits | | | | $+r_{d-1}.D_{c-1}$ | | | $-r_{d-1}.D_{c-1}$ | | | 0 |
| | Loans | | | | | $-r_{l-1}.L_{-1}$ | | $+r_{l-1}.L_{-1}$ | | | 0 |
| | CB advances | | | | | | | $-r_{A-1}.A_{-1}$ | $+r_{A-1}.A_{-1}$ | | 0 |
| | Government bonds | | | $-r_{b-1}.B_{-1}$ | | | | $+r_{b-1}.B_{b-1}$ | $+r_{b-1}.B_{cb-1}$ | | 0 |
| *Changes in the stocks of* | Deposits | | | | $-\Delta D_c$ | | $-\Delta D_f$ | $+\Delta D$ | | | 0 |
| | Loans | | | | | | $+\Delta L$ | $-\Delta L$ | | | 0 |
| | High-powered money | | | | | | | $-\Delta H_b$ | | $+\Delta H$ | 0 |
| | Treasury bills | | | $+\Delta B$ | | | | $-\Delta B_b$ | | $-\Delta B_{cb}$ | 0 |
| | CB advances | | | | | | | $+\Delta A$ | | $-\Delta A$ | 0 |
| Σ | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: author's computations.
Note: positive signs refer to receipts, negative signs represent expenditures.

Since the accounting structure defined from the stock and flow matrices is insufficient to close the model, we need to introduce the behavioral equations. To clarify, we present each sector separately.

### 3.1 Workers

The workers' disposable income ($Yd_w$) consists of the wage bill (WL) subtracted by taxes ($T_w$) and workers' pension system contributions ($Z_w$). Following Dafermos (2012), we adopted the hypothesis that workers receive in the period $t$ salaries corresponding to period $t$ - $1$[1]. We assume that workers' disposable income is spent entirely on consumption goods.

$$Yd_w = WB_{-1} - Z_w - T_w \quad (1)$$

$$C_w = Yd_w \quad (2)$$

The taxes paid by workers is a fixed rate $\theta_w$ multiplied by the wage bill. The pension system contributions stem from the pension system tax rate/contribution $\tau$ multiplied by the wage bill and by the proportion of formal workers in the labor

[1] It is important to note that this hypothesis can be traced back to Samuelson (1939). We thank an anonymous referee for bringing this to our attention.

force, denoted by $\lambda_w$. The model assumes that a firm or worker is formal if they contribute to the Pension System.

$$T_w = \theta_w W B_{-1} \quad (3)$$

$$Z_w = \lambda_w \tau W B_{-1} \quad (4)$$

### 3.2 Retirees

The retiree's[2] income results from the value of their received benefit ($A$) multiplied by the number of retirees ($N_r$). The income after-tax payments are totally consumed ($C_r$). We consider that the value of the benefit is a proportion $\Omega$ of the wage, and that the number of retirees is a proportion $\rho$ of the number of employees ($N$). Total taxes are a fixed rate $\theta_r$ that multiplies retirees' income.

$$Y_r = AN_r \quad (5)$$

$$A = \Omega W_{-1} \quad (6)$$

$$N_r = \rho N \quad (7)$$

$$C_r = Y_r - T_r \quad (8)$$

$$T_r = \theta_r Y_r \quad (9)$$

### 3.3 Government

Government revenue ($Y_g$) is the sum of taxes (T), Pension System contributions (Z) and Central bank profits ($F_{cb}$). Government expenditures ($G$) are divided between consumption ($C_g$), retirees' payments ($AN_r$) and the expenses with interest on debt ($r_{b,-1}B_{-1}$). Government consumption adjusts passively to maintain its deficit ($DG$) as a fixed proportion ($\sigma$) in relation to the GDP of the previous period ($Y_{-1}$). The government debt ($B$) is equal to the deficit plus the debt of the previous period.

$$Y_g = T + Z + F_{cb} \quad (10)$$

$$G = C_g + AN_r + r_{b,-1}B_{-1} \quad (11)$$

$$C_g = DG - r_{b,-1}B_{-1} - AN_r + T + Z + F_{bc} \quad (12)$$

$$DG = \sigma Y_{-1} \quad (13)$$

$$B = B_{-1} + DG \quad (14)$$

[2] In our model, we consider the existence of retirees only. We abstract away the existence of pensioners.

$$T = T_w + T_r + T_c + T_f \quad (15)$$

$$Z = Z_w + Z_f \quad (16)$$

### 3.4 Capitalists

The capitalists' disposable income ($Yd_c$) is the sum of the profits distributed by the firms ($F_{d,-1}$), by Banks ($F_{b,-1}$) and their gains with bank deposits ($r_{d,-1}D_{c,-1}$), all of them discounted from the tax rate ($\theta_c$). The consumption function ($C_c$) hinges on disposable income and wealth ($V_{-1}$). Wealth is allocated in the banking sector ($D_c$), and its amount is equal to the stock of the previous period added to the savings ($Yd_c - C_c$).

$$Yd_c = (1 - \theta_c)(F_{d,-1} + F_{b,-1} + r_{d,-1}D_{c,-1}) \quad (17)$$

$$C_c = \alpha_1 Yd_c + \alpha_2 V_{-1} \quad (18)$$

$$T_c = \theta_c(F_{f,-1} + F_{b,-1} + r_{d,-1}D_{c,-1}) \quad (19)$$

$$V = V_{-1} + Yd_c - C_c \quad (20)$$

$$D_c = V \quad (21)$$

### 3.5 Firms

The firms' revenue (Y) consists of investment expenditures (I) and the sum of the consumption of workers, retirees, capitalists and government. Profits ($F_f$) are the results of subtracting these earnings from the wage bill ($WB_{-1}$), borrowing ($r_{l,-1}L_{-1}$), taxes ($T_f$) and firms' pension system contributions ($Z_f$). The wage bill stems from the multiplication between the number of workers (N) and the wage rate (W). The division of the output by the labor productivity (*pr*) gives the total employment (N). We assume that wages grow along with productivity[3]. The firms' Pension System contributions is the $\chi$ rate multiplied by the wage bill and by the proportion of contributing firms, denoted by $\lambda_f$.

$$Y = C_{tot} + I \quad (22)$$

$$C_{tot} = C_w + C_r + C_c + C_g \quad (23)$$

$$F_f = Y - WB_{-1} - r_{l,-1}L_{-1} - T_f - Z_f \quad (24)$$

$$Z_f = \lambda_f \chi WB_{-1} \quad (25)$$

[3] We acknowledge that this is a simplification. In the last decades, the wage growth rate is not following productivity growth.

$$T_f = \theta_f Y \quad (26)$$

$$WB = N.W \quad (27)$$

$$W = W_{-1}(1 + g_{pr}) \quad (28)$$

$$N = \frac{Y}{pr} \quad (29)$$

$$pr = pr_{-1}(1 + g_{pr}) \quad (30)$$

The investment function responds to changes in the capacity utilization, proxied by the variable *u*, and the interest rate of loans ($r_l$). The investment adds to the pre-existing capital stock, increasing current capital stock (*K*). Bank loans ($\Delta L$) finance a fixed portion (*x*) of investments. Retained earnings ($F_n$) fund the remaining investments. The difference between total profits and retained earnings is the distributed profits, which take the form of bank deposits ($D_f$) at the end of the period and are distributed in the following period. We follow a simplifying hypothesis that these deposits are unremunerated.

$$I = (\beta_0 + \beta_1 u_{-1} - \beta_2 r_e)K_{-1} \quad (31)$$

$$u = \frac{Y}{K_{-1}} \quad (31)$$

$$K = K_{-1} + I \quad (33)$$

$$\Delta L = xI_{-1} \quad (34)$$

$$F_n = I - \Delta L \quad (35)$$

$$F_d = F_f - F_n \quad (36)$$

$$D_f = D_{f,-1} + F_d - F_{d,-1} \quad (37)$$

### 3.6 Comercial Banks

Bank profits ($F_b$) corresponds to the difference between the sum of the interest received by loans ($r_{l,-1}L_{-1}$) and government bonds ($r_{b,-1}B_{b,-1}$) and the sum of interest paid to the deposits of capitalists ($r_{d,-1}D_{c,-1}$) and to the Central Bank advances ($r_{a,-1}Adv_{-1}$). The total stock of loans (*L*) is equal to the previous stock plus the granting of new loans. The stock of money, here denoted by HPM (High Powered Money), is the rate of compulsory deposits (μ) multiplied by the sum of capitalists' and firms' deposits.

$$F_b = r_{l,-1}L_{-1} + r_{b,-1}B_{b,-1} - r_{d,-1}D_{c,-1} - r_{a,-1}Adv_{-1} \quad (38)$$

$$L = L_{-1} + \Delta L \quad (39)$$

$$HPM_b = \mu(D_c + D_f) \quad (40)$$

The modeling for the purchase of government bonds by banks is more complex. Equation 41 establishes the number of resources available for the purchase of bonds ($B_{b,p}$). If this value is positive, the whole amount is reverted to the acquisition of bonds ($B_b$). If it is negative, it means that banks have lent in addition to their availability of resources, which obliges them to acquire Central Bank advances ($Adv$).

$$B_{b,p} = D_c + D_f - HPM_b - L \quad (41)$$

$$B_b = \begin{cases} B_{b,p}, & B_{b,p} \geq 0 \\ 0, & B_{b,p} < 0 \end{cases} \quad (42)$$

$$Adv = \begin{cases} 0, & B_{b,p} \geq 0 \\ HPM_b + L - D_c - D_f, & B_{b,p} < 0 \end{cases} \quad (43)$$

Interest rates on loans and deposits' remuneration comply with a simple mark-up structure.

$$r_l = r_b + m_l \quad (44)$$

$$r_d = r_b - m_d \quad (45)$$

### 3.7 The Central Bank

The Central bank's profit results from its interest receipts upon advances to commercial banks and its' retention of government bonds. Profits are fully reverted to the government. We assume that the interest rate of the advances is the same as the interest rate of the bonds. The Central bank supplies the currency demanded by the agents. The Central bank is a residual purchaser of public bonds.

$$F_{bc} = r_{a,-1}Adv_{-1} + r_{b,-1}B_{bc,-1} \quad (46)$$

$$r_a = r_b \quad (47)$$

$$HPM = HPM_b \quad (48)$$

$$B_{bc} = B - B_b \quad (49)$$

## 4. Model parameters, calibration, and scenarios

Stock Flow Consistent (SFC) models require parameters usually obtained from economic censuses, national accounts, empirical papers, assumptions that rely

on economic theory and country's specificities. We calibrate the present model to describe the Brazilian economy schematically. We summarize the parameter values and their references in Box 1.

Box 2 – Model's parameters

| Parameters | Description | Values | References |
|---|---|---|---|
| $\theta_w$ | Tax rate upon workers | 30% | Afonso, |
| $\theta_r$ | Tax rate upon retirees | 30% | Soares and |
| $\theta_c$ | Tax rate upon capitalists | 22% | Castro (2013) |
| $\theta_f$ | Tax rate upon firms | 7% | Rabelo and Oliveira (2015) |
| $\tau$ | Pension system tax/contribution - workers | 10% | |
| $\chi$ | Pension system tax- firms | 18% | |
| $\lambda_w$ | Formal workers (proportion to total workers) | 73% - 90% | BRASIL (2016) |
| $\lambda_f$ | Formal firms | 80% - 95% | |
| $\sigma$ | Government deficit (in relation to GDP) | 3% | Kappes and Milan (2017) |
| $\alpha_1$ | Capitalists' marginal propensity to consume out of income | 61% | Leite (2015) |
| $\alpha_2$ | Capitalists' marginal propensity to consume out of wealth | 2% | Ludvigson and Steindl (1999) |
| $g_{pr}$ | Growth rate of productivity | 0% - 1,4% | Cavalcante e De Negri (2014) |
| $\beta_0$ | Investment function constant | 0.01 | |

| | | | |
|---|---|---|---|
| $\beta_1$ | Elasticity of investment in relation to capacity utilization | 0.02 | Kappes and Milan (2017) |
| $\beta_2$ | Elasticity of investment in relation to interest rate | 0.02 | |
| $r_b$ | Government bonds' interes rate | 6% | Santos (2017) |
| $r_a$ | Interest rate upon Central Bank advances | 6% | Santos (2017) |
| $m_l$ | Markup on loans | 1% | Calibrated |
| $m_d$ | Markup deposits | 2% | Calibrated |
| $\mu$ | Required reserves | 15% | BCB (2012) |
| $\Omega$ | Value of pension benefits in relation to wages | 100% | BRASIL (2016) |
| $\rho$ | Proportion of retirees in relation to the total number of workers | 34% - 50% | BRASIL (2016) |
| $x$ | Proportion of investment financed with loans | 60% | Santos (2017) |

Source: author's elaboration.

SFC models are solved numerically. Thus, parameters' values and the endogenous variables' initial values were imputed in the Eviews VII software. We achieved the models' steady state after some periods of simulation when all variables grow at the same rate and, consequently, the proportions between stocks and flows remain constant. We analyze these proportions in the next section.

We will explore the steady state results for eight sub scenarios, reported in Table 3. We consider three types of changes in the economy. Firstly, we consider the process of demographic transition, captured through an increase in the proportion of beneficiaries in relation to employees (ρ). Secondly, we consider an increase in the formalization of the economy through a higher proportion of workers ($\lambda_w$) and a rise in the number of firms ($\lambda_f$) contributing to the system. Finally, situations with productivity growth and constant productivity ($g_{pr}$) are applied.

Table 3 also shows the parameter values used in the simulations. The first division in our scenarios is between a situation like the current one in the Brazilian pension system (named "current beneficiaries") and another in which a demographic transition has occurred, translated into a higher proportion of beneficiaries (named "increased beneficiaries"). In the first situation, the retirees' group has the size of 34% of the total employed workers. The relationship between the number of beneficiaries and the total number of employees was based on the pension system dependency ratio (RDP). In the second case, this percentage grows to 50%.

A second division is between two different shares of the formal economy, one similar to the current situation (named "current formalization") and another with less informality (named "increased formalization"). In the first case, we consider that 80% and 73% of firms and workers, respectively, are formal. The proportion of taxpayers in relation to total employees was measured from the pension system dataset for the year 2014. We considered the percentage of contributing firms regarding the level of participation in GDP, following the results found by ETCO (2014). In the second case, we assume an increase to 95% and 90% for firms and workers, respectively.

Lastly, we divide our simulations between an economy without productivity growth and another in which productivity grows at 1.4%[4]. those are, respectively, the "no $g_{pr}$" and the "with $g_{pr}$" cases. The values of the remaining parameters of the model are equal in every scenario, as shown in Box 1.

[4] Which is the Brazilian average for the period of analysis (IPEA, 2011).

Table 3 – Parameters' values used in each scenario

| Variable description | Scenarios | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Current beneficiaries | | | | Increased beneficiaries | | | |
| | Current formalization | | Increased formalization | | Current formalization | | Increased formalization | |
| | No $g_{pr}$ | With $g_{pr}$ | No $g_{pr}$ | With $g_{pr}$ | No $g_{pr}$ | With $g_{pr}$ | No $g_{pr}$ | With $g_{pr}$ |
| Percentage of contributing workers in relation to total workers ($\lambda_w$) | 73% | 73% | 90% | 90% | 73% | 73% | 90% | 90% |
| Percentage of contributing firms in relation to total firms ($\lambda_f$) | 80% | 80% | 95% | 95% | 80% | 80% | 95% | 95% |
| Percentage of retirees in relation to total workers ($\rho$) | 34% | 34% | 34% | 34% | 50% | 50% | 50% | 50% |
| Productivity growth ($g_{pr}$) | 0% | 1.4% | 0% | 1.4% | 0% | 1.4% | 0% | 1.4% |

Source: author's computations.

## 5. Results

Table 4 shows the results of the eight sub scenarios in steady state. In the next subsections, we will present our main exercises: (i) an increase in the number of beneficiaries; (ii) increased formalization in the labor market; and (iii) rises in labor productivity. We will analyze three main variables: GDP growth rate, the proportion of the pension system deficit relative to GDP, and the proportion of benefits paid in relation to GDP.

Table 4 – Simulation results

| | Scenarios | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Current beneficiaries | | | | Increased beneficiaries | | | |
| | Current formalization (baseline) | | Increased formalization | | Current formalization (baseline) | | Increased formalization | |
| | No $g_{pr}$ | With $g_{pr}$ | No $g_{pr}$ | With $g_{pr}$ | No $g_{pr}$ | With $g_{pr}$ | No $g_{pr}$ | With $g_{pr}$ |
| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| GDP growth | 2.00% | 2.00% | 2.15% | 2.15% | 2.00% | 2.00% | 2.15% | 2.15% |
| (Pension system deficit*)/GDP | -7.63% | -7.35% | -5.07% | -4.79% | -17.23% | -16.82% | -14.67% | -14.25% |
| Benefits/GDP | 20.40% | 20.12% | 20.40% | 20.12% | 30.00% | 29.59% | 30.00% | 29.59% |

Source: author's computations.
*The pension system result (deficit) abstract away from government transfers.

### 5.1 Increasing the number of beneficiaries

One of the indicators of the unsustainability of a pay-as-you-go-pension system is population aging. As the demographic transition (from a younger to an older population) takes place, the cost of maintaining retirees rises since the number of taxpayers becomes relatively lower than the number of beneficiaries. In this situation, we applied reforms in the system to ensure its sustainability. Increases in the contributions and the retirement age and decreases in benefit values are some available measures that can balance the system.

In the model developed here, we applied a set of simulations to evaluate the impact of population aging on economic growth and pension system deficit. We tested scenarios in which the number of beneficiaries as a proportion of employees has expanded. The results suggest that this increase does not affect GDP growth, but it raises the pension system's deficit. This can be seen by comparing the first four columns of table 4 (which shows the simulation results calibrated with current

demographic values, with different assumptions regarding the degree of informality and productivity growth) against the last four columns (which shows the impacts of a demographic change, again with different assumptions on informality and productivity).

Although it does not affect growth in the SFC model, the demographic change affects the pension system results. This is a consequence of the increased amount of paid benefits and expresses the increase in the dependency ratio of the pension system. In general, population aging is one of the factors that pressure social security accounts. This is central to the arguments in favor of the reform of the Brazilian pension system (Giambiagi et al., 2004).

Comparing column 1 with column 5, we can assess the impact of the demographic change in an economy with Brazilian's current levels of formalization and no improvements in productivity. The increase in the number of beneficiaries does not affect GDP growth, as can be seen in the first line. The pension system deficit, by its turn, experiences a marked increase, from 7.63% of GDP to 17.23% of GDP. Therefore, the demographic change will harshly affect the pension system budget. The proportion of benefits in relation to GDP also increases, from 20.40% to 30%.

A possible reaction of the government in the face of the demographic change is to pursue policies that increase the formality of the economy and, therefore, increase the system's revenues. A comparison of column 1 with column 7 points out some of these features. The simulation results show that the system deficit will increase, but for relatively lower levels than when the change in formalization level is not considered (comparison between columns 1 and 5). The results improve by a small amount when productivity growth is added to the model (comparing columns 5 with 6 and 7 with 8).

### 5.2 Increased Formalization in the Labor Market

The way in which the pension system is structured does not prevent informal workers from contributing to it and accessing rights and guarantees. However, some factors make it difficult for these individuals to be socially covered. The first is the lack of familiarity that workers have with the bureaucratic processes related to the

contribution of the system (Arantes, Delfino and Gomes, 2016). The second factor relates to some economic characteristics of informal occupations, such as low wages and the high turnover rate that hinder the continuous payment of contributions from workers in the informal sector and wish to contribute (Fagundes and Souza, 2017).

Based on these evidences, our simulations assess the impact of an increase in economic formality. The results indicate that the increase in formalization leads to a reduction in the pension deficit as a proportion of GDP between 2 to 3 percentage points in each scenario. Table 4 shows this by comparing the columns below the heading "current formalization" against the columns under the heading "increased formalization", for each assumption regarding the number of beneficiaries. This evidence is in line with Arbache (2003), and Delgado et al. (2007), Song et al. (2012) and Boulhol (2019), who assesses the influence of the policies of reducing informality on social security revenues and, consequently, on the social security balance.

The model also estimates the impact of the reduction of informality on economic growth. Regardless of the assumption about the beneficiaries' number or productivity growth, the comparison of different scenarios seems to point out that a higher degree of firms' and workers' formalization contributes to GDP growth. A possible 'inside the model' explanation for this dynamics is the following. On the one hand, an increase in formalization reduces firms' profits, which will translate into lower capitalists' consumption in the next period. However, the parameter $\alpha_1$ mediates this consumption decrease, which is calibrated at 0.61 (see box 1). On the other hand, a higher formalization also means a future increase in government expenditures due to the greater number of benefits paid[5]. Therefore, there is a net increase in overall expenditure, leading to higher growth. Another explanation, which cannot be inferred directly from our model, is that countries with higher levels of informality tend to have lower rates of economic growth when compared to other countries - see, for example, Schneider, Buehn and Montenegro (2010). One of the causes for sluggish growth in scenarios of high informality is the firms' reduced scale of production. Informal companies usually operate with a small production scale to avoid being detected by the government. Consequently, there is a low a reduced

[5] We thank an anonymous referee for bringing this to our attention.

achievement of labor productivity gains, leading to lower rates of growth. In Brazil, the low production scale in conjunction with other economic, social and cultural variables further deepens the problem of informality and structural heterogeneity.

### 5.3 Increases in Labor Productivity

Population aging is a global trend that imposes a challenge for the management of Pension Systems worldwide. In this context, the rise in labor productivity becomes central to reduce the negative effects caused by demographic transition. One of the ways this occurs is by the impact on the economic growth generated by increased productivity. Rada (2009) argues that economic growth hinges on two key variables: the labor force growth and labor productivity. The increase in productivity can compensate the reduction in the size of the labor force. Paley (1998) and Yasar (2013), based respectively on American and Turkish economies, show that the incorporation of productivity into the analysis alters the very diagnosis of the demographic situation. Based on the concept of effective workers (which incorporates productivity), they debunk the argument that population aging was responsible for weakening the funding capacity of the pension system.

Here, we also test the capacity of labor productivity to improve the system's result in the SFC model. The change of a regime without productivity growth for a scenario with increasing productivity (comparison between the values below "no $g_{pr}$" columns against "with $g_{pr}$" columns) causes a small reduction in the system deficit. This result is in line with Paley (1998), Rada (2009), Song et al. (2012), Yasar (2013) and Moreira et al. (2019). However, this reduction is insufficient to generate a surplus.

To capture the different ways in which productivity impacts the economy, we can analyze the results when both the number of formal workers and productivity increases (columns 1 against column 4, or columns 5 against column 8).

In column 4, in which there is no change in the number of beneficiaries, the analyzed variables improved across the board. Economic growth increased and the social security deficit dropped, reaching its lowest level found in the simulations. The

number of beneficiaries also decreased. In column 8, in which the increase in the number of beneficiaries plays a part, the results also improved.

Since productivity (via Okun's law) and degree of formality are both pro-cyclical variables, economic expansion can alleviate the pressures in the pension system. In this way, policymakers should avoid draconian reforms based on forecasts results from mainstream models (that do not allow for productivity growth and rise in formality) during a slump.

## 6. Concluding remarks

There are two main interpretations of the Brazilian pension system's sustainability. The first is the mainstream view, which pushes for draconian reforms since the benefits given by the Federal Constitution of 1988 were too benevolent and above the country's possibilities (Zilberstajn et al., 2017). The second view argues that the system is in balance when the correct approach (including tax payments originally directed to finance the system) is applied (Puty et al., 2017). We offered a third intermediary view that claims that this sustainability should include labor informality (Dotsey et al., 2015) and labor productivity, two variables lacking in the debate (Yasar, 2013). We have explored these ideas by developing an empirically calibrated stock-flow consistent model, in which we analyzed the impacts of demographic change, reduction of informality and increases in labor productivity.

Overall, the results indicated positive effects on the economy, something that is in line with other studies that incorporate these variables (Song et al., 2012; Boulhol, 2019). However, the increased formalization and productivity were unable to reverse the system deficit, a result that is also found in Moreira et al. (2019) when analyzing the Portuguese social security system. This result helps to understand some of the challenges for overcoming Brazilian pension problems.

Our findings show that raising the number of contributors reduces the deficit of social security and generates a small increase in economic growth, but the system is unable to reach a surplus. Moreover, incorporating productivity growth maintains unaltered the overall dynamics of the system, although it modestly improves the results. The present paper opens space for other analyzes using the SFC

methodology, serving as a basis for assessing the impact of other policies on the pension system.

The results reinforce the role of government transfers in ensuring the system's sustainability (Ferreira, 2007; Lavinas and Cordilha, 2019; Melis and Truda, 2020). However, economic growth combined with a rise in formalization allows for a lower dependence of the pension system on government transfers. Therefore, a possible aim of future reforms should be in stabilizing the dependence of the system on government transfers. In this sense, it seems that with growing labor productivity and formality, the necessity of the system in using draconian reforms diminishes considerably. We propose a reform of the system to guarantee its long-term balance, but this reform is not as profound as the mainstream suggests.

## References


Afonso, J. R. R.; Soares, J. M.; Castro, K. P. (2013), "*Avaliação da estrutura e do desempenho do sistema tributário brasileiro: Livro Branco da Tributação Brasileira*". Brasília: Banco Interamericano de Desenvolvimento (BID).

Arantes, A. B.; Delfino, M. F. N. S.; Gomes, W. A. (2016), "Trabalho informal e previdência social: Desafios da atualidade". *Revista Científica da Escola* de *Saúde Pública* "*Cândido Santiago*", São Paulo, 2(2), p.80-94.

Arbache, J. S. (2003), "Informalidade, encargos trabalhistas e previdência social". In: Brasil. Ministério da Previdência Social. *Base de Financiamento da Previdência Social: Alternativas e Perspectivas*. Brasília: MPS, p. 231-252.

Arbex, A.; Galiza, M. (2017), "Reforma da Previdência, Agricultura Familiar e os Riscos de Desproteção Social". *Boletim do Mercado de Trabalho*, Brasília, 62.

Banco Central do Brasil (2012), "Uma avaliação dos recolhimentos compulsórios". *Relatório de Inflação*, Brasília, 14(4), p. 86-91.

Bezemer, D. J. (2010), "Understanding financial crisis through accounting models". *Accounting, Organizations and Society*, 35(7), 676-688. DOI: https://doi.org/10.1016/j.aos.2010.07.002

Boulhol, H. (2019), "Objectives and challenges in the implementation of a universal pension system in France". Paris: *OECD Working Papers*, n. 1553. DOI: https://doi.org/10.1787/18151973

Brasil. Ministério da Previdência Social (2015), "Evolução do negro no mercado de trabalho brasileiro - 1993, 2003 e 2013". *Informe de Previdência Social*, 27(2), p. 13-26.

Brasil. Ministério do Trabalho e Previdência Social (2016), "*Anuário Estatístico Da Previdência Social*". Brasília: MTPS, 2016.

Burgess, S.; Burrows, O.; Godin, A.; Kinsella, S.; Millard, S. (2016), "A dynamic model of financial balances for the United Kingdom". *Bank of England Staff Working Paper*, n. 614.

Cavalcante, L. R.; De Negri, F. (2014), "Evolução Recente dos Indicadores de Produtividade no Brasil". In: De Negri, F., Cavalcante, L. R. (Org.) *Produtividade no Brasil*: Desempenho e Determinantes. Brasília: IPEA.

Caverzasi, E.; Godin, A. (2015), "Post-keynesian Stock-Flows-Consistent modelling: A survey". *Cambridge Journal of Economics*, Cambridge, 39(1), p. 1-31. DOI: https://doi.org/10.1093/cje/beu021

Cipriani, G. P. (2014), "Population aging and PAYG pensions in the OLG model". *Journal of Population Economics*, 27(1), p. 251-256. DOI: https://doi.org/10.1007/s00148-013-0465-9

Dafermos, Y. (2012), "Liquidity preference, uncertainty, and recession in a stock-flow consistent model". *Journal of Post Keynesian Economics*, 34(4), p. 749-776. DOI: 10.2753/PKE0160-3477340407

Dedry, A.; Onder, H.; Pestieau, P. (2017), "Aging, social security design, and capital accumulation". *The Journal of the Economics of Ageing*, 9, p. 145-155. DOI: https://doi.org/10.1016/j.jeoa.2016.10.003

Delgado, G.; Campos, A.; Querino, A. C (2007), "Avaliação do simples: Implicações à formalização previdenciária". *Textos para discussão do IPEA*, n. 1277.

Diamond, P. A. (1965), "National debt in a neoclassical growth model". *The American Economic Review*, 55(5), p. 1126-1150.

Dotsey, M.; Li, W.; Yang, F. (2015), "Home production and social security reform". *European Economic Review*, 73, p. 151-150. DOI: https://doi.org/10.1016/j.euroecorev.2014.11.006

Fagundes, H. S.; Souza, M. H. M. (2017), "Relações informais de trabalho e o acesso à proteção social". *Revista Pesquisa Qualitativa*, São Paulo, 5(8), p. 327-343.

Fanti, L; Gori, L. (2012), "Fertility and PAYG pensions in the overlapping generations model". *Journal of Population Economics*, 25(3), p. 955-961. DOI: https://doi.org/10.1007/s00148-011-0359-7

Feldstein, M. (1998), "*Privatizing social security*". Chicago: University of Chicago Press.

Ferreira, S. G. (2007), "Sistemas previdenciários no mundo: Sem "almoço grátis"". In: Tafner, P.; Giambiagi, F. (Org.). *Previdência no Brasil: debates, dilemas e escolhas*. Rio de Janeiro: IPEA, p. 65-94.

Galbraith, J. (2012), "Who Are These Economists, Anyway?" In.: Papadimitriou, D.; Zezza, G. *Contributions to Stock-Flow Modeling: Essays in Honor of Wynne Godley*. New York, Palgrave Macmillan, p. 63-75.

Gentil, D. L. (2006), "*A Política Fiscal e a Falsa Crise da Seguridade Social Brasileira*: análise Financeira do Período 1990-2005". 2006. 357 p. Tese (Doutorado em Economia) – Faculdade de Ciências Econômicas, Universidade Federal do Rio de Janeiro, Rio de Janeiro.

Gentil, D. L.; Araujo, E. C.; Puty, C. C. B.; Silva, C. P. A. (2017), "Uma Análise não Convencional para o Problema da Previdência Social no Brasil: Aspectos Teóricos e Evidências Empíricas". *Revista da ABET*, João Pessoa, 16(1), p. 138-159. DOI: 10.22478/ufpb.1676-4439.2017v16n1.36034

Giambiagi, F.; Mendonça, J. D. O.; Beltrão, K. I.; Ardeo, V. L (2004), "Diagnóstico da previdência social no Brasil: o que foi feito e o que falta reformar?". *Texto para Discussão do IPEA*, n. 1050.

Godley, W. (1996), "Money, finance and national income determination: an integrated approach". *Jerome Levy Economics Institute Working Paper* No. 167.

Godley, W.; Lavoie, M. (2007), "*Monetary economics: An integrated approach to credit, money, income, production and wealth*". New York: Palgrave Macmillan.

Hatzius, J.; Stehn, J. (2012), "*The US economy in 2013-2016: Moving over the hump*". New York: Goldman Sachs. (US Economics Analyst, n. 12/48).

Hill, M. (2006), "*Social policy in the modern word: a comparative text*". Oxford: Blackwell.

Holland, M.; Málaga, T. (2018), "Previdência social no Brasil: Propostas para uma reforma de Longo Prazo". *FGV Working Paper,* n. 487.

Instituto Brasileiro de Ética Concorrencial - ETCO (2014), "*Índice sobre economia subterrânea*". São Paulo: ETCO.

Instituto de Pesquisa e Economia Aplicada - IPEA (2011), "*Retrato das desigualdades de gênero e raça*". Brasília: IPEA.

Kappes, S. A.; Milan, M. (2017), "Fiscal policy rules in a stock-flow consistent model". *Brazilian Keynesian Review*, São Paulo, 3(2), p. 32-55. DOI: https://doi.org/10.33834/bkr.v3i2.123

Lavinas, L.; Cordilha, A. C. (2019), "Reforma da previdência: qualificando o debate brasileiro". *Revista NECAT*, 8(15).

Lavoie, M; Godley, W. (2001-2002), "Kaleckian models of growth in a coherent stock-flow monetary framework: a Kaldorian view." *Journal of Post Keynesian Economics*, 24(2), p. 277-311. DOI: https://doi.org/10.1080/01603477.2001.11490327

Leite, F. P. (2015), "Como o grau de desigualdade afeta a propensão marginal a consumir? Distribuição de renda e consumo das famílias no Brasil a partir dos dados das POF 2002-2003 e 2008-2009". *Economia e Sociedade*, São Paulo, 24(3), p. 617-650. DOI: https://doi.org/10.1590/1982-3533.2015v24n3art5

Ludvigson, S. C.; Steindel, C. (1999), "How important is the stock market effect on consumption?". *Federal Reserve Bank of New York Economic Policy Review*, New York, n.9821, p. 29-51.

Melis, R.; Trudda A. (2020), "Critical issues of public pension system: The Italian case". In: PERIS-ORTIZ M., ET AL (eds) *Economic challenges of pension systems*. London: Springer.

Moreira, A.; Botelho A. A.; Manso, L.; Nicola, R. (2019), "Financial *and social sustainability of the portuguese pension system*". Lisboa: Fundação Francisco Manuel.

Morimoto, T.; Nakabo, Y.; Tabata, K. (2018), "Population aging, labor market frictions, and PAYG pension". *Kwansei Gakuin University Discussion Paper,* n. 172.

Neri, M. C. (2007), Informalidade. In: Tafner, P.; Giambiagi, F. (Org.*).* "*Previdência no Brasil*: debates, dilemas e escolhas". Rio de Janeiro: IPEA, p. 285-319.

Palley, T. I. (1998), "The economics of social security: an old keynesian perspective". *Journal of Post Keynesian Economics*, Philadelphia, 21(1), p. 93-110. DOI: https://doi.org/10.1080/01603477.1998.11490181

Puty, C. A. C. B.; Francês, C. R. L.; Carvalho, S. V.; Silva, M. S.; Silva, C. P. A. (2017), "Quão acuradas são as projeções financeiras e atuariais do regime geral da previdência social?". *Revista da ABET,* João Pessoa, 16(1), p. 160-173. DOI: https://doi.org/10.22478/ufpb.1676-4439.2017v16n1.36037

Rabelo, G. G.; Oliveira, J. M. (2015), "Tributação sobre empresas no Brasil: Comparação internacional". *Radar*, Brasília, 41, p. 33-39.

Rada, C. (2009), "Introducing demographic changes in a model of economic growth and income distribution". *University of Utah Working Paper Series*, n. 2009-01.

Rada, C. (2012), "Social security tax and endogenous technical change in an economy with aging population". *Metroeconomica,* Oxford, 63(4), p. 727-756. DOI: https://doi.org/10.1111/j.1467-999X.2012.04162.x

Rego, J. S.; Paula, R. Z. A.; Brito, A. S. (2018), "O debate previdenciário contemporâneo: "perspectiva conservadora" versus "perspectiva das demandas por seguridade social"". *Revista de Políticas Públicas*, 87.

Samuelson, P. A. (1939), "A synthesis of the principle of acceleration and the multiplier". *Journal of Political Economy*, 47(6), 786-797.

Samuelson, P. A. (1958), "An exact consumption-loan model of interest with or without the social contrivance of money". *Journal of political economy*, 66(6), p. 467-482.

Santos, J. F. C. (2017), "*Ensaios sobre crescimento, restrição ao balanço de pagamentos e distribuição de renda em abordagens Stock-Flow Consistent*". Tese (Doutorado em Economia) - Pós-graduação em Economia. Universidade Federal de Minas Gerais (UFMG), Belo Horizonte.

Schneider, F.; Buehn, A.; Montenegro, C. E. (2010), "New estimatives for shadow economies all over the world". *International Economic Journal*, Amsterdan, 24(4). DOI: https://doi.org/10.1080/10168737.2010.525974

Silva, S. P. (2018),. O Panorama Laboral Brasileiro no Contexto Recente da Economia Latino Americana. *Mercado de Trabalho: Conjuntura e Análise*, 65(24), p. 73-84.

Song, Z.; Storesletten, K.; Zilibotti, F. (2012), "Rotten parents and disciplined children: A politico-economic theory of public expenditure and debt". *Econometrica*, 80(6), p. 2785–2803. DOI: https://doi.org/10.3982/ECTA8910

Yasar, Y. (2013), "The crisis in the turkish pension system: A post keynesian perspective". *Journal of Post Keynesian Economics*, Oxford, 36(1), p. 131-152. DOI: 10.2753/PKE0160-3477360107

Zylberstajn, H.; Oliva, B.; Afonso, L. E.; Zylberstajn, E. (2017), "Previdência Social: Reforma em Três Atos". *Informações FIPE*, v. 8.