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Market Power and Inequality: a model of the Brazilian economy

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November 3, 2021

Abstract

This paper attempts to draw some lines regarding the interplay between market concentration and income inequality in the Brazilian economy. Our goal is to uncover some of the mechanisms by which market power influences macroeconomic aggregates and, consequently, indicators such as the share of the income appropriated by the richest and the Country's Gini index. For this purpose, we have first conducted an empirical estimation using a PVAR approach with data from Brazilian states. We found that the markup shock is positively related to inequality. Moreover, that result is robust to changes in the model specification or different Cholesky ordering. Second, we built a dynamic general equilibrium model and calibrated it to reproduce the Brazilian economy. The model has three representative agents and heterogeneity in asset market participation and labor supply/skills. Additionally, firms exhibit endogenous oligopolistic and oligopsonistic (in the labor market) behavior. In response to unexpected markup shocks, the model showed a regressive dynamic, transferring income from the bottom to the top of the distribution. Nevertheless, its effects on economic growth may be positive in the short term, due to the increased investment in creating new companies. The disturbances in the TFP reduce inequality on impact, which is due to the countercyclical behavior of the markup. Instead, when we allow the TFP shock to be correlated with the markup, this effect is reversed, with the largest share of income being appropriated by the wealthiest. Finally, it is noteworthy that the labor supply elasticities partially determine the behavior of income distribution between poor and middle-class households.

Keywords: market power, inequality, markup, general equilibrium, antitrust policy, income distribution, Brazil.

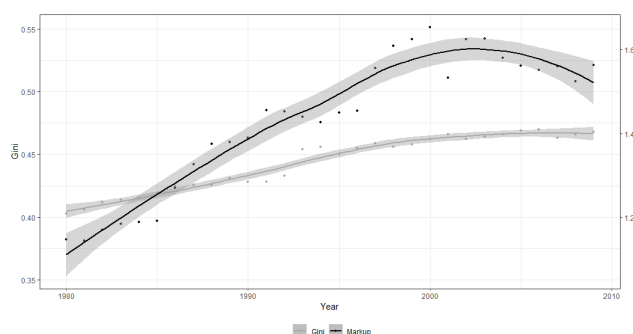
1 Introduction

Should antitrust policy consider the implications of competition for income and wealth distribution? Traditionally, the antitrust analysis takes as standard the efficiency principle, which assumes, to a large extent, that distribution is not an issue — allowing, for example, the use of total welfare as the reference index (the sum of consumers and producers surpluses). Under this view, agencies should clear mergers that increase market power if there is evidence of efficiency gains capable of coping with the pressure to raise prices. When considering distributive effects, a more complex and generalized analysis is required. Even the policy of privileging the consumer surplus in the antitrust assessment (a practice that has been adopted by a considerable number of authorities regarding distribution concerns) is not enough.

In principle, it is necessary to recognize that consumers and producers are heterogeneous between markets and intra-markets. The effects of increased market power are asymmetric between different types of agents. For instance, [Baker and Salop \(2015\)](#) recognize that the “continued application of consumer welfare standard likely would lead to less inequality than a reliance on aggregate welfare considerations”. But, suggest that antitrust policy should do more and prioritize cases that benefit the middle class and the less advantaged and design antitrust remedies focusing on the poorer consumers.

Therefore, the income and wealth inequality agenda is a significant change in the antitrust authorities’ usual methods and practices. Even so, this kind of claim has been recurrent between practitioners and academics. This behavior has been incentivized by some recent macroeconomic trends, especially in the United States. Since the 1980s, and with some deepening after the great recession, estimates show an increase in the price/marginal cost markup, combined with an upward trend in profits share, a reduction in labor share, and a consequent increase in the income inequality indexes ([De Loecker et al., 2020](#); [Edmond et al., 2018](#); [Colciago and Mechelli, 2020](#)). [Figure 1](#) reports Markups and Gini index trends from 1980 to 2010. It is straightforward questioning whether these trends are linked with the changes observed in the American antitrust policy during the 1980s, a period marked by a significant deregulation process, revealing a non-negligible influence of competition policy in inequality.

Figure 1: US - Estimated Markup and Gini index trends (1980-2009)



Source: FRED/U.S.; US Census Bureau; [De Loecker et al. \(2020\)](#)

[Stiglitz \(2017\)](#) gives a clear and simple mechanism to explain this link between inequality and competition:

Market power has, of course, distributive effects as well. The monopolist's monopoly rents come at the expense of consumers: as monopolies raise their prices, their profits increase while the well-being of consumers and workers decreases. An increase in market power is associated with an increase in inequality (p. 4).

Despite its reasonable intuition, there is no broad consensus about the connection between competition, antitrust policy, and inequality. Furthermore, the argument against it is as well very straightforward. In countries with developed financial systems, the shareholding is distributed through the income classes. Furthermore, labor market protection, like labor unions, can generate a rent-sharing process between workers and owners. Therefore, the gains from monopoly rents are not necessarily going to those on the top, minimizing market power's effect on inequality. This kind of reasoning is followed by [Crane \(2015\)](#), for example.

The impact of market power and the lack of competition on income and wealth inequality is an ongoing debate. However, a growing body of work in the economic literature highlights that there may exist sufficient transmission mechanisms to justify the concerns about the relationship between market regulation, antitrust interventions (or lack of them), and inequality. Perhaps the inaugural paper was [Comanor and Smiley \(1975\)](#), recently extended by [Ennis and Kim \(2017\)](#). The latter calibrated the seminal model for several OECD countries and shows that the wealth of the top 10 percent of households rises by 10 to 24 percent in the presence of market power. So a fiercer competition policy

could reduce inequality.

[Dierx et al. \(2017\)](#) opened a field of work with dynamic stochastic equilibrium models, capable of connecting, with some coherence, the micro and macroeconomic impacts of antitrust interventions. In their study, the authors explored a DSGE model for Europe (QUEST model) to assess the distributional response to shocks on firms' markups (across different households, savers/non-liquidity-constrained, and hand-to-mouth/liquidity-constrained). The micro side approach, connected with antitrust agencies' performance, was possible through defining the shock level with estimates for direct and indirect (deterrent) effects of competition policy interventions. The model simulations show some significant redistributive results, with liquidity-constrained households increasing their consumption more. "This supports the view that competition policy interventions, by lowering prices and—as studied in other work, also by increasing the quality and variety of products—are particularly beneficial for the poorest in the society" (p.182).

Finally, still in a general equilibrium framework, but enriched with an oligopolistic and endogenous market structure and heterogeneous agents, [Colciago and Mechelli \(2020\)](#) could simulate markups and inequality trends similar to those found in the US post-1980 data. To build this scenario, the authors imposed a transition between models' steady states, increasing entry barriers for firms, resulting in incumbents' market power gains.

Understanding the relationship between competition and inequality also benefits from empirical papers, although this type of application is not yet widespread due to the difficulties in estimating market power and dealing with endogeneity. Yet, in this literature it is worth highlighting among others the papers of [Gans et al. \(2019\)](#); [De Loecker et al. \(2020\)](#) and [Han and Pyun \(2021\)](#).

To check the "distributed shareholding" argument, [Gans et al. \(2019\)](#) calculated the relative distribution of consumption and corporate equity ownership for the United States and found that ownership is more skewed than consumption. Consequently, increased markups should increase inequality. Moreover, they were able to show that corporate equity has become more skewed during the last decades. [De Loecker et al. \(2020\)](#) relies on firms' cost minimization assumption to construct estimates for markups in the US, from 1950 to 2016, and show that the upward trend started in 1980 are significantly related with the fall of the labor share and the rise of profits participation in the national income. Building on these markups insights, [Han and Pyun \(2021\)](#) found that an increase in the wedge

between marginal cost and prices was positively associated with rising income inequality for 20 countries during 1975–2011 and that the top 1% income earners tend to benefit more from higher markups. Moreover, they show that labor market protection mitigates this positive relationship between market power and rising inequality.

So far, we have presented good theoretical and empirical reasons for discussing inequality issues in antitrust policies and routines. However, we must recognize that the actual effect of greater market power on the levels of inequality in developed countries is in dispute. Especially if one considers that equity ownership is more or less distributed, among the middle classes, the same could occur with abnormal profits from companies' margins. Instead, our central question's answers take place in a significantly different environment regarding the developing world. In countries like Brazil, wealth is more concentrated on the top, equity markets are likely undeveloped, the labor market is not very fluid, and there is evidence of oligopolistic behavior – with conglomerate and vertically integrated enterprises, exclusive legal privileges for incumbents, and a collection of formerly or still state-owned enterprises (and their respective exclusive markets). [Crane \(2015\)](#) recognizes this specificity:

The answer might very well be different for developing countries than for more developed ones. There is a strong a priori argument that the introduction of competition laws—prohibitions on monopolistic conduct and agreements—in developing countries can have progressive wealth redistribution effects (p. 1178).

In the Brazilian case, during the second half of the 20th century, the strong presence of the Federal Government's as a leader in a development policy, planning or directly acting on markets, distorted incentives, mainly by controlling prices and fostering the establishment of oligopolies in strategic industrial sectors:

By reinforcing entry and exit barriers, this set of governmental policies played a role in establishing uncontested markets; weakened entrepreneurship; and made market positions more rigid and stable. Therefore, the governmental policy was not only reckless but opposite to competition ([Fiuza, 2001](#), p. 04, free translation).

Price control was a widespread reality during the 1970s (mainly to cope with high inflation) and, according to [Frischtak \(1980\)](#), served as an official business cartel coordinated by the Federal Government, based on sector-specific agreements entered with the most representative firms in the market.

To [Considera \(2002\)](#) governmental activity was highly harmful because it promoted a process of concentration in the leading firms, discouraging small firms; defined the market leader signaling the establishment of tacit agreements; and undermined the work of antitrust authorities, making unnecessary and unfeasible any prosecution to cartels since these were primarily organized by the government itself.

Of course, it is impossible to make any causal statement without an empirical strategy for this purpose, which is greatly hampered by the absence of frequent and reliable data series. Still, it is notable that, while European countries and the United States lived, in the second half of 20th century, the “great leveling” in income distribution, Brazil has seen, at best, stability at high levels of inequality, despite the existence of intervals of fall or sharp rise. As [De Souza \(2018\)](#) points out, the military dictatorship, a period of great state intervention in the economy, coincides with an increase in income concentration at the top. The top 1% share of income, which had reached 17–19% on the eve of the military coup, increased steadily until 1971 – when it marked 26%, the highest share since the 1940s.

Even with the democratization, in the second half of the 1980s, Brazil started the new century as one of the world’s most unequal countries, and got a famous nickname in the 1990s: *Belíndia*. This expression reflected that the most inferior part of the population’s income levels was very close to the misery experienced by the poorest in India. However, on the other hand, the top of the Brazilian income distribution had an income similar to that observed in developed European countries, like Belgium.

As we can see in [table 1](#), this reality has changed very little since then. Estimates based on tax data and national income tables, produced for 2015 by the World Inequality Database (WID), indicate that, in purchasing power parity US\$, the bottom 50% in Brazil has an income 38% higher than the poorest in India. Nevertheless, Brazil’s poor earn only 27% of the income registered at the lowest tail of the Portuguese distribution. On the other hand, Brazilians’ wealthiest have a comparatively higher income than Belgians, reflecting the large gap between the top and the end of Brazil’s income distribution.

Any aggregate indicator that compares countries, with specificities beyond the observed data, should be viewed with a critical eye. However, the global markup estimates produced by [De Loecker and Eeckhout \(2020\)](#), based on a similar framework used for the US, give evidence that, among developing

Table 1: Average incomes, Brazil and selected countries (2015, US\$ PPP)

Income groups	Brazil	Portugal	Belgium	US	India
Bottom 50%	\$4,059.62	\$14,671.21	\$25,304.13	\$20,301.10	\$2,927.00
Middle 50%	\$25,329.93	\$53,954.85	\$85,073.95	\$105,074.87	\$13,197.00
Top 1%	\$544,456.49	\$439,269.36	\$500,753.94	\$1,405,440.8	\$212,976.00

Source: World Inequality Database (based on Brazilian national income accounts and tax data).

countries, Brazilian firms are between the ones with the highest market power (table 2). They are the second, behind only Peru, with a margin of 60% between the marginal cost and the products' final price. If we analyze this indicator in detail, we will see that there are ups and downs between the covered period (1980-2016). Still, the final result is marked by the stability in high values, with a negligible variation of -0.01.

Table 2: Countries ranked by estimated Markup

Rank	Country	Markup (2016)	Change (1980-2016)
1	Peru	1.64	-0.04
2	Brazil	1.61	-0.01
3	Colombia	1.56	+0.41
4	Mexico	1.55	+0.21
5	Indonesia	1.53	+0.26
6	Philippines	1.50	-0.77
7	Venezuela	1.47	-0.46
8	Argentina	1.45	+0.64
9	Thailand	1.44	+0.21
10	China	1.40	-0.49
11	Chile	1.37	-2.24
12	South Africa	1.34	+0.14
13	Malaysia	1.33	+0.03
14	India	1.32	+0.34
15	Taiwan	1.23	-0.15
16	Pakistan	1.17	-0.01
17	Turkey	1.16	-0.32

Source: [De Loecker and Eeckhout \(2020\)](#).

Since democratization, Brazil has seen an attempt to build policies focused on redistribution. As an example, the Country created universal health and social security systems. However, although the antitrust policy has been reformulated a few times, it has neglected wealth and income issues. These two stylized facts, Brazil's presence among the world's unequal countries and those with the highest market concentration, may be a piece of evidence that this path may not be correct. Therefore, the interaction between income distribution and competition policy should, in principle, be analyzed with some emphasis, either by a normative view based on social justice principles or because the intensification of income inequalities has repercussions on the Country's institutional quality and, consequently, in the conditions available for economic development.

This paper is an initial attempt to draw a few lines regarding the interplay between market concentration and income inequality in the Brazilian economy. Our goal is to uncover some of the mechanisms by which markups and barriers to entry influence macroeconomic aggregates and, consequently, indicators such as the share of the income appropriated by the richest and the Country's Gini index. For this purpose, we have first conducted an empirical estimation as motivation procedure. We study the response of Gini and the top 1% share of income to a markup shock, using a PVAR approach estimated with data from Brazilian states. Consistent with the recent empirical literature, we find that the markup shock is positively related to inequality. Moreover, that result is robust to changes in the model specification or different Cholesky ordering.

Second, we built a dynamic general equilibrium model and calibrated it to reproduce the Brazilian economy. To keep it as simple as possible, revealing only the critical characteristics needed for our goal, this model is initially based on a traditional Real Business Cycle framework, first developed by [Kydland and Prescott \(1982\)](#). Nevertheless, it has a set of frictions useful for matching some Brazilian economy characteristics, especially the wealth and income distribution through three quantiles of the Country's population (bottom 50%, middle 49%, and top 1%) and the firm's behavior. These characteristics give our model reasonably different aspects from those we saw in previous papers, making it computationally lighter and more appropriate to deal with the Brazilian economy. As the critical factors in our model, we can highlight the presence of three representative agents, heterogeneity on asset market participation and on labor skills (a way to overcome the two agents models' difficulty of reproducing the income distribution), and a more complex supply side, featuring oligopolistic in the goods market and oligopsonistic behavior in the labor market. Together, these features can illustrate some of the possible effects of TFP and markup shocks through income distribution.

The remainder of the paper is organized as follows: Section 2 presents a more profound revision of the literature related to our proposal; Section 3 give details about the PVAR estimation and results; Section 4 spells out the model, equilibrium conditions, and steady-state; Section 5 analyze some model's static properties; Section 6 discuss the macroeconomic and distributional effects of TFP and markups shocks; and Section 7 presents some policy discussion and concludes.

2 Related Literature

This paper is related to the broad economic literature on the determinants of income inequality. The inequality phenomenon is multifactorial and dependent on each Country's specific institutional context, as shown by [Nolan et al. \(2019\)](#). Among these factors, the authors highlight, for example, changes in globalization, technological progress, the role of financial markets, the composition of the population (in terms of age and family structure, and changing patterns of household labor force participation). They list distribution policies as well. Other authors point out the lack of good institutions ([Acemoglu and Robinson, 2015](#)), lobbying and government corruption ([Gupta et al., 2015](#); [Gilens and Page, 2014](#)), and intergenerational persistence ([De Nardi, 2004](#)). In the Brazilian context, since the 1970s, there was a polarized debate about the role of education versus structural issues like segregation/discrimination/limited access to production factors and the need for redistributive policies ([Gandra, 2005](#); [Barros and Mendonça, 1995](#)).

Instead, as far as we know, our paper is the first to look closely at market power as a source of inequality, in an underdeveloped country, through a general equilibrium model that, as we shall see, combine labor skills heterogeneity (what may be considered an education-related process), structural features (like limited access to production factors) and oligopolistic behavior, both in goods and labor markets.

For our work purpose, we first rely on general equilibrium models that incorporate several levels of heterogeneity between agents. The DSGE models were initially marked by a representative agent's presence, which obviously denied the possibility of any assessment regarding income inequality. However, this framework has recently been revised to make it possible to incorporate some heterogeneity, either by liquidity-constrained or credit-constrained households (as in [Galí et al., 2007](#) and [Iacoviello, 2005](#), respectively). This trend was further deepened by authors who added to the basic models a complete distribution of heterogeneous agents, much in line with [Aiyagari \(1994\)](#) and [Krusell and Smith \(1998\)](#). These models are commonly known as Heterogeneous Agents New Keynesian (HANK) models (e.g., [Kaplan et al., 2018](#)).

However, all these works aimed to study income inequality as a mechanism affecting macroeconomic policies and aggregates. Oppositely, a normative concern about inequality, regarding how these policies impact the functional distribution of income, has gained relevance only after Piketty's work about the

concentration at the top. In this last line of studies, we can highlight papers from [Hohberger et al. \(2020\)](#), who examined optimal conventional and unconventional monetary policies in the presence of agents with no access to the financial system; [Gornemann et al. \(2016\)](#), who analyzed the same type of policies but in a complete heterogeneous framework, and [Bayer et al. \(2020\)](#), who estimated a HANK model and showed that a set of macroeconomic shocks, including markup shock, have significantly contributed to the evolution of US wealth and income inequality.

Our model's supply side is inspired as well by a series of papers that incorporate oligopolistic market structures with endogenous entry, as in [Bilbiie et al. \(2012\)](#), [Jaimovich and Floetotto \(2008\)](#), and [Etro and Colciago \(2010\)](#). In these papers, the degree of market power, synthesized by markups between price and marginal cost, depends not only on the usual parameter of substitutability between goods (as in traditional monopoly competition) but also on the number of firms present in the economy. The number of firms, in turn, is defined by a dynamic rule of zero profit, in which the time equilibrium condition determines that the companies' sunk cost, or entry cost, must be equal to the expected profit, endogenizing the process of entry and exit of these firms. Thus, the markup level is determined endogenously as its possible impact on the economy's income distribution.

Still on the supply side, we incorporate insights from two studies that modeled the Brazilian economy's income inequality. [Areosa and Areosa \(2016\)](#) introduced different skilled agents in the production function, with one of them having limited access to the financial system, and examined the optimal monetary policy in the presence of inequality. [Ferreira and Guimarães \(2018\)](#) explored the same type of heterogeneity in the production function in a model of educational and savings choice with heterogeneous agents. Their model apparently had a good fit on the data on income and wealth inequalities, explaining existing Brazil's inequality patterns.

Finally, several studies, mentioned earlier in this paper, modeled the mechanisms by which market power affects individual income distribution. Two of them, closely related to ours, deserve a detailed analysis of their specificities. The first, [Dierx et al. \(2017\)](#), did something relatively simple but quite ingenious. As we explained earlier, the authors used a complete model for the European Union (Quest model) and simulated the possible impacts of the European competition agency's work on the distribution of consumption among the agents/ individuals.

Quest is a New Keynesian model with two regions and an open economy. Its supply side has a

production function with different labor types (skilled and non-skilled), similar to what we propose in our model, but the market structure differs since firms face monopolistic competition. Therefore, the level of competition is exogenously determined by the inverse of the elasticity of substitution between the goods varieties, limiting the model possibilities in two ways. First, there is a muting effect on the mechanisms that transfer productivity shocks to income distribution since changes in firms' profits are not reflected in firms' entry and exit decisions and, consequently, in markups. Second, as we will see later, this mechanism can amplify or reduce the effects of economic growth on inequality, depending on the markup's cyclicality. Besides, the markup's level shocks also lose a propagation mechanism when it does not affect investment decisions in new firms.

On the consumption side, the Quest model features two representative agents, households that are liquidity constrained and consume their disposable income and non-liquidity-constrained (so-called Ricardian) and households that have full access to financial markets. There is, therefore, a new limitation when studying the distribution of income. Models with two agents tend to overestimate inequality when there is a high proportion of hand-to-mouth agents. Simultaneously, the reverse occurs when the economy is populated with too many Ricardian agents (the comparison between models presented below will make this point more evident).

The modeling strategy in [Colciago and Mechelli \(2020\)](#) is also quite clever in bringing together the households' heterogeneity observed in [Aiyagari \(1994\)](#) with the oligopolistic market structures presented in [Jaimovich and Floetotto \(2008\)](#), and [Etro and Colciago \(2010\)](#), achieving a representation of the economy with the complete distribution of income and endogenous structure of competition between firms. Thus, overcoming two of the main limitations previously pointed out in the Quest model. There is, however, an evident trade-off between the heterogeneity supported by the model and its solution's complexity/computational burden. This computational burden leads the authors to simplified supply-side and asset markets. Therefore, their production function uses only labor, without capital, since the agents had no capital choice, investing only in firms' shareholding. Besides, the Aiyagari type of model rules out the aggregate uncertainty, limiting the analysis possibilities. Therefore, the authors only studied transitions between steadies-states, excluding, for example, the analysis of short-term economic cycles.

That said, the novelty in our model is the choice for an intermediate path, with an economy populated by three representative agents. This option allows keeping the model computational requirements at

a low level, opening doors to a broader asset market (which includes capital and government bonds, in addition to the companies shares), while at the same time achieving an income distribution that is reasonably adherent to the reality of a developing economy, such as Brazil (the features of each of the agents aims to reproduce patterns observed in three ranges of the Brazilian distribution: Bottom 50%, middle 49%, and top 1%).

As a final note, we must cite the work by [Alpanda \(2019\)](#). This author built a New Keynesian model with strategic interactions between firms in both labor and goods markets. Although the paper worked only with a representative agent and did not explore the income distribution repercussions, it brings light to market power's role on labor share. Inspired by his work, another essential feature from our paper is the endogenous reaction of labor market power to variations in the number of firms and its consequences on the economy's resources distribution.

3 Market Power and Inequality: empirical evidence

To obtain some empirical motivation for our modeling purpose, we estimate, through a GMM PVAR approach, the response of two inequality indexes (Gini and the income share of the top 1%) to a markup shock. Nevertheless, before reporting our econometric specification and results, we must clarify what should be understood by markup.

Through our paper, the markup will always be referenced as the ratio between price and marginal cost:

$$u = \frac{P}{MC} \tag{1}$$

For estimation, we will rely upon the insights from [De Loecker et al. \(2020\)](#), who focused on the firms' cost-minimization problem for variable inputs to derive markup estimates. Following [Nekarda and Ramey \(2020\)](#), consider the process of choosing variable input V_i , $i = 1, \dots, N$ to minimize

$$C = \sum_{i=1, \dots, N} (W_i \cdot V_i) \tag{2}$$

subject to

$$\bar{Y} = F(V_1, V_2, \dots, V_N) \quad (3)$$

W_i is the factor price, V_i is the variable input, Y is output, and $F(\dots)$ the production function. λ is the Lagrange multiplier, and so the first-order condition for V_i can be written as:

$$W_i = \lambda \cdot \frac{\partial Y}{\partial V_i} \quad (4)$$

Given the Envelop Theorem, the Lagrange Multiplier λ could be seen as the marginal cost. Substituting equation 4 into equation 1, we get the markup:

$$u = \frac{\alpha}{S_{V_i}} \quad (5)$$

where

$$S_{V_i} = \frac{W_i \cdot V_i}{P \cdot Y} \quad (6)$$

and

$$\alpha = \frac{\partial Y}{\partial V_i} \cdot \frac{V_i}{Y} \quad (7)$$

S_{V_i} is V_i 's factor share of revenue. While α is the elasticity of output with respect to V_i . The markup can be estimated as the ratio between the output elasticity with respect to a variable factor and the input's revenue share. If we assume that the production function is of Cobb-Douglas type, the elasticity can be considered constant and we can recover a proxy of the markup using only the inverse of factor's share:

$$\hat{u} = \frac{1}{S_{V_i}} \quad (8)$$

Given all the data limitations, we choose to estimate the Brazilian state's markup using regional

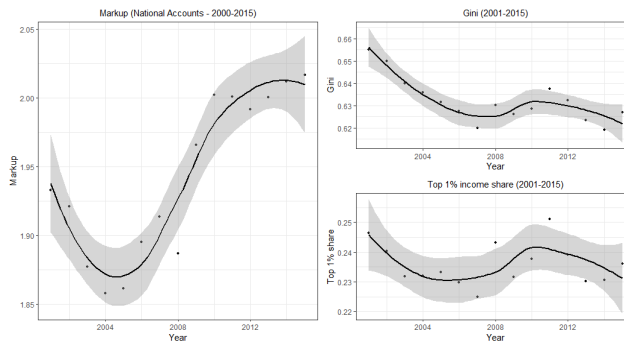
accounts tables. Therefore, our approach’s variable factors are intermediate goods and service consumption (IC), and the gross output (GO) in a year is the revenue. The inverse of factor share is given by:

$$S_{V_i}^{-1} = \frac{GO}{IC} \quad (9)$$

For an initial visual analysis, we estimated Brazil’s aggregate markup using the national accounts data from 2000 to 2015 (provided by Brazil’s statistical office, IBGE). Then, as a measure of inequality, we took two indexes from World Inequality Database for the same period. The first one is the income Gini index calculated by combining household survey data with income tax information. The second takes the same database to calculate the share of income received by the wealthiest 1% of the population.

The trends of both the estimated markup and the inequality indicators can be seen in the figure 2. As in the previous chart from the United States, there is some comovement between the estimated market power and the inequality, although it was not so straightforward because the trends have seen changes over the period. This evidence, however, encourages us to assess the direction of this relationship with a more robust econometric procedure.

Figure 2: Brazil - Estimated Markup (national accounts) and Inequality trends (2000-2015)

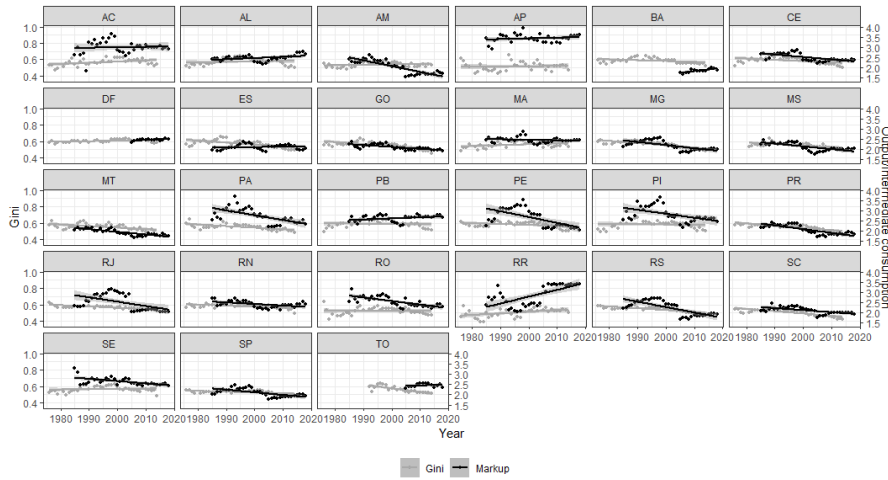


Source: IBGE - National Accounts; World Inequality Database

Thus, similar to the approach in [Da Silva \(2020\)](#), we estimate a Panel VAR model with data at the Brazilian state level. The choice for this level of evaluation is justified by the lack of a long time series for the Country, which would make the hypothesis tests unfeasible. Therefore, we opted to use a panel data with 27 cross-sectional units and 22 points in time, summing 594 observations. Figure

3 gives some taste about the Markup and Gini trends in Brazilian states. It is necessary to say that we should not take the absolute values of markup in its face value, but only its tendency, as we did not discount the output elasticity with respect to the variable factor (which is not observable since we neither estimate a production function).

Figure 3: Brazilian states - Estimated Markup (regional accounts) and Inequality trends (2000-2015)



Source: IBGE - Regional Accounts; IPEA

Our estimation is based on annual data, with observations from 1993 to 2014 (the Brazilian states' panel is relatively balanced with few missing values). As previously stated, we retrieve a markup proxy in each Brazilian state through the regional accounts, released by the Brazilian statistical office (IBGE). Therefore, the inverse of the variable input's share is formed by the ratio between the total income (gross output) and the economy's intermediate consumption in a given state. The variables regarding income distribution are two, Gini and Income Share of Top 1%, both calculated by the Institute for Applied Economic Research (IPEA), a governmental think tank. It is worth emphasizing that, unlike the WID's indexes, IPEA only considered data from the IBGE's household surveys and, therefore, bringing together all the questions related to the underestimation of income at the top of the distribution, as discussed in [Medeiros et al. \(2015\)](#). Besides, we adopted as a third variable, the unemployment series for each of the Brazilian subnational units, made available also by IPEA based on IBGE's household survey data (the PVAR specification with three variables will be a test of robustness and stability for the bivariate estimation results).

All variables were tested for the existence of a unit root (in level and first differences, with and without

trend), with the tests obeying specifications focused on panel data (Levin-Lin-Chu, Harris- Tzavalis, Im-Pesaran-Shin, and Fisher (ADF) methods). The proxy for the markup, the Top 1% Income Share, and unemployment did not have a unit root in any of the cases, being, therefore, stationary in the period under analysis. However, the unit root was found in level without trend for the Gini index, restoring stationarity when we took the first difference. For this reason, we chose to incorporate Gini in the first difference in our estimation.

Finally, we employed a GMM approach of [Abrigo and Love \(2016\)](#) to our data, which is consistent in cases with small T. A Forward Orthogonal Deviation (FOD) transformation eliminated the individual fixed effects. In our bivariate specification, to achieve identification, we assume that markups do not respond contemporaneously to an inequality shock within the year. This assumption is justified because markup should affect real income, and this income is the component of the Gini index and the Top 1% Share, so it is expected that this change in real income will affect inequality on impact, but not otherwise. Formally, after a PVAR estimation, we use a lower triangular matrix to recover orthogonalized disturbances (Cholesky decomposition), which will give our orthogonal impulse-response function.

Before proceeding to the results, two final notes are required. First, the optimal lag-order selection in the base specification of the PVAR and the other robustness tests (first order in all cases) was based on minimizing multiple criteria (Bayesian information criterion, MBIC, Akaike information criterion, MAIC, Quinn information criterion, MQIC). Also, the choice of lag length and the instruments' validation was made employing the Hansen's J overidentification test, in which the null hypothesis of validity of the instruments was not rejected.

The base model results for the impulse-response function of the inequality with respect to a one standard deviation shock in the markup can be inspected in [figure 4](#). They are in line with what is assumed from the trend analysis in the United States and Brazil cases and with what we recovered from the empirical evidence in the literature ([Han and Pyun, 2021](#)). Overall, the increase in the economy's markup (which can occur both due to changes in consumer demand functions and reduced competition in markets) has significantly regressive effects, increasing the concentration of income measured by the Gini index and the Top 1% Share. However, these effects occur after the second period because, on impact, the result appears to be zero or slightly progressive (the bands of the 95% confidence interval do not allow us to state with certainty the proper signal). Finally, it appears that

the effect is short-lived, not exceeding the seventh year after the shock.

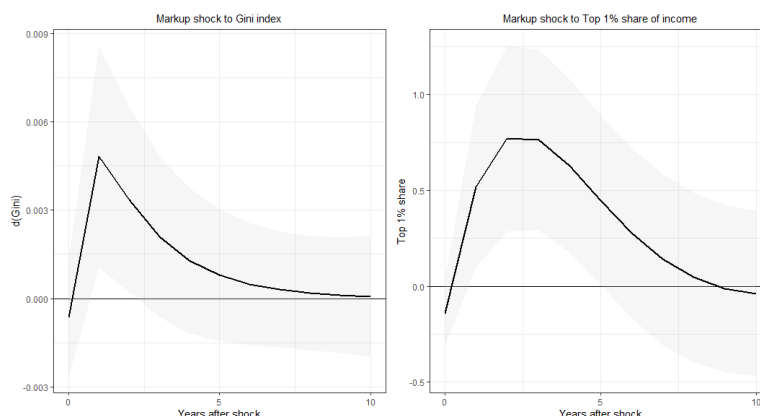


Figure 4: Orthogonal impulse-response functions from two variate specification (Cholesky ordering: Markup - Inequality). GMM Panel VAR ($N=27$, $T=22$) with standard errors from simulation (1000 repetitions) - 90% confidence interval.

Using another Cholesky ordering (Inequality - Markup) as a robustness check does not alter the results, despite the zero effect on impact being more evident. In response to a markup shock, the Gini index and Top 1% share still increase, revealing market power's regressiveness. Figure 5 presents these results.

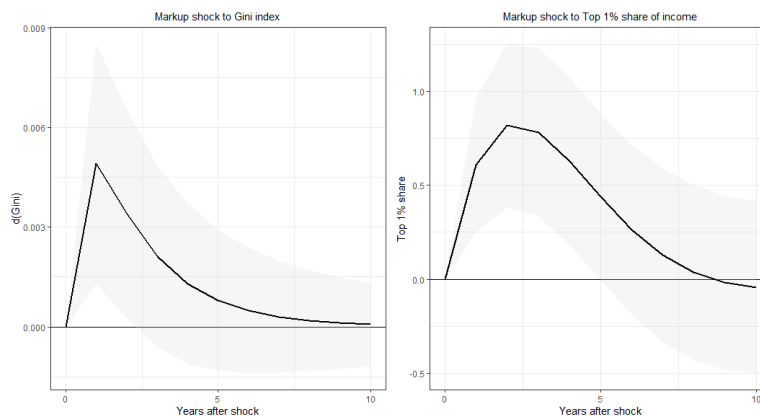


Figure 5: Orthogonal impulse-response functions from two variate specification (Cholesky ordering: Inequality - Markup). GMM Panel VAR ($N=27$, $T=22$) with standard errors from simulation (1000 repetitions) - 90% confidence interval.

To end the empirical motivation, a second model was estimated, this time with a third variable, unemployment, capable of capturing possible repercussions of the macroeconomic environment both in the markup and inequality indicators. The new results, available in the figure 6 are again in line with the basic model and reaffirm the initial findings on the negative effect of markup on Brazilian states' income distribution. This evidence gives us confidence regarding the interconnection between

market concentration and inequality in developing countries like Brazil and leads to the second part of this work. Next, we will model some of the possible transmission channels in this relationship.

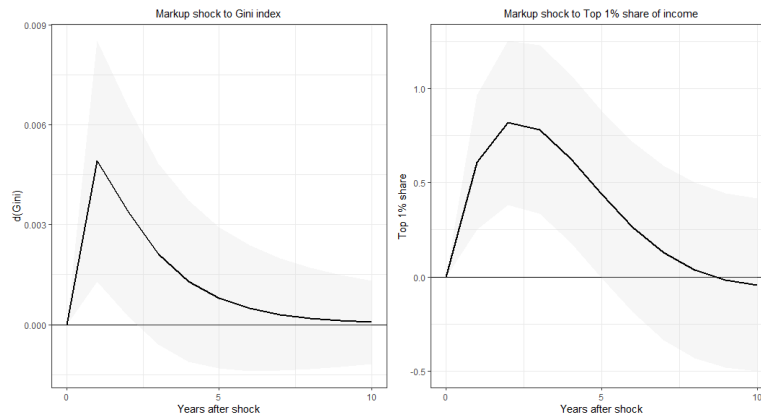


Figure 6: Orthogonal impulse-response functions from three variate specification (Cholesky ordering: Markup - Unemployment - Inequality). GMM Panel VAR ($N=27$, $T=22$) with standard errors from simulation (1000 repetitions) - 90% confidence interval.

4 General Equilibrium Model

In order to study the impact of market power on economic aggregates and, more importantly, on inequality, we propose a framework considerably simpler than heterogeneous agent models but with some capacity to reproduce aspects from the income distribution in a developing country like Brazil. The simplification of household heterogeneity allows exploring more complexity on the supply side, also permits adding aggregate uncertainty with a range of short-term shocks. In short, between the main features of our model, it is worth citing the existence of three representative households, with heterogeneity on asset market participation (capital, bonds, and firms shareholding), on labor skills, and on labor supply elasticities. Moreover, in our setting, firms face oligopolistic/oligopsonistic competition on goods and labor market with an endogenous entry-exit decision. This environment was later calibrated to match Brazilian economy characteristics, especially the wealth and income distribution through three quantiles of the Country's population (bottom 50%, middle 49%, and top 1%).

4.1 Demand side

4.1.1 Households

Our economy is populated by three types of infinitely lived households $i \in \{c, o, h\}$, with no population growth. The first one, $c - agent$, represents Capitalists or top 1%. The $o - agent$ are constrained optimizers or middle 49%. Finally, $h - agent$ are poor/hand-to-mouth households or the bottom 50%. Throughout the paper, all these terms will be used interchangeably, referring to the type of agents. The parameters ω^o and ω^h are the proportion of constrained optimizers and hand-to-mouth households, respectively. The number of capitalists is given by $1 - \omega^o - \omega^h$.

Households i derives utility or desutility from consumption, c_t^i , and labor, l_t^i , obeying a preference function with the same specification for all of them:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t^i)^{1-\chi^c}}{1-\chi^c} - \theta^i \frac{(l_t^i)^{1+\chi^l}}{1+\chi^l} \right) \quad (10)$$

β is a common discount factor, χ^c is the relative risk aversion, and χ^l is the inverse of Frisch-elasticity of labor supply (notice that these two last parameters are the same for the three types of agents). Finally, θ^i is an agent-specific parameter that weights the disutility of working and allows obtaining a steady-state equilibrium with calibrated working hours. The types of agents differ in their optimizing behavior, as they face different limitations when accessing the asset market, resulting in specific budget constraints profiles.

Therefore, top 1% households, agents who owns the firms and have savings in the form of government bonds, solve the expected utility maximization problem subject to the following budget constraint:

$$c_t^c + b_t^c + vN_{et}^c = r_{t-1}b_{t-1}^c + w_t^c l_t^c + \pi_t N_t^c - \frac{1 - \Omega^o \omega^o - \Omega^h \omega^h}{1 - \omega^o - \omega^h} t_t \quad (11)$$

and to the following law of motion for the number of firms:

$$N_t^c = (1 - \delta^v) N_{t-1}^c + N_{et}^c \quad (12)$$

The budget's left-hand side represents contemporaneous spending, given that c_t^c is consumption, b_t^c the resources used to buy new government bonds, and is vN_{et}^c the total investment in new firms. The v is a key variable in the model representing the firm entry cost. It will define the optimum number of active companies in the economy. N_{et}^c is the capitalists' per capita number of new firms entering in a period. On the income side, $r_{t-1}b_{t-1}^c$ is the resource obtained from the stock of bonds, $w_t^c l_t^c$ and $\pi_t N_t^c$ are, respectively, labor income and total profits received by capitalists households. While N_t is the number of active firms, in per capita terms, and π is the profit collected by each one of them. Finally, t_t is a lump-sum tax given to the government at a period (the term before t_t is a device guaranteeing tax neutrality, allowing each agent to pay, per capita, an amount proportional to their total income).

Now, let look with more attention to the number-of-firms law of motion. Recall that the number of firms that enter in period t is given by N_{et}^c . As we can see in equation 12, each period, a fraction δ^v of firms exits exogenously. In the same equation, it is worth noticing that, as in [Jaimovich and Floetotto \(2008\)](#), there is no time to built – a new firm starts producing in the same period.

Deriving the first-order conditions for top 1% households, we obtain the inverse of consumption's marginal utility:

$$U_t^c = (c_t^c)^{\chi^c} \quad (13)$$

A Frisch labor supply function relating labor and consumption choices:

$$w_t^c = U_t^c \theta^c (l_t^c)^{\chi'} \quad (14)$$

Capitalists' bond/saving decision:

$$1 = r_t \beta E_t \left\{ \frac{U_t^c}{U_{t+1}^c} \right\} \quad (15)$$

And shareholding decision:

$$v_t = \pi_t + \beta (1 - \delta^v) E_t \left\{ \frac{U_t^c}{U_{t+1}^c} v_{t+1} \right\} \quad (16)$$

The last turns out to be a dynamic zero profit condition since the owners will invest in new firms until the left-hand side, the entry cost v (this parameter will be pinned down when calibrating the model to achieve the desired markup level), equals the right-hand side, the sum of discounted expected profits.

In what respects to middle 49% households, as previously stated, these agents have constrained access to financial markets. Similar to [Cantore and Freund \(2021\)](#), middle classes agents bonds' choices are subject to a cost. These households are penalized when their bond holdings deviate from steady-state levels. The per-period budget constraint for constrained optimizers reads:

$$c_t^o + i_t^o + b_t^o + \frac{\varphi^o}{2} \frac{(b_t^o - b_{ss}^o)^2}{c_{ss}^o} = r_t^k k_{t-1}^o + r_{t-1} b_{t-1}^o + w_t^o l_t^o + f_t - \Omega^o t_t \quad (17)$$

The adjustment cost takes a simple quadratic form, and the weight for the bond friction is given by φ^o . The costs' wealth effects are neutralized by a lump-sum transfer f_t . In addition, the budget is, in all aspects, similar to the one for capitalists agents, except for the presence of the investment in physical capital and income from rental rate (in substitution of income from ownership and spending in intermediate-goods firms), represented by i_t . With a standard specification found in the DSGE literature, these households also pay adjustment costs when choosing to change their investment level, given the following law of motion for capital:

$$k_t^o = (1 - \delta) k_{t-1}^o + \left[1 - \frac{\kappa_I}{2} \left(\frac{i_t^o}{i_{t-1}^o} - 1 \right)^2 \right] i_t^o \quad (18)$$

Deriving the first-order conditions for these households we get an Euler equation for bonds:

$$bc = r_t \beta E_t \left\{ \frac{U_t^o}{U_{t+1}^o} \right\} \quad (19)$$

Where bc_t is the optimizers' bond adjustment cost:

$$bc_t = 1 + \frac{\lambda^o (b_t^o - b_{ss}^o)}{c_{ss}^o} \quad (20)$$

We also get the FOC for capital, with the associated Tobin's q :

$$1 = \beta E_t \left\{ \frac{\frac{U_t^o}{U_{t+1}^o} [r_{t+1} + (1 - \delta) q_{t+1}]}{q_t} \right\} \quad (21)$$

And, finally, the FOC for investment decision:

$$1 = q_t \left[1 - \frac{\kappa_I}{2} \left(\frac{i_t^o}{i_{t-1}^o} - 1 \right)^2 - \kappa_I \left(\frac{i_t^o}{i_{t-1}^o} \right) \left(\frac{i_t^o}{i_{t-1}^o} - 1 \right) \right] \\ + \beta \kappa_I E_t \left\{ \frac{U_t^o}{U_{t+1}^o} q_{t+1} \left(\frac{i_{t+1}^o}{i_t^o} - 1 \right) \left(\frac{i_{t+1}^o}{i_t^o} \right)^2 \right\} \quad (22)$$

The Frisch labor supply and the inverse of marginal utility are similar as those for top 1% agents:

$$U_t^o = (c_t^o)^{\chi^o} \quad (23)$$

$$w_t^o = U_t^o \theta^o (l_t^o)^{\chi'} \quad (24)$$

The Bottom 50% classes are Hand-to-Mouth or non-Ricardian households. This type of agent has no access to financial markets and does not decide on savings, consuming all their income. Thus, given their utility function and budget constraint, the only choice is between work/leisure levels, based on the relationship consumption marginal utility/labor marginal disutility and wages (Frisch labor supply function). Those decision equations are expressed below.

Budget constraint:

$$c_t^h = w_t^h l_t^h - \Omega^h t_t \quad (25)$$

Labor supply:

$$w_t^h = U_t^h \theta^h (l_t^h)^{\chi'} \quad (26)$$

4.1.2 Government

Closing our model's demand side, there is the government consumption. Public expenditure, g_t , is financed by raising lump-sum taxes t_t and issuing debt:

$$b_t = g_t + r_{t-1} b_{t-1} - t_t \quad (27)$$

However, to rule out explosive debt path, it must follow a tax evolution given by a fiscal rule that reads:

$$\tilde{t}_t = \rho_t \tilde{t}_{t-1} + \rho_{tg} \tilde{g}_t + \rho_{tb} \tilde{b}_t \quad (28)$$

Where the variables with tilde indicate deviations from the steady-state share of income.

4.2 Supply side

Our model's supply side is an extension of original works from [Jaimovich and Floetotto \(2008\)](#), and [Alpanda \(2019\)](#). Basically, the economy is defined by a continuum summing one of sectors, indexed by ι . In each sector and period, there is a finite number N_t of intermediate firms that produce a differentiated good, indexed by $j \in \{1; 2; \dots; N\}$. Thus, each intermediate-good firm possesses oligopoly power in the goods market and, as we will show, oligopsony power in labor markets. It is worth highlight that the entry and exit of intermediate producers into the sectors are endogenous, obeying a dynamic “zero-profit” condition established by capitalists' decision with respect to the investment in new firms.

4.2.1 Goods market

The economy's final good, used by households to consume and invest, is produced by perfectly competitive firms, which aggregates the sector-specific goods, $y_i(\iota)$, to the aggregate good, y_t , using a constant-returns-to-scale production function:

$$y_t = \left(\int_0^1 y_t(\iota)^{\frac{\phi-1}{\phi}} d\iota \right)^{\frac{\phi}{\phi-1}} \quad (29)$$

Where ϕ is the elasticity of substitution between the sectoral goods. Solving the final good firms' optimization problem, the demand function for sectoral goods reads:

$$y_t(\iota) = \left(\frac{p_t(\iota)}{p_t} \right)^{-\phi} y_t, \quad (30)$$

Where $p_t(\iota)$ is the price index for sector ι , and the aggregate price (p_t) is given by:

$$p_t = \left(\int_0^1 p_t(\iota)^{1-\phi} d\iota \right)^{\frac{1}{1-\phi}}. \quad (31)$$

Furthermore, departing from the traditional monopolistic competition with [Dixit and Stiglitz \(1977\)](#) formulation, the sectoral goods, $y_t(\iota)$, are now the result from the transformation of firm-specific goods, $y_t(\iota; j)$, using the following CES function:

$$y_t(\iota) = N_t^{-\frac{1}{\tau-1}} \left(\sum_{j=1}^{N_t} y_t(\iota, j)^{\frac{\tau-1}{\tau}} \right)^{\frac{\tau}{\tau-1}} \quad (32)$$

Here the elasticity of substitution between goods is given by the parameter τ . Notice that the number of firms may vary across periods. For tractability, there is a first right-hand side term that rules out the possible variety effect on the CES function formulation. At the aggregate, imposing symmetric equilibrium, this combination of measure one sectors and N firms will guarantee that $y_t(\iota, j) = y_t(\iota) = y_t$ for all ι and j . The same will apply to the desegregation process in labor market in the next section.

With this CES function, we can obtain a demand curve for firms goods as follows:

$$y_t(\iota, j) = \left(\frac{p_t(\iota, j)}{p_t(\iota)} \right)^{-\tau} \frac{y_t(\iota)}{N_t} \quad (33)$$

And $p(\iota)$ is a price index as:

$$p_t(\iota) = N_t^{\frac{1}{\tau-1}} \left(\sum_{j=1}^{N_t} p_t(\iota, j)^{1-\tau} \right)^{\frac{1}{1-\tau}} \quad (34)$$

Including 27 into 30, the demand function for each firm j in each sector ι is given by:

$$y_t(\iota, j) = \left(\frac{p_t(\iota, j)}{p_t(\iota)} \right)^{-\tau} \left(\frac{p_t(\iota)}{p_t} \right)^{-\phi} \frac{y_t}{N_t} \quad (35)$$

The above demand function formulation results in a price elasticity faced by a single firm which is a function of the number of firms within the sector, and, taking symmetry assumption, has the following specification:

$$\eta_{y(\iota, j)p(j, \iota)}(N_t) = \tau - \frac{1}{N_t} (\tau - \phi) \quad (36)$$

4.2.2 Labor market

In the middle and the bottom of the income distribution (Constrained Optimizers and Hand-to-Mouth), the homogeneous labor supplied by each household is differentiated by competitive intermediaries into sector and firm labor services.

The first step, the disaggregation of homogeneous labor into sector labor $l_t^i(\iota)$, for each household i , respect the following function:

$$L_t^i = \left[\int_0^1 L_t^i(\iota)^{\frac{\phi_w^i + 1}{\phi_w^i}} d\iota \right]^{\frac{\phi_w^i}{\phi_w^i + 1}} \quad (37)$$

Notice that the elasticity of substitution, ϕ_w^i , is specific for the household. Considering the competitive behavior among the labor intermediaries, we obtain a sector labor supply function for sector ι as:

$$L_t^i(\iota) = \left(\frac{w_t^i(\iota)}{w_t^i} \right)^{\phi_w^i} L_t^i \quad (38)$$

In this setting, $w_t^i(\iota)$ is the wage index in each sector for each household. In addition, there is an household specific aggregate wage index, w_t^i , linked to the sector-specific wage by:

$$w_t^i = \left(\int_0^1 w_t^i(\iota)^{1+\phi_w^i} d\iota \right)^{\frac{1}{1+\phi_w^i}} \quad (39)$$

Similar as in [Alpanda \(2019\)](#), there is a second disaggregation, from sector-household-specific labor, $L_t^i(\iota)$, to firm-household-specific, $L_t^i(\iota, j)$, following another CES function:

$$L_t^i(\iota) = N_t^{\frac{1}{\tau_w^i+1}} \left(\sum_{j=1}^{N_t} L_t^i(\iota, j)^{\frac{\tau_w^i+1}{\tau_w^i}} \right)^{\frac{\tau_w^i}{\tau_w^i+1}} \quad (40)$$

Once again, it is worth noticing that the elasticity of substitution, τ_w^i , is specific for the household i (Bottom 50% and Middle 49%). Furthermore, first right-hand side term, $N_t^{\frac{1}{\tau_w^i+1}}$, rules out the variety effect on this CES function. Symmetric equilibrium assumption gives that $N_t L_t^i(\iota, j) = L_t^i(\iota) = L_t^i$ for all ι and j

From 36 and given perfect competition, we achieve a supply curve faced by firm j , in sector ι , for household i 's labor:

$$L_t^i(\iota, j) = \left(\frac{w_t^i(\iota, j)}{w_t^i(\iota)} \right)^{\tau_w^i} \frac{L_t^i(\iota)}{N_t} \quad (41)$$

Now can be showed that the sector wage index is given by:

$$w_t^i(\iota) = N_t^{-\frac{1}{1+\tau_w^i}} \left(\sum_{j=1}^{N_t} w_t^i(\iota, j)^{1+\tau_w^i} \right)^{\frac{1}{1+\tau_w^i}} \quad (42)$$

Finally, combining firm and sector functions for each household, we get a supply function faced by the firm as:

$$L_t^i(\iota, j) = \left(\frac{w_t^i(\iota, j)}{w_t^i(\iota)} \right)^{\tau_w^i} \left(\frac{w_t(\iota)}{w_t} \right)^{\phi_w^i} \frac{L_t^i}{N_t} \quad (43)$$

The supply function formulation results in a specific wage elasticity for each household i (Bottom 50% and Middle 49%) that reads:

$$\eta_{L(\iota,j)w(j,\iota)}^i(N_t) = \tau_w^i - \frac{1}{N_t} \left(\tau_w^i - \phi_w^i \right) \quad (44)$$

4.2.3 Firms decision

As shown before, the model has, in each sector, at each period, a number N of intermediate firms selling goods with some market power, in an oligopolistic kind of market structure, and buying input with oligopsonistic behavior. Thus, one crucial assumption that gives tractability to the model is that the number of firms is the same in goods and labor market.

The firm j in sector ι faces a production frontier determined by the following Cobb–Douglas function:

$$y_t(\iota, j) = A_t k_{t-1}(\iota, j)^\alpha L_t^c(\iota, j)^{\alpha^c} L_t^o(\iota, j)^{\alpha^o} L_t^h(\iota, j)^{\alpha^h} \quad (45)$$

As in [Areosa and Areosa \(2016\)](#), there is heterogeneity in labor, since each of the three agents/households offers differentiated labor services (L_t^c , L_t^o , L_t^h), with specific output elasticities (α^c , α^o , α^h). Despite of that, the production exhibits constant returns to scale, given that it was imposed the following restriction: $1 - \alpha = \alpha^c + \alpha^o + \alpha^h$.

The oligopolistic intermediate-good firms chooses price, output, wages, labor and capital, aiming to maximize profits, given by:

$$\begin{aligned} \pi_t(\iota, j) = & p_t(\iota, j)y_t(\iota, j) - w_t^c(\iota, j)l_t^c(\iota, j) - w_t^o(\iota, j)l_t^o(\iota, j) \\ & - w_t^h(\iota, j)l_t^h(\iota, j) - r_t^k k_{t-1}(\iota, j) \end{aligned} \quad (46)$$

The optimization problem above is static and is subject to demand and supply functions (equations 32 and 39) and sectorial/aggregate wages indexes. Firms solve the maximization while taking as given the decisions of their competitors in the same industry and economy aggregates (treating their rivals as parameters).

Imposing symmetry, the first order conditions for this problem brings the economy price/marginal markup, $\mu_t(N_t)$:

$$\mu_t(N_t) = \frac{\tau - \frac{1}{N_t} (\tau - \phi)}{\tau - \frac{1}{N_t} (\tau - \phi) - 1} \quad (47)$$

Wages markdowns, $md_t^i(N_t)$, for each type of household (except for capitalists since their labor market are perfectly competitive):

$$md_t^i(N_t) = \frac{\tau_w^i - \frac{1}{N_t} (\tau_w^i - \phi_w^i)}{\tau_w^i - \frac{1}{N_t} (\tau_w^i - \phi_w^i) + 1} \quad (48)$$

And economy's factor prices (wages and capital rental rate):

$$w_t^i = md_t^i \frac{y_t \alpha^i}{l_t^i} \frac{1}{\mu_t} \quad (49)$$

$$w_t^c = \frac{y_t \alpha^c}{l_t^c} \frac{1}{\mu_t} \quad (50)$$

$$r_t^k = \frac{y_t \alpha}{k_{t-1}} \frac{1}{\mu_t} \quad (51)$$

Both the economy's markup and the markdowns for poor and middle-class households depend on the number of firms, which is endogenous since N is a function of profits and capitalists' behavior (given by the shareholding equation). Furthermore, firms' market power and profits are a combination of the effects between markdown and markups, both dampening the value of wages for poor and middle-class households (each one with different elasticities resulting from labor supply function, and so with specific markdowns). These are fundamental features of the model, with an impact on inequality levels and dynamics.

4.3 Aggregation and Market Clearing

Since the model have some heterogeneity between households, to obtain the economy's aggregates, it is necessary to transform per capita variables, weighting them by the population parameters ω^o and ω^h , as follows:

Consumption:

$$c_t = c_t^o \omega^o + c_t^h \omega^h + c_t^c (1 - \omega^o - \omega^h) \quad (52)$$

Physical capital:

$$k_t = k_t^o \omega^o \quad (53)$$

Number of firms:

$$N_t = N_t^c (1 - \omega^o - \omega^h) \quad (54)$$

Constrained optimizers' aggregate labor:

$$L_t^o = l_t^o \omega^o \quad (55)$$

Hand-to-Moth's aggregate labor:

$$L_t^h = l_t^h \omega^h \quad (56)$$

Capitalists' aggregate labor:

$$L_t^c = l_t^c (1 - \omega^o - \omega^h) \quad (57)$$

Government bonds:

$$b_t = b_t^o \omega^o + b_t^c (1 - \omega^o - \omega^h) \quad (58)$$

Physical capital investment:

$$i_t = i_t^o \omega^o \quad (59)$$

Investment in new firms:

$$Ne_t = Ne_t^c (1 - \omega^o - \omega^h) \quad (60)$$

Finally, at equilibrium, the market clearing conditions given below must hold:

$$y_t = c_t + i_t + v_t Ne_t + g_t \quad (61)$$

4.4 Alternative Models

As shown in the previous sections, our model proposes adding some frictions to the classic general equilibrium framework in order to reveal possible mechanisms through which market power, on both goods and inputs (labor) side, affects general macroeconomic indicators and, in particular, the functional distribution of income generated by the economy (with focus on developing countries like Brazil).

Among these modeling options, it is worth highlighting the existence of three types of agents, with heterogeneity in their access to the asset market and their marginal contribution to the firms' output. In addition, two of the existing agents in this economy face an oligopsonistic structure in the input (labor) market. Thus, to deepen our analysis regarding these frictions' impact on outcomes, we established three alternative versions of the base model, with specific changes related to each of the characteristics under scrutiny.

In the first alternative specification, households still have labor skills heterogeneity, so there is no change in the intermediate-goods firms' production function. However, now these same firms do not have market power in the input-labor market anymore. Each type of household (capitalists, constrained optimizers, and hand-to-mouth) supplies differentiated labor (j_l) to type-specific unions that bundle this labor and sell it to firms. These union aggregate differentiated labor using a [Dixit and Stiglitz \(1977\)](#) function below:

$$l_t^i = \left(\int_0^1 l_t^i(j_l^i)^{\frac{\phi_w^i - 1}{\phi_w^i}} dj_l^i \right)^{\frac{\phi_w^i}{\phi_w^i - 1}} \quad (62)$$

Where ϕ_w^i is the elasticity of substitution among the differentiated workers from each type of household. The latter is a standard New Keynesian model's way to add workers market power, but since we do not have wage stickiness in our model, the solution for household problem gives a simple labor supply function with a wedge:

$$w_t^i = \frac{\phi_w^i}{\phi_w^i - 1} U_t^i \theta^i l_t^i \chi^l \quad (63)$$

The second alternative model maintains the same monopolistic competition structure in the inputs (labor) market but lost all heterogeneity in the workforce. There are no different substitution elas-

ties in this new formulation, as all types of households provide differentiated workers for the same aggregator union. In addition, there are no productivity differentials in the production function; the following specification replaces the former:

$$y_t(\iota, j) = A_t k_{t-1}(\iota, j)^\alpha L_t(\iota, j)^{1-\alpha} \quad (64)$$

The aggregation of labor provided by the households (Top 1%, Middle 49% and Bottom 50%) also needs to assume a new aspect:

$$L_t = l_t^o \omega^o + l_t^h \omega^h + l_t^c (1 - \omega^o - \omega^h) \quad (65)$$

The third and last modification aims to assess the impacts of the number of agents in the model. With this objective in mind, we rescued the base model and made only one significant change, reducing the number of households. Only the two standard agents from TANK models remained in our framework: hand-to-mouth household, which does not have access to the asset market, and Ricardians household, the one that smooth consumption through savings and investment instruments. Therefore, the problem of non-Ricardian households (equivalent to the bottom 50% of the previous model) remains the same. However, there is now a specific budget constraint for the new Ricardian agent, which incorporates all the economy's assets; bonds, physical capital, and the companies' ownership (and, consequently, investment in new capital, new good, and in the creation of new firms):

$$c_t^R + b_t^R + vN_{et}^R + i_t^R = r_{t-1}b_{t-1}^R + w_t^R l_t^R + \pi_t N_t^R + r_t^k k_{t-1}^R - t_t \quad (66)$$

It is worth noticing that this last model still has oligopsonistic competition in the labor market, but it is faced only by hand-to-mouth agents since Ricardian households are in most aspects similar to the base model's capitalists, and so supply work hours in a perfectly competitive structure.

5 Steady State, Calibration and Comparative Analysis

Our steady-state model equations are, in most parts, very similar to other dynamic general equilibrium frameworks found in the economic literature. However, in this section, it is important to

emphasize how, in the static equilibrium, we pinned down the circular relationship between entry cost/markup/number of firms/profits. For this equilibrium to be found, it was necessary to calibrate a specific exogenous value for the markup (alternatively, we could have chosen the number of firms).

As we have seen, the steady-state markup is given by:

$$\mu_{ss}(N_{ss}) = \frac{\tau - \frac{1}{N_{ss}} (\tau - \phi)}{\tau - \frac{1}{N_{ss}} (\tau - \phi) - 1} \quad (67)$$

The inverse function gives the number of firms N , since τ and ϕ are parameters to be calibrated. The profit per firm obeys the following formulation:

$$\pi_{ss} = \frac{y_{ss} - r_{ss} k_{ss} - w_{ss}^o l_{ss}^o - w_{ss}^h l_{ss}^h - w_{ss}^c l_{ss}^c}{N_{ss}} \quad (68)$$

Assume that we have the stationary values of the aggregated variables (output, capital, and working hours). We will then recover a value for π since the markup and the markdown, which also depend on N , determine the economy's factor prices. Thus, finally, we will obtain the fixed cost of entry, because, in the steady-state, it is given by a combination of parameters plus the value of the individual firms' profit:

$$v_{ss} = \pi_{ss} + \beta(1 - \delta^v)v_{ss} \quad (69)$$

It is worth noting that our equilibrium concept involves the calibration/normalization of a unit output, which allows comparisons between the base model and its alternative versions. The values for different agents' worked hours were also exogenously set, taking as a reference the average number of hours in each income distribution range in the household survey carried out annually by the Brazilian statistical office (IBGE). This survey is from 2015, the last year with inequality indices estimates provided by the World Inequality Database - WID. All values for parameters calibration are in table 3.

Table 3: Base model - parameters values

Parameter	Value	Description
α	0.30	Capital share
α^o	0.46	Middle 49% labor share
α^h	0.16	Bottom 50% labor share
α^c	0.08	Top 1% labor share
β	0.97	Discount Factor
δ	0.025	Depreciation
δ^v	0.036	Firms exit
ω^o	0.49	Middle 49% share
ω^h	0.50	Bottom 50% share
τ	16	Elasticity of substitution
τ_w^o	25	Elasticity of substitution, Labor Middle 49%
τ_w^h	5	Elasticity of substitution, Labor Bottom 50%
ϕ	1	Elasticity of substitution
ϕ_w^o	1	Elasticity of substitution, Labor Middle 49%
ϕ_w^h	1	Elasticity of substitution, Labor Bottom 50%
χ^l	2	Frisch elasticity of labor supply
χ^c	2	Intertemporal elasticity
κ^i	5	Investment cost
λ^o	0.25	Bond cost, Middle 49%
y_{ss}	1	Output at steady state
A_{ss}	2.9435	TFP at steady state
l_{ss}^o	0.3483	Middle 49% worked hours
l_{ss}^c	0.3766	Top 1% worked hours
l_{ss}^h	0.3033	Bottom 50% worked hours
μ_{ss}	1.08	Markup at steady state
v_{ss}	0.3122	Entry cost
g_{ss}	0.32	Public spending at steady state

Parameterization was defined regarding a quarterly calibration. Some of the parameters were taken from Brazilian and international literature related to DSGE models, including α (capital share, [De Carvalho and Valli, 2011](#)), δ (depreciation, [Cavalcanti and Vereda, 2011](#)), χ_l (Frisch elasticity of labor supply, [Alpanda, 2019](#)) χ_c (Intertemporal elasticity, benchmark), κ^i (Investment cost, benchmark) and λ^o (Bond cost, [Cantore and Freund, 2021](#)). Others were guided by official Brazilian data sources, such as hours worked, previously cited – l_{ss}^o (Middle 49%), l_{ss}^c (Top 1%) and l_{ss}^h (Bottom 50 %). In addition, β (Discount Factor) was pinned down considering the implicit interest rate on the Brazilian public debt (in 2015, according to Brazilian independent fiscal institution – IFI). The same data were used to set the share of government spending, g_{ss} . Finally, δ^v (firms exit) was established taking into account the IBGE’s firms demography indicators (2015).

Second, there is the parameterization of elasticities, both in the goods and labor markets. Regarding the elasticities between sectors, we chose a safe path and, very similar to what did [Jaimovich and Floetotto \(2008\)](#), we set it to 1, although there is literature ([Nechio and Hobijn, 2017](#)), which points to an upper limit of up to 5 in the case of the goods market. Still, in the goods market, the literature

is not consensual on the elasticity between firms in the same sector, with calibrations ranging from 3 to 20 (Alpanda, 2019). Therefore, we opted for a conservative path, choosing a value of 16 for τ .

Regarding τ_w^o and τ_w^h , there is not a great diversity of studies that tried to estimate the wage elasticity of labor supply in Brazil. For this reason, our primary reference was Tucker (2017), which estimated elasticities in an interval between 15 and 75 for the Brazilian formal labor market. In theory, this formal market encompasses both workers in the middle of the distribution and the top. Therefore, we adopted values closer to the lower range when calibrating τ_w^o (25). On the other hand, most of the lower class members do not access the formal labor market. So, given the lack of empirical evidence, we assumed that their labor supply is more inelastic, an option justified by the possible frictions that raise firms' market power (e.g., informational difficulties and restricted access to markets given mobility restrictions). Due to the degree of uncertainty in these parameters, we will further test the results through sensitivity analysis.

Our last parameter of concern, the economy-wide markup (u), also faces a high degree of uncertainty because there are numerous difficulties in its empirical estimation. Previously, we have shown the figures from De Loecker and Eeckhout (2020). They estimated markup of 1.60 for Brazil. In our calibration, however, we opted for a considerably lower value (1.08). Here are some of the reasons. First, some facts lead us to believe that De Loecker and Eeckhout's markup is overestimated, although the relative positions in the rankings of developing countries may be somewhat accurate. In their paper, the authors use data from the Worldscope dataset. As they notice, companies tend to be large and mainly publicly traded (and probably could have more market power) in this database. Therefore, genuine concerns may exist about the representativeness of the sample. In addition, they calculated the markup for various countries using the variable input elasticities estimated for the United States in De Loecker and Eeckhout (2020). It would not be absurd to imagine the possibility of obtaining lower elasticities if they have estimated production functions for Brazil. Equation 5 reveals that this would lead to lower markups.

To conclude this point regarding markups, it is relevant to emphasize that, in our model, market power is a combination of markups and wage markdowns, something not considered in De Loecker and Eeckhout (2020) empirical specification since they assumed that firms take inputs prices as given. To observe the repercussions of these modeling differences, consider the bottom 50% case. The markup level of 1.08 combined with a wage markdown of 0.81 will result in a margin between labor marginal

product and wages paid by firms of around 25%, in the steady-state. Despite these considerations, the markup calibration will also be subject to sensitivity analysis.

For comparison purposes, after calibrating the base model and its alternative versions (as far as possible, with the same parameters), we simulated the steady-states and collected the outputs related to the income distribution (Gini index and income shares from the bottom 50% and the top 1%). This exercise was carried out to assess the ability of each model in reproducing the income inequality observed in the Brazilian data (World Inequality Database estimates for the year 2015). The results are in table 4.

Table 4: Steady State - comparison for key income inequality indicators

Key indicators	Data (WID)	Baseline	Monopolistic	No skills	Two agents*
50% share (2015)	12.5%	10.4%	14.4%	37.2%	15.7%
1% share (2015)	23.6%	25.6%	18.7%	8.9%	84.3%
Gini (2015)	0.62	0.51	0.44	0.16	0.74

*Hand-to-Mouth (90%), Capitalists (10%).

The first point to stand out is that models with only two agents and without heterogeneity in the workforce (last two columns) have a poor performance when the objective is to mimic income distribution. With a substantial share of non-Ricardian households, the two-agent model overestimates inequality (the inverse would occur if we increased the number of agents with access to the asset market). At the same time, the absence of labor skills generates a more equitable distribution than the one found in the data. Adding a third and middle-class agent improves the model’s performance concerning the indicators of the income distribution. Even so, the assumption that the labor markets have a monopolistic competition structure (a device quite common in models with stickiness in wages) dampens the results with respect to WID estimates (although it does not invalidate this modeling option, since the outcomes are not so discrepant, and with different calibration could achieve better results).

Our original model obtains the best approximation to the data, considering the proposed calibration, despite a lower Gini index. However, we must consider that the model does not account for inequalities within the income groups, which would increase the index. Furthermore, we must recognize a trade-off between supply-side/asset market complexity and household distribution accuracy. Heterogeneous models, depicting the complete distribution, should give better results with respect to the Gini index, but with simplifying assumptions about the market structure, asset options, and economy-wide shocks.

Regarding the limitations, we think that our proposed model delivers a viable alternative, giving good results in distribution outcomes and considerable gains about supply-side and aggregate uncertainty possibilities.

6 Comparative static analysis

In this section, before getting to the model's dynamics, we are interested in how changes in some of the calibration parameters impact macro aggregates outcomes observed in the steady-state (output and inequality indexes). Our focus is mainly on two types of parameters without apparent consensus in the literature: markup (u) and within sector household-specific labor elasticity of substitution (τ_w^h and τ_w^o). Additionally, we also considered how calibrating the number of firms would change the model's steady-state results, and there are two main reasons for this exercise. First, in practice, when dealing with an antitrust case, markup values are unobservable for authorities. However, by defining a market, these authorities can notice the number of competing firms. So, it is relevant to observe, in a comparative static way, how changes in this market feature are capable of impacting inequality, for example. Furthermore, as we shall see, our second reason is related to the fact that the number of firms has a richer and nonlinear influence on outcomes, while the results from the markup exercise are very straightforward.

Figure 7: Sensibility to markup (u_{ss})

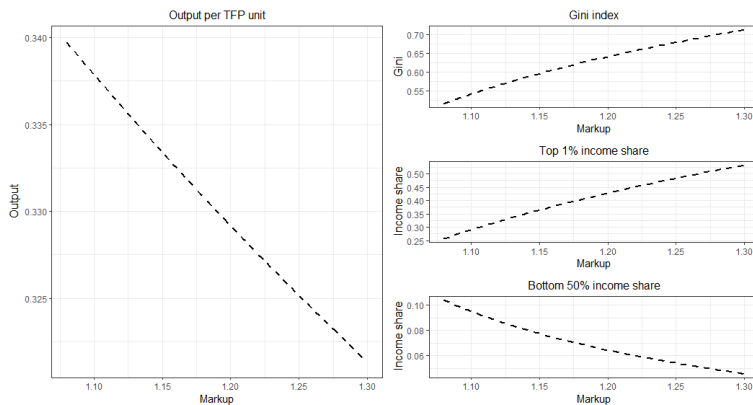
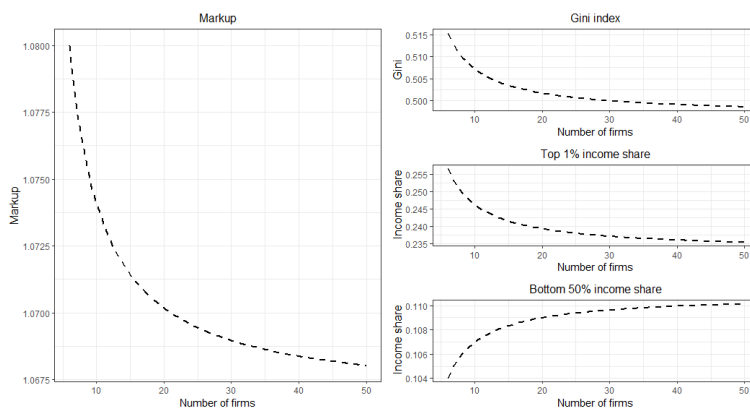


Figure 7 gives the sensibility analysis for markup. Departing from our benchmark calibrated markup ($u_{ss} = 1.08$), we gradually increased the parameter value until reaching 1.30. As we can verify, increasing markup, while maintaining all others parameters constant, reduces economy-wide productivity on steady-state (considering that y_{ss} was normalized, the efficiency is measured by output per TFP unit:

$\frac{y_{ss}}{A_{ss}}$). It is worth noticing that this relationship does not diverge with respect to the traditional economic literature results, since basic models also predict inefficient outcomes. Markup's effect on output is marked linear, and more or less the same occurs with inequality indexes. Instead, the impact on the Gini index and inequality, in general, is more dramatic. In our initial configuration, the Gini value was about 0.50. If we consider a markup up to 1.30, the Gini's result goes up to 0.70. This is an extremely high value, but it is not far from the WID estimate (0.62). However, for our model specification, the higher bound of this sensibility exercise begins to seem unrealistic when we observe the income share values. The 1.30 markup translates to above 50% income share for the top and below 5% share for the bottom of the distribution. Therefore, this is one more reason for not calibrating the model with [De Loecker and Eeckhout \(2020\)](#) values. Their markup will give implausible results for the economy's income distribution.

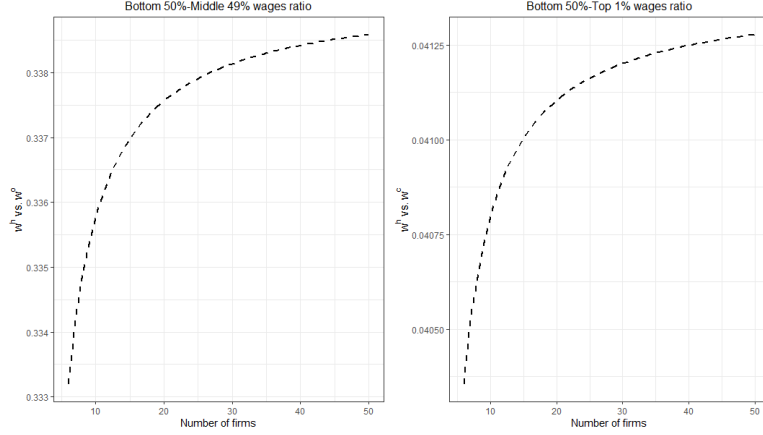
Figure 8: Sensibility to number of firms (N_{ss})



In what concerns the impact of the sector-specific number of intermediate goods firms (figure 8), we assist a downward sloped nonlinear effect on markups. As we vary the steady-state number of competitors (N_{ss}), price markup changes fast when N is low but reaches a stable threshold level when it goes above 50 firms. Recovering equation 67, we observe that, as N goes to infinity, the markup tends to the one for monopolistic competition ($u_{ss} = \frac{\tau}{\tau-1}$). On the other hand, market concentration affects the Gini index and income shares through effects on markups and wage markdowns, so there is another source of nonlinear effects in the income distribution. As the wage markdown works like a markup multiplier, we have one important policy implication from the model's comparative static results. When considering horizontal mergers, if competition agencies are accounting for distribution consequences, the concerns are very different with respect to the impact of cases that departs from

different numbers of competing firms in the market (e.g., the scrutiny should be more strict if the merger leads to a reduction from 6 to 5 competitors than the one that leads from 12 to 11).

Figure 9: Wage ratios sensibility to number of firms

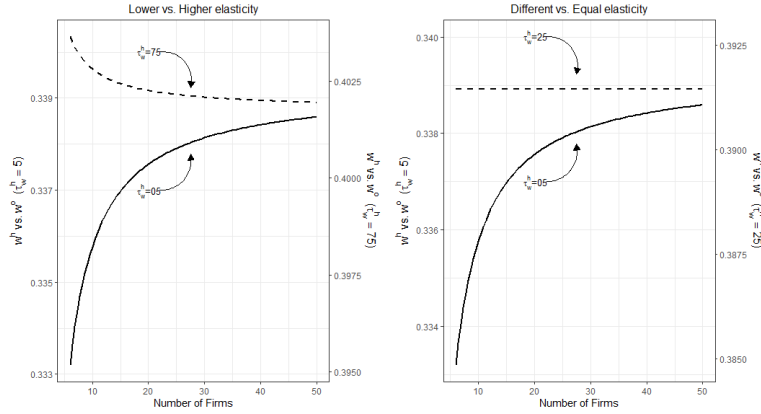


Results in figure 9 highlight the impact of wage markdown’s channel on the distribution between the income quantiles. Moreover, it reveals the role of labor supply heterogeneity (differences in τ_w). The first panel shows how the ratio between the bottom and middle-classes wages varies as we change the market concentration (number of intermediate firms). The second panel gives the same analysis but for the ratio bottom 50%/Top 1% wages. It is worth looking in detail at the first panel. As the market competition grows, the bottom 50% wages react strongly than middle-classes agents’ wages, increasing the ratio. This movement is explained by labor supply heterogeneity. Given that $\tau_w^o > \tau_w^h$ (constrained optimizers’ labor elasticity parameter is more prominent than hand-to-mouth’s), the labor market for middle-classes agents is closer to perfect competition, being less affected by changes in the number of firms. Contrary, poor households face an immense oligopsony power in the labor market, which is alleviated when more firms enter the economy.

This feature is another relevant outcome from our model, with possible policies repercussions. In the presence of oligopolistic labor markets and heterogeneity, market power affects income distribution not only through markups and profits (in a top-bottom direction) but also through wages. Further, with our calibration (where labor supply is more elastic for middle 49%), there is an extended distribution effect from middle to bottom households. As competition grows, the gains are more significant for poor households, although there are widespread benefits for workers in general. The model’s interaction between competition, labor market outcomes, and inequality puts in question the antitrust enforce-

ment focus, still significantly in consumer prices due to the belief that labor markets are, in general, competitive. A growing literature supports these findings on the impacts of monopsony/oligopsony power on antitrust policy (e.g., [Azar et al., 2020](#) and [Marinescu and Hovenkamp, 2019](#)).

Figure 10: Elasticity heterogeneity (τ_w^i) - impact on wage ratios



We can take a step further to see how the choice of elasticity parameters impacts the model’s outputs. Figure 10 shows that the increase in the hand-to-mouth/constrained optimizers ratio directly results from our calibration of the τ_w^o and τ_w^h values. In panel one, the dashed line indicates this ratio when the bottom 50% elasticity is greater than that of the middle 49%. Therefore, we see a reversal of the result, with a distributive effect more favorable to the middle classes when competition is increased. In the next panel, where the dashed line illustrates the case when there is no heterogeneity in elasticities, the effect of increased competition on the ratio of the wages is null. Our assumption about the lower elasticity parameter for the poor households is based on several features from the Brazilian labor market — great levels of informality, for example, supposedly give much bargain power to firms. However, because of the relevance of this parameter for the model’s outcomes, we recognize that exists an open door to future work aiming to estimate elasticities differences between income distribution classes. Moreover, the reliance on these elasticity parameters also leads us to conduct a sensitivity test in the session that presents the model’s dynamic behavior.

7 Model dynamics

An important advantage of the model with limited heterogeneity (three agents) is the ease in studying the dynamics of economic aggregates, that is, how the main outcomes respond to unexpected shocks. In this section, we will initially focus on two types of shock. The first one addresses our initial focus

related to the results of empirical motivation. It is an exogenous shock that changes the markup level. The following equation describes the dynamic evolution of this shock, which follows an AR(1) process:

$$\mu_t = (1 - \rho_\mu) \mu_{ss} + \rho_\mu \mu_{t-1} + \epsilon_{\mu t} \quad (70)$$

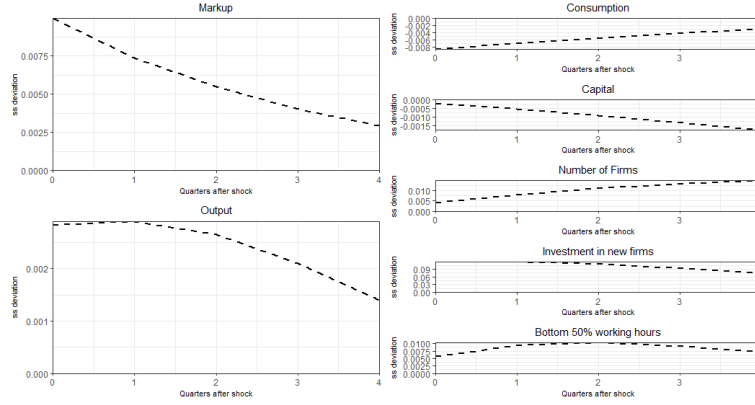
Where μ_{ss} is the markup on steady-state, ρ_μ is the persistence parameter, and ϵ_μ is the unexpected shock, calibrated to be equivalent to 1% variation in markup level. The second shock that we will study is related to short-term growth driven by productivity gains. It is, therefore, a disturbance in the TFP, with dynamics similar to markup:

$$A_t = (1 - \rho_a) A_{ss} + \rho_a A_{t-1} + \epsilon_{at} \quad (71)$$

The TFP disturbance was also calibrated to be equivalent to a 1% rise. Both the markup and TFP persistence parameters were set at 0.75.

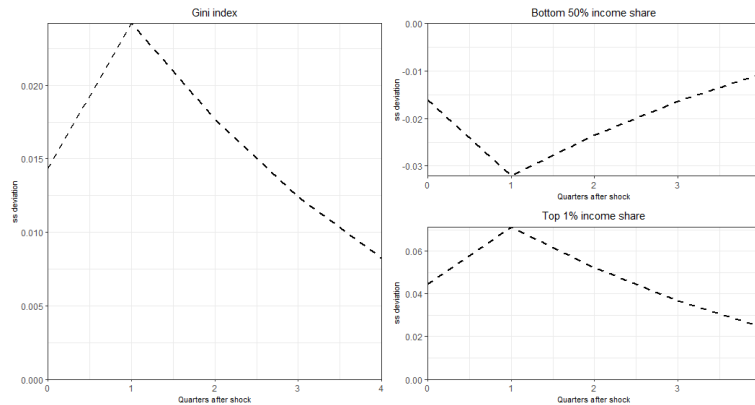
When verifying the macroeconomic aggregates' response to markup, in figure 11, a marked difference between the dynamic (general equilibrium) and static (partial equilibrium) analysis emerges. Here, the effect of an unexpected increase in markup is richer and counterintuitive: output increases, even without any efficiency gain. This phenomenon is due, in particular, to the dynamic response of the three agents. The income effect leads poor households to increase the number of working hours, in this way, compensating for the decrease in consumption (the marginal utility of consumption grows and mitigates the higher labor disutility). At the same time, the higher profit per firm leads the top 1% of households to invest more in creating new companies, alleviating the economic decline due to reduced physical capital expenditure.

Figure 11: Markup shock - Aggregates impulse-response functions



This short-run behavior favors much of the arguments used to justify long-lasting Brazilian growth/industrial policies that favored the firm’s market power (e.g., state price-wages interventions during the military dictatorship). However, note that, in our model, permanent markup increases are inefficient in the long run, as we could see in the previous session analysis. In addition, the markup impact on inequality is relevant. The dynamics for the inequality indicators are shown in figure 12. Thus, it is possible to verify that, similar to the PVAR impulse response functions (IRF) estimated in the empirical motivation section, the markup perturbation has a positive effect on the Gini index. The increasing inequality reflects the income redistribution among the different agents, as the top 1% share increases while there is a reduction in income going to the poorest households.

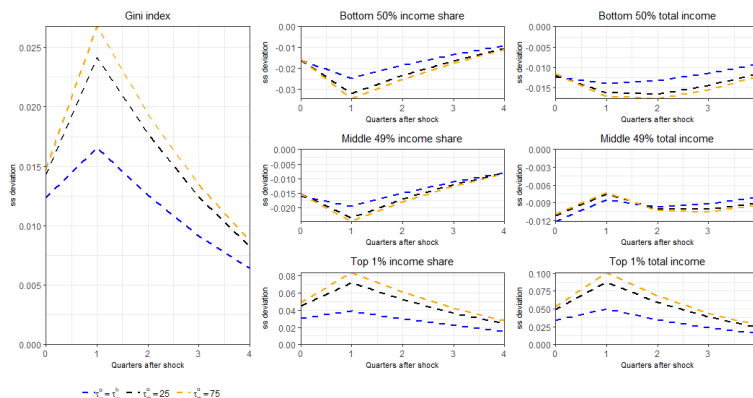
Figure 12: Markup shock - Inequality impulse-response functions



But how the inequality’s response to a markup perturbation change with labor supply heterogeneity? The dynamic sensibility test is plotted in figure 13. The blue line depicts the IRF from the model calibrated with $\tau_w^o = \tau_w^h = 5$. The black and orange ones represents, respectively, calibrations with

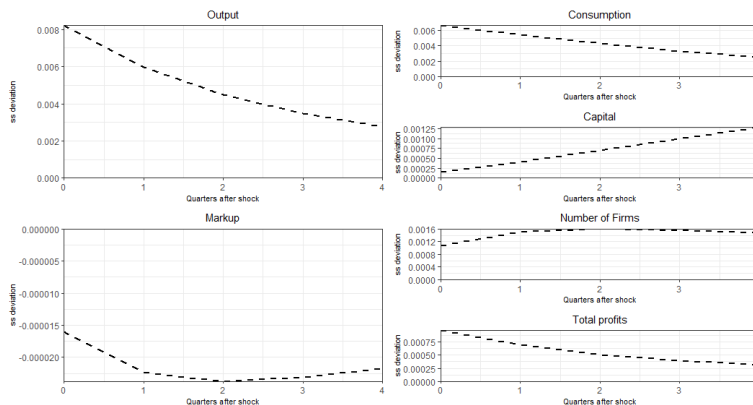
$\tau_w^o = 25$ and $\tau_w^o = 75$, while τ_w^h remains in 5. In this calibration exercise, the labor supply heterogeneity between poor and middle-income households (remember that the labor market for the top 1% is perfectly competitive) seems to have no relevant developments in the general dynamics behavior of the inequality. In all scenarios, markup shock has a consistent regressive effect.

Figure 13: Markup shock - Impulse-response functions from different τ_w^o



However, there are evident changes in the response levels. When elasticities are low and equal, the markdown channel dampens the inequality growth. The mechanism is the following: as a result of greater profitability, the investment in new firms grows and, if, on the one hand, the higher markup redistributes income towards the top, in the other, the oligopsonistic effect diminishes due to the greater number of competitors in the labor market. As we increase the elasticity of one of the groups, this effect becomes less important (this group is closer to the competitive labor market, less influenced by the number of firms), allowing more significant expansion of Gini and other indicators.

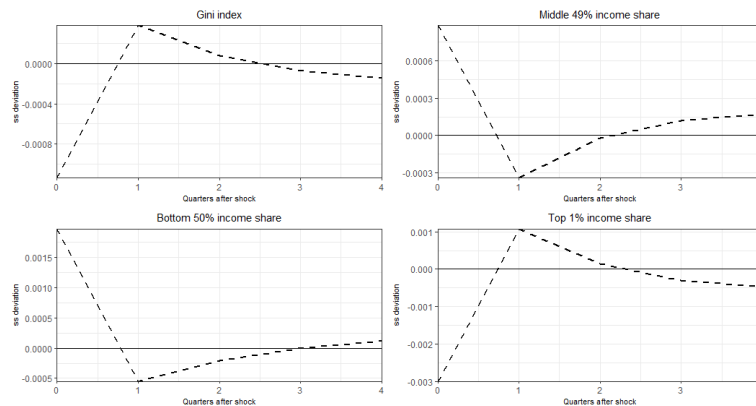
Figure 14: TFP shock - Aggregates impulse-response functions



When the disturbance in the model steady-state is due to an unexpected increase in productivity,

results are consistent with the literature on stochastic dynamic equilibrium. The economy’s production increases, as well consumption and investment in physical capital. Nevertheless, our variable of interest is markup due to its fundamental role in the distribution of income. As in [Jaimovich and Floetotto \(2008\)](#) and [Etro and Colciago \(2010\)](#), in response to TFP shock, our model has a countercyclical markup. With greater marginal production, our dynamic zero profit condition (equation 16) pushes the creation of new firms to equalize profit and entry cost. This results in a lower markup. Thus, at the same time, two channels play a role, on impact, reducing inequality. The lower markup redistributes income from the top to the middle and poor classes. Similarly, the tightening of competition in the labor market provides an increase in wage markdowns. Note, additionally, that, on impact, the gain of the poorest agents is more significant due to the heterogeneity in the labor supply seen in the previous session. This would be in line, for example, with a stylized fact observed in the Brazilian economy between 2006 and 2014. During this period of the tightened labor market, a singular reduction in the Gini of the labor income occurred, with the bottom households seeing a higher labor income increase (with some middle classes ”compression”).

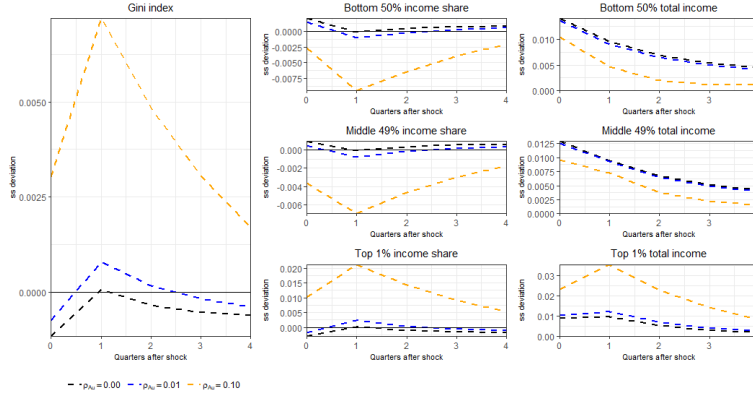
Figure 15: TFP shock - Inequality impulse-response functions



The sign of markup’s business cyclical behavior is a matter in dispute in the macroeconomic field (e.g., [Nekarda and Ramey, 2020](#)). From the market competition point of view, markup may be pro or counter-cyclical depending on the type of reaction to a productivity gain. On the one hand, the response could be extensive when higher profitability allows firms entry, resulting in fiercer competition. On the other hand, the reaction can assume an intensive characteristic due to entry barriers, with larger and more productive companies acquiring more market shares and market power. Unfortunately, our model does not have supply-side heterogeneity. Thus it is not able to simulate the

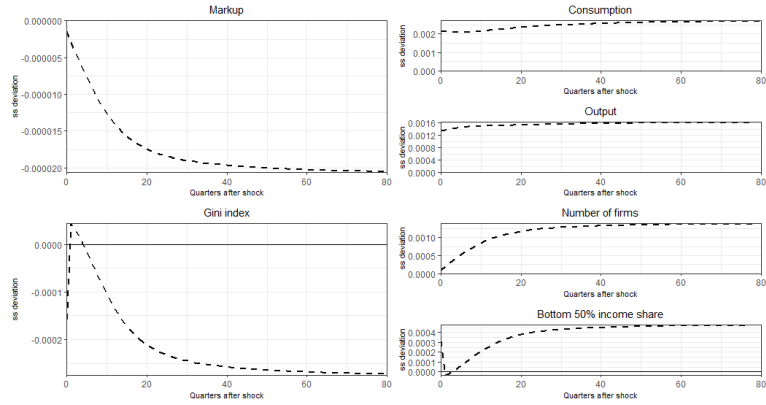
intensive channel repercussion on inequality. Even so, to highlight the markup cyclical importance on inequality behavior, we ran another sensibility test, allowing TFP shock to be positively correlated with markup shock ($\rho_{a\mu}$ parameter).

Figure 16: TFP shock correlated with Markup shock (ρ_{Au})



As we can deduce from figure 16, especially from the panel that represents the Gini's impulse response function, the direction of the markup's response determines the model's outputs regarding inequality. First, when the shock of the markup is in no way related to the unexpected gains in the TFP, there is a process of income deconcentration in the short run. Then, as we incorporate a correlation between the disturbances, the inequality-reducing behavior is progressively dampened until it reverses into an increase in Gini and top household income share. Some models that address the determinants of mergers and acquisitions waves point to a positive correlation between these processes and the business cycle (e.g., Lambrecht, 2004), which, in theory, would allow the increase of the firms market power during the period of economic expansion (ϵ_a correlated with ϵ_μ). Consequently, the strength of the antitrust policy when dealing with this type of merger wave in times of economic growth may have repercussions on the resulting income distribution, based on our modeling exercise.

Figure 17: Permanent shock on preferences (market growth)



So far, we have studied the short-run effects of supply-side disturbances. As a final analysis, we focus briefly on the impact of the demand-side on market power and inequality. A robust prediction of oligopoly theory is that larger markets are more competitive and have price-cost reductions (e.g., [Campbell and Hopenhayn, 2005](#)). To verify that this assumption applies to this paper’s model, we simulate an unexpected and permanent shock on consumer preferences (a proxy for market growth). As a result, if we look at figure 17, we can see that, in line with the IO literature, a greater demand for goods and services increases the number of firms and reduces markup. In addition, there are gains in productivity, generating greater output. Finally, a novelty of our model is that greater demand also positively affects income distribution, reducing, in the long run, although not on impact, the Gini index, and increasing the share of the poorest households in the economy’s income.

8 Conclusion

The antitrust policy has been increasingly criticized for the lack of more general analyzes, which consider the effects of its policies beyond the narrowed markets defined in mergers or abuse of dominance investigations. The impacts of market concentration on inequality are among the blind spots pointed out by researchers and practitioners and reveal that authorities should go beyond a homogeneous consumer surplus view. The channels that link inequality and market power need to be investigated deeply, especially in developed countries. In an economy with mature equity markets and high union participation, the distribution of abnormal profits generated by oligopolies is not trivial. However, in developing countries, such as Brazil, this regressive feature of market power seems more evident. First, because the ownership of oligopolistic firms is considerably more concentrated at the top of

the income distribution ([Medeiros and Castro, 2018](#)). Second, the levels of informality in the labor market and the low unionization rate make it plausible that firms retain a higher monopolistic power. With this in mind, this paper proposed a general equilibrium model, with an endogenous firm's entry mechanism, to assess how market power, both in the goods and labor markets, affects the dynamics of income inequality.

Our model has some important features that allow us to capture developing countries' demand and supply sides. First, there are three representative households with heterogeneity in asset market participation (capital, bonds, and firms shareholding), labor skills, and labor supply elasticities. This is crucial to mimic Brazilian income distribution in a complete way than the traditional two-agents model, without the computational burden of the full heterogeneous agents model. Moreover, in our setting, firms face oligopolistic/oligopsonistic competition on goods and the labor market. This market structure was endogenized by a dynamic zero profit condition related to the owner's decision about investing in new firms. Furthermore, each agent faces different degrees of oligopolistic power in the labor market through heterogeneity in labor supply elasticities, which is relevant to extend the distributional consequences of market power to labor income. Whenever possible, this framework has been calibrated with data from the Brazilian economy. Nevertheless, for the parameters in which it was impossible to use the available information, and there was no consensus in the economic literature (labor supply elasticities and markups, mainly), we conduct sensitivities analysis, both for the model's steady-state and dynamics.

The simulation in steady-state showed that, compared to the possible alternative specifications (two agents, monopolistic competition in labor markets, and no heterogeneity in labor skills), our model has a better performance when the objective is to reproduce the Brazilian inequality – regarding Gini indexes and shares of income estimated by the World Inequality Database (based on household, tax, and national income data). Still, about the steady-state, our results indicated that high markup values, such as those estimated by [De Loecker and Eeckhout \(2020\)](#), produce unlikely results for income distribution. This is due, among other factors, to a characteristic of our model that, in reality, makes market power a combination of markup and markdown of wages. In addition, our exercise concerning market concentration showed that the number of firms in each sector of the economy has a non-linear relationship with the model's outcomes, with its effect on inequality being, for example, more dramatic when the number of companies is low, tending to a constant level as more competitors

enter into the market. Finally, we saw that the calibration of labor supply elasticities defines much of the inequality behavior since the bottom/middle classes' wage ratio path depends on which workers are more sensitive to wage changes (more elastic supply).

Regarding the dynamic behavior of the model in response to unexpected shocks, it is worth highlighting the fact that the temporary increase in the firm's markup is, in line with our empirical result, clearly regressive, transferring income from the bottom to the top of the distribution. Nevertheless, its effects on economic growth may be positive in the short term, due to the increased investment in creating new companies. Furthermore, the disturbances in the TFP reduce inequality on impact, which is due to the countercyclical behavior of the markup. Instead, when we allow the TFP shock to be correlated with the markup, this effect is reversed, with the largest share of income being appropriated by the wealthiest. Finally, it is noteworthy that the labor supply elasticities partially determine the behavior of income distribution between poor and middle-class households. Households with less elastic supply suffer more with oligopsonistic power, but they are more benefited on impact when the economic growth generated by the increased TFP tightened the market competition (which, in theory, could be one of the explanations for the better performance of the poorest during the Brazilian economic boom between 2006-2014).

Our modeling exercise has some relevant implications for antitrust policy. Throughout this paper, we present some of them, such as the non-linear impact of concentration on market power and inequality. Therefore, the concern about the effects of mergers should grow exponentially the smaller the number of competitors is. Another point worth mentioning is the relationship between cyclical markup behavior and inequality. Countercyclical markups reduce inequality and vice versa, and the direct implication of this for the authorities' work is the need to closely monitor waves of mergers and acquisitions triggered by economic booms. Nevertheless, perhaps the most outstanding contribution of this work in terms of competition policy is the emphasis on the repercussions of oligopsonistic behavior in the labor market. An antitrust policy concerned with inequality must look carefully at the sectorial dynamics of the labor supply. As we have seen, it is crucial for the functional redistribution of income, both top to bottom and middle to bottom. Hence, being pro-poor if the bottom agents are less sensitive to changes in firms-sector specific wages and otherwise.

Evidently, this work has some limitations that should stimulate further research. Greater attention is needed to the relationship between market power, informality, and the minimum wage regarding the

dynamics of inequality. The minimum wage could add some discontinuity in the model, functioning as a lower bound for more privileged classes and as a ceiling for the bottom of the distribution. We also do not advance issues related to firms' heterogeneity, which could condition some of the conclusions drawn from our framework. Finally, from an empirical point of view, it would be essential to better understand the labor supply behavior throughout the income distribution, estimating the differences in elasticities with robust empirical strategies.

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