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ARTICLE

The effects of public sector employment on household savings and labor supply

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Abstract

In many countries, the structure of wages and the labor law legislation are completely different for public and private sector employees. In this paper, we develop a general equilibrium overlapping generations model to study the effect of such differences on household savings and labor supply. To conduct our analysis, first we use microdata from two Brazilian household surveys to document that civil servants save and work significantly less than their counterparts in the private sector. Second, we use matched employer–employee microdata from Brazil (RAIS) to document differences between the two sectors in terms of wage and unemployment risk. Then, we calibrate the model to be consistent with micro and macro evidence for Brazil. Our counterfactual exercises show that differences in wages characteristics and labor law legislation account for nearly 70% of the gap in savings between civil servants and private sector workers, and 57% of the gap in labor supply. In addition, we find that eliminating those differences can produce sizable increase on aggregate savings, employment, and welfare.

Keywords: Public sector employment; household savings; labor supply

1. Introduction

The fraction of civil servants is large in many countries. For example, public sector employment as a percentage of total employment in the OECD countries is nearly 21%. This is also true in some Latin American countries, such as Argentina, Brazil, Uruguay, Mexico, and Chile where public sector employees on average nearly 14% of the labor force.[1] Despite its large size, the public sector also has distinct features in terms of wage and employment policies. In fact, Giordano et al. (2015) report that the average share of workers with a tertiary education is 2.6 times higher in the public than in the private sector in Euro Area countries, ranging from 1.6 times in Belgium to 4.3 times in Portugal.[2] In the case of Latin America, Mizala et al. (2011) report that the average years of education in the public sector are 3–6 years higher than in the private sector. In addition, Clark and Postel-Vinay (2009) show that public sector jobs have greater job security and are perceived to be by and large insulated from labor market fluctuations. Given its magnitude and distinguishing characteristics, the public sector employment is likely to have first-order effects on individuals behavior and on the overall macroeconomic performance.

This paper studies the effects of public sector employment on household savings and labor supply. To conduct our analysis, we first use microdata from two Brazilian household surveys to document that civil servants save and work significantly less than their counterparts in the private sector. Second, we use matched employer–employee microdata from Brazil (RAIS) to document differences between the two sectors in terms of wage and unemployment risk. Then, we develop a general equilibrium overlapping generations (OLG) model that connects these two pieces of evidence to study the following questions: how much of the gap in savings and labor

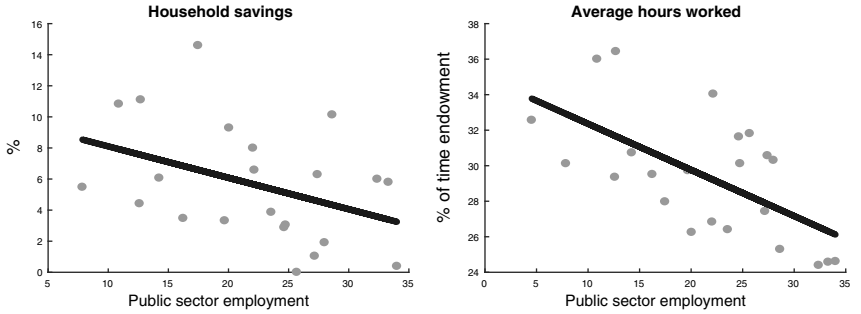

Figure 1. Household savings, labor supply, and the share of civil servants. *Left graph:* Average household savings. *Right graph:* Average hours worked. *Source:* OECD and ILO. Public sector employment corresponds to the share of civil servants over total employment. Household savings are the total amount of net saving as a percentage of net household disposable income. Hours worked equal the total number of hours actually worked per year divided by the number of working days in a normal year.

supply can be explained by the existing differences in income risk between the two sectors? How would aggregate savings, output, and welfare change in the absence of those differences?

Fig. 1 presents cross-country evidence on the relationship between household savings (left) and hours worked (right) versus the share of public sector employment in the labor force for the OECD countries from 2008 to 2014. The best linear fit is shown by a solid line in each graph. Although the correlation in this figure does not imply a causal effect, we can observe that there is a negative relationship between the share of civil servants and household savings and hours worked.

There are many channels through which public sector employment can affect the economy-wide performance. On the one hand, in an economy in which the public sector is productive, the presence of a large share of civil servants does not generate necessarily any allocation problem. A larger government can even increase aggregate output and welfare if the provision of public infrastructure is below the optimal scale. In addition, job stability in the public sector can also improve the insurance provision if private insurance markets are absent. On the other hand, differences in earnings, compensation, and labor legislation between public and private workers can distort agents' savings and labor supply decisions, reducing capital accumulation and welfare.

In line with the life cycle consumption theory, when opportunities for unsecured borrowing and risk sharing are limited, households use asset accumulation and hours worked to serve as a precautionary buffer against zero or very low-income states of nature. We show that both wage and unemployment risk at the household level are much higher in the private sector than in the public sector. Since the observed differences in the properties of household income for the two sectors are stark and conspicuous, it seems reasonable to ask whether these differences in income characteristics can generate the divergent saving rates observed in the data.

The model we use to guide our quantitative assessment is a life cycle OLG model with heterogeneous agents and incomplete markets. Our artificial economy is populated by agents who live for a realistic number of periods, have preferences over consumption and leisure, and choose at each period whether to work in the private sector or to apply for a job in the public sector. The likelihood of finding a job depends on individuals' skills and search behavior. Individuals are ex ante heterogeneous with respect to their ability and face wage and unemployment risk over their life cycle. In line with the empirical evidence mentioned above, we allow for the wage structure and the employment shocks to differ between the two sectors. Markets are incomplete and agents can accumulate a single risk-free asset to partially self-insure themselves. Because of differences in wage and unemployment risk, our framework generates differences in precautionary savings motive between the two sectors, which can explain differences in savings rate and labor supply observed in the data.

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We discipline our quantitative assessment with a calibration firmly grounded on Brazilian micro evidence. The parameters of the model are obtained partly from estimating the wage process in both sectors using the Brazilian matched employer–employee panel data (RAIS). We find that civil servants indeed face much less labor income risk than their counterparts in the private sector. The remainder parameters are calibrated to fit several key moments of the Brazilian economy. The model is able to match very closely the income inequality, household savings rate, and hours worked over the life cycle by sector. The model is also consistent with key statistics of the public sector employment, in particular the flow in and out of the public sector and the share of civil servants over the life cycle and by income quintile.

We use the model to evaluate the effects of an experiment in which we align the parameters related to wage and unemployment risk in the public sector with their counterparts in the private sector. In particular, first we turn off the differences in the stochastic process governing the wage growth between the two sectors, as well as in the separation rate. We find that these two channels together account for nearly 70% of the gap in savings between civil servants and private sector workers, and 57% of the gap in labor supply. In addition, aggregate saving rate increases by 1.54 percentage points, implying a 14% increase in the level of capital and 6.2% in the output. The sizable increase in the aggregate savings happens despite the fact that the share of civil servants in the labor force is just 13.4%. This is so because public sector workers are concentrated in the right end of the income distribution, which accounts for almost all of the household savings in the economy. Thus, changes in their savings behavior can have a sizable impact on total savings and capital accumulation. As for welfare, we find gains, as measured by the consumption equivalent variation (CEV), of 1.79%. Interestingly, if a specific group were to oppose the reform, it should be the high productivity group, which would have a substantial welfare loss, -1.51%, which under a utilitarian metric is more than compensated by the extraordinary gains, 3.35%, obtained by the lowest productivity agents in society.[3]

We then compare the effects of the two sources of risk separately. We show that aligning just the wage structure of civil servants with their counterparts in the private sector accounts for nearly 70% of the gap in savings rate. While differences in wage risk between the two sectors account for most of the changes in aggregate savings and output, we find that they explain just 28% of the overall welfare gains. However, when we decompose the CEV as in Domeij and Floden (2004), we find that the efficient component associated with differences in wage risk is actually much bigger than the one associated with changes in unemployment risk (2.76% as opposed to 1.78%), which is compensated by a large welfare loss due to the insurance component (–2.25% as opposed to –0.32%). The reason behind such difference in the insurance component is that, in contrast to very persistent productivity shocks to wages, job destruction leads to a transitory shock in income, making it easier for individuals to self-insurance themselves against this type of shocks.

Our results point out to a very important role for precautionary savings as a substitute for the higher stability from public sector jobs. The current evidence on the importance of overall precautionary saving is mixed, but most studies find that income risk drives households to hold about 20–50% of wealth as a precaution. Specifically related to the role of public sector jobs, the predictions of the model are consistent with recent empirical evidence presented in He et al. (2018) who finds weak precautionary savings motive in the Chinese public sector. The authors use a China's large-scale reform of state-owned enterprises (SOEs) in the late 1990s as a natural experiment to identify exogenous variation in income uncertainty. Prior to the reform, workers in the SOEs and the government sector (GOV) enjoyed similar job security. Following the reform, 27% of SOE employment in 1997 were laid off between 1997 and 2002, while few workers in the government sector were affected by the reform. The massive layoffs in the SOE sector significantly changed the perceived job security for the remaining SOE workers. Their estimation suggests that precautionary saving accounts for about 40% of the wealth accumulation by urban households employed in SOEs.

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This paper relates to a growing literature studying the effects of the public sector on wages and employment. Papers in that vein include Burdett (2012) and Bradley et al. (2017), which incorporate a public sector into the Burdett and Mortensen (1998) model of on-the-job search and Quadrini and Trigari (2007), Michaillat (2014), and Gomes (2018), which use a Mortensen–Pissarides framework. These papers abstract from risk-averse consumers facing partly uninsurable risk, household savings, and labor supply over the life cycle. Hörner et al. (2007) consider a model with a private and a public sector, risk-averse agents, and direct search. They find that public sector higher stability increases unemployment by inducing too many unemployed workers to queue for public sector jobs. Gomes (2015) uses a dynamic stochastic general equilibrium model with labor market frictions to study the optimal public sector compensation policy. Albrecht et al. (2019) incorporate heterogeneous human capital and match specific productivity in the model to analyze various distributional questions, such as what types of workers tend to work in the public versus the private sector. Gomes (2018) examines the effects of a public-sector wage reform that eliminates the wage premium for all types of public-sector workers. Chassamboulli and Gomes (2023) set up a search and matching model with a private and a public sector to study the effects of wage policies in the public sector on unemployment and education decisions.

Taking a different approach, Cavalcanti and Santos (2020) develop a life cycle model with occupational choice to study how higher wages in the public sector may lead to misallocation of resources with a lower entrepreneurship rate. Glomm et al. (2009) uses an OLG model where workers are initially randomly assigned to each sector to study the effects of early retirement in the public sector. Gomes and Wellschmied (2019) set up a partial equilibrium life cycle model with a public sector and search frictions to study how the accumulated wealth of an unemployed affects the decision to search for public sector jobs.

This paper also relates to a large literature studying the implications of income risk on precautionary savings. Blundell et al. (2008) and Guvenen (2009), for instance, analyze the stochastic process governing wages and study their implication on self-insurance and inequality. More recently, Guvenen et al. (2014) and (2021) also estimate the stochastic process with additional moments using large administrative databases. We contribute to this literature by studying how public sector jobs affect the degree of risk agents face in the economy and the resulting impact on aggregate savings and welfare.

The remainder of the paper is structured as follows. Section 2 presents the evidence that serves as inputs and outputs in our analysis. The model is presented in Section 3, and the calibration procedures and data are presented in Section 4. In Section 5, results are presented and discussed; Section 6 concludes.

2. Evidence

In this section, we document the main facts which motivate our exercise and provide empirical support to some of our modeling strategies described below. To this end, we rely on data from two Brazilian household surveys, PNAD Continua (Continuous National Household Sample Survey) and POF (Consumer Expenditure Survey).

PNAD Continua is a nationally representative survey conducted since 2012 which aims to provide information about Brazilian labor market dynamics on a quarterly frequency, tied to demographic and educational characteristics. Hence, with PNAD Continua we can evaluate the relevance of the public sector employment as a share of the labor force, as well as characterize the main differences in terms of education, labor income, and other characteristics compared to the private sector. In addition, it follows individuals for five consecutive periods (quarters), which allow us to construct the transitions between the private and public sector and unemployment.

In the top panel of Fig. 2, we display the distribution of workers by education and income between the public and the private sector.[4] It can be seen that the public sector in Brazil employs

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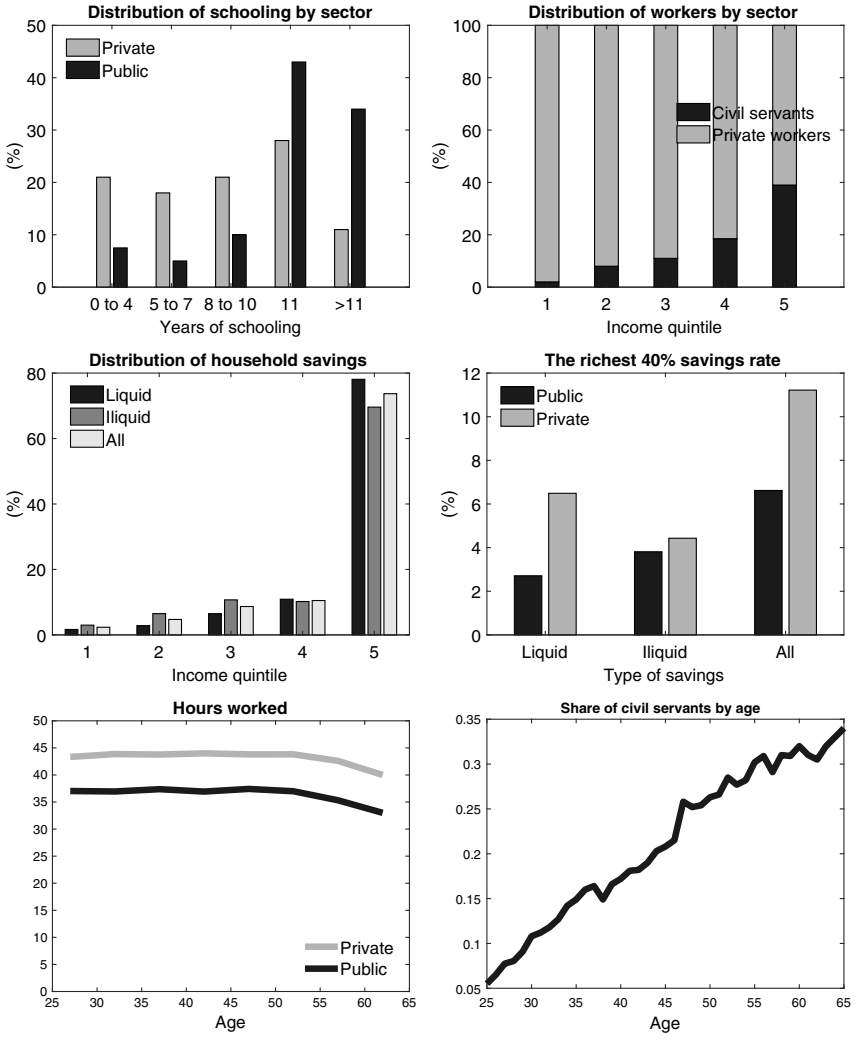

Figure 2. Household savings and hours worked by sector. *Source:* The Brazilian consumer expenditure survey (POF), 2008–2009, and continuous national household sample survey (PNAC Continua), 2014, from IBGE. In the middle row panel, we show the distribution of household savings by income quintile (left), and the savings rate of the richest 40% by type of assets. The left bottom panel shows the average weekly hours worked, while the right bottom panel shows the share of civil servants by age.

37% of college graduates (left top graph), but only 17% of workers with lower qualifications. In addition, the mass of civil servants is concentrated at the top of the income distribution (right top graph). In fact, among the richest 20%, the share of the public employment corresponds to nearly 39%, while this figure is just 1% and 8.5% for the first and second quintile, respectively.

However, PNAD Continua does not provide information about household savings. To this end, we rely on data from POF, which assesses the structures of consumption, expenditures, income, and the asset variation of the households, providing a profile of the life conditions of the population based on the analysis of the household budgets. Using the 2008/2009 survey, we are able to compute savings by income quintile and sector. We use two measures of savings. The first is

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a more comprehensive measure of household savings, including savings accounts, stocks, funds, and housing. In the second measure, we separate savings allocated to illiquid assets from savings allocated to liquid assets, considering all but housing expenditures as liquid assets.

In the middle panel of Fig. 2, we present the distribution of household savings by income quintile and type of assets (liquid and illiquid) by sector. The left middle graph shows that the richest 40% accounts for nearly 90% of the household savings in Brazil. The right middle graph shows the savings rate for the richest 40% by sector. It can be seen that the savings rate among the civil servants is 4.6 percentage points lower than the savings rate among the private sector workers. It should be noticed that almost all this difference in the total household savings between the two sectors is due to differences in savings into liquid assets. In fact, while the top 40% of private workers save into liquid assets 6.5% of their disposable income, their counterpart in the public sector saves only 2.6% of the disposable income into these types of assets. The fact that almost all the gap between the two sectors is associated with the liquid assets suggests that the difference in savings behavior can be linked to differences in income risk. Presumably, lower income risk in the public sector implies that civil servants have less incentives to hold large balances of liquid wealth for transaction and precautionary reasons.

Finally, we display in the bottom panel of Fig. 2 the average hours worked and the share of civil servants by age. The graph on the left shows that for any given age civil servants work on average 10 h less per week than individuals in the private sector. Moreover, the last graph shows that the share of civil servants is increasing on age.

2.1. Estimating differences in wage risk

We estimate the stochastic process for public and private sector wages using the Brazilian matched employer–employee microdata (RAIS). We follow the estimation procedure presented in Low et al. (2010). We first estimate separate wage regressions for each sector and then use the method of moments to identify the persistence and the variance from the residuals.

To deal with potential selection bias, we take into account the participation decision in the estimation process. To this end, we first estimate quarterly probits for participation controlling for age, gender, education, and year.[5,6] We then estimate wage equation including the selection terms obtained from the probit estimates.

We assume wages are given by:

$$\ln w_{it} = d_i + x'_{it}\psi + u_{it} \tag{1}$$

where w_{it} is the (real) wage, d_i is the human capital, x_{it} is the vector of controls, including age, sector, and year dummies, and u_{it} is the persistent component of wages, which we assume to follow an AR(1) process:

$$u_{it} = \rho u_{it-1} + \varsigma_{it}, \quad \rho < 1 \text{ and } \varsigma \sim N\left(0, \sigma_\varsigma\right)$$

In order to control for selection, we have two latent indices associated with participation:

$$P^*_{it} = z'_{it}\gamma + \pi_{it} \tag{2}$$

$$P^*_{it-1} = z'_{it-1}\gamma + \pi_{it-1} \tag{3}$$

Taking expectations for employed workers (conditional on participation):

$$\mathbf{E}(\ln w_{it} | P_{it} = 1, P_{it-1} = 1) = d_t + x'_{it}\psi + \rho_{\varsigma\pi}\sigma_\varsigma\bar{\lambda}_{it} + \rho_{\varsigma\pi-1}\sigma_\varsigma\bar{\lambda}_{it-1} \tag{4}$$

where $\rho_{\varsigma\pi}$ is the correlation between the persistent component of wages and the participation equation, and σ_ς and $\bar{\lambda}$ are the variance and Mills ratio associated with this persistent component.

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Table 1. Stochastic process estimation

	Private and public		Only private		Only public	
	(1)	(2)	(3)	(4)	(5)	(6)
σ_ς	0.335***	0.321***	0.332***	0.319***	0.175***	0.222***
	(0.00176)	(0.00219)	(0.00180)	(0.00232)	(0.0501)	(0.0509)
ρ	0.874***	0.899***	0.876***	0.905***	0.976***	0.969***
	(0.00482)	(0.00624)	(0.00496)	(0.00662)	(0.249)	(0.201)
$\rho_{\varsigma\pi}$		−0.0273***		−0.0266***		−0.0159
		(0.000340)		(0.000345)		(0.0100)
N	7,056,360	6,477,449	6,844,658	6,282,577	59,678	55,026

Standard errors in parentheses. $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Let the residual wage growth be $g_{it} = \hat{w}_{it} - w_{it}$, where $\hat{w}_{it}$ is the wage growth predicted by the model. In order to identify the variance of the shocks, we use the first two moments and the first-order auto-covariance of this residual, which are defined below.

$$E(g_{it}|P_{it}=1, P_{it-1}=1) = \sigma_u\left(\rho_{\varsigma\pi}\bar{\lambda}_{it} + \rho_{\varsigma\pi-1}\bar{\lambda}_{it-1}\right)$$
$$E(g_{it}^2|P_{it}=1, P_{it-1}=1) = \sigma_u^2\left(1 - \rho_{\varsigma\pi}^2 z_{it}'\gamma\bar{\lambda}_{it} - \rho_{\varsigma\pi-1}^2 z_{it-1}'\gamma\bar{\lambda}_{it-1} + 2\rho_{\varsigma\pi}\rho_{\varsigma\pi-1}\bar{\lambda}_{it}\bar{\lambda}_{it-1}\right)$$
$$E(g_{it}g_{it-1}) = \rho\sigma_u^2$$

with $\sigma_u^2 = \frac{\sigma_\varsigma^2}{1-\rho^2}$

Given the residuals from the wage equation, we use the method of moments in order to estimate the parameters governing the productivity for each sector. More specifically, we use the first two moments and the first-level autocorrelation from the residuals in order to estimate the persistence and the variance of this process.

We first report the results for the process estimated without separating private and public sector, and then for each sector separately. Moreover, for each of these groups, we obtain the results with and without considering the participation adjustment. We are able to do this by simply imposing $\rho_{\varsigma\pi} = 0$ in the case without participation. Moreover, in order to be able to identify all the parameters properly in the case with participation we assumed that: $\rho_{\varsigma\pi} = \rho_{\varsigma\pi-1}$. Table 1 shows our results.

We can observe that considering both sectors together the variance of the process is higher and the persistence is lower when we do not take into account the participation decision. This results still holds considering only the private sector workers. The results from including the participation estimation only for civil servants are the opposite but for them $\rho_{\varsigma\pi}$ is not statistically significant. Moreover, comparing the estimates for each sector separately we can see that the persistent is higher and the variance is lower in the public sector compared to the private sector, consistent with the fact that public sector jobs are more stable and less riskier than jobs in the private sector.

2.2. Unemployment shocks

In order to estimate the unemployment risk, we also rely on data from Rais since it allows to identify the cause of separation. For the period between 2010 and 2014, we find that the separation rate in the private sector is more than four times larger than in the public sector. Despite being small, we do observe some separation in the public sector, most of which being involuntary such as dismissal by the firm and compulsory retirement. Fig. 3 plots the exogenous separation for each sector by age for 2010.

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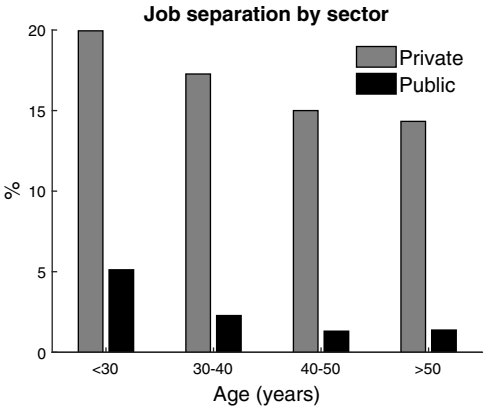

Figure 3. Unemployment risk for private and public sector. *Source*: Rais (2010).

3. Model

3.1. Demography

Time is discrete and at each period t a new generation is born. Individuals may live for at most T periods. Uncertainty regarding the time of death is captured by the fact that each individual faces a probability ψ_{t+1} of surviving to the age $t+1$ conditional on being alive at age t. We map the survival probability into the time invariant age profile of the population denoted by $\{\mu_t\}_{t=1}^{T}$. Let g_n denote the population growth rate, the fraction of agents t years old in the population is found using the following law of motion $\mu_t = \frac{\psi_t}{1+g_n}\mu_{t-1}$, with $\mu_t \geq 0$ and $\sum_{t=1}^{T} \mu_t = 1$. For most of our analysis, we will focus on the steady-state allocations. Since it greatly simplifies the presentation, we shall drop all time indices, j, from aggregate variables and use t to represent age.

3.2. Private sector technology

Firms in the private sector produce the consumption good through a standard constant returns to scale production function:

$$Y_p = G^{\chi} K_p^{\alpha} N_p^{1-\alpha},\ \alpha \in (0,1). \tag{5}$$

where G is the public good produced by the government, which is taken as given.[7] Private sector firms also take prices as given and choose K_p and N_p to maximize profits.[8] The first-order conditions of a representative firm are given by:

$$r = \alpha G^{\chi} \left(\frac{K_p}{N_p}\right)^{\alpha-1} - \delta, \tag{6}$$

$$w = (1-\alpha) G^{\chi} \left(\frac{K_p}{N_p}\right)^{\alpha}. \tag{7}$$

where r denotes the interest rate, w is the wage rate, and δ is the depreciation rate.

3.3. Government sector

We assume that the public good is produced by the government. The public good, G, is produced using efficient labor units N_g and capital K_g according to the following technology:

$$G = A_g K_g^{\alpha} N_g^{1-\alpha},\ A_g > 0. \tag{8}$$

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This is an aggregation of labor and capital to produce public goods and services such as paved roads and the rule of law. It is important to highlight that K_g in our model is capital, such as machines and equipment, employed in the public sector to produce public infrastructure. Capital employed in the public sector evolves according to the following law of motion:

$$K_{g,t+1} = I_g + (1 - \delta_g)K_{g,t}, \tag{9}$$

where I_g is financed through taxes.

There are two different social security regimes: a scheme for private sector workers and a scheme for public workers. The replacement rate for civil servants is different from the one faced by private sector workers. Consequently, in the model we have two types of retirees: individuals who retired from the public sector and individuals who retired from the private sector.

In addition, we assume that the government carries out an exogenous flow of expenditure, C_g, which includes other parts of government consumption such as military expenditure that is deemed to be unproductive in our model. C_g is just useful to allow the model to match the actual aggregate share of government spending in the economy and it is kept constant in the quantitative exercises. In order to finance its expenditures, the government levies proportional taxes on consumption, τ_c, and on capital income, τ_k. Labor income taxes are allowed to be nonlinear. In particular, we use the specification $T(y) = y - (1 - \tau_w)y^{1-\varrho}$.

3.4. Households

Labor supply and earnings. In each period of life, agents can choose to search for a job in the private or in the public sector. Conditional on the career choice, individuals make decisions about asset accumulation and labor supply. They can also choose not to work and stay nonemployed, in which case they supply zero hours in the labor market.

An individual of age t who works for n hours in the private sector earns $y_p = wn_t h_t e^{(u+z_{p,t})}$, where w is the rental rate. The variable $u \sim \mathcal{N}\left(0, \sigma_u^2\right)$ is a permanent component of an individual's skills. It is realized at birth and retained throughout one's life. On the other hand, $z_{p,t}$ evolves stochastically according to an AR(1) process, $z_{p,t} = \varphi_p z_{p,t-1} + \varepsilon_{p,t}$, with innovations $\varepsilon_{p,t} \sim N\left(0, \sigma_{\varepsilon_p}^2\right)$. Analogously, an individual of age t who works for n hours in the public sector earns $y_{cs} = (1 + \zeta)wh_t e^{(u+z_{g,t})}$, where $z_{g,t}$ follows an AR(1) process given by $z_{g,t} = \varphi_g z_{g,t-1} + \varepsilon_{g,t}$, with innovations $\varepsilon_{g,t} \sim N\left(0, \sigma_{\varepsilon_g}^2\right)$. We allow the stochastic process for z to differ to capture differences in wage risk between sectors. This to be consistent with the fact that labor legislation and job characteristics in the public sector may be different from the ones in the private sector.

In addition, agents face at each period an exogenous sector-specific age-dependent probability of job separation, $\varsigma_{m,t}$ with $m = g, p$. As shown in Section 2, we have that $\varsigma_{p,t} > \varsigma_{g,t}$ in the data. In fact, low risk of unemployment should be one of the main reasons for agents to search for a job in the public sector.

The age-efficiency profile, h_t, is endogenous and evolves according to a learning-by-doing technology in which individuals accumulate human capital by working. We introduce human capital accumulation to account for differences in the age-efficiency profile arising from differences in hours worked and job tenure between the two sectors. The law of motion for h_t is given by

$$h_{t+1} = q_m h_t^{\xi_m} n_t^{1-\xi_m} + (1 - \delta_h)h_t \text{ with } m = g, p \tag{10}$$

where q_m is a scale parameter and ξ_m are parameters that govern both the persistence of the age-efficiency profile and the impact of hours worked on its evolution.

Preferences and choices. Each person has a unit time endowment which can be directly consumed in the form of leisure, l, or used in market-related activities. An agent's period-by-period time constraint is $l_t + n_t + s_{g,t}\phi_t = 1$, where ϕ_t is a time cost of searching for a public job and $s_{g,t} \in [0, 1)$ is the search intensity. In addition, we assume that households are subject to a non-convexity constraint due to setup costs for work, which is intended to generate an extensive

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margin of labor supply adjustments. In particular, we specify $n_t = \max\{n_t - \bar{n}, 0\}$. Preferences are such that agents derive utility from random paths for consumption, c, and leisure, l, according to

$$U = \max_{\{c_t, n_t, s_{g,t}\}_{t=1}^{T}} : \mathbb{E} \sum_{t=1}^{T} \beta^t \prod_{j=1}^{t} \psi_j u\left(c_t, n_t, s_{g,t}\right)$$

where

$$u\left(c_t, n_t, s_{g,t}\right) = \frac{c_t^{1-\gamma_c}}{1-\gamma_c} + \rho_t \frac{\left(1 - n_t - s_g \phi_t\right)^{\left(1+\frac{1}{\gamma_n}\right)}}{1+\frac{1}{\gamma_n}}$$

where $\beta, \gamma_c, \gamma_n$ are, respectively, the discount factor, the risk aversion parameter, and the Frisch labor supply elasticity.

There is no on-the-job search within sector. At each period, nonemployed agents and private sector workers can search for a job in the public sector. Given the search intensity, s_g, the probability of finding a public sector job next period is $\pi_g(s_g, u)$, which also depends on the ex ante ability to be consistent with the fact that the public sector hires proportionally more skilled workers. The cost of job search in the public sector is specified as $\phi_t = \phi_0 t^{\phi_1}$, where ϕ_0 is a scale parameter and ϕ_1 governs the elasticity of the application cost to age. This age dependency of ϕ_t is important for the model to be able to replicate the share of civil servants over the life cycle. In addition, nonemployed agents can also search for a job in the private sector and we denote the job finding rate by π_p. In line with the empirical evidence, which suggests that the public sector is an absorbing state, we assume the civil servants cannot search.

Besides making decisions about job search and hours worked, agents can trade a risk-free asset which holdings we denote by a_t. Asset holdings are subject to an exogenous lower bound. More precisely, for our main exercise, we assume that agents are not allowed to contract debt at any age, so that the amount of assets carried over from age t to $t+1$ is such that $a_{t+1} \geq 0$. Because no agent can hold a negative position in assets at any time, we assume without loss that asset takes the form of capital, $a_t = k_t$, as in Aiyagari (1994).

In addition, in order for the model to be able to reproduce the distribution of savings rate observed, we assume that individuals derive utility from leaving a bequest to their children: $\nu(a) = \eta_0 \left(1 + \frac{a}{\eta_1}\right)^{(1-\gamma_c)}$. This type of bequest motive has been called warm glow, was first introduced by Andreoni (1989), and has been used in other papers as a way to generate a wealth distribution closer to the data.[9] Considering a more sophisticated form of altruism would increase the number of state variables and, in some cases, would generate strategic parent–child interaction. The term η_0 reflects the individual's concern about leaving bequests, while η_1 measures the extent to which bequests are a luxury good. In particular, when η_1 is relatively large, bequests are treated as a luxury good. Thus, richer agents choose to save in order to leave bequests, while poorer agents do not, or less frequently so.

Budget constraints. The flow budget constraint that individuals in working age face in our model is

$$(1+\tau_c)c + a' = [1 + (1-\tau_k)r]\, a + \hat{y} - T(\hat{y}) \tag{11}$$

where a' denotes next period assets.

At age T_r, agents retire and start collecting social security payments at an exogenously specified replacement rate of the last period earnings. There are two main differences in the calculation of retirement benefits in each sector. First, the replacement rate, θ_j, in the public sector is higher than in the private sector. Second, benefits in the private sector are capped by a limit denoted by $\bar{b}$, while there is no benefit cap in the public sector. Thus, the budget constraint for retirees can be written as follows:

$$(1+\tau_c)c + a' = [1 + (1-\tau_k)r]\, a + b_j \tag{12}$$

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Recursive formulation of individuals' problems. Let $V_{m,t}(\omega_t)$ denote the value function of an individual aged $t < T_R$ with employment status $m = g, p, o$, where $\omega_t = (a_t, u, z_{p,t}, z_{g,t}, h_t)$ is the individual state space. Thus, the choice problem of individuals aged t who work in the private sector can be recursively represented as follows:[10]

$$\begin{aligned} V_p(\omega) = \max_{c,n,a',s_g} & \; u(c, n, s_g) \\ & + \beta\Big[\pi_g(s_g, u)E_{z'} \max\{V_p(\omega'), V_g(\omega'), V_o(\omega')\} + \varsigma_{p,t}E_{z'}V_o(\omega') \\ & + (1 - \varsigma_{p,t} - \pi_g(s_g, u))E_{z'} \max\{V_p(\omega'), V_o(\omega')\}\Big] \end{aligned} \tag{13}$$

subject to (7). Similarly, for public sector and nonemployed workers:

$$V_g(\omega) = \max_{c,n,a'} u(c, n, 0) + \beta\Big[(1 - \varsigma_{g,t})E_{z'} \max\{V_g(\omega'), V_o(\omega')\} + \varsigma_{g,t}E_{z'}V_o(\omega')\Big] \tag{14}$$

$$\begin{aligned} V_o(\omega) = \max_{c,a',s_g} & \; u(c, 0, s_g) \\ & + \beta\Big[\pi_g(u, s_g)E_{z'} \max\{V_g(\omega'), V_o(\omega')\} + \pi_{p,t}E_{z'} \max\{V_p(\omega'), V_o(\omega')\} \\ & + ((1 - \pi_g(u, s_g) - \pi_{p,t})E_{z'}V_o(\omega')\Big] \end{aligned} \tag{15}$$

In addition, since agents live up to age T, they start facing a mortality risk after the retirement age, T_R. Hence, with probability $(1 - \psi_{t+1})$ agents might die leaving a bequest.

$$V_{r,j,t}(a, u) = \max_{c,a'} u(c, 0, 0, 0) + \beta\Big[\psi_{t+1}V_{r,j,t+1}(a', u) + (1 - \psi_{t+1})\nu(a')\Big] \tag{16}$$

Recursive competitive equilibrium. At each point in time, agents differ from one another with respect to age t and to state $\omega_t = (a_t, u, z_{p,t}, z_{g,t}, h_t) \in \Omega$. Agents of age t identified by their individual states, ω, are distributed according to a probability measure λ_t defined on Ω as follows. Let $(\Omega, F(\Omega), \lambda_t)$ be a space of probability, where $F(\Omega)$ is the Borel σ-algebra on Ω: for each $\eta \subset F(\Omega)$, $\lambda_t(\eta)$ denotes the fraction of agents aged t that are in η. Given the asset t distribution, λ_t, $Q_t(\omega, \eta)$ induces the asset $t+1$ distribution λ_{t+1} as follows. The function $Q_t(\omega, \eta)$ determines the probability of an agent at age t and state ω transiting to the set η at age $t+1$. $Q_t(\omega, \eta)$, in turn, depends on the agents' policy functions and on the exogenous stochastic process for z_m. Now, we have all the tools to characterize the stationary recursive competitive equilibrium. Households' optimal behavior was previously described in detail above as well as the firms maximization problem and the government sector. It remains, therefore, to characterize the market equilibrium conditions, the aggregate law of motion, and the government budget constraint. In each period, there are two prices in this economy (w, r). The equilibrium in the labor and capital markets is defined by:

$$K = \sum_{t=1}^{T} \mu_t \int_{\Omega} d_{a,t}(\omega) d\lambda_t$$

$$N_p = \sum_{t=1}^{T} \mu_t \int_{\Omega} d_{p,t} d_{h,t}(\omega) d\lambda_t$$

$$N_g = \sum_{t=1}^{T} \mu_t \int_{\Omega} d_{cs,t} d_{h,t}(\omega) d\lambda_t$$

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where $d_{a,t}(\omega)$ and $d_{h,t}(\omega)$ denote the policy functions for asset holding and hours worked, respectively, while $d_{p,t}(\omega)$ and $d_{cs,t}(\omega)$ are indicator functions describing the sectoral choice.

The consumption tax rate, τ_c, is such that it balances the government's budget,

$$C_g + I_g + (1+\zeta)wN_g + B = \tau\left(wN_p + (1+\zeta)\,N_g\right) + \tau_k rK_p + \tau_c C,$$

where C denotes the aggregate consumption and B denotes the total benefits. The distribution of accidental bequests is given by:

$$\epsilon = \sum_{t=1}^{T} \mu_t \int_{\Omega} (1-\psi_{t+1}) d_{a,t}(\omega) d\lambda_t.$$

Finally, given the decision rules of households, $\lambda_t(\omega)$ satisfies the following law of motion:

$$\lambda_{t+1}(\eta) = \int_{\Omega} Q_t(\omega,\eta) d\lambda_t \;\; \forall \eta \subset F(\Omega).$$

4. Quantitative analysis

In order to quantitatively evaluate how public sector employment affects savings and labor supply, we must assign values for the model parameters. We proceed by calibrating and estimating parameters such that the model economy matches key micro and macro statistics of the Brazilian economy. Brazil is an interesting case since it has a large public sector where jobs are much more stable and provides a different set of compensation in relation to the private sector, characterized by higher wages and a more generous pension system. Moreover, the selection process to jobs in the public sector is based on a public exam which allows us to assume that looking for a job in the public sector entails a time cost.

4.1. Calibration and estimation

Table 2 lists the value of each parameter for the Brazilian economy and includes a comment on how each was selected.

Model period and age distribution. The model period is 1 year. We assume that individuals start their lives at the age of 25 and live until the age of 80. Therefore, the extension of their lifetimes in the model is 56 periods ($T=56$). The age population distribution, $\{\mu_t\}_{t=1}^{T}$, and the mortality risk are obtained from the life tables for the Brazilian population constructed by IBGE (National Central Statistical Agency) based on the 2010 census data.

Preference parameters. First, we choose the discount factor β in such a way that the equilibrium of our benchmark economy implies a capital-output ratio around of 2.8, which is the value observed in the data.[11] We fix the coefficient of relative risk aversion, γ, to 2.0, in line with the bulk of the literature on consumption surveyed by Attanasio (1999). This value is also consistent with the literature that estimates γ using Brazilian data, which suggests a range from 1 to 3 (see, e.g., Gandelman and Hernández-Murillo (2014) and Fajardo et al. (2012)). Then, we choose the share of leisure in the utility function, ρ_t to match average hours for different age groups and the average labor force participation. In particular, we assume that $\rho_t = \rho_0 + \rho_1 t$. To calibrate ρ_0, we use the average working hours for ages 25–40 and for ρ_1 the average between 41 and 60. The first group works on average 37.86 while the second 40.37 of their time endowment. For the last 5 years, we specify a new profile $\rho_t = \rho_{60} + \rho_2 t$. We calibrate ρ_2 to match the average hours during those last 5 years equal to 35.16.[12] Finally, we set the parameter related to the cost of work, $\bar{n}$, so that the model matches a labor force participation rate of 83%, which is calculated using PNAD 2014 for males older than 25 in 2014.

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Table 2. Parameters calibrated externally

Parameter	Description	Values	Source
γ_c	Risk aversion	2	Fajardo et al. (2012)
γ_n	Frisch elasticity	0.5	Kaplan (2012)
χ	Importance of infrastructure	0.15	Hulten (1996)
α	Capital share	0.36	Gomes et al. (2005)
$\delta = \delta_g$	Depreciation rate	0.06	Growth literature
ζ	Public-sector wage premium	0.19	PNAD survey
τ_w	Income tax rate	18%	Paes and Bugarin (2006)
τ_k	Capital income tax rate	15%	Paes and Bugarin (2006)
θ_g	Replacement rate, pub. sector	1	Afonso (2016)
θ_p	Replacement rate, priv. sector	0.82	Afonso (2016)
δ_h	Human capital depreciation	0.04	Browning et al. (1999)

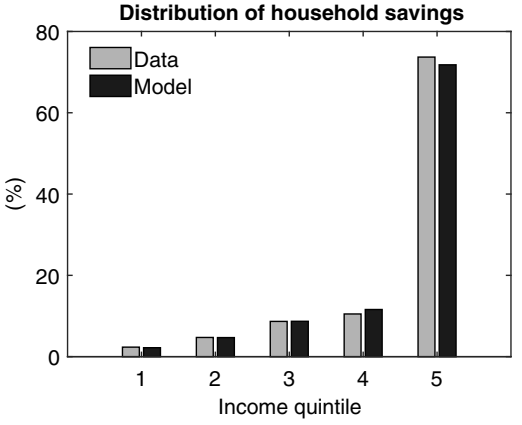

Figure 4. Distribution of savings by income: data vs. model.

The remainder preferences parameters are related to the utility function of bequests. The parameter η_0 represents the weight on the utility from bequeathing. Since it measures the strength of bequest motives, we calibrate η_1 so that the model matches the aggregate savings rate in the data. The term η_1 is the shifter of bequests in utility function. It reflects the extent to which bequests are luxury goods, affecting the bequest distribution, especially the high end of it. Thus, we set η_1 to match the savings rate of the richest 20% individuals. In Fig. 4, we show the simulated distribution of savings by income quintile. It can be seen that the model matches the data very well, specially among the top 20% who are responsible for almost all of the household savings.

Production technologies. We set the capital share α at 0.36. This number is consistent with the one reported by Gomes et al. (2005), when the correction suggested by Gollin (2002) and Young (1995) about the self-employed income is taken into account. In addition, we assume that the capital stock depreciates at a rate of 6% per year, which is consistent to the figures used in the growth and development literature (cf., Parente and Prescott (2000)). We also set $\delta_g = 0.06$. According to the Brazilian Institute of Geography and Statistics (IBGE), the ratio of public goods to output is roughly 16%—using information on production costs. Then, in order to match this ratio we set $A_g = 0.80$. To calibrate parameter χ, we rely on estimates provided by Hulten (1996) who uses a cross-section of low-income countries including Latin American countries and obtains a point estimate of 0.15 for χ, which is the value we use.

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Table 3. Parameters calibrated internally

Parameter	Description	Values	Target
β	Discount factor	0.983	Capital/Output, 2.80
ρ_t	Weight of leisure	–	Average hours worked
κ_w	Utility cost of work	−1.048	Average employment rate
$\pi_{p,t}$	Job finding rate in p	–	Flow from nonemployment to p
ϕ_0,ϕ_1	Search cost for a PS job	0.30, 0.19	Flow of individuals aged 30–34 from private to public jobs
ξ_g, ξ_p	On the job training parameter	0.16, 0.15	Life cycle workers' income
$\varsigma_{p,t}$, $\varsigma_{g,t}$	Separation rate	–	Flow into nonemployment
φ_p, φ_g	Persistence parameter	0.88, 0.98	Section 2
$\sigma^2_{\epsilon_p}, \sigma^2_{\epsilon_g}$	Var. of innovation	0.11, 0.02	Section 2
ι	Job finding prob in the PS	2.5	Share of cs by income
τ_c	Consumption tax	0.24	Balance gov. budget constraint
A_g	TFP—Government sector	0.80	Share of public goods
C_g	Unproduct. gov. spending	2% of Y	Aggregate government spending

Labor income shocks. We calibrate the parameters of the stochastic process for wages, $(\varsigma_p, \varsigma_g, \sigma_{\epsilon_p}, \sigma_{\epsilon_g})$, using the estimates reported in Section 2. The variance of the permanent component, σ^2_u, is chosen to match the income Gini index at age 25. To solve the model, we use the algorithm described in Tauchen (1986) to discretize the two shocks, using 7 states to represent the permanent shock and 11 states for the persistent shock. We also use the data reported in Section 2 to calibrate the unemployment shocks. In particular, we use a second-order polynomial to interpolate the flows reported in Table 3 to obtain the age profile for $(\varsigma_p, \varsigma_g)$ by exact age.

Job-offer probability. For the transition from unemployment to private sector employment, we specify an age-dependent function $\pi_t = \pi_0 \exp \pi_1 t$, where π_0 and π_1 are parameters to be chosen in such a way that the model matches key moments regarding unemployment in the data. The first moment we target is an unemployment rate of 7%. To discipline the employment profile over the life cycle by the data, they also use the shape of the age profile of employment rate.

Human capital functions. The parameters of the human capital functions are calibrated as follows. First, given that the evidence for the human capital depreciation rate ranges from 0.0016 to 0.089, with most of the estimates concentrated around 0.04 (Browning et al. (1999)), we set $\delta_h = 0.04$. As it is usual in the macro-labor literature, the other parameters are then chosen in order to approximate the simulated earnings profiles to their counterparts estimated from the data.[13] This procedure is carried out for civil servants and workers and we obtain $(\xi_g, \xi_p) = (0.16, 0.15)$.[14] The resulting profiles are presented in Fig. 5. In order to measure the goodness of the fit, we calculate the average (percentage) deviation, in absolute terms, between the model implied earnings profiles and the data. By this measure, on average, the model implied earnings profiles differed from the data by 2.93% in the case of civil servants and 1.98% in the case of private workers.

Public sector parameters. Based on Paes and Bugarin (2006), we assume a labor income tax rate of 18% and a capital tax of 15%. The consumption tax is determined in such a way that the government budget balances in equilibrium, which implies a tax rate equal to 30.7% in the benchmark economy. The replacement rate in the private sector, η_{rp}, is taken from Afonso (2016) who, based on microdata from the private sector social security system, provides a value of 0.82. In the public sector, the replacement rate, η_{rg}, is equal to one, which is consistent with the fact that civil servants receive their last salary as benefits. We assume that agents can get the public pension system only if they start to work in the public sector 5 years before the retirement age. We also impose a ceiling on private pensions, $\bar{b}$, such that the maximum pension in the private

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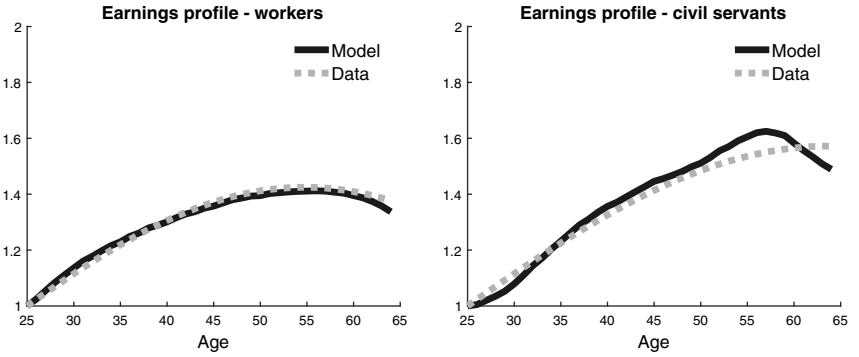

Figure 5. Earnings profile and income distribution. *Source:* PNAD.

sector is 20% of the maximum pension in the public sector.[15] We set the public wage premium for workers to be equal to $\zeta = 0.19$, which is consistent with the estimate of the conditional public wage premium provided in regression (5), Table A.1 in Appendix A.

We specify the probability of finding a job in the public sector as $\pi_g(s_g, u) = 1 - \left(\frac{\bar{u} - s_g u}{\bar{u} - s_g \underline{u}}\right)^{\iota}$, where $(\bar{u}, \underline{u})$ are the upper and the lower bound of the ex ante productivity shock, respectively. The advantage of this specification is that it has only one parameter, ι, which governs the curvature of the job finding rate in the public sector as a function of the search intensity, s_g. We calibrate ι and the parameters of the cost of job search function (ϕ_0, ϕ_1) in order to minimize the distance between a set of simulated moments and their counterparts in the data. In particular, we use as targets the total share of civil servants, 13.4%, the share of civil servants at ages 30–35 and 45–50, and the share of civil servants among the richest 20%. These data moments were taken from the 2014 Continuous National Household Sample Survey (PNAD Continua) compiled by the Brazilian Institute of Geography and Statistics (IBGE). In Fig. 6, we present the simulated and the actual flow of individuals to public jobs by age. It can be seen that this flow increases with age in the model as well as in the data. This pattern could be explained by the fact that the retirement benefits in the public sector are much more generous than in the private sector, which makes the public sector jobs more attractive as individuals approach retirement.

5. Results

5.1. Model fit

Before discussing the properties of the model economy, we state our measures of wealth and saving. The concept of household wealth we use in the model economies at a point in time t is simply net asset holdings, a_t. This choice reflects the fact that the concept of wealth typically measured in the data is one that includes neither social security wealth nor the value of human capital. The notion of saving used is then simply the change in wealth holding across a period. Thus, saving for a particular household is $a_{t+1} - a_t$. Given the budget constraint, the saving of an age t household in state $\omega_t = (a_t, u, z_{p,t}, z_{g,t}, h_t)$ can also be calculated as after-tax income plus transfers less consumption:

$$a_{t+1} - a_t = (1 - \tau_k) r a_t + \hat{y}_{m,t} - T(\hat{y}_{m,t}) + b_{m,t}(u) - (1 + \tau_c) c_t \text{ with } m = g, p, o \qquad (17)$$

This measure of saving is equal at the aggregate level to both economy-wide net saving and individuals savings. This is due to the fact that government savings are always equal to zero.

Given the specified calibration, our model is able to provide implications in regard to untargeted savings and labor supply behavior by sector. In Fig. 7, left graph, we show the household savings rate by sector in the benchmark economy and in the data. It can be seen that the model

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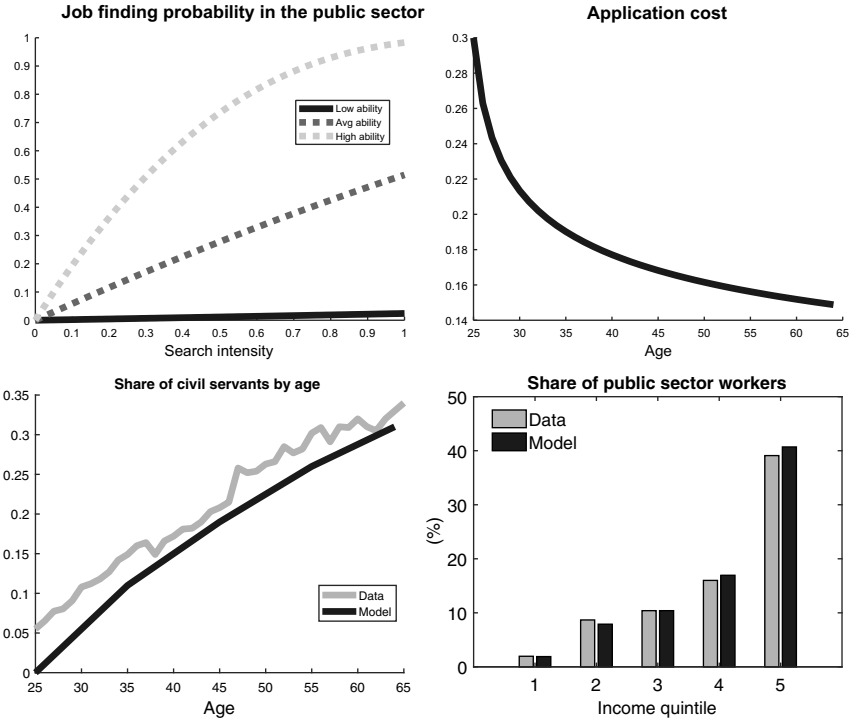

Figure 6. Share of civil servants by age and income. *Source:* PNAD.

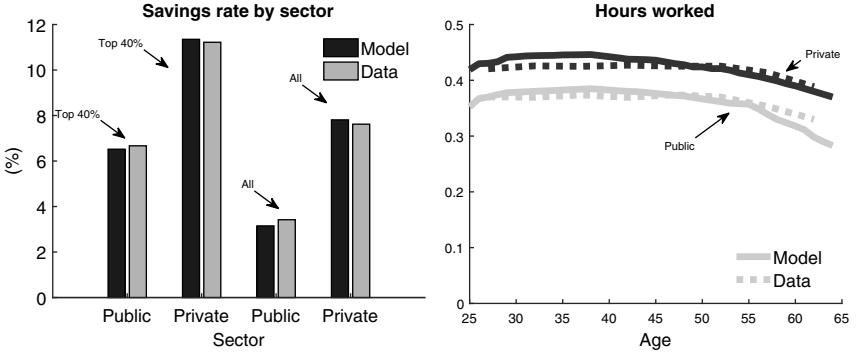

Figure 7. Benchmark economy.

is able to match very well the difference in savings behavior between sectors not only among all agents but also among the richest 40%, which, as shown before, are responsible for most of the household savings both in the data and in the model. In addition, we show in the right graph of Fig. 7 that the model can also replicate very closely the life cycle profile of hours worked by sector. It should be stressed that because we targeted the aggregate savings rate and the average hours worked among all workers, the results in Fig. 7 are not a consequence of the calibration. Thus, they indicate that differences in the wage structure, labor law legislation, and social security can account for most of the differences in savings behavior and labor supply between the public and private sector workers observed in the data.

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Table 4. Effects of aligning income risk across sectors

Variable	Benchmark	Counterfactual
Y	0.674	0.720
K	1.680	1.921
N_p	0.690	0.698
Hours worked (public)	0.358	0.388
Hours worked (private)	0.418	0.415
Nonemployment	17.85%	17.17%
Labor/hours	1.210	1.261
Share of civil servants	13.41%	13.82%
w	0.625	0.661
r	7.96%	7.00%
τ_c	24.0%	21.97%
Savings rate	6.25%	7.79%
Savings rate (public)	3.15%	6.88%
Savings rate (private)	7.81%	8.26%
G/Y	15.07%	15.05%
Welfare		
CEV	–	1.79%
CEV low	–	3.35%
CEV high		−1.51%
CEV efficiency	–	4.10%
CEV insurance	–	−2.32%

5.2. Implications of differences in income risk

Table 4 presents the results of an experiment in which we align the wage and the unemployment risk in the public sector with the ones in the private sector. Because this change makes the public sector less attractive, fewer agents apply to those jobs, which reduces public sector employment and the supply of public goods. Thus, to isolate this size effect from the one directly associated with changes in wage risk and job stability, we adjust the cost of job search, ϕ_0, to keep G/Y at its benchmark value.[16] The lower cost of search increases the share of low-skilled agents in the public sector. In fact, we show in Fig. 8 the distribution of civil servants by income in the benchmark economy as well as in the counterfactual economy. It can be seen that the share of civil servants in the fifth quintile decreases substantially from nearly 40% to 23%, leading to a more uniform distribution.[17]

In the second column of Table 4, we show the value of output, capital, labor, prices, and savings rate for the baseline economy, while the third column shows the correspondent values for the counterfactual economy. It can be seen that the savings rate among civil servants increases by 3.73 percentage points from 3.15% to 6.88%. Making labor income in the public sector more volatile pushes civil servants to hold more wealth as a precautionary saving instrument. Thus, the gap in savings rate between the two sectors falls from 4.66% to 1.38%, which entails that differences in income risk account for nearly 70% of the total gap observed in the data. The aggregate effects are sizable with long-run capital and output increasing by 14% and 6.8%, respectively.

Notice that the large increase in the aggregate savings rate happens despite the fact that the share of civil servants in the labor force is just 13.4%. This is not surprising since public sector workers are concentrated in the right end of the income distribution, which accounts for almost

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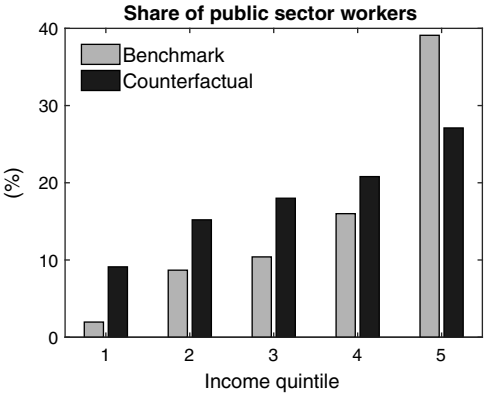

Figure 8. Share of civil servants by income: benchmark vs. counterfactual.

all of the household savings in the economy. Thus, changes in their savings behavior can have a sizable impact on total savings and capital accumulation.

The self-insurance mechanism also induces public workers to work longer hours when income risk increases. Intuitively, hours worked are adjusted to alleviate the effect of income shocks on consumption. In fact, when the degree of idiosyncratic risk in the public sector increases, civil servants' labor supply goes up by nearly 8.3%.[18] This increase along with the rise in the share of civil servants explains the growth in the supply of public goods. Notice that the gap in hours worked between the two sectors falls from nearly 16.7% to 6.9% and thus the model predicts that differences in income risk account for nearly 58% of the difference in labor supply behavior between the public and private sector workers. In addition, the labor to hours ratio, which is the ratio of weighted (by productivity) to unweighed hours, increases by 4.2%. Since the government hires predominantly high skill individuals, the effect on hours is stronger for this type of workers.[19]

In the bottom of Table 4, we show the welfare implications of our experiment. Our social welfare function is given by the expected utility of a newborn agent under the veil of ignorance. In particular, we compute the welfare variation (CEV) as follows: Let $V_1(\omega)$ denote the expected utility of an agent who starts life at state ω under the policy we aim at evaluating. Then, we define

$$V_1^0(\omega) = \mathbb{E}\left[\sum_{t=1}^{T}\prod_{s=1}^{t}\psi_s u_{t,0}\left((1+\Delta)c_t, n_t, s_{g,t}\right)\right]$$

where $u_{1,0}(c_t, 1-n_t)$ is the flow utility attained by the agent under the benchmark at age t. Our relevant measure of welfare variation is

$$CEV = \min_{\Delta}\left[\mathbb{E}_\omega V_1^0(\omega) - \mathbb{E}_\omega V_1^1(\omega)\right]$$

where CEV corresponds to the change in consumption that an agent must receive to be indifferent between been born into the benchmark economy and in the counterfactual economy. If $CEV > 0$ ($CEV < 0$), then the policy change entails an increase (decrease) in aggregate welfare. This welfare criterion takes into account the concern of the policy maker for insurance against idiosyncratic shocks, as well as the distortions the policy instruments impose on labor supply and capital accumulation decisions.

The welfare gains of the reform studied in Table 4 are sizable with a CEV of 1.79%. Interestingly, if a specific group were to oppose the reform, it should be the high productivity group, which would have a substantial welfare loss—$CEV = -1.51\%$—, which under a utilitarian metric is more than compensated by the extraordinary gains—$CEV = 3.35\%$—obtained by the lowest productivity agents in society.

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Table 5. Wage risk versus employment risk

Variable	Benchmark	Wage risk	Unemployment risk
Y	0.674	0.702	0.686
K	1.680	1.834	1.747
N_p	0.690	0.695	0.688
Hours worked (public)	0.358	0.381	0.361
Hours worked (private)	0.418	0.415	0.417
Nonemployment	17.85%	16.93%	18.10%
Labor/hours	1.210	1.252	1.220
Share of civil servants	13.41%	13.71%	13.53%
w	0.625	0.648	0.637
r	7.96%	7.36%	7.60%
τ_c	24.0%	22.68%	23.05%
Savings rate	6.25%	7.31%	6.75%
Savings rate (public)	3.15%	5.76%	4.28%
Savings rate (private)	7.81%	8.19%	8.01%
G/Y	15.07%	15.08%	15.07%
Welfare			
CEV	–	0.49%	1.25%
CEV low	–	3.05%	2.03%
CEV high	–	−1.45%	−0.61%
CEV efficiency	–	2.76%	1.78%
CEV insurance	–	−2.25%	−0.32%

To evaluate the source of welfare gains, we provide a decomposition of the CEV following Domeij and Floden (2004) approach.[20] The efficient component captures the welfare change due to changes in the average level of the life cycle consumption and hours worked, while the insurance component captures the changes in their dispersion.[21] As can be seen in Table 4, the aggregate welfare change is a consequence of two opposing effects. On the one hand, there is a large welfare loss due to worst insurance in the economy, which indicates that agents value a lot the insurance role of stable jobs in the public sector. On the other hand, there is an even bigger increase in efficiency associated with better incentives in the public sector.

5.3. Wage risk versus employment risk

In Table 5, we compare the effects of the two sources of risk separately. In column two, we change only the variance and the persistence parameters of the civil servants' productivity shocks, while in column three we change only the rate of job destruction in the public sector.

It can be seen in the table that differences in the wage structure between the two sectors have larger impact on aggregate savings, capital accumulation, and output. In fact, when we align just the wage structure of civil servants with their counterparts in the private sector, the gap in savings rate reduces from 4.66% to 2.43%. Comparing this change with the one obtained when both factors are altered at the same time, one can see that differences in wage risk account for 69% of the gap in savings rate. Aggregate savings go from 6.25% to 7.31%, and capital and output increase by 9.17% and 4.15%, respectively. These figures are smaller for the case in which we change only the employment risk: aggregate savings increase nearly 0.5 percentage point, and capital and output go up 4% and 1.78%, respectively.

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Table 6. Effects when G/Y is allowed to change

Variable	Benchmark	Counterfactual
Y	0.674	0.642
K	1.680	1.784
N_p	0.690	0.682
Hours worked (public)	0.358	0.377
Hours worked (private)	0.418	0.411
Nonemployment	17.85%	18.28%
Labor/hours	1.210	1.228
% of civil servants	13.41%	7.65
w	0.625	0.601
r	7.96%	6.45%
τ_c	24.0%	19.38%
Savings rate	6.25%	7.29%
Savings rate (public)	3.15%	6.41%
Savings rate (private)	7.81%	7.68%
G/Y	15.07%	10.26%
Welfare		
CEV	–	−3.12%
CEV low	–	−4.85%
CEV high		−1.63%
CEV efficiency	–	−1.13%
CEV insurance	–	−2.01%

The reason why aligning the job separation in the public sector with the one in the private sector has a smaller effect on savings and output is twofold. On the one hand, a higher job separation rate in the public sector increases nonemployment. On the other hand, the rate of wealth accumulation decreases with a higher value of job separation because the increase in time unemployed reduces opportunities for accumulation.

While changes in wage risk account for most of the changes in aggregate savings and output, they imply smaller welfare change. In fact, one can see in the bottom of Table 5 that the welfare improvement of reducing the wage risk in the public sector is 0.49%, while it is 1.25% when we change just the employment risk. However, applying the same decomposition used in the last section reveals that the welfare impact of changing the wage risk is actually much bigger. In fact, while there is a larger effect associated with the efficient component (2.76% as opposed to 1.78%), there is an even larger welfare loss due to the insurance component (–2.25% as opposed to –0.32%).

The reason why the insurance component associated with the change in wage risk is nearly seven times greater than the one implied by changing the unemployment risk is that, in contrast to very persistent productivity shocks to wages, job destruction leads to a transitory shock in income, making it easier for individuals to self-insurance themselves against this type of shocks.[22]

5.4. Public sector size is allowed to change

In this section, we study how the results presented above are affected if we allow the size of public sector to change as we align the wage structure and the unemployment risk in the public sector with the ones in the private sector. Table 6 shows the results.

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Table 7. Sensitivity analysis

	Risk aversion		Bequest	
Variable	Benchmark	Counterfactual	Benchmark	Counterfactual
Y	0.689	0.733	0.669	0.708
K	1.742	1.982	1.660	1.869
N_p	0.696	0.703	0.687	0.694
Hours worked (public)	0.360	0.389	0.361	0.387
Hours worked (private)	0.421	0.419	0.422	0.419
Nonemployment	17.79%	17.21%	17.78	17.22%
Share of civil servants	13.39%	13.77%	13.38	13.79%
w	0.634	0.668	0.623	0.654
r	7.75%	6.82%	8.00%	7.14%
τ_c	23.8%	22.01%	23.90%	22.04%
Savings rate	6.55%	8.02%	6.21%	7.63%
Savings rate (public)	3.33%	6.91%	3.07%	6.18%
Savings rate (private)	8.02%	8.40%	7.79%	8.06%
G/Y	15.05%	15.06%	15.04%	15.05%

Notes: In columns "Risk aversion," we set the parameter γ_c to 1.5. In columns "Bequest," we set the bequest parameters, η_0 and η_1, to zero and adjust β to keep the same capital to output ratio as in the baseline calibration. In both cases, we carry out the experiment as in Table 4.

First, since the reform makes public sector jobs less attractive, there is less applications for those jobs, which causes the supply of public goods to output ratio to fall by nearly 5% percentage points. Given that the public good directly affects the production function, the fall in G causes a decrease in prices, mitigating the incentives to save generated by the reform. As a consequence, the increase in aggregate savings rate is now lower than in the baseline case (1.04% as oppose to 1.54%). Notice that the fall in wages also depresses labor supply in the private sector. Therefore, even though the reform generates an increase of 6.2% in aggregate capital, the overall aggregate effect is negative with output decreasing by 4.74%. This result indicates that reducing the attractiveness of the public sector does not necessarily stimulate output in the long run since public infrastructure might be seriously reduced.

In addition, as one can see in the bottom of Table 6, the overall welfare impact of the reform is also negative, –3.12. This is so mainly because, while the insurance component of the welfare change is similar to the baseline experiment, the efficiency component is much lower (–1.13% as opposed to 4.10%) due to the deterioration of the public sector infrastructure, as well as a lower labor supply in the private sector.

5.5. Sensitivity analysis

To assess the role of γ_c, the main parameter controlling the intertemporal elasticity of substitution, we set γ_c to 1.5 and carry out the same experiment as in Table 4. The results are reported in Table 7. It can be seen that the results are in line with the ones obtained under the baseline calibration. We find a smaller effect of differences in income risk on the gap in savings between the two sectors, 68% as opposed to 70%, which should be expected as lower risk aversion weakens the response of precautionary savings to income risk.[23]

Next, we shut down the bequest channel. Since the removal of the bequest motive significantly decreases savings and assets accumulation, we adjust the discount factor to keep the same capital

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to output ratio as in the benchmark. Then, we repeat the same experiment as in Table 4. We find smaller aggregate effects—see Table 7—with capital and output increasing by 12.6% and 5.8%, as opposed to 14.3% and 6.8% under the baseline calibration, respectively. We also find a smaller effect of differences in income risk on the gap in savings between the two sectors, 60% as opposed to 70%.

6. Conclusions

In this paper, we use microdata from two Brazilian household surveys to document that civil servants save and work significantly less than their counterpart in the private sector. We also show that both wage and unemployment risk at the household level are much higher in the private sector than in the public sector. We then develop a general equilibrium OLG model with a public and private sector to evaluate the aggregate impact of the differences in income characteristics and the extent to which they can account for the divergent savings and labor supply behavior observed in the data.

We evaluate an experiment in which we align the parameters related to wage and unemployment risk in the public sector with their counterparts in the private sector. We find that these two channels together account for nearly 70% of the differences in savings and 57% of the differences in labor supply behavior between civil servants and private sector workers. In addition, aggregate saving rate increases by 1.54 percentage points, implying a 14% increase in the level of capital and 6.2% in the output.

We find large welfare gains associated with this experiment, 1.79%. Interestingly, if a specific group were to oppose the reform, it should be the high productivity group, which would have a substantial welfare loss, –1.51%, which under a utilitarian metric is more than compensated by the extraordinary gains, 3.35%, obtained by the lowest productivity agents in society. We find that this sizable increase in welfare is due to better incentives in the public sector that increases economy-wide efficiency, which more than compensates a large welfare loss due to worst insurance in the economy.

Thus, although a large government can help to improve the performance of the economy if, for example, the provision of public infrastructure is below the optimal scale, differences in earnings characteristics and labor legislation between public and private workers can distort agents' savings and labor supply decisions, reducing capital accumulation and output. In addition, these differences can lead to large aggregate welfare loss despite the fact the agents value a lot the insurance role of public sector jobs.

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Notes

1 These numbers are from OECD (2020) for 2018.

2 Garibaldi et al. (2021) using data from CPS show that in the USA, government employees correspond to 20% of workers with college degree. For workers with education above college, these numbers are even higher, around 30%.

3 A decomposition of welfare gains using the methodology proposed Domeij and Floden (2004) shows that, although there is an increase in efficiency associated with better incentives in the public sector, there is also a large welfare loss due to worst insurance in the economy, indicating that agents value a lot the insurance role of stable jobs in the public sector.

4 We consider individuals between 25 and 65 years old who have worked at least 20 h in the main occupation. For the public sector, we consider only the nonmilitary civil servants under statutory regime.

5 We take the average of the estimates over the quarters in order to obtain an annual measure of participation and use this measure to predict workers' participation and the associated Mills ratio defined by $\lambda = \phi/\Phi$, where ϕ and Φ are the standard normal density and probability functions associated with participation.

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6 We do not have in our data set a variable that affects participation and is not related to wages such as marital status. Thus, exclusion restrictions cannot be fulfilled. Following Heckman (1979), we assume that error terms follow a bivariate normal distribution and are independent. It should be noted though that departures from normality may lead to inconsistent estimates as discussed in Mroz (1987) and Vella (1998).
7 We introduce G in the production function of the private sector to be consistent with the fact that in an economy where the public sector is productive, the presence of a large share of civil servants does not necessarily generate any allocation problem. A larger government can even increase aggregate output and welfare if the provision of public goods such as toll-free roads and the rule of law is below the optimal scale. This specification follows Barro (1990), Glomm et al. (2009), and others.
8 Profits are given by $Y_p - wN_p - (r+\delta)K_p$.
9 The idea to incorporate such preferences in a canonical incomplete markets life cycle economy goes back to at least De Nardi (2004).
10 In order to simplify the notation, we have suppressed the subscript for age from both the state and control variables.
11 Using the Heston et al. (2012) Penn World Tables 7.1 and the inventory method, we find a value of 2.80 for the capital-to-output ratio in the Brazilian economy.
12 The data for hours worked are PNAD 2014.
13 See, for example, Huggett et al. (2006).
14 Estimates of the elasticity parameters ψ are surveyed by Browning et al. (1999). These estimates range from 0.5 to almost 1.0. Thus, we restrict our search to this interval. In the case of the scale parameters, (ξ_g, ξ_p), we consider values in the interval [0.05, 0.20].
15 Both the ceiling in the public sector and in the private sector are determined by the social security legislation. In the public sector, the ceiling corresponds to the salary of the Ministry of Justice of the Supreme Court.
16 The reduction in ϕ_0 can be interpreted as less preparation time required to be successful in the recruitment process due to lower competition for jobs in the public sector.
17 Note that unskilled workers are poorer, so they cannot afford to search as intensely as skilled workers. In addition, the concavity of the job finding probability function entails that when ϕ_0 is reduced, one additional unit of search effort increases the likelihood of success more among workers at the lower rungs of skill distribution than among those at the top.
18 This precautionary effect on labor supply has been previously analyzed, for instance, in Pijoan-Mas (2006), Flodén (2006), and more recently Chopra (2022).
19 While our results indicate that differences in wage characteristics and labor law legislation can explain a sizable share of the differences in outcomes between the two sectors, it is important to bear in mind that there are other potentially relevant factors not taken into account in our analysis. For instance, Gomes and Kuehn (2019) point out to an important role of preferences for working in the public sector.
20 The details of the decomposition are presented in Appendix B.
21 This decomposition approach has been widely used in the Macro-Public Finance literature. See, for instance, Conesa et al. (2009) and Peterman and Sager (2022) and the papers they cite.
22 This results in line with the empirical evidence in Blundell et al. (2008) and Kaplan and Violante (2010). They find that households are able to self-insurance well against transitory shocks—such as unemployment shocks—while they have a hard time to smooth permanent or very persistence shocks.
23 See, for instance, Jappelli and Pistaferri (2010) for a review of the literature on consumption response to income shocks.
24 That is, we take expectations with respect to all possible permanent types and histories.

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Appendix A. Mincerian regressions

Table A.1 presents results for seven Mincerian wage equations in which the dependent variable is the logarithm of income per hour. Columns (1)–(3) use the standard human capital variables, such as schooling and experience (represented by age and age squared) as controls. There are 16 schooling dummies, each representing the number of years of completed schooling of the individual. The dummy goes from no schooling to 15 or more years of completed schooling. In addition to these variables, in column (4) we also add the variable gender and whether or not the worker has a formal job. In column (5), we add control for 13 occupations. Notice that the coefficient of the variable *civil servant* is statistically different from zero in all regressions and it ranges from 19% to 25%. The potential problem of unobservable selectivity implies that our OLS regression might not be capturing the exogenous effects of public sector premium on wages. The standard approach to address this issue is to use instrumental variable (IV) techniques. However, this procedure depends on the presence of valid instruments for the indicator variable *civil servant*. Since we do not have a valid instrument in our sample and it is difficult to address this bias in non-experimental data, we use the procedure developed by Altonji et al. (2005) to investigate the potential size of any bias due to unobservable variables. The main hypothesis in their procedure is that selection of observable variables is the same as that of unobservable variables, such that: $\frac{Cov(\epsilon,\ civil\ servant\ (CS))}{Var(\epsilon)} = \frac{Cov(\beta X,\ civil\ servant(CS))}{Var(\beta X)}$, where X is a vector of observable characteristics, and ϵ is the error term potentially correlated with *civil servants*. This is a valid procedure when the point estimates for *civil servant* are sensitive to the inclusion of additional control variables, which corresponds to our case, since when we introduce control for occupations and the formal sector dummy the estimated coefficient of the variable civil servant decreases in magnitude from 25% to 19%. The biased from OLS is $\frac{Cov(\epsilon,\ \tilde{CS})}{Var(\tilde{CS})}$, where $\tilde{CS}$ denotes the residuals from a regression of the variable *civil servant* on X. Although positive which is an evidence of a positive correlation of unobservable variables in the wage equation and the variable *civil servant*, the estimated bias in the two most complete specifications (columns (4) and (5)) is not statistically different from zero and it does not seem that the estimated public sector wage premium is driven by unobservable variables.

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Table A.1. Log of income per hour. Source: 2008 PNAD

	(1) All indiv. (>= 16 yrs)	(2) All indiv. (25–65 yrs)	(3) Workers and civil servants (25–65 yrs)	(4) Workers and civil servants (25–65 yrs)	(5) Workers and civil servants (25–65 yrs)	(6) Only workers (25–65 yrs)	(7) Only civil servants (25–65 yrs)
Constant	−0.4075**	−0.3324**	−0.1899**	−0.2582**	0.0318	−0.2102**	0.0077
	(−27.00)	(−10.28)	(−5.46)	(−7.66)	(−0.83)	(−5.73)	(0.07)
Schooling dummies	YES	YES	YES	YES	YES	YES	YES
Age	0.0439**	0.0411**	0.0417**	0.0433**	0.0426**	0.0438**	0.0383**
	(57.27)	(25.49)	(24.19)	(26.01)	(25.74)	(23.92)	(7.13)
Age^2	−0.0004**	−0.0004**	−0.0004**	−0.0004**	−0.0004**	−0.0004**	−0.0003**
	(−36.59)	(−17.38)	(−17.17)	(−18.65)	(−18.46)	(−17.71)	(−3.97)
Civil servant	0.2379**	0.2309**	0.2549**	0.2383**	0.1875**		
	(36.91)	(32.82)	(36.11)	(34.39)	(22.89)		
Female				−0.2953**	−0.2624**		
				(−71.04)	(−57.14)		
Formal				0.2115**	0.1892**		
				(45.23)	(38.98)		
Occupation	NO	NO	NO	NO	YES	NO	NO
N. of Observ.	152,309	116,478	91,265	91,265	91,265	79,146	12,119
Adjusted R^2	0.3649	0.3806	0.3839	0.4294	0.4393	0.3190	0.3351
Residual variance	0.3976	0.3980	0.3995	0.3674	0.3890	0.4061	0.4102

Appendix B. Welfare decomposition

Aiming at understanding the source of welfare gains we decompose the CEV in variations that are due to improved insurance and those that are due to a more efficient use of aggregate resources. Let $C_{0,t}$ and $L_{0,t}$ denote average consumption and average hours worked by t years old agents at the benchmark, respectively. Let also $C_{1,t}$ and $L_{1,t}$ denote the same statistics at the alternative tax system. We may, in this case, implicitly define Δ_{lev} through

$$\sum_t \beta^{t-1} \prod_{j=1}^{t} \psi_t \left(\left((1+\Delta_{lev})\, C_{0,t} \right)^{1-\rho_t} \left(1 - L_{0,t}\right)^{\rho_t} \right)^{1-\gamma}$$
$$= \sum_t \beta^{t-1} \prod_{j=1}^{t} \psi_t \left(C_{1,t}^{1-\rho_t} \left(1 - L_{1,t}\right)^{\rho_t} \right)^{1-\gamma}. \tag{B1}$$

For $(c_{t,0}, l_{t,0})_t$, the benchmark equilibrium allocations, and $(c_{t,1}, l_{t,1})_t$, the equilibrium allocations under the alternative policy, implicitly define p_0 and p_1, through

$$\sum_t \beta^{t-1} \prod_{j=1}^{t} \psi_t \left(\left((1-p_0)\, C_{0,t} \right)^{1-\rho_t} \left(1 - L_{0,t}\right)^{\rho_t} \right)^{1-\gamma}$$
$$= \mathbb{E}\left[\sum_t \beta^{t-1} \prod_{j=1}^{t} \psi_t \left(c_{t,0}^{1-\rho_t} \left(1 - l_{t,0}\right)^{\rho_t} \right)^{1-\gamma} \right],$$

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and

$$\sum_t \beta^{t-1} \prod_{j=1}^{t} \psi_t \left(\left((1-p_1)\, C_{1,t} \right)^{1-\rho_t} \left(1 - L_{1,t}\right)^{\rho_t} \right)^{1-\gamma}$$
$$= \mathbb{E}\left[\sum_t \beta^{t-1} \prod_{j=1}^{t} \psi_t \left(c_{t,1}^{1-\rho_t} \left(1 - l_{t,1}\right)^{\rho_t} \right)^{1-\gamma} \right],$$

.

In both expressions, $\mathbb{E}$ denotes the unconditional expectation operator.[24] Then,

$$CEV_{unc} \equiv \frac{1-p_1}{1-p_0} - 1. \tag{B2}$$

It is important to note that CEV_{unc} only takes into account smoothing across agents of the same age. The fact that preferences are age dependent implies that complete smoothing across ages is not optimal.

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