Working and Saving Informally*

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Abstract

The high level of informality and the low level of savings observed in developing countries are typically analyzed in isolation. This paper recognizes the fundamental links between the two phenomena by developing and estimating a labor market model where workers can be employed both formally and informally and where agents can save through both formal and informal financial institutions. We estimate the model with nationally representative data for Colombia and use the estimated model to simulate counterfactual experiments. Results show that reaching full financial inclusion of informal workers will increase their saving rate by 10 percentage points and the overall saving rate by 7 percentage points. Achieving the same saving rate increase using only labor market policies would require a huge reduction in the proportion of informal wage offers. Full financial inclusion would also slightly decrease inequality in consumption and in formal assets.

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1 Introduction

High informal employment and low saving rates are two well-known characteristics of the developing world. They are particularly acute issues in the Latin America and the Caribbean (LAC) region. According to Schneider et al. (2010), the informal sector represents, on average, one third of the world's GDP: out of this third, 42% is produced in LAC. The informal sector employs between 30% and 80% of the workforce in the region (Gasparini and Tornarolli, 2009) and savings equal only 17% of GDP (World Bank's World Development Indicators) compared with 22% and 30% of high and middle income countries, respectively. This low saving rate has persisted despite policy efforts aimed at increasing it and relatively good macroeconomic conditions over a number of years (Reinhardt, 2008).

The theoretical and empirical literature typically analyze the high level of informality and the low level of savings as two separate issues. This paper is a contribution in the recent literature which attempts to go beyond this approach by recognizing the fundamental links between the two phenomena. To this end, we develop a labor market model where workers can be employed both formally and informally and where agents can save through both formal and informal financial institutions (Eeckhout and Munshi, 2010). We estimate the model combining information from two household surveys for Colombia[1] and use the estimated model to perform counterfactual experiments. Results show that reaching full financial inclusion of informal workers will increase their saving rate by 10 percentage points and the overall saving rate by 7 percentage points. To achieve the same improvement in the saving rate with labor market policies would require reducing the proportion of informal wage offers by a huge amount, about 50 percentage points. In addition, our simulated experiments show that full financial inclusion would slightly decrease inequality in consumption and in formal assets.

Our paper contributes to numerous strands of the literature. First, we can provide foundation to the mixed empirical results on the relation between labor market informality and saving. In LAC, Lorenzo and Osimani (2001) show that informal households in Uruguay have lower saving rates than their formal counterparts. More recently, Schclarek and Caggia (2015) use a financial survey for Chile to show that, controlling for other determinants of savings, informal households save, on average, less than formal households, more so in the case of precautionary savings. In contrast, Granda and Hamann (2015) use a financial survey for Colombia to find that the saving rate of those who are informally employed is higher than that of those who are formally employed.

[1]The *Gran Encuesta Integrada de Hogares* (GEIH), a nationally representative monthly survey focusing on the labor market; and the *Encuesta Longitudinal Colombiana* (ELCA), a longitudinal survey focusing on consumption and saving behavior and access to financial services.

In other developing countries, Dupas and Robinson (2013) argue that informal households save less because they are financially excluded. The experiment they run in Kenya shows that providing a safe place to save increased health care savings by more than 60%, supporting the existence of capital market segmentation between the formal and the informal sectors (see also Batini et al. (2010)). From an aggregate perspective, Ogbuabor et al. (2013) use time series data for Nigeria showing that informality potentially hinders the growth of aggregate domestic savings due to the lack of a well-working mechanism of financial intermediation. Financial segmentation also implies that informal households have lower access to formal credit and depend strongly on informal sources of financing (Gatti and Honorati, 2008; Dabla-Norris and Koeda, 2008). With respect to this literature, we are able to propose a better integration between informality in the labor markets and informality on the financial markets, recognizing that individual agents' decisions are simultaneously affected by both.

Second, our contribution relates to the growing literature using models with frictions to explain the equilibrium effects of market informality (Albrecht et al., 2009; Bosch and Esteban-Pretel, 2012; Charlot et al., 2013; Meghir et al., 2015; Bobba et al., 2021, 2022). While this literature has been effective in producing counterfactual experiments and in assessing a wide range of issues –from the impact of enforcement to the effect on schooling decisions–, none of these contributions have been able to take into account saving behavior, and therefore cannot assess the impact of the financial exclusion associated with informality.

Third, we contribute to the recent literature by analyzing the implications of savings behavior in the presence of idiosyncratic risk when capital market are imperfect and labor markets are affected by frictions (Rendon, 2006; Krusell et al., 2010; Lise, 2013). While these papers are the closest to our formal setting, none of them address labor and financial market informality nor focus on data from low- and middle-income countries.

Finally, we contribute to the handful of papers that have attempted to jointly analyze labor market informality and optimal saving decisions. Both Esteban-Pretel and Kitao (2021) and Granda and Hamann (2015) develop and calibrate a model which includes a segmented labor market and allow for endogenous consumption and saving behavior. However, labor market segmentation does not seem the appropriate environment to describe LAC labor markets, where significant transitions between formal and informal jobs are observed (Maloney, 1999; Perry et al., 2007; Bosch and Maloney, 2010). Our labor market model seems more appropriate to describe LAC labor market dynamic. In addition, we propose an original identification strategy which allows for the estimation of the model using micro data and incorporating more empirical heterogeneity than the one present in these previous contributions. Flórez (2017) is a theoretical contribution that studies the impact of savings on worker's decisions to participate in the informal sector. While providing valuable theoretical insight, the contribution cannot provide quantitative assessments grounded on data and does not allow for endogenous wage distributions and segmented financial markets, eliminating two important channels in the dynamic of informal work and informal saving.

The paper is organized as follows. In section 2 we describe the theoretical model, define the equilibrium, and briefly discuss the solution method. In section 3 we present the data, the identification, and the estimation method and results. In section 4 we analyze a series of counterfactual experiments, assessing the importance of labor market informality and financial exclusion on saving rates and inequality. Finally, 5 concludes.

2 The Model

This section describes the model used to analyze the relationship between the job acceptance and asset accumulation decisions and characterizes the steady state equilibrium. We extend the partial equilibrium on-the-job search model with asset accumulation developed by Lise (2013) to include two types of jobs (formal and informal) and portfolio choice between two types of liquid assets, namely risk-less and risky assets. We interpret the risk-less assets as those accumulated in the formal financial system, while the risky assets are any means that individuals can use to save outside of it (in words of Eeckhout and Munshi, 2010, using informal financial institutions). In the model, the distributions of individuals working as formal or informal employees, the total wealth, and the type of assets they used to accumulate that wealth arises endogenously as a part of the equilibrium.

2.1 Environment

Time is continuous and the environment is assumed to be stationary. Individuals discount the future at common rate ρ and face identical probability of death. We model the event of death as a Poisson shock with parameter θ.[2] Therefore, the effective discount rate is $\tilde{\rho} = \rho + \theta$. Individuals are ex-ante homogeneous in every aspect, but they differ ex-post in their labor market histories, and hence in the total wealth they were able to accumulate. Individuals are risk averse and derive utility from consumption. We also assume that markets are incomplete in the sense that individuals cannot fully insure against labor income risk, so the only partial mechanism in the model is self-insurance by accumulating assets (as is standard in the Huggett, 1993; Aiyagari,

[2] The presence of a death shock ensures stationarity in the model environment.

1994, economies). Individuals seek to maximize the following additive separable expected lifetime utility function:

$$E_0 \int_0^\infty e^{-\tilde{\rho}t} u(c) \tag{1}$$

where c is consumption and the instantaneous utility function satisfies $u'(\cdot) > 0$ and $u''(\cdot) < 0$. As is standard in the literature, we parametrized the instantaneous utility function as a Constant Relative Risk Aversion (CRRA), that is $u(c) = \frac{c^\delta}{\delta}$ (see for example Dey and Flinn, 2005; Krusell et al., 2010; Lise, 2013).

The labor market is characterized by three states: non-employment, employment in a formal job, and employment in an informal job. Both non-employed and employed individuals are allowed to search for a job. Jobs offers arrive at Poisson rates λ^u and $\lambda^e(f)$ when non-employed and employed, respectively. We define f as an indicator variable that takes the value of 1 if the individual is working formally and zero if he/she is working informally. We characterize a job offer as a pair wage and type of job, (w, f) with $f = \{0, 1\}$, where wages are draws from the exogenous distributions of wage offers $F(w|f)$ and f is a draw from a Bernoulli distribution with probability $p(f)$. Notice that the wage offers distributions at market level is the mixture $\sum_{f=0,1} F(w|f)p(f)$. Jobs are terminated at job type specific exogenous Poisson rate $\eta(f)$.

On the financial market side, we assume that there are two types of liquid assets available in the economy. The first asset a_1 is a risk-less *bank or other formal financial institution asset* that has a rate of return of r_1, while the second asset a_2 is a risky *informal (other) asset* that has a rate of return of r_2. Let's define the total wealth $(a_1 + a_2)$ as a and the share of the formal asset in the total wealth as ϕ, that is $\phi = \frac{a_1}{a}$. As in Bonaparte and Cooper (2009); Bonaparte et al. (2012), we also assume that individuals are able to adjust their portfolio composition at a cost. In particular, we assume that there is a convex cost function that depends on the labor market status, that is $\frac{\psi}{2}\phi^2$ where the parameter ψ can be ψ^u or $\psi^e(f)$.[3] Note that the parameter ψ allows us to incorporate in the model the idea of partial exclusion of non formal workers from the formal financial system (see for example Perry et al., 2007). When an individual dies, his/her assets are reverted to the government and a new agent is born non-employed with zero assets. Putting all these ingredients together, and following the derivation described by Merton (1971) for a multi-asset optimal decision problem, the individual budget constraint can be written as:

$$da = \left[(r_1\phi + r_2(1-\phi))a + i - c - \frac{\psi(f)}{2}\phi^2 \right] dt \tag{2}$$

[3]Instead of assuming non-convex portfolio adjustment costs as in Bonaparte et al. (2012), we simplify the analysis by assuming that the adjustment cost function is convex. This is particularly convenient because it generates a well defined decision rule for the portfolio choice, keeping the model tractable while maintaining the essence of the adjustment cost as the source of partial segregation in the financial market.

where i and r_2 are the stochastic processes for income and for the rate of return of the risky informal asset, respectively. As in Aiyagari (1994), we assume that there is a borrowing constraint $a \geq \underline{a}$, where $\underline{a}$ is the borrowing limit.[4] The stochastic process for the income i is defined as:

$$di = \begin{cases} dq_{\lambda_1^u}\mathbf{I}_{u1}w_1 + dq_{\lambda_0^u}\mathbf{I}_{u0}w_0 - b & u \\ dq_{\eta_1}b + dq_{\lambda_1^e}\mathbf{I}_{11}w_1' + dq_{\lambda_0^e}\mathbf{I}_{10}w_0' - w_1 & f = 1 \\ dq_{\eta_0}b + dq_{\lambda_1^e}\mathbf{I}_{01}w_1' + dq_{\lambda_0^e}\mathbf{I}_{00}w_0' - w_0 & f = 0 \end{cases} \tag{3}$$

where $\lambda_f^u = \lambda^u p(f)$, $\lambda_f^e = \lambda^e(f)p(f)$, dq_s are indicator variables that takes the value of 1 if the shock s arrives and zero otherwise, and $\mathbf{I}_{ij}$ are indicator variables that take the value of 1 for acceptable offers coming from $i = u, 1, 0$ and going to $j = 1, 0$. The first case in equation (3) indicates that if an acceptable offer arrives, the individual's income changes from non-employment flow income b to the wage rate w_1 (w_0) if that offer comes from a formal (informal) job. The second and the third cases, in turn, has three possible outcomes. First, if a termination shock arrives the income change is $b - w_1$ ($b - w_0$) if the individual is currently working in a formal (informal) job. Second, if an acceptable offer from a formal job arrives the income change is $w_1' - w_1$ ($w_1' - w_0$) if the individual is currently employed as a formal (informal) employee. Finally, if an acceptable offer from an informal job arrives the income change is $w_0' - w_1$ ($w_0' - w_0$) if the individual is currently working in a formal (informal) job.

In turn, we assume that r_2 follows a Ornstein-Uhlenbeck process, also known as the elastic random walk process (Vasicek, 1977; Munk and Sørensen, 2010):

$$dr_2 = \kappa(\bar{r}_2 - r_2)dt + \sigma dz \tag{4}$$

where z is a standard Brownian motion with $dz = \varepsilon_t\sqrt{dt}$ and $\varepsilon_t \sim \mathcal{N}(0,1)$; and κ, $\bar{r}_2$, and σ are positive constants. This process is the analogue of the AR(1) stationary process with autocorrelation $e^{-\kappa} \approx 1 - \kappa$. The instantaneous drift $\kappa(\bar{r}_2 - r_2)$ represents the force that keeps the process around the long term mean $\bar{r}_2$, while the stochastic component with variance σ^2 generates the erratic but continuous fluctuations of the process from the mean. In steady state, the distribution of the rate of return of the risky informal asset is $\mathcal{N}\left(\bar{r}_2, \frac{\sigma^2}{2\kappa}\right)$.

2.2 Value Functions

Given an initial distribution of the stock of assets, the individual's problem is to choose the paths of consumption c and portfolio composition ϕ, in order to maximize (1) subject to (2), (3),

[4] A self-imposed borrowing limit for a permanent state of non-employment, equivalent to that derived in the context of Lise (2013) model, is $\underline{a} = -\frac{b - \frac{\psi^u}{2}\phi^2}{r_1\phi + r_2(1-\phi)}$. Instead, we assume that individuals cannot borrow, that is $\underline{a} = 0$.

and (4). This problem can be conveniently represented by the set of labor market state specific stochastic Hamilton-Jacobi-Bellman equations presented below[5]. Let $U(a, r_2)$ be the value of being non-employed with a stock of assets of a and currently facing a rate of return r_2 for the risky informal asset. Similarly, let $W(a, r_2, w, f)$ be the value of being employed in a type f job, receiving a wage rate of w, while maintaining a stock of assets of a and currently facing a rate of return r_2 for the risky informal asset. The steady state value of non-employment satisfy:

$$\begin{aligned}
\tilde{\rho}U(a, r_2) \quad = \quad & \max_{0\leq c\leq \bar{c}, 0\leq\phi\leq 1} \Bigg\{ u(c) + \partial_a U(a, r_2) \left[(r_1\phi + r_2(1-\phi))a + b - c - \frac{\psi^u}{2}\phi^2 \right] \\
& + \partial_{r_2} U(a, r_2)\kappa(\bar{r}_2 - r_2) + \frac{1}{2}\partial^2_{r_2} U(a, r_2)\sigma^2 \\
& + \lambda^u \sum_{f=0}^{1} \left(\int_w \max\{W(a, r_2, w, f) - U(a, r_2), 0\} dF(w|f)p(f) \right) \Bigg\} \qquad (5)
\end{aligned}$$

where $\partial_a U(a, r_2) = \frac{\partial U(a, r_2)}{\partial a}$, $\partial_{r_2} U(a, r_2) = \frac{\partial U(a, r_2)}{\partial r_2}$, and $\partial^2_{r_2} U(a, r_2) = \frac{\partial^2 U(a, r_2)}{\partial r_2^2}$. Equation (5) indicates that non-employed individuals receive a flow utility $u(c)$ plus the expected change in the value of non-employment. The expected change, in turn, is comprised of three parts. First, the value changes because individuals accumulate (or decumulate) assets $\frac{da}{dt}$ and this change in assets is valued at the marginal value of assets $\partial_a U(a, r_2)$. Second, the value also changes because the rate of return of the informal asset deviates from its long term mean $\frac{dr_2}{dt}$ and these deviations are valued at the marginal value of the rate of return $\partial_{r_2} U(a, r_2)$. The disutility associated with the uncertainty generated by shocks on the rate of return of the informal asset is captured by the diffusion term $\partial^2_{r_2} U(a, r_2)\sigma^2$. Lastly, the value changes because individuals move from non-employment to employment. In particular, a job offer (w, f) arrives at rate λ^u and if it is acceptable there is value gain of $W(a, r_2, w, f) - U(a, r_2)$.

Similarly, the steady state value of employment is:

$$\begin{aligned}
\tilde{\rho}W(a, r_2, w, f) \quad = \quad & \max_{0\leq c\leq \bar{c}, 0\leq\phi\leq 1} \{ u(c) + \epsilon f + \partial_a W(a, r_2, w, f) \left[(r_1\phi + r_2(1-\phi))a \right. \\
& \left. + w - c - \frac{\psi^e(f)}{2}\phi^2 \right] + \partial_{r_2} W(a, r_2, w, f)\kappa(\bar{r}_2 - r_2) \\
& + \frac{1}{2}\partial^2_{r_2} W(a, r_2, w, f)\sigma^2 + \delta(f)\left[U(a, r_2) - W(a, r_2, w, f) \right] \\
& + \lambda^e \sum_{f=0}^{1} \left(\int_{w'} \max\{W(a, r_2, w', f') - W(a, r_2, w, f), 0\} dF(w'|f')p(f') \right) \Bigg\} \quad (6)
\end{aligned}$$

where the analogous definitions are $\partial_a W(a, r_2, w, f) = \frac{\partial W(a, r_2, w, f)}{\partial a}$, $\partial_{r_2} W(a, r_2, w, f) = \frac{\partial W(a, r_2, w, f)}{\partial r_2}$, and $\partial^2_{r_2} W(a, r_2, w, f) = \frac{\partial^2 W(a, r_2, w, f)}{\partial r_2^2}$. As before, equation (6) indicates that employed individuals

[5] For a detailed derivation of the Hamilton-Jacobi-Bellman equations see the on-line Appendix.

receive a flow utility $u(c)$ plus the expected change in the value of employment, which is now comprised of four terms. The first two elements, $\partial_a W(a, r_2, w, f)\frac{da}{dt}$ and $\partial_{r_2} W(a, r_2, w, f)\frac{dr_2}{dt}$ plus the diffusion term, have the same interpretation as the case of the non-employed individuals. The third term is associated with the value change that occurs when a termination shock arrives, which occurs at rate $\delta(f)$ and generates a value loss of $U(a, r_2) - W(a, r_2, w, f)$. Finally, when an employed individual earning w in a job type f receives a job offer (w', f'), which occurs at rate λ^e, and this offer is acceptable, there is a value gain of $W(a, r_2, w', f') - W(a, r_2, w, f)$.

2.3 Decision rules

The optimal consumption and portfolio decision rules for individuals are derived from the first order conditions of equations (5) and (6), that is:

$$\begin{aligned} u'(c) &= \partial_a U(a, r_2) && (7) \\ (r_1 - r_2)a &= \psi^u \phi && (8) \\ u'(c) &= \partial_a W(a, r_2, w, f) && (9) \\ (r_1 - r_2)a &= \psi^e(f)\phi && (10) \end{aligned}$$

Equations (7) and (9) are the standard inter-temporal conditions for non-employed and employed individuals, respectively, indicating that the marginal utility of consumption is equal to the marginal value of assets (wealth). Using these conditions, we have that the optimal rules for consumption are $c^u(a, r_2) = u'^{-1}(\partial_a U(a, r_2))$ and $c^e(a, r_2, w, f) = u'^{-1}(\partial_a W(a, r_2, w, f))$. Equations (8) and (10) establish that in the optimal portfolio allocation the marginal benefit of adjusting the portfolio, which depends on the differential return, is equal to the marginal cost of doing so. Using these conditions, the optimal rules for the portfolio decisions are $\phi^u(a, r_2) = \frac{(r_1 - r_2)a}{\psi^u}$ and $\phi^e(a, r_2, f) = \frac{(r_1 - r_2)a}{\psi^e(f)}$. Note that corner solutions on 0 and 1 are possible on these rules, being the solution interior whenever $0 < (r_1 - r_2)a < \psi$ holds (with ψ being ψ^u or $\psi^e(f)$).

Individuals also decide if they accept or reject a job offer while non-employed or employed. The optimal decision rules on this margin have a reservation value property and depend on the type of transition. In particular, let's define the reservation wage of a non-employed individual with assets a , facing a rate of return r_2, and transitioning to a job type f as $\tilde{w}(a, r_2, f)$. Similarly, let $\hat{w}(a, r_2, w, f, f')$ be the reservation wage of an individual with assets a, facing a rate of return r_2, currently employed in a type f job with a wage w, and transitioning to a job type f'. These reservation wages satisfy:

$$W(a, r_2, \tilde{w}(a, r_2, f), f) = U(a, r_2) \quad (11)$$

$$W(a, r_2, \hat{w}(a, r_2, w, f, f'), f') = W(a, r_2, w, f) \quad (12)$$

If an individual receives an offer from a type f job while non-employed, he/she will accept that offer if the wage is greater than the reservation wage $\tilde{w}(a, r_2, f)$. The same arguments apply for an employed individual: he/she will accept an offer from a type f' job if the wage is greater than the reservation wage $\hat{w}(a, r_2, w, f, f')$.

2.4 Equilibrium and solution method

The steady state equilibrium in this model is defined as follows:

Definition. Given the primitive parameters $\{\rho, \theta, \lambda^u, \lambda^e(1), \lambda^e(0), \eta(1), \eta(0), \psi^u, \psi^e(1), \psi^e(0), b\}$, the instantaneous utility function $u(c)$, the distributions of wage offers $F(w|1)$ and $F(w|0)$, the distributions of availability of job types $p(1)$ and $p(0)$, the steady state equilibrium are the value functions $U(a, r_2)$ and $W(a, r_2, w, f)$ that satisfy the Hamilton-Jacobi-Bellman equations in (5) to (6), together with the invariant distributions of individuals across labor market states $(u, e(1), e(0))$ and of the total assets $\Lambda(a)$. Moreover, given the individual state, the optimal consumption and portfolio decision rules satisfy the first order conditions in equations (7) to (10).

We use a two-step approach to solve the model. In the first step, we solve the Hamilton-Jacobi-Bellman equations using a value function iteration method. Following Achdou et al. (2014, 2017), the derivatives of the value functions are approximated using a finite difference with an upwind scheme. That is, a forward difference is used whenever the drift of the state variable (here, $da > 0$ or $dr_2 > 0$) is positive. On the contrary, the backward difference is used when a negative drift occurs. According of Barles and Souganidis (1991), if the conditions of monotonicity, stability, and consistency hold, the solution of the Hamilton-Jacobi-Bellman equations is unique. As Achdou et al. (2017) argues, stability and consistency conditions are relatively easy to hold in this type of model, however for the monotonicity condition to be satisfied the upwind scheme is crucial. An additional advantage of the upwind finite difference scheme is that it allows for the handling of optimization state constraints in a very convenient way. In particular, if the boundary condition associated with the borrowing constraint $a \geq \underline{a}$ is set for the backward difference, and not for the forward difference, and the upwind scheme is allowed to choose the right difference, according to the drift at the bottom of the assets distribution, it will be possible to guarantee that the borrowing constraint is never violated.[6]

In the second step we solve for the invariant distributions of labor market states and of total assets. For this highly non linear model, the transition equations for the state distributions (i.e. the Kolmogorov Forward equations) do not have an obvious explicit algebraic representation and, therefore, cannot be used to compute the invariant distributions. Instead, we use a simulation approach, that is we simulate labor market careers for a large number of individuals, starting everyone as non-employed with zero assets, and for a large number of periods until the distributions of labor market states and total assets both stabilizes. In each period of the career we use the value functions of the first step, together with the optimal decision rules, to govern individual choices on job offers, portfolio allocation and consumption/savings. In the computations we simulate 10,000 careers and obtain the invariant distributions after 800 model periods.

3 Estimation

We estimate the model using the Method of Simulated Moments (MSM) with supply side data for the Colombian urban labor market. We combine information from two sources: a standard labor market focused survey and a survey that contains information on the saving and borrowing behaviors of individuals. This section describes the data available for estimation and briefly discusses the estimation method, the identification strategy, and the estimation results.

3.1 Data description

To estimate the model we combine information from two household surveys for Colombia. The first survey is the *Gran Encuesta Integrada de Hogares* (GEIH), which is a monthly survey that is representative at the national level and that is carried out by the Administrative Department of National Statistics (known by its spanish acronym DANE). This survey contains, cross-section data on individual characteristics, such as gender, age, schooling, as well as labor market outcomes such employment status, duration of the current status, monthly labor income, weekly hours worked, and occupational characteristics, among other information. We use the 2016 data and pool together the surveys of January to December[7].

To ensure a certain degree of homogeneity consistent with the theoretical model we restrict

[6] See the on-line Appendix for a detailed description of the solution method using the upwind finite difference scheme.

[7] The sampling method in the GEIH survey does not have a rotative panel characteristic as does the Current Population Survey in the United States.

the estimation sample to unskilled men head of household (or spouse) between 25 and 65 years old and living in urban areas. Unskilled individuals are those who have not completed college. With respect to the definition of the labor market states, we follow the social protection definition of informality of the International Labor Organization (ILO), that is informal workers are those who do not contribute to social security (Kanbur, 2009). In our characterization of informal employment we do not distinguish between informal employees and self-employed. Additionally, for employed individuals, we restrict our attention only to those who are full-time employees and those who are working 48 hours a week or more in the case of self-employed. The non-employed individuals, in turn, are defined as those who are non-employed plus those who are non participating in the labor market. For each job, labor income is defined as real monthly wage expressed in US dollars of December 2016.

Given that it is not possible to construct a panel data with the GEIH, and hence a complete transition matrix across labor market states, we reconstruct partial information on transitions using durations and the retrospective questions about the immediately previous labor market states available in the survey. In particular, we are able to recover yearly transitions from non-employment to each type of job for those individuals who were previously non-employed and their current job has a duration of less than 12 months. In the same fashion, we recover transitions from employment to non-employment and to each type of job for those whose current job or current non-employment state has a duration of less than 12 months and were previously employed. Unfortunately, information on the formality status of the previous job is not available. Finally, for non-employed and for formal and informal workers we characterize those who remain in the same state, and job in the case of those who are working, as individuals who's current state has a duration of more than 12 months.

The second survey is the *Encuesta Longitudinal Colombiana* (ELCA), which is a longitudinal survey that follows approximately 10,000 households in rural and urban areas every three years; the available waves are 2010, 2013, and 2016. This survey is carried out by the Center for Studies on Economic Development (CEDE) of the School of Economics of the Universidad de los Andes, and is part of the ELCA project designed to follow individuals for 12 years to provide information regarding individual characteristics, employment, income and consumption, education and health, access to financial services, among other information.[8] We use the 2016 wave of the survey to estimate the model. This survey contains similar information to that in the GEIH survey with respect to individual characteristics and current labor market outcomes. More importantly, in the survey, individuals report whether they are able to save, and if so they report the average

[8]For detailed information on the survey see https://encuestalongitudinal.uniandes.edu.co/en/.

monthly savings. Additionally, individuals also report whether the majority of their savings are in formal financial institutions such as banks and/or employee funds/credit unions; or whether they mostly save in cash, chit funds, or other informal means of savings. Finally, individuals also provide information on the reasons for saving and those for not using the formal financial system.

Table 1, which presents descriptive statistics on labor market outcomes, computed using the GEIH survey, shows that informality is a very important phenomenon in the sample of unskilled men since almost half of them work informally (as informal employees or as self-employed). On the contrary, only 36% are hired formally. Moreover, workers earn US$342 and US$152 per month, on average, if they work formally or informally, respectively; this means that the wage gap between type of jobs is 30% in favor of formal workers. Also important to highlight is that the observed wages distribution for formal jobs are slightly more spread out than its informal counterpart (standard deviation of 1.5 vs. 1.2, respectively). With respect to the labor market dynamics, 7.5% stay non-employed after a year, while almost 29% and 40% of formal and informal workers stay in their same job during the same period. Additionally, almost 6% of non-employed individuals leave that state after a year, 2.7% go to a formal job, while the rest end up in an informal job. Finally, 7.4% of those who are employed, formally or informally, become non-employed after a year, while 5% (5.6%) find another job in the formal (informal) sector.

Descriptive statistics on savings behavior are presented in table 2. The differences in the savings behavior are notorious because 45% of formal employees have their total assets mostly in formal institutions, while this percentage drops sharply to 27% and 21% when individuals are working informally or are non-employed, respectively. The differences are also large when describing individuals who are able to save a positive amount of their total income each month. Indeed, while 27% and 19% of formal and informal workers are able to save, respectively, only 8% are able to do so if they are non-employed. With respect to the amount saved, formal and informal employees save on average similar amounts per month (US$56 vs US$59), while non-employed individual save around US$48 per month. Finally, it is also observed that the conditional distribution of savings is more spread out for informal workers.

3.2 Method

We estimate the parameters of the model using the Method of Simulated Moments (MSM). This method is commonly used to estimate highly non-linear models like the model outlined in section 2 (Gouriéroux and Monfort, 2002). Let Θ denote the set of parameters to estimate, M_N^D the set of appropriately chosen statistics derived from our data sample of size N, and $M_T(\Theta)$ the corresponding set of simulated statistics extracted from a sample of size T obtained from the steady state equilibrium implied by Θ. Then $\hat{\Theta}$ satisfies:

$$\hat{\Theta}_{N,T}(W) = \text{argmin}_{\theta} \frac{1}{2} \left[M_N^D - M_T(\Theta) \right]' W_N \left[M_N^D - M_T(\Theta) \right] \tag{13}$$

where W is a symmetric, positive-definite weighting matrix. As is common in the literature, we parameterize the wage offers distributions as log-normal, that is $\log(w)|f \sim \mathcal{N}\left(\mu(f), \sigma(f)\right)$, with $f = 0, 1$ (Eckstein and van den Berg, 2007). All in all, the complete set of parameters included in Θ are:

$$\{b, \lambda^u, \lambda^e(1), \lambda^e(0), \eta(1), \eta(0), p(1), \mu(1), \sigma(1), \mu(0), \sigma(0), \psi^u, \psi^e(1), \psi^e(0), \kappa, \sigma\}$$

The set of chosen moment statistics (and their corresponding notation in terms of the model) in equation (13) are the proportion of individuals in each labor market states $(u, e(1), E(0))$; the average $E[w]$, the standard deviation $SD[w]$, and the bottom 5 percent $P5[w]$ of the observed wages distributions for formal and informal jobs, the proportion of non-employed individuals that transit to non-employment $\Pr[u \to u]$, to formal employment $\Pr[u \to e(1)]$ and to informal employment $\Pr[u \to e(0)]$; the proportion of individuals who stay in the same job for formal and informal employment, $\Pr[e(1) \to e(1)|\textit{same job}]$ and $\Pr[e(1) \to e(0)|\textit{same job}]$; the proportion of employed individuals, regardless of the type of job, that transit to non-employment $\Pr[e \to u]$, to formal employment $\Pr[e \to e(1)]$ and to informal employment $\Pr[e \to e(0)]$; the proportion of individuals in each labor market state who have their total assets mostly in the form of formal assets $\Pr[\phi > 0.5]$; and finally, the average $E[I_{s>0} \times s]$ and the standard deviation $SD[I_{s>0} \times s]$ of the distributions of savings by labor market state, where $s = da/dt$ and $I_{s>0}$ is an indicator variable that takes the value of one if the individual save and zero otherwise. Our estimation includes 26 moments and 16 parameters to be estimated. We use the Nelder-Mead simplex algorithm to minimize equation (13). Finally, to asses the precision of our estimates we compute the standard errors using bootstrap, that is we estimate the model a number of times (replications), each of them using a new set of statistics obtained by re-sampling the observations in the data.

3.3 Identification discussion

Given the highly non-linear nature of the model a formal proof of identification is not feasible, therefore in this subsection we provide a rather informal discussion of identification.

We start the identification discussion focusing on the mobility parameters λ^u, $\lambda^e(f)$, and $\eta(f)$; and on the distributions of wage offers $p(f)$ and $F(w|f)$ for $f = 0, 1$. Standard identification arguments based on Flinn and Heckman (1982) apply to these parameters. On the one hand, they show that proportions in labor market states and duration information (or transitions between labor market states) are enough information to identify the hazard rates out of the searching state and termination rates out of employment. In our case, the set of moments we use in estimation contains information on the proportions of labor market states and on transitions across different states. First, the transitions from non-employment to formal and informal jobs contain information on the hazard rates out of non-employment, which in turn depend on λ^u and $p(1) = 1 - p(0)$. Second, transitions from employment to new formal and informal jobs contain information on hazard rates out of the current employment to a new one, which depend on $\lambda^e(1)$, $\lambda^e(0)$, and also on $p(1) = 1 - p(0)$. Finally, transitions from employment to non-employment, together with the proportions of labor market states, allow for the identification of $\eta(1)$ and $\eta(0)$ because the steady state restrictions (i.e. equality of flows in and out of employment) has to hold in equilibrium.

On the other hand, Flinn and Heckman (1982) also show that the wage offers distribution is identified from the observed wages distribution if the former can be completely recovered from the later given the truncation point, which is the reservation wage. This condition is called the *recoverability condition* and distributions that belong to the location-scale family meet this requirement. As stated previously, we parametrize the wage offers distributions $F(w|f)$, $f = 0, 1$, as log-normal, which not only meet the recoverability condition (they belong to log-location-scale family of distributions), but also have proven to fit the data very well (Eckstein and van den Berg, 2007). We use the cross-section mean and standard deviation by type of job in the data as relevant information to identify the location and the scale parameters of the log-normal distributions. In this model, as opposed to the Lise (2013) model, the reservation wage out of non-employment is not the flow income b, hence we cannot set the minimum observed wage as estimator of these parameters as in Flinn and Heckman (1982). This occurs because the rate at which the different types of jobs arrive when non-employed and while on the job are different; hence, non-employed individuals take into account the possibility of getting new offers in the future in their decision of accepting a job. Even though b is not the reservation wage, it is a crucial parameter because it affects the shape of the accepted wages distribution at the bottom. To identify this parameter we use as relevant information in the data the bottom 5% of the observed wages distributions by type of job.

The next block of parameters are related with the portfolio adjustment cost functions, that is ψ^u and $\psi^e(f)$ for $f = 0, 1$. Given an initial distribution of assets, the optimal consumption and portfolio decisions determine a flow savings da/dt which in turn generates, after converging in time, the steady states distribution of assets. Therefore, the relevant pieces of information to identify the steady state equilibrium assets distribution, given the structure of the model, are the initial distribution of assets and the change in assets in equilibrium. In the data, we observe who saves, and if they do, how much they save. As a result, we are able to exploit the information contained in the distribution of savings by labor market states (in particular, we use the mean and the standard deviation of that distribution). The piece of information that is missing is the initial distribution of assets, hence we assume that all workers start with zero assets.[9] In turn, the optimal portfolio decision in equilibrium depends on the differential return, the cost of portfolio adjustment parameter, and the steady state distribution of assets. In the data, we observe whether individuals keep the majority of their assets in formal financial institutions according to their labor markets states, which are informative of the adjustment costs parameter in that state given the steady state distribution of assets and the differential returns.

We now discuss the identification of the rate of returns in both formal and informal institutions. There is no information on how informal financial institutions behave. To identify the parameters of the rate of return process for informal assets we follow Eeckhout and Munshi (2010). In particular, they find that the implied rate of return for chit funds in South India, given a stable relationships in a matching equilibrium with informal financial institutions, is around 2.1 times the rate of return of formal financial institutions. Therefore, given that in 2016 the risk-less yearly rate of return of a 10-year Colombian Government Bond is 7.5% (we set $r_1 = 0.075$), the maximum implied rate of return that an informal asset could pay would be 15.8%. To identify the mean and the variance of the rate of return we assume that 99% of the time that rate of return belongs to the interval $[0, 0.158]$. Using the fact that r_2 is distributed as $\mathcal{N}\left(\bar{r}_2, \frac{\sigma^2}{2\kappa}\right)$, we have that $\bar{r}_2 = 0.079$ and $\frac{\sigma}{\sqrt{2\kappa}} = 0.031$. The only free parameter that we estimate by the MSM is κ, which is shared by workers in all labor market states. Therefore, information on savings and portfolio allocations should be informative of this parameter, given the restrictions implied by the model.

The set of parameters we do not attempt to estimate are the discount rate, the death rate and the relative risk aversion parameter. First, according to Moore et al. (2020), the discount rates recommended for Latin America by multilateral development banks are between 10% and 12%, hence we set $\rho = 0.12$. Second, based on Colombia's life expectancy of 77 years (see the WDI of the World Bank) we set $\theta = 0.013$. Finally, Bond et al. (2008) estimate a dynamic empirical model of entrepreneurship using Colombia data and the estimates for the CRRA utility function parameter generate a 95% confidence interval of $[-0.53, -1.17]$. Using these estimates, we set our parameter at the bottom of that interval, that is $\delta = -0.53$.

[9] We also tried an alternative assumption on the initial distribution of assets, based on the observed distribution of bank assets available in the Colombian *Encuesta de Carga Financiera y Educación Financiera de los Hogares* of 2016. The results of the estimation were very similar.

3.4 Estimation results

Table 3 reports the estimated parameters. The first block show the parameters that govern the dynamics of the labor market states. The estimates of the arrival rate of job offers while non-employed λ^u imply that workers expect offers approximately every 6.3 months, on average. In turn, the arrival rate of offers while on the job, $\lambda^e(1)$ and $\lambda^e(0)$, indicate that new job opportunities while on the job arrive considerably less often. In particular, formal and informal workers expect the arrival of new job opportunities, on average, every 43 and 33 months, respectively. Estimates of the arrival rates of involuntary separations, parameters $\eta(1)$ and $\eta(0)$, indicate that jobs last, on average, 37 (20) months for formal (informal) workers.

The second block corresponds to the parameter of job offers. The estimates of the parameter, $p(1)$, indicated that only 28% of the job offers that arrive are formal (and 72% are informal). Moreover, the estimates of the parameters of the wages distributions, that is $\mu(f)$ and $\sigma(f)$, imply an average offered wage of US\$349 and US\$236 per month for formal and informal workers, respectively.[10] Therefore, formal workers receive offers that are, on average, almost 48% higher that those received by informal workers. The standard deviation of offered wages to formal and informal workers are around 126 and 120, respectively; that is, the former is slightly (5%) more dispersed than the later. These results imply that the wage offers distribution of formal jobs stochastically dominates that of informal jobs, implication that is consistent with recent literature on informality. Indeed, given that most firms/workers in the informal sector tend to be less productive than their formal counterparts, they are typically offered or are able to bargain lower wages (see for example Bosch et al., 2015; Meghir et al., 2015; Bobba et al., 2021, 2022).

The third block presents the estimated parameters of the portfolio adjustment cost function. These parameters are a measure of the degree of exclusion of workers from formal financial institutions because the higher the parameter is, the higher the cost of maintaining a high share of formal assets in the portfolio. Given that formal workers have, in general, easier access to formal financial institutions, we use the adjustment cost parameter for these workers as a benchmark. It is important to note there are no significant differences between the estimated parameters for non-employed individuals and for formal workers, 0.023 vs. 0.024, which means that the non-employed are not excluded. On the contrary, the cost parameter for informal workers is more than 7 times that for formal workers, 0.174 vs. 0.024, implying a high degree of exclusion for these type of workers. To put these numbers in perspective, if an average worker wants to keep 45% of their assets in formal financial institutions, he/she has to pay US\$0.2 (US\$1.8) while being a formal (informal) employee, which represent approximately 1% (9%) of his/her monthly savings.

[10] Recall that if $\log(x) \sim \mathcal{N}\left(\mu, \sigma^2\right)$, then $E[x] = \exp\left(\mu + 0.5\sigma^2\right)$ and $V[x] = \left[\exp\left(\sigma^2\right) - 1\right] \exp\left(2\mu + \sigma^2\right)$.

The fourth and fifth blocks presents the estimated parameters for the process of the rate of return of informal assets and the flow income in the non-employment states, respectively. With respect to the former, the implied autocorrelation is about 0.5, while the uncertainty about the shock on the rate of return is 3.6 percentage points on an annual basis. For the case of the later, in turn, non-employed individual receive a non labor income of approximately US$22 per month.

In figure 1, we show the steady state distributions by labor market states of total assets, formal financial assets, consumption, and savings. Note that an important mass of non-employed individuals have very low assets compared with formal and informal workers; this is particularly true for formal financial assets. Given the low estimate of the non labor income for these individuals, the consumption levels are also low and financed by using assets accumulated when working (disaving). Comparing the steady state distributions between formal and informal workers, we have that the distribution of total assets of the former stochastically dominates that of the later. This is also observed in the case of the distributions of consumption. Finally, the distributions of savings for formal and informal workers are very similar, having the informal workers a slightly more mass around zero.

Finally, in table 4 we compare the moments in the data and those simulated using the model. The model fits very well the moments related with the labor market states and the distributions of wage offers. Also, the model is able to fit reasonably well the probability maintaining the majority of assets in formal financial assets across labor market states and the mean and standard deviation of savings for formal and informal workers. On the contrary, the model has a hard time fitting the moments in those related with the savings behavior while non-employed and with the transitions across labor market states. In the first case, only 8% of the non-employed in the data are able to save and some of them save a significant amount each month. Hence, it is difficult to capture this small group of individuals in the model with non-employed individuals, who mostly disave and are homogeneous in their non-labor income, b. In the second case, in a model with search and savings there is a tension between fitting the assets/savings and the dynamics of the labor market because the former determines the outside option of individuals to leave the different labor market states, affecting the latter Lise (2013).

4 Counterfactual experiments

Using the model and the point estimates of the parameters presented in table 3, we perform two sets of counterfactual experiments. In the first, we evaluate the importance of the partial exclusion of informal workers from the formal financial system by equating the portfolio adjustment costs of informal workers to those of formal workers.[11]. In the second, we evaluate if using labor market policies that are able to reduce job informality can lead to similar changes in saving behavior. Specifically, we reduce the proportion of informal job offers from the baseline 72% to a value of 20%.

In each counterfactual scenario, we evaluate the average impact on labor market outcomes, savings, portfolio decisions, and financial assets, after taking into account the endogenous adjustment in individual's optimal behaviors. We also compute and report the impact of the policy experiments on wealth and consumption inequality. To give a more complete picture, we use three indices in the class of the Generalized Entropy inequality indices. They are defined as:

$$GE(\alpha) = \begin{cases} \frac{1}{\alpha(\alpha-1)}\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^{\alpha}-1\right] & \alpha \neq 0,1 \\ \frac{1}{N}\sum_{i=1}^{N}\frac{y_i}{\bar{y}}\ln\left(\frac{y_i}{\bar{y}}\right) & \alpha = 1 \\ -\frac{1}{N}\sum_{i=1}^{N}\ln\left(\frac{y_i}{\bar{y}}\right) & \alpha = 0 \end{cases} \tag{14}$$

where N is the number of individuals, y_i is the measure of assets or consumption for individual i and α is a parameter that weights the distance between measurement variable along the distribution. The larger the parameter α, the greater is the weight of the assets/consumption differences among the rich. Also, according to the value of the parameter α, several inequality statistics arise. For example, $GE(0)$ is the mean log deviation, $GE(1)$ is the Theil index, and $GE(2)$ is half the coefficient of the variation.

4.1 Financial inclusion

Table 5 reports a set of descriptive statistics in the benchmark model and in the counterfactual simulations. The first column reports the benchmark, the second and third columns report, the value and the ratio with respect to the benchmark of the same statistics in the financial inclusion experiment, respectively.

When we set the portfolio adjustment costs equally for formal and informal workers, the saving rate increases by 7.1% overall and by 10.5% for the informally employed. Importantly, the proportion of informal workers able to save more than 50% of their assets formally increases by more than 60%. The resulting increase in assets held in formal financial institutions is 46.1%. These large changes in formal saving also have an aggregate impact: overall assets slightly increase, driven by a 1.9% increase in assets accumulated by informal workers.

Saving behavior also has an impact on labor market decisions since it affects outside options and reservations wages. Working informally is now more attractive because at least one if its cost

[11] Consistently with equation (2) and table 3's estimate, we set $\psi^e(0) = \psi^e(1) = 0.024$.

–the costlier access to formal financial institutions– has been eliminated. As a result, a slightly higher proportion of workers is informal and their average accepted wage is slightly higher. This is an example of what are called "unintended consquences" of policy interventions since an increase in labor market informality is typically not a policy objective. However, the magnitude of the impact is very modest: the non-employment rate only increases by 0.3% and the proportion of informal workers only by 0.5%.

Finally, both saving and labor market behaviors have an impact on inequality. Table 6 reports the inequality indices defined in equation (14). The experiment (again reported in columns 2 and 3) shows a small decrease in consumption inequality and a larger decrease in the inequality in assets held in formal financial institutions, in particular when evaluated on the base of the Theil index ($GE(1)$).

4.2 Lower labor market informality

Results for the second experiment are reported in the fourth and fifth columns of Table 5. The experiment proxies labor market policies that are able to significantly reduce the proportion of informal job offers, possibly through a combination of enforcement mechanisms and structural reforms aiming at reducing the incentives of informal work. We impose a large reduction in the proportion of job offers that are for informal jobs ($p(0)$): from the baseline 72% to the experiment 20%. The most striking result is that even such massive change is not quite able to increase savings as much as the financial inclusion experiment: the overall saving rate increases by 6.8% compared with the 7.1% found in the financial inclusion experiment. The aggregate change in portfolio allocation is instead similar, driven by the higher proportion of formal workers. The same composition effect in the labor market lead to a 3.4% increase in total assets.

The impact on inequality (table 6) is stronger than in the financial exclusion experiment: inequality is reduced across the board, with the stronger impact registered again on the Theil index for assets in formal institutions. These larger impacts are in part driven by the underlining differences in the wage offers distributions for formal and informal workers, which are left unchanged in the experiment.

5 Concluding remarks

Workers in many low- and middle-income countries are characterized by two features: they have a high probability to work informally, at least for part of their life, and they have low savings, frequently allocated outside formal financial institutions. Many contributions look at the two phenomena in isolation, due to lack of data or to complications in modeling a joint environment.

We develop an environment able to integrate the behaviors leading to both phenomena. We use data from Colombia that are complete enough to characterize both labor market and saving behaviors. Thanks to this strategy, we are able to estimate a stylized but complete model that we can use to understand the channels leading to these outcomes and to perform counterfactual experiments. The model is an extension of the partial equilibrium on-the-job search model with asset accumulation developed by Lise (2013). The extensions consist of including two types of jobs (formal and informal) and a portfolio choice between two types of liquid assets a (formal) risk-less asset and an (informal) risky assets. The distributions of individuals working as formal or informal employees, the total wealth, and the type of assets they use to accumulate wealth arises endogenously as a part of the equilibrium. The data are obtained by combining two data sets from Colombia: The *Gran Encuesta Integrada de Hogares* (GEIH), a nationally representative monthly survey focusing on the labor market; and the *Encuesta Longitudinal Colombiana* (ELCA), a longitudinal survey focusing on consumption and saving behavior and access to financial services. The estimation results show that informal workers face significantly higher costs in adjusting their portfolio toward formal financial assets, signaling a lack of financial inclusion. They also show that labor market dynamic is crucial: workers' transits between formal and informal jobs with some frequency so that the formality state is not a permanent state of a typical individual labor market career. Still, spells in informality are characterized by lower saving rates.

We perform counterfactual experiments using the estimated model so as to evaluate policy changes in an equilibrium setting. We proxy a policy able to achieve full financial inclusion of informal workers by equating the portfolio adjustment costs of informal workers to those of formal workers. The result is a significant increase in the overall saving rate (more than 7 percentage points) and an even larger increase in the informal workers saving rate (more than 10 percentage points). As a comparison, we perform an experiment where we reduce the proportion of informal job offers received by workers. This experiment proxies labor market policies that are able to achieve such results, possibly through a combination of enforcement mechanisms and structural reforms aiming at reducing the incentives of informal work. We find that a massive reduction of the proportion of informal job offers from the baseline 72% to a value of 20% is able to just barely generate a saving rate similar to the one obtained with full financial inclusion. We also assess the impact of each policy on inequality, finding that full financial inclusion slightly decreases inequality in consumption and in formal assets but less so than the labor market policy.

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Table 1: Descriptive Statistics on Labor Market Outcomes

	Non-Employment	Formal Employment	Informal Employment
Labor Market States			
Proportion	0.151	0.361	0.488
Wages (hundred of US$ of 2016 per month)			
Mean	–	3.420	2.632
Standard Deviation	–	1.524	1.246
Ratio of Average Wages	–	1.299	1.000
Labor Market Yearly Transitions (row=from, col=to)			
Non-Employment	0.075	0.027	0.032
Formal Employment	–	0.287	–
Informal Employment	–	–	0.400
Employment	0.074	0.049	0.056
Sample			
Number Obs. GEIH	9782	23310	31481

Table 2: Descriptive Statistics on Saving Behavior

	Non-Employment	Formal Employment	Informal Employment
Individuals who's assets are mostly in formal financial institutions			
Proportion	0.214	0.453	0.270
Individuals who save			
Proportion	0.083	0.271	0.186
Savings (hundred of US$ of 2016 per month)			
Mean	0.483	0.561	0.588
Standard Deviation	0.447	0.549	0.791
Sample			
Number Obs. ELCA	170	506	617

Table 3: Estimated Parameters

Definition	Parameter	Est. Value	Std. Error
		Mobility	
Job offer rate - non-employment	λ^u	0.168	(0.03598)
Job offer rate - formal employment	$\lambda^e(1)$	0.023	(0.00921)
Job offer rate - informal employment	$\lambda^e(0)$	0.030	(0.00673)
Job separation rate - formal employment	$\eta(1)$	0.027	(0.00275)
Job separation rate - informal employment	$\eta(0)$	0.049	(0.00712)
		Job Offers Distributions	
Proportion of formal jobs	$p(1)$	0.280	(0.01020)
Mean of wages distribution - formal employment	$\mu(1)$	1.190	(0.01005)
Std.Dev. of wages distribution - formal employment	$\sigma(1)$	0.350	(0.00671)
Mean of wages distribution - informal employment	$\mu(0)$	0.742	(0.01286)
Std. Dev. of wages distribution - informal employment	$\sigma(0)$	0.481	(0.01498)
		Portfolio Adjustment Cost	
Adjustment cost - non-employment	ψ^u	0.023	(0.00572)
Adjustment cost - formal employment	$\psi^e(1)$	0.024	(0.00504)
Adjustment cost - informal employment	$\psi^e(0)$	0.174	(0.03599)
		Informal Assets Returns Process	
Persistence of the rate	κ	0.683	(0.01657)
Standard Deviation of the shock	σ	0.036	(0.02562)
		Non-employment Income	
Flow value	b	0.220	(0.05350)
		Fixed Parameters	
Relative risk aversion	δ	-0.530	
Discount rate	ρ	0.120	
Death rate	θ	0.013	
Rate of return of formal assets	r_1	0.075	
Mean rate of return of informal assets	$\bar{r}_2$	0.079	
Std. Dev. of the rate of return of informal assets	σ_{r_2}	0.031	
Value of the loss function		0.134	

NOTE: Bootstrap standard errors in parentheses.

Table 4: Moments Fit

	Data	Model
u	0.151	0.157
$e(1)$	0.361	0.348
$e(2)$	0.488	0.495
$E[w(1)]$	3.420	3.643
$SD[w(1)]$	1.524	1.273
$E[w(0)]$	2.632	2.596
$SD[w(0)]$	1.246	1.287
$P5[w(1)]$	2.287	2.028
$P5[w(0)]$	1.001	1.068
$\Pr[u \to u]$	0.075	0.143
$\Pr[u \to e(1)]$	0.027	0.007
$\Pr[u \to e(0)]$	0.032	0.020
$\Pr[e(1) \to e(1) \mid same\ job]$	0.287	0.339
$\Pr[e(0) \to e(0) \mid same\ job]$	0.400	0.471
$\Pr[e \to u]$	0.074	0.014
$\Pr[e \to e(1)]$	0.049	0.002
$\Pr[e \to e(0)]$	0.056	0.004
$\Pr[\phi > 0.5 \mid u]$	0.214	0.241
$\Pr[\phi > 0.5 \mid e(1)]$	0.453	0.470
$\Pr[\phi > 0.5 \mid e(0)]$	0.270	0.246
$E[I_{s>0} \times s \mid u]$	0.040	0.000
$SD[I_{s>0} \times s \mid u]$	0.183	0.000
$E[I_{s>0} \times s \mid e(1)]$	0.152	0.220
$SD[I_{s>0} \times s \mid e(1)]$	0.379	0.360
$E[I_{s>0} \times s \mid e(0)]$	0.110	0.239
$SD[I_{s>0} \times s \mid e(0)]$	0.410	0.378

NOTE: $s = da/dt$ is the amount saved and $I_{s>0}$ is an indicator variable that takes the value of 1 if the individual saves a positive amount and zero otherwise.

Table 5: Counterfactual Experiments - Labor Market and Financial Outcomes

	Benchmark	Financial Inclusion $\psi^e(0) = \psi^e(1) = 0.024$		Lower LM Informality $p(0) = 0.2$	
	Value	Value	Ratio	Value	Ratio
Labor market states					
u	0.157	0.158	1.003	0.134	0.851
$e(1)$	0.348	0.345	0.992	0.765	2.198
$e(0)$	0.495	0.497	1.005	0.102	0.205
Wages					
$E[w \mid e(1)]$	3.643	3.618	0.993	3.723	1.022
$E[w \mid e(0)]$	2.596	2.628	1.012	2.607	1.004
$E[w \mid e(1)]/E[w \mid e(0)]$	1.403	1.377	0.981	1.428	1.018
Savings					
$E[s]$	0.113	0.122	1.071	0.121	1.068
$E[s \mid e(1)]$	0.182	0.182	1.000	0.188	1.037
$E[s \mid e(0)]$	0.205	0.226	1.105	0.207	1.011
Portfolio Allocation					
$E[\phi]$	0.328	0.411	1.252	0.406	1.236
$E[\phi \mid e(1)]$	0.464	0.475	1.023	0.463	0.997
$E[\phi \mid e(0)]$	0.267	0.433	1.622	0.256	0.957
Assets in Formal Institutions					
$E[\phi a]$	3.462	4.104	1.186	4.174	1.206
$E[\phi a \mid e(1)]$	5.208	5.238	1.006	4.883	0.938
$E[\phi a \mid e(0)]$	2.852	4.166	1.461	2.514	0.881
Total Assets					
$E[a]$	8.650	8.681	1.004	8.945	1.034
$E[a \mid e(1)]$	11.011	10.789	0.980	10.204	0.927
$E[a \mid e(0)]$	8.715	8.880	1.019	7.709	0.885

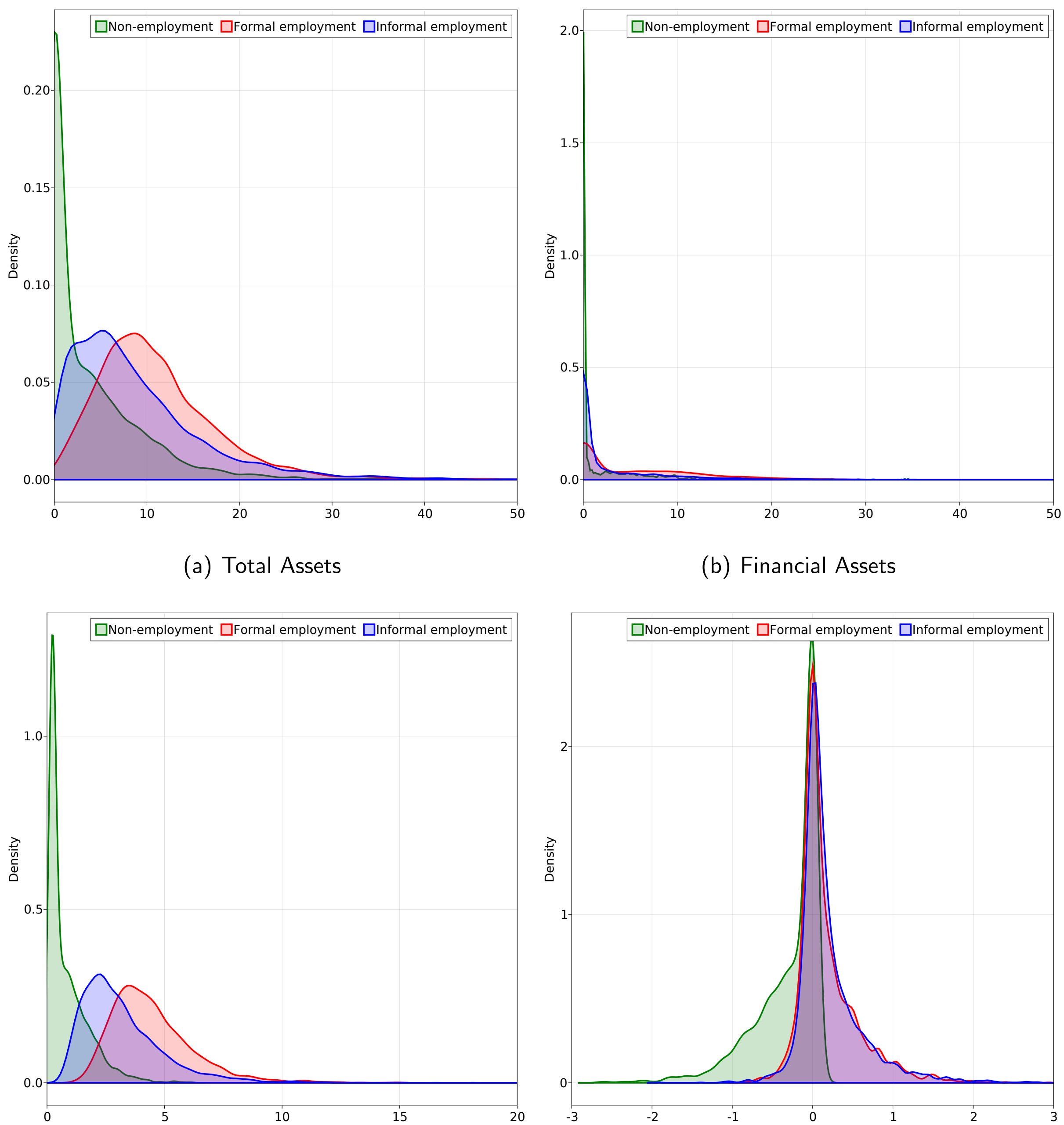
NOTE: Benchmark's values are: $\psi^e(0) = 0.174; \psi^e(1) = 0.024; p(0) = 0.72$. $s = da/dt$ is the amount saved. Results are based on simulations of 10.000 individuals. The column Ratio presents the ratio with respect to the benchmark.

Table 6: Counterfactual Experiments - Inequality

	Benchmark	Financial Inclusion $\psi^e(0) = \psi^e(1) = 0.024$		Lower LM Informality $p(0) = 0.2$	
	Value	Value	Ratio	Value	Ratio
		Total Assets			
$GE(0)$	2.990	3.083	1.031	2.967	0.992
$GE(1)$	0.330	0.327	0.991	0.275	0.833
$GE(2)$	0.349	0.341	0.977	0.272	0.778
		Assets in Formal Institutions			
$GE(0)$	6.340	6.080	0.959	6.158	0.971
$GE(1)$	0.581	0.450	0.775	0.413	0.710
$GE(2)$	1.434	1.159	0.808	1.047	0.730
		Consumption			
$GE(0)$	0.285	0.284	0.995	0.261	0.917
$GE(1)$	0.204	0.201	0.984	0.169	0.830
$GE(2)$	0.200	0.193	0.966	0.153	0.766

NOTE: Benchmark's values are: $\psi^e(0) = 0.174; \psi^e(1) = 0.024; p(0) = 0.72$. Results are based on simulations of 10.000 individuals. The column Ratio presents the ratio with respect to the benchmark.

Figure 1: Steady State Distributions of Assets, Consumption and Savings



(a) Total Assets

(b) Financial Assets

(c) Consumption

(d) Savings

NOTE: Simulated samples of 10,000 individual-level observations based on the estimates reported in Table 3.