Household job search and labor supply of secondary earners

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Abstract

We aim to investigate the labor market transitions of Brazilian young sons and daughters and their mothers within the household. We develop and estimate a structural household job search model, using data from the Brazilian Monthly Employment Survey (PME/IBGE) for 2004 and 2014. Our main contributions are that i) we explicitly consider sons or daughters as decision-makers in a household job search model; ii) we distinguish and allow for the unemployment and inactivity of mothers and sons and daughters, and for different search behavior and job acceptance, depending on the situation of the other member in the labor market, and on the non-labor and labor income of the primary earner in most families, the father; and iii) we develop and estimate a job search model for Brazilian households.

Our counterfactual simulations allow us to verify that the own labor market opportunities and conditions of the sons/daughters and mothers mostly contributed to their decreasing unemployment rates in the period between 2004 and 2014. On the other hand, the increasing trend in the inactivity of sons/daughters is mostly determined by a decreasing encouragement rate and an increasing dropout rate observed among these members in the period. These exogenous factors that determine the move to or the permanence in the inactivity state could be related to the lower cost of education in Brazil, through public policies in this period. Furthermore, the cross parameters (or parameters of the other member) seem to have an impact on some stocks of households, and their role is relatively greater for the inactivity. The higher average welfare of youth between 2004 and 2014 is mostly determined by the wage offer distribution of the mother and the income of fathers.

Therefore, we confirm the relationship between the labor market conditions of parents and the labor supply decisions of sons/daughters, mainly concerning the inactivity, through a model which allows replicating the equilibrium unemployment and inactivity of an economy. These preliminary results also allow inferring about some effect of policies that decrease the education costs on the inactivity of Brazilian sons/daughters. Finally, our results strengthen the argument about the relevance of household search behavior in the labor supply decisions of secondary earners in families and about how using individual job search models to understand aggregate unemployment and inactivity can be misleading.

Keywords: Household job search model; youth; mothers; unemployment; inactivity.
JEL codes: E23, J64, J22.

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1 Introduction

Recent studies have shown that the unemployment rate declined in Brazil in the last decade, from 13% in 2003 to 5% in 2013 in metropolitan regions and from 9% in 2002 to 6% in 2012 in Brazil as a whole [25]. Cabanas, Komatsu and Menezes Filho (2015) show that although unemployment is low and the overall level of economic activity is high in Brazil, the labor market participation of children aged 15 to 24 years decreased, and the proportion of children in full-time education increased. They argued that this result is related to the high dependence of labor market decisions of young sons/daughters on household income. In addition, Vieira, Menezes Filho and Komatsu (2016) show that the increase in parental income, particularly for mothers, may explain the increase in the proportion of sons/daughters who only study and the reduction in the proportion who only work. The real increase in the wage of adults in Brazil is thus considered an important factor associated with youth leaving the labor force.

The unemployment rate of any locality in a period, that is, the proportion of unemployed workers who are willing to work or have made an attempt to find a job among individuals of working age, is the aggregate result of the unemployment rates of several demographic and socioeconomic groups. Similarly, the total inactivity rate, that is, the proportion of individuals outside the labor market who do not search for jobs among the individuals of working age, is composed of inactivity rates of different groups in a locality. Therefore, the analysis of the aggregated trend of these rates can hide particular labor market dynamics related to some groups or different members in a household.

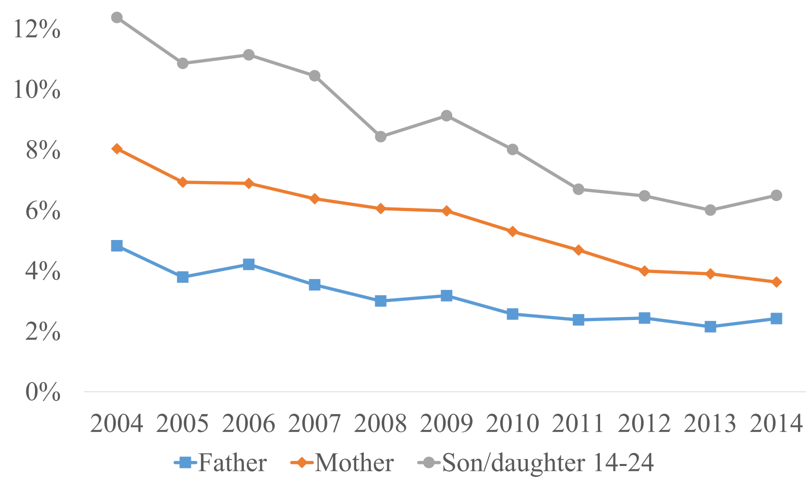
Figures 1 and 2 show, respectively, the unemployment rate and the inactivity rate among individuals aged 14 years or over, for the period 2004 to 2014, calculated separately for fathers, mothers and sons and daughters aged up to 24 years, using data from the Monthly Employment Survey (PME) of the Brazilian Institute of Geography and Statistics (IBGE), a longitudinal and monthly database that investigates the population resident in urban areas of six Brazilian metropolitan regions[1].

We observe that the unemployment rate decreased until 2013 for all analyzed members (Figure 1). However, the inactivity among youth shows a growth trend in the period, whereas the inactivity rate among fathers was almost constant and among mothers was decreasing, mainly after 2010 (Figure 2). The increasing inactivity among sons and daughters can be related to a growing number of children in full- or part-time education, as discussed by Cabanas, Komatsu and Menezes Filho (2015).

Therefore, a lower aggregate unemployment rate, as seen in Brazil in recent years, may be the result of both better labor market opportunities for parents, as these members do not seem to have moved to inactivity, and the reduced job search of youth. Indeed, since the labor market decisions of members in a family are made jointly in an intra-household decision process, the

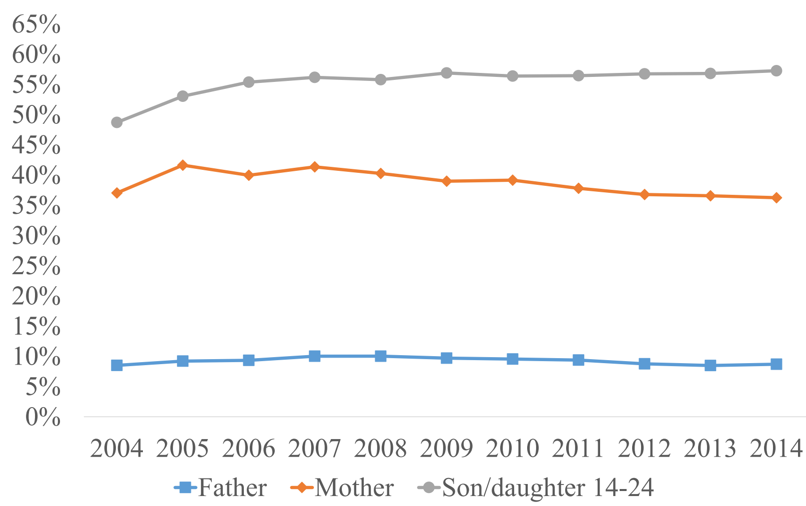
[1] We apply the PME's weight (variable V215) in all of the statistics generated in this study.

Figure 1: Evolution of the unemployment rate among household members



Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) 2004-2014. Note: Unemployment rate, as calculated using the first interview of individuals, is the proportion of unemployed individuals who were willing or searching for jobs, among individuals over 14 years of age.

Figure 2: Evolution of the inactivity rate among household members



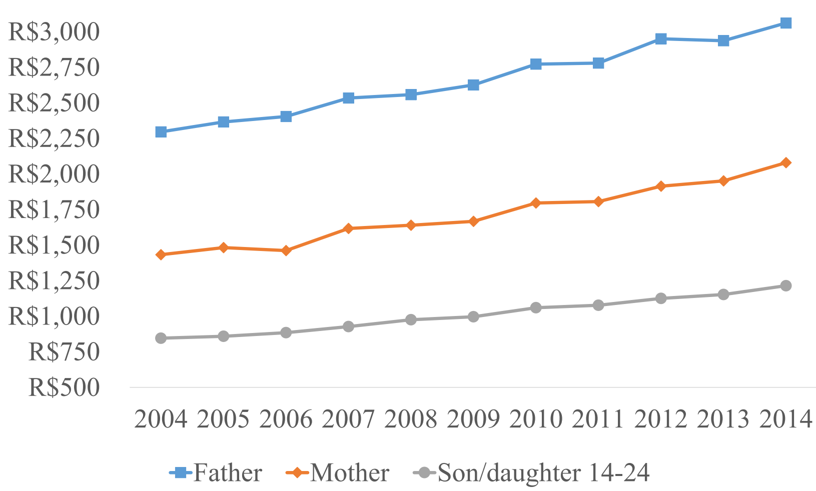
Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) 2004-2014. Note: Inactivity rate, calculated using the first interview of individuals, is the proportion of individuals outside the labor market, who do not search for jobs.

better labor market opportunities of parents during a time period could strengthen the transition of sons and daughters to inactivity at that moment and in future periods, resulting in an even lower unemployment rate. In this context, the effect of lower economic activity and GDP growth on the aggregate unemployment rate can be retarded, as in a hysteresis process, as observed in Brazil in recent years, regardless of whether the increasing unemployment among parents is compensated by a decreasing search for jobs by children. In Brazil, we verify that the proportion of unemployed individuals has increased only after 2013.

Thus, the hidden labor market transitions of the different members in a family may explain some puzzles in the relationship between economic activity and labor market outcomes, which challenge policy-makers and researchers. Mankart and Oikonomou (2016) show that this is also a persistent puzzle in data from the United States because the aggregate employment is procyclical but the labor force participation is not correlated with economic activity.

Figure 3 complements the analysis above, presenting the evolution of the individual labor income, in real terms, for the period 2004 to 2014 and the employed household members. We observe that all of the analyzed members had real increases in labor income in this period, related to economic growth, improvements in labor market conditions, and real increases in the minimum wage. Thus, the inactivity rate growth among youth occurs in a context of improvements in labor market opportunities, even for sons and daughters. In addition, we observe that the fathers income is the primary income for a household, whereas the mothers presents the second highest individual labor income.

Figure 3: Evolution of the average individual labor income among household members



Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) 2004-2014.
Notes: The values of the labor income are adjusted by the National Consumer Price Index (INPC), as calculated by the Brazilian Institute of Geography and Statistics (IBGE) of February 2016. The labor income is calculated using the first interview of members.

Given the puzzle and the facts presented above concerning the labor market trends of different members in a family as well as the relationship between the income of adults and the labor supply decisions of sons and daughters, this study aims to investigate the labor market transitions of young sons and daughters and their mothers within the household. The existence of search frictions introduce restrictions to the possibility to apply the traditional labor supply framework, and using the regression approach is inappropriate for an inherently dynamic phenomenon.

Thus, we use a dynamic framework that considers that labor market decisions are frequently made at the household level and not at the individual level. We develop and estimate a structural household job search model with on-the-job search considered by Dey and Flinn (2008). We build on this previous work to allow for the unemployment and inactivity of mothers and sons and daughters who are subject to employment shocks and income shocks to fathers. These shocks may determine different search behavior and job acceptance, depending on the job status and the wage of the other family member. Modeling inactivity as a distinct state from unemployment is relevant not only because of the greater movement of sons and daughters out of the labor force in recent years, contrary to mothers, whose inactivity diminished, but also because authors such as Guner, Kulikova and Valladares-Esteban (2015) noted that this transition plays a fundamental role for married females.

The model is estimated using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014. We consider these two years since we aim to simulate counterfactual scenarios. These counterfactual simulations allow verifying the relevance of parameters, wage offer distributions and other household income changes, when explaining the trends in unemployment and inactivity of family members.

The main contributions of this study are the following: i) we explicitly consider sons or daughters as decision-makers in a household job search model, which, to the best of our knowledge, it is still not performed in the household job search literature; ii) we distinguish and allow for the unemployment and inactivity of mothers and sons and daughters and for different search behavior and job acceptance, depending on the situation of the other member in the labor market, and the non-labor and labor income of the primary earner in most families, the father; and iii) we collaborate to the recent and incipient literature that develop and estimate household job search models, besides contributing to the job search literature that models the labor supply decisions of workers in Brazil.

Our counterfactual simulations allow us to verify that the decreasing unemployment rate of sons and daughters would not have changed between 2004 and 2014 if the labor market opportunities and conditions of this member remained the same. The unemployment rate of mothers did not change significantly in this period. The increasing trend in the inactivity of sons/daughters is mostly determined by a decreasing encouragement rate and the increasing dropout rate observed among these members in this period. These exogenous factors that determine the move to or the permanence in inactivity could be related to the lower cost of education through public policies of access to public and private universities and cash transfer to poor households with teenagers, which increases the years of schooling and the attendance of sons and daughters in high school. The increasing inactivity of mothers seems to be explained by the same parameters, but in the subgroup analysis, we verify that the dropout rate presents a greater increase among more educated mothers. Contrary to the expectation, the labor income of fathers and the labor market conditions of mothers contribute only marginally to the inactivity rate of sons/daughters. However, the decreasing job destruction rate for mothers, the shifted to right wage offer distributions of the two members, and the increasing income of fathers are the factors that mostly contribute to the higher average welfare of youth. The welfare of mothers in largely determined by their better labor market condition.

This version is organized into eight sections, in addition to this introduction. The second section presents a brief literature review of the household job search models. The third section is a detailed description of the household job search model, and the fourth section presents the estimation procedure. The fifth section describes the dataset and sample. A descriptive analysis is in the sixth section, and the estimation results are in the seventh one. The eighth section has the simulations results, and the last section presents a discussion about the limitations of this study and the directions for improvements in this research.

2 Household job search models: a brief literature review

In the macroeconomic literature, the importance of looking at unemployment phenomena at the household rather than the individual level was first recognized by Humphrey (1939). Moreover, since Becker's theory of the family (BECKER, 1981 , 1974), the relevance of household-level decisions in affecting labor market outcomes has been clear. However, the empirical literature in this field usually does not apply models that can replicate equilibrium unemployment, as in the job search models [18].

Burdett and Mortensen (1977) presented the first study that theoretically developed and analyzed a two-person household search model, but in the empirical literature, the pioneering article in developing and estimating a household job search model is that of Dey and Flinn (2008). These authors extend a standard partial equilibrium job search model, allowing head and spouse in the household search for jobs. They use data from the United States for 1996 and focus on the impacts of health insurance coverage that was expanded for spouses in the US on employment, wages and health coverage of spouses.

These authors highlight the potential dependence of couples' labor market decisions and show that the single-agent specifications are misspecified because they do not account for the earning process and job status of the other member. They also indicate that the household job search model generates different equilibrium decisions compared to the individual job search model. Moreover, they argue that the conclusions of empirical studies focused on individual behavior to estimate the marginal willingness to pay for health insurance must be questioned.

In the same direction, Albrecht, Anderson and Vroman (2010) and Compte and Jehiel (2010) develop a more general framework, in which they model the search decisions made by individuals in a collective agreement, called search by committee. These authors also conclude that the unique symmetric equilibrium obtained under search by committee is different from that achieved in the individual search problem.

Flabbi and Mabli (2012) also discuss the empirical relevance of ignoring the household as a unit of decision-making when estimating job search models. They estimated the model developed by Dey and Flinn (2008), with the on-the-job search and allowing for the labor supply decisions of spouses, by adding part- and full-time labor supply. They use data from the United States for the period 2001 to 2003 and estimate the model using the Method of Simulated Moments. Their main contribution was to run a specification test for the individual search model and to compare the individual and household job search models through a policy-relevant application for the lifetime inequality. They conclude that ignoring the household as a unit of decision-making in job search models has relevant empirical consequences, particularly on gender differentials. The household search model may explain part of the gap through the decrease in the wives' reservation wages that is implied by the husbands' labor market status.

Other contributions to the household model literature are found in the works of Gemici (2011) and Guler, Guvenen and Violante (2012). The first article develops and estimates a model of household migration with frictions. The author considers a life-cycle search model with intra-household bargaining to understand the importance of geographical location. Guler, Guvenen and Violante (2012) analyze the locational and labor market decision of stable couples, using a partial equilibrium search model in which each spouse stochastically receives wage offers.

Some recent studies extend and estimate household models, determining the joint equilibrium distribution of labor market and marriage market. Flabbi and Flinn (2015) is an example of this recent literature, which provides an empirical assessment of the relevance of taking into account the joint nature of the decision process in the two markets. They use data from the United States for 2007, and the Method of Simulated Moments, and introduce an endogenous schooling choice that occurs before entering both markets, but they focus only on adult males or females aged 25 to 49 years. Another example of study concerning a household model of marriage and labor decisions is Chiappori, Dias and Meghir (2015), who also allow for marriage, labor, and schooling decisions, the latter occurring prior to former decisions, in an household equilibrium lifecycle model for males and females aged 16 years or over, and use the British Household Panel Survey (BHPS) for 1991 to 2008.

Other recent articles develop and estimate household job search models in policy analysis. Garcia-Perez and Rendon (2012) set up a utility maximizing household job search model in which consumption and job search decisions are made jointly to evaluate how the unemployment benefits affect the intra-household decisions. In this model, each member's reservation wage is highly dependent on the partner's labor market status and his/her wage. Moreover, both wealth and the employment situation of the partner allow individuals to be more selective and search longer. They assume independent job markets to the individuals in a couple, on-the-job search, no marital transitions, work-assignment when one member accepts an offer and allow for borrowing constraints. The authors estimate the model using the United States data for the period 1996 to 1999 and for households in which the individuals have at least a high school education.

Fang and Shephard (2014) analyze the effect of the Affordable Care Act (ACA) of the United States on firms' decisions to offer spousal health insurance benefits in an equilibrium model of joint household labor supply. They consider that the distribution of job offers is determined endogenously and that the compensation packages comprise a wage and a menu of insurance offerings. The authors allow for both household and firm heterogeneity and use a multi-step estimation procedure. They have been successful in fitting the features of the data and find a relatively higher concentration of low-wage offers among firms that do not provide health insurance.

Finally, Conti, Ginja and Narita (2016) build a household search model to evaluate the effects of a non-contributory health insurance scheme of Mexico, the *Seguro Popular* (SP), on labor market outcomes. The structural model incorporates the valuations of being in the informal sector or nonemployed relative to the formal sector. They model the choices of the members of couples (heads and spouses). The authors aim to understand the extent to which the increase in informality in Mexico is associated with the free access to health care associated with SP. In addition, they use the model to recover the marginal willingness to pay for health insurance under SP. They combine non-parametric with Method of Moments estimation and find that the value placed on SP is low, between 1.3% and 4.2% of the median wage. They conclude that the expansion of the health coverage until at least 2012 is not associated with significant increases in informality, which is corroborated by the reduced form estimation.

It is important to highlight that the cited articles do not explicitly consider sons and daughters as decision-makers in the labor market household decisions and rarely account for the possibility to distinguish unemployment from inactivity; further, none of them is estimated using Brazilian data.

3 Household search model

3.1 Basic assumptions

In this study, we extend the Dey and Flinn (2008) model[2], in which the economy comprises a continuum of stable households. Time is continuous, and households are infinitely lived and make labor market decisions to maximize their lifetime expected income. A household comprises a young son or daughter (member 1) and his/her mother (member 2), who have preferences represented by a household utility function, and may have a father whose decisions are determined outside the model, for simplicity. These two members maximize a common utility function where

[2]We also relate to papers that estimate search models, in particular following Burdett and Mortensen (1998), such as Bontemps, Robin and Van den Berg (1999) and Van den Berg and Ridder (1998).

they pool income, as occurs in a unitary model of the household[3]. We consider the shocks that may affect member 1 or member 2, who may be in one of the following states: employed (e), unemployed (u) or inactive/outside the labor force (i)[4].

We assume that the instantaneous household utility associated with consumption is a function of the household non-labor and labor income, and there is no saving or borrowing in the model, a common assumption in the search literature, which can be justified by market completeness[5]. Thus, the instantaneous utility of a household that comprises a father, a mother, and a son/daughter has the following form:

$$U(I) = g(I)$$

in which I is the total household income, such as

- $I = w_1 + w_2 + Y$, if both the son/daughter and the mother are employed
- $I = w_1 + b_2 + Y$, if only the son/daughter is employed
- $I = b_1 + w_2 + Y$, if only the mother is employed
- $I = b_1 + b_2 + Y$, if neither the mother nor the son/daughter are employed

where: w_1 is the labor income of the son/daughter, w_2 is the labor income of the mother[6], b_1 is the non-labor income of the son/daughter, b_2 is the non-labor income of the mother[7], and Y includes additional household non-labor income and the labor income of the father[8]. In particular, we assume that g has the Constant Relative Risk Aversion (CRRA) form, given by

$$g(I, \rho) = \frac{I^\rho}{\rho}$$

where $\rho \in [0, 1]$. In this case,

[3]Models based on cooperative or non-cooperative behavior may generate different income sharing, and the strategic household interaction may generate higher sensitivity of the labor supply decisions of one member about the other member labor market status [18]. Dey and Flinn (2008) also omit strategic interactions between members. Gemici (2011) is an exception and considers a life-cycle search model with intra-household bargaining.

[4]Unemployed workers search for jobs, whereas inactive workers do not.

[5]Dey and Flinn (2008) also ignore saving or borrowing and assume that all income is consumed in the same moment it is received. Garcia-Perez and Rendon (2012) develop a household search model in which the households are allowed to make savings decisions.

[6]Labor income is the usually received monthly income in the main job, that is, the wage before payment of social security contributions, but after labor income taxes.

[7]We do not distinguish the non-labor income or value of leisure of sons/daughters and mothers, b_1 and b_2, for the situations of unemployment and inactivity. Instead, we have estimated the model in different subsamples of households by the education of mothers and the age group of sons/daughters. In a future version of the study, we intend to do that, if the addition of the hypothesis about these values is not too restrictive. According to Fang and Shephard (2014), the continuous heterogeneity in leisure enriches the model's ability to capture heterogeneity in job acceptance behavior and smoothes the labor supply function that the firm is facing.

[8]Job opportunities for the father are determined outside the model, for simplicity. However, simulated wage shocks related to the labor market policies, such as the minimum wage policy, which affects the fathers income may increase the opportunity cost of supplying labor of other household members.

$$\lim_{\rho \to 1} g(I, \rho) = I$$
$$\lim_{\rho \to 0} g(I, \rho) = \ln(I)$$

in which $\rho = 1$ is the linear form of the utility function. Dey and Flinn (2008), Flabbi and Moro (2012), Flabbi and Mabli (2012) and Garcia-Perez and Rendon (2012) also assume a CRRA form for the utility function. Fang and Shephard (2004) assume Constant Absolute Risk Aversion (CARA) preferences.

The risk aversion implies a concave utility function. In this context, an increase in Y would imply a more than proportional decrease in the reservation wages of sons/daughters or mothers and a higher job offer acceptance and employment.

We assume that the mother and son/daughter face mutually exclusive shocks in the labor market. In continuous time, the intervals between periods are infinitesimal, and it is possible that at most one shock affects the household in a period but that both members respond to this same shock. Dey and Flinn (2008) discuss the advantages and drawbacks of using a continuous time framework. These authors note that despite fiction, by using the continuous framework, we avoid the multiple equilibria problem and the arbitrariness of the choice of the decision period and time aggregation, which can affect estimates and inferences.

The structural model parameters are member-specific, and job offers may arrive for mothers if they are unemployed (λ_2^0) or if they are employed (λ_2^1), but job offers may arrive for sons/daughters only if they are unemployed (λ_1^0). For simplicity[9], we only allow for the on-the-job search of mothers. We decide to simplify because the household model alone generates sufficient heterogeneity in the reservation wages.. Jobs may be exogenously destroyed at the rate δ_1 for sons/daughters and at δ_2 for mothers. The job destruction moves the household member from employment to unemployment.

Shocks that affect the mother impact the labor market decisions of sons/daughters and vice versa. In particular, when both are unemployed and the mother accepts a job offer, the son/daughter may decide to become inactive, and vice versa. Additionally, if the son/daughter is unemployed and the employed mother faces a job destruction, the son/daughter may decide to search for a job.

If a member is unemployed, he/she may decide stop searching for jobs and become inactive. The rate of discouragement or dropout (move from unemployment to inactivity) is β_1 for sons/daughters and β_2 for mothers. Sons/daughters encourage (move from inactivity to unemployment) at a rate α_1, and mothers encourage at a rate α_2.

We assume that mothers and sons/daughters do not draw from the same wage offer distributions. Thus, we denote the wage offer distribution faced by sons/daughters as $F_1(w_1)$ and the wage offer distribution faced by mothers as $F_2(w_2)$.

[9] Contrarily to Dey and Flinn (2008) and Fang and Shephard (2014)

3.2 Household value functions

The household labor market decisions are based on their value functions, which are defined recursively. There are nine household value functions for each state in which the household is. Thus, a value function W_{jk} is the lifetime income that a household has if the son/daughter is in state j and mother is in state k, for $j, k = e, u, i$. The Bellman (1957) equation for the value functions defined at the household level are described below:

- Both the son/daughter and the mother are employed:

$$
\begin{aligned}
rW_{ee}(w_1, w_2) = & \frac{(w_1 + w_2 + Y)^{\rho}}{\rho} + \\
& \delta_1(W_{ue}(0, w_2) - W_{ee}(w_1, w_2)) + \delta_2(W_{eu}(w_1, 0) - W_{ee}(w_1, w_2)) + \\
& \lambda_2^1 \int \max[W_{ee}(w_1, x) - W_{ee}(w_1, w_2), 0] dF_2(x)
\end{aligned}
$$

where r is the discount rate. This value function, the discounted value that the family has if the son/daughter and the mother are both employed, is the sum of the instantaneous household utility (the wage of son/daughter plus the wage of mother added to the household non-labor income and other labor income, such as the wage of the father (Y)) and the option values of changing labor market state, that is, the risks and job opportunities in the lifetime household income. First, with probability δ_1 the employed son/daughter suffers job destruction. The employed mother may also suffer job destruction, which occurs at the rate δ_2. Job offers arrive to the mother while employed at the rate λ_2^1, and the household decides whether the mother should accept them by comparing the value of the current state with the value of being employed at this new job. If the mother accepts a job offer, she draws a wage x from the distribution F_2, and if the mother does not accept it, she continues to receive the last wage, w_2, which is stationary.

- The son/daughter is employed and the mother is unemployed

$$
\begin{aligned}
rW_{eu}(w_1, 0) = & \frac{(w_1 + b_2 + Y)^{\rho}}{\rho} + \\
& \delta_1(W_{uu}(0, 0) - W_{eu}(w_1, 0)) + \beta_2(W_{ei}(w_1, 0) - W_{eu}(w_1, 0)) + \\
& \lambda_2^0 \int \max\left[W_{ee}(w_1, x) - W_{eu}(w_1, 0), 0\right] dF_2(x)
\end{aligned}
$$

In this second value function, we have the discounted value that the household has if the son/daughter is employed and the mother is unemployed. In this case, the household instantaneous utility is the wage of son/daughter plus the value of leisure of the unemployed mother added to household non-labor income and the labor income of father, denoted by Y. Moreover, it is possible that the unemployed mother receives job offers at the rate λ_2^0, and the household decides whether the mother must accept or reject them by comparing the value of the current state with the value of being employed at this job. Job offer acceptance means to increase the household well-being. In addition, the unemployed mother may be discouraged and move to inactivity.

- The son/daughter is employed and the mother is inactive

$$\begin{aligned}rW_{ei}(w_1,0) =&\frac{(w_1+b_2+Y)^\rho}{\rho}+\\&\delta_1\max[W_{ui}(0,0)-W_{ei}(w_1,0),W_{uu}(0,0)-W_{ei}(w_1,0)]+\\&\alpha_2(W_{eu}(w_1,0)-W_{ei}(w_1,0))\end{aligned}$$

The third value function is similar to the second one, but the mother is in the inactive state and does not look for jobs or receive job offers. In this case, if the son/daughter suffers job destruction, it is possible that the mother starts looking for jobs and moves from inactivity to unemployment.

- The son/daughter is unemployed and the mother is employed

$$\begin{aligned}rW_{ue}(0,w_2) =&\frac{(b_1+w_2+Y)^\rho}{\rho}+\\&\beta_1(W_{ie}(0,w_2)-W_{ue}(0,w_2))+\delta_2(W_{uu}(0,0)-W_{ue}(0,w_2))+\\&\lambda_1^0\int\max\left[W_{ee}(x,w_2)-W_{ue}(0,w_2),0\right]dF_1(x)+\\&\lambda_2^1\int\max\left[W_{ue}(0,x)-W_{ue}(0,w_2),0\right]dF_2(x)\end{aligned}$$

The fourth function concerns the situation in which the son/daughter is unemployed and the mother is employed. In this case, the mother may suffer job destruction or may receive job offers when employed. Moreover, job offers arrive to the unemployed son/daughter, but the unemployed son/daughter may also be discouraged.

- Both the son/daughter and the mother are unemployed

$$\begin{aligned}rW_{uu}(0,0) =&\frac{(b_1+b_2+Y)^\rho}{\rho}+\\&\beta_1(W_{iu}(0,0)-W_{uu}(0,0))+\beta_2(W_{ui}(0,0)-W_{uu}(0,0))+\\&\lambda_1^0\int\max\left[W_{eu}(x,0)-W_{uu}(0,0),0\right]dF_1(x)+\\&\lambda_2^0\int\max\left[W_{ue}(0,x)-W_{uu}(0,0),0\right]dF_2(x)\end{aligned}$$

This fifth value function is similar to the fourth, but the mother is also in the unemployment state and can move to employment or inactivity.

- The son/daughter is unemployed and the mother is inactive

$$
\begin{aligned}
rW_{ui}(0,0) =& \frac{(b_1 + b_2 + Y)^\rho}{\rho} + \\
& \beta_1(W_{ii}(0,0) - W_{ui}(0,0)) + \alpha_2(W_{uu}(0,0) - W_{ui}(0,0)) + \\
& \lambda_1^0 \int \max\left[W_{ei}(x,0) - W_{ui}(0,0), 0\right] dF_1(x)
\end{aligned}
$$

For this sixth value function, we have the situation in which the son/daughter is unemployed; that is, he/she searches for a job and receives job offers, and the mother is in the inactive state and thus neither search for jobs nor receive job offers.

- The son/daughter is inactive and the mother is employed

$$
\begin{aligned}
rW_{ie}(0,w_2) =& \frac{(b_1 + w_2 + Y)^\rho}{\rho} + \\
& \delta_2 \max[W_{iu}(0,0) - W_{ie}(0,w_2), W_{uu}(0,0) - W_{ie}(0,w_2)] + \\
& \alpha_1(W_{ue}(0,w_2) - W_{ie}(0,w_2)) + \\
& \lambda_2^1 \int \max\left[W_{ie}(0,x) - W_{ie}(0,w_2), 0\right] dF_2(x)
\end{aligned}
$$

- The son/daughter is inactive and the mother is unemployed

$$
\begin{aligned}
rW_{iu}(0,0) =& \frac{(b_1 + b_2 + Y)^\rho}{\rho} + \\
& \alpha_1(W_{uu}(0,0) - W_{iu}(0,0)) + \beta_2(W_{ii}(0,0) - W_{iu}(0,0)) + \\
& \lambda_2^0 \int \max\left[W_{ie}(0,x) - W_{iu}(0,0), 0\right] dF_2(x)
\end{aligned}
$$

The seventh and eighth value functions above are similar to the presented third and fourth value functions, respectively, exchanging the states of mother and son/daughter and adding to the seventh function the possibility that the mother receives job offers while employed.

- The son/daughter and the mother are both inactive

$$
\begin{aligned}
rW_{ii}(0,0) =& \frac{(b_1 + b_2 + Y)^\rho}{\rho} + \\
& \alpha_1(W_{ui}(0,0) - W_{ii}(0,0)) + \alpha_2(W_{iu}(0,0) - W_{ii}(0,0))
\end{aligned}
$$

Finally, in the last value function, we have the discounted value for the household in which the son/daughter and the mother are both inactive. In this case, changes in the household status only occur due to encouragement.

3.3 Reservation wages

Each worker's strategy has a reservation wage property; that is, there is a wage in which the agent is indifferent among states. The reservation wage or the minimum acceptable wage offer of one member potentially depends on the job status and the wage of the other family member. For example, the reservation wage $\hat{w}_{ee-eu}(w_1)$ is the one which equates $W_{ee}(w_1, \hat{w}_{ee-eu}(w_1)) = W_{eu}(w_1, 0)$. In this case, the unemployed mother chooses to accept the job if $w_2 \geq \hat{w}_{ee-eu}(w_1)$, for a given w_1.

Thus, it is possible that a wage that is acceptable to the mother when the son/daughter is unemployed becomes not acceptable if the son/daughter is employed. The analysis is symmetric for sons/daughters.

3.4 Steady state flow conditions

We consider the steady state of the labor market. In steady state equilibrium, we derive flow equations for the joint labor market states of the two members. The measure of households in which the son/daughter is in state j and the mother is in state k, for $j, k = e, u, i$, must be constant; that is, the inflows and outflows to and from a given joint condition must be equal. Then, we have a system of nine flow equations described below:

- Both the son/daughter and the mother are employed

$$\begin{aligned}
&m_{ee}G_{ee}(w_1, w_2)[\delta_1 + \delta_2 + \lambda_2^1 \bar{F}_2(w_2)] = \\
&\qquad \lambda_1^0 m_{ue} \int^{w_2} \max(F_1(w_1) - F_1(\hat{w}_{ee-ue}(w_2)), 0) g_{ue}(w_2) dw_2 + \\
&\qquad \lambda_2^0 m_{eu} \int^{w_1} \max(F_2(w_2) - F_2(\hat{w}_{ee-eu}(w_1)), 0) g_{eu}(w_1) dw_1
\end{aligned}$$

The first flow equation concerns the measure of households in which the son/daughter and the mother are both employed receiving wages w_1 and w_2, in which m_{jk} is a measure or stock of households in which the son/daughter is in state $j = e, u, i$ and the mother is in state $k = e, u, i$; G_{jk} is the joint cumulative distribution function of wages and g_{jk} is the joint density of wages; and $\bar{F}_1 = 1 - F_1$ and $\bar{F}_2 = 1 - F_2$.

The flow out of the situation in which the son/daughter and the mother are both employed is given by i) exogenous job destruction shocks that take the son/daughter or the mother to unemployment and ii) the job-to-job transition with a wage increase of the mother. The flow into the situation in which the son/daughter and the mother are both employed is given by the job acceptance by the unemployed son/daughter or mother.

- The son/daughter is employed and the mother is unemployed

$$
\begin{aligned}
m_{eu}G_{eu}(w_1,0)[\delta_1+\beta_2]+ \\
&\lambda_2^0 m_{eu}\int^{w_1}\bar{F}_2(\hat{w}_{ee-eu}(w_1))g_{eu}(w_1)dw_1 = \\
&\delta_2 m_{ee}G_{ee}(w_1,\overline{w_2})+\alpha_2 m_{ei}G_{ei}(w_1,0)+ \\
&\lambda_1^0\max(F_1(w_1)-F_1(\hat{w}_{eu-uu}),0)
\end{aligned}
$$

This second measure concerns the households in which the son/daughter is employed, and the mother is unemployed. The flow out of this situation is given by i) exogenous job destruction shocks that take the son/daughter to unemployment; ii) dropout or discouragement that affects the mother; and iii) job acceptance performed by the unemployed mother. The flow into the situation is given by i) exogenous job destruction shock to the mother; ii) encouragement that induces the mother to search for jobs; and iii) job acceptance performed by the unemployed son/daughter.

The other flow equations are described below and have similar interpretations.

- The son/daughter is employed and the mother is inactive

$$
\begin{aligned}
m_{ei}G_{ei}(w_1,0)[\delta_1+\alpha_2] = \\
&\beta_2 m_{eu}G_{eu}(w_1,0)+ \\
&\lambda_1^0 m_{ui}\max((F_1(w_1)-F_1(\hat{w}_{ei-ui}),0)
\end{aligned}
$$

- The son/daughter is unemployed and the mother is employed

$$
\begin{aligned}
m_{ue}G_{ue}(0,w_2)[\delta_2+\lambda_2^1\bar{F}_2(w_2)+\beta_1]+ \\
&\lambda_1^0 m_{ue}\int^{w_2}[\bar{F}_1(\hat{w}_{ee-ue}(w_2))(w_2)g_{ue}(w_2)dw_2 = \\
&\delta_1 m_{ee}G_{ee}(\overline{w_1},w_2)+\alpha_1 m_{ie}G_{ie}(0,w_2)+ \\
&\lambda_2^0 m_{uu}\max((F_2(w_2)-F_2(\hat{w}_{ue-uu}),0)
\end{aligned}
$$

- The son/daughter and the mother are both unemployed

$$
\begin{aligned}
m_{uu}[\beta_1+\beta_2+\lambda_1^0\bar{F}_1(\hat{w}_{eu-uu})+\lambda_2^0\bar{F}_2(\hat{w}_{ue-uu})] = \\
&\delta_1 m_{eu}G_{eu}(\overline{w_1},0)+\delta_2 m_{ue}G_{ue}(0,\overline{w_2})+ \\
&\delta_1 m_{ei}\mathbf{1}(W_{uu}(0,0)>W_{ui}(0,0))G_{ei}(\overline{w_1},0)+ \\
&\delta_2 m_{ie}\mathbf{1}(W_{uu}(0,0)>W_{iu}(0,0))G_{ie}(0,\overline{w_2})+ \\
&\alpha_1 m_{iu}+\alpha_2 m_{ui}
\end{aligned}
$$

- The son/daughter is unemployed and the mother is inactive

$$m_{ui}[\beta_1 + \alpha_2 + \lambda_1^0 \bar{F}_1(\hat{w}_{ei-ui}))] = \delta_1 m_{ei} \mathbf{1}(W_{ui}(0,0) > W_{uu}(0,0)) G_{ei}(\overline{w_1}, 0) + \alpha_1 m_{ii} + \beta_2 m_{uu}$$

- The son/daughter is inactive and the mother is employed

$$m_{ie} G_{ie}(0, w_2)[\delta_2 + \alpha_1 + \lambda_2^1 \bar{F}_2(w_2)] = \lambda_2^0 m_{iu} \max((F_2(w_2) - F_2(\hat{w}_{ie-iu}), 0) + \beta_1 m_{ue} G_{ue}(0, w_2)$$

- The son/daughter is inactive and the mother is unemployed

$$m_{iu}[\alpha_1 + \beta_2 + \lambda_2^0 \bar{F}_2(\hat{w}_{ie-iu}))] = \delta_2 m_{ie} \mathbf{1}(W_{iu}(0,0) > W_{uu}(0,0)) G_{ie}(0, \overline{w_2}) + \beta_1 m_{uu} + \alpha_2 m_{ii}$$

- The son/daughter and the mother are both inactive

$$m_{ii}[\alpha_1 + \alpha_2] = \beta_1 m_{ui} + \beta_2 m_{iu}$$

3.5 The value of leisure

We assume strong monopsony power for the lowest income workers. Assuming also that $\underline{w}$ is the minimum wage offer accepted by unemployed individuals, it is possible to identify the value of leisure for the son/daughter, b_1, by equating $W_{eu}(\underline{w}, 0) = W_{uu}$ and the value of leisure for the mother, b_2, by equating $W_{ue}(0, \underline{w}) = W_{uu}$.

3.6 Firms and market equilibrium

We assume that wages of sons/daughters and mothers are determined in separate markets and are denoted by 1 and 2, respectively. In each market, firms are heterogeneous, and in their productivity $p^i \sim \Gamma^i(p)$, continuous, $i = 1, 2$. The productivity can capture technology and price differences across firms.

We do not consider minimum wage as we do not distinguish between formal and informal employment. The firm solves

$$\max_{w_i} (p^i - w^i) l^i(w^i)$$

where $i = 1, 2$ and $l^i(w^i)$ is the equilibrium size of a firm in the market i offering wage w^i.

The labor force size comes from the flow conditions in steady state. Normalizing the number of firms to one in each market, we have

$$l^i(w) = m_e^i \frac{dG_i(w)}{dF_i(w)}$$

where $m_e^1 = m_{ee} + m_{eu} + m_{ei}$, $m_e^2 = m_{ee} + m_{ue} + m_{ie}$ and $G_i(w)$ is the marginal distribution of wages obtained from integrating over the joint distribution of wages $G_{ek}(w_1, w_2)$, $k = e, u, i$, for sons/daughters, and $G_{ke}(w_1, w_2)$ for the mothers.

In equilibrium (following Bontemps, Robin and Van den Berg (1999)), $\Gamma^i(p) = F_i(w_i(p))$, where $w_i(p)$ solves the firms' profit maximization. That is,

$$w_i(p) = p - \frac{l(w_i(p))}{\frac{dl(w_i(p))}{dw_i(p)}}$$

4 Estimation

Based on the household search model, it is possible to estimate the wage offer distributions, the values of leisure, and the arrival, job destruction, dropout and encouragement rates. The model can be characterized in terms of the following vector:

$$\Theta = (F_1, F_2, \delta_1, \delta_2, \alpha_1, \alpha_2, \beta_1, \beta_2, \lambda_1^0, \lambda_2^0, \lambda_2^1, b_1, b_2)$$

where the parameters and distributions have been previously defined.

The estimation procedure is an extension of the multi-step estimation procedure that has been used in some empirical applications of the Burdett and Mortensen (1998) model. We do not use the Maximum Likelihood estimator, which is the most common in empirical applications of the Burdett and Mortensen (1998) model. Dey and Flinn (2008) present the advantages and drawbacks of implementing a maximum likelihood estimator in a two-agent case when using a continuous time framework[10]. Therefore, we use an estimation process that combines non-parametric estimation with Method of Moments.

The steps of the estimation process are detailed below:

1. First, the distributions F_1 and F_2 are estimated from the data on wages accepted in the second interview by the workers that were unemployed in the first interview. The solution for the remaining model parameters is based on fixed-point iteration;

2. We set an initial guess for the vector of transition parameters $(\delta_1, \delta_2, \alpha_1, \alpha_2, \beta_1, \beta_2, \lambda_1^0, \lambda_2^0, \lambda_2^1)$, for the measure of households for which the joint status is $\frac{m_{jk}}{m_{ii}} G_{jk}(w_1, w_2)$, and for the

[10] These authors argue that an alternative to using a maximum likelihood estimator would be to assume a discrete framework, but as discussed above, the arbitrariness of the choice of the decision period and time aggregation imposes serious problems since it affects estimation and inference.

minimum and maximum support for each value function. We calibrate the values of leisure b_1 and b_2;

3. Using the Clenshaw-Curtis quadrature, we interpolate the minimum and maximum support of the value functions;

4. Using the value functions, we calculate the reservation wages;

5. Using the flow equations, we update $\frac{m_{jk}}{m_{ii}} G_{jk}(w_1, w_2)$ and we obtain the firm size, which permits us to identify the wage policy function $w(p)$ and the firm profit flows;

6. We set the wages w_1 and w_2 to infinity and the mass of households across all joint status to one, which allows the flow equation to m_{ii} to be obtained as residual. Then, it is possible to obtain the stocks of households in all joint status m_{jk} and the joint G_{jk} distributions separately;

7. Using the model restrictions, we update the values of leisure b_1 and b_2;

8. We also update the value functions;

9. Using the transition moments, we update the transitions parameters. We use the transition probability between two states, i.e., the hazard rate out of a given labor market state and into another state, that is equal to the probability of exogenous shocks times the probability that the transition is optimal for the member. These transition parameters are estimated using the Method of Moments and following the household members over T intervals in a period. Specifically, we use the first and second interviews of households in an interval of one month (so $T = 1$), and we obtain the transitions $\tilde{D}^1_{ss'}$ and $\tilde{D}^2_{ss'}$ from the data, where $s, s' = e, u, i$ and s denote the status in the first period and the s', the status in the second one. We use the transition probabilities (conditional on the initial status of the member) of sons/daughters and mothers to and from unemployment and from employment to employment of mothers (totalizing nine moment conditions) that identify the vector $(\delta_1, \delta_2, \alpha_1, \alpha_2, \beta_1, \beta_2, \lambda^0_1, \lambda^0_2, \lambda^1_2)$. We also can use the cross moments, that is, the moments from unemployment to employment conditional on the other member being employed earning w. The durations are exponentially distributed. Thus, we construct transitions from the model for the son/daughter ($D^1_{ss'}$) and for the mother ($D^2_{ss'}$) as follows:

   - Transitions to unemployment:

$$D^1_{eu} = \int (1 - \exp^{-\delta_1 T}) dG_1(x) = (1 - \exp^{-\delta_1 T})$$

$$D^1_{iu} = \int (1 - \exp^{-\alpha_1 T}) dG_1(x) = (1 - \exp^{-\alpha_1 T})$$

$$D^2_{eu} = \int \frac{\delta_2}{d_2(x)} (1 - \exp^{-d_2(x) T}) dG_2(x)$$

$$D^2_{iu} = \int (1 - \exp^{-\alpha_2 T}) dG_2(x) = (1 - \exp^{-\alpha_2 T})$$

where $d_2(w_2) = \delta_2 + \lambda_2^1 \bar{F}_2(w_2)$.

- Transitions out-of unemployment:

$$D^1_{ue} = \int \frac{\lambda_1^0 \sum_{k=e,u,i} (\bar{F}_1(\hat{w}_{ek-uk}(w_2)) \frac{m_{uk}}{m_u}}{a_1} (1 - \exp^{-a_1 T}) dG_{2u}(w_2)$$

$$D^1_{ui} = \frac{\beta_1}{a_1}(1 - \exp^{-a_1 T})$$

$$D^2_{ue} = \int \frac{\lambda_2^0 \sum_{k=e,u,i} (\bar{F}_2(\hat{w}_{ke-ku}(w_1)) \frac{m_{ju}}{m_u}}{a_2} (1 - \exp^{-a_2 T}) dG_{1u}(w_1)$$

$$D^2_{ui} = \frac{\beta_2}{a_2}(1 - \exp^{-a_2 T})$$

where $a_1 = \int \lambda_1^0 \sum_{k=e,u,i} \bar{F}_1(\hat{w}_{ek-uk}(w_2)) \frac{m_{uk}}{m_u} dG_{2u}(w_2) + \beta_1$ and

$$a_2 = \int \lambda_2^0 \sum_{k=e,u,i} \bar{F}_2(\hat{w}_{ke-ku}(w_1)) \frac{m_{ju}}{m_u} dG_{1u}(w_1) + \beta_2$$

- Job-to-job transition (only for mothers):

$$D^2_{ee} = \int \frac{\lambda_2^1 \bar{F}_2(x)}{d_2(x)} (1 - \exp^{-d_2(x) T}) dG_2(x)$$

- Conditional transitions from unemployment to employment:

$$D^1_{ue}|(w_2 = w) = \frac{\lambda_1^0 \bar{F}_1(\hat{w}_{ee-ue}(w))}{a_1(w)} (1 - \exp^{-a_1(w) T})$$

$$D^2_{ue}|(w_1 = w) = \frac{\lambda_2^0 \bar{F}_2(\hat{w}_{ee-eu}(w))}{a_2(w)} (1 - \exp^{-a_2(w) T})$$

where $a_1(w) = \lambda_1^0 \bar{F}_1(\hat{w}_{ee-ue}(w)) + \beta_1$ and

$a_2(w) = \lambda_2^0 \bar{F}_2(\hat{w}_{ee-eu}(w)) + \beta_2$

10. Then, procedures 2-9 are repeated until convergence.

Thus, we construct the model stocks m_{jk}, where $j, k = e, u, i$ and the marginal distributions $G_1(w_1)$ and $G_2(w_2)$. Additionally, using the model parameters, we obtain the transition probabilities. Then, the model stocks, marginal distributions and transition probabilities can be checked against, respectively, i) the empirical proportion of households in which the son/daughter and the mother can be employed, unemployed or inactive in the first interview; ii) the empirical individual wage distributions in the first interview; and iii) the empirical transition probabilities.

5 Dataset and sample

The database for this study is the Monthly Employment Survey (PME) from the Brazilian Institute of Geography and Statistics (IBGE) for the years 2004 and 2014. This survey is a longitudinal and monthly database and investigates the population resident in urban areas of six metropolitan areas: Recife, Salvador, Belo Horizonte, São Paulo, Rio de Janeiro and Porto Alegre. The PME is a household survey that collects data on labor market activity of the population, including earnings, mobility decisions, occupational sector and formality status, and socioeconomic aspects such as schooling.

The sample used for descriptive analysis and to estimate the household job search model is selected from the original sample of households, and it comprises those households whose composition is i) mother, father and sons/daughters aged 14 to 24 years and ii) mother and sons/daughters aged 14 to 24 years, for which we can establish that the labor income of fathers is equal to zero[11].[12]. The households can or cannot have children aged 0 to 13 years. Thus, we exclude the households in which the sons/daughters live alone because we do not model the decision of children to leave the parents' house and the households with children aged over 24 years[13].

We exclude the households whose members have problems in the identification code or some inconsistent information throughout the panel [14]. We build the individual identifier code by applying a pairing algorithm developed by Ribas and Soares (2008). Additionally, we exclude the households with fathers or mothers aged below 14 years and the households with two mothers or two fathers.

Table 1 shows, by household composition, the percentage of households in 2004 and 2014 as well as the average unemployment and inactivity duration, and the average household labor income in 2014. This table is constructed to highlight the most important differences among the families to which we apply the household job search model in this study, which are present in the first and second rows of the table, and the households that we exclude from our analysis. The average unemployment and inactivity duration, measured in months, are calculated only for the households with at least one member with these statuses.

We observe that we estimate the household job search model for approximately 50% of the

[11]For households whose composition is i) mother, father and children aged 0 to 13 years, ii) mother and children aged 0 to 13 years, iii) father and sons/daughters aged 14 to 24 years, and iv) individuals aged 14 to 24 years and children aged 0 to 13 years, in a relationship that is not parenthood, we intend to estimate, in a future version of the study, the household job search model focusing on the decisions of sons/daughters aged 14 to 24 years who do not live with mothers and on the decisions of mothers who do not live with sons/daughters aged 14-24.

[12]We do not exclude the households in which the father is not present, but we do not model marriage formation and dissolution.

[13]Camarano et al. (2003) show that in Brazil, the average age of children who leave their parents' house and become the head of a family is 26 years. Thus, we consider 24 years to be a general threshold for children to become a household head or a spouse.

[14]Inconsistency problems include the presence of more than one head or the absence of a head, which is not possible based on the PMEs questionnaire.

Table 1: Unemployment and inactivity duration and labor income, by household composition

Household composition	Proportion		Duration		Labor income
	2004	2014	u	i	
Mother, father, sons/daughters 14-24	40.85	43.94	12	26	4,387
Mother, sons/daughters 14-24	9.32	10.96	10	22	1,937
Father, sons/daughters 14-24	1.09	1.26	10	27	2,600
Mother, father, sons/daughters <14	41.00	37.01	14	27	4,061
Father, sons/daughters <14	0.63	0.52	8	35	2,084
Mother, sons/daughters <14	6.42	5.19	12	23	1,159
Sons/daughters 14-24 and <14	0.68	1.11	12	26	3,783

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: The numbers in the first and second columns are percentages. Statistics in the first interview. i: inactivity and u: unemployment. Durations are in months and calculated for individuals with up to 72 months of unemployment/inactivity. Durations and labor income for 2014. Household labor income in Brazilian Reais, adjusted by the National Consumer Price Index (INPC), calculated by the Brazilian Institute of Geography and Statistics (IBGE) of February 2016.

total sample of families in 2004 and approximately 55% of the total sample of households in 2014. It is important to highlight that among these families, more than 80% have the presence of a father in both 2004 and 2014. In addition, if we compare the households that include sons/daughters aged 14 to 24 years, with and without a father, we verify that the presence of this member in a household is related to a higher average unemployment and inactivity durations. Finally, as expected, the households with a father, a mother and at least one son/daughter aged 14 to 24 years have the highest household labor income because these families potentially have more members in the labor force, followed by the families with a father, mother and sons/daughters aged up to 14. Thus, we observe that the most relevant contribution to the household labor income comes from the income of fathers.

We use the first and second interviews of each household, separated by one month, in our household job search estimations, for which we compute transition probabilities and wage changes. Thus, since we use transition information in our estimation process, we exclude the attrited households and the households whose sons/daughters aged 14 to 24 years and/or mother have attrition or do not have information about labor market status in one of the two observations[15]. In Appendices, Table 22, we show all of the performed exclusions and the respective decrement of individuals and families.

Applying these selection criteria, our subsample has 9,654 families in 2004 and 8,153 families in 2014, in which we have, respectively, 13,308 and 9,952 sons/daughters aged 14 to 24 years. We present in Tables 2 and 3 some descriptive statistics for the full sample of households[16] and

[15]The father must be present in the two considered interviews if the father is a member of the household, and we allowed children aged below 13 years to suffer attrition.

[16]We exclude only the households with problems in the identification code and the families with members who are not head, spouse or children.

Table 2: Continuous variables of the full samples and the subsamples, for 2004 and 2014

Variables	Full sample				Subsamples			
	2004		2014		2004		2014	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Age	31	20	37	21	29	16	31	17
Male	48.35	49.97	47.70	49.95	48.30	49.97	47.30	49.93
White	55.94	49.65	54.70	49.78	54.14	49.83	50.04	50.00
Schooling years	8	4	9	4	8	4	9	3
Formal	52.69	49.93	64.14	47.96	48.37	49.97	63.68	48.10
Unemp. duration	28	22	29	22	24	21	22	20
Individual income	802	2,175	1,248	2,795	716	1,886	1,092	2,460
Household income	2,602	4,268	3,628	5,302	2,763	4,035	3,898	5,070
Number of households	39,099		40,451		9,654		8,153	
Number of individuals	117,456		103,592		36,522		28,160	

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Statistics in the first interview. Male, White and Formal are percentages. Formal are registered employees and professionals who contribute to social security. Unemployment duration in months. Individual and household income in Brazilian Reais, adjusted by the National Consumer Price Index (INPC), calculated by the Brazilian Institute of Geography and Statistics (IBGE) of February 2016.

for the selected subsamples, after applying the selection criteria listed above for 2004 and 2014.

We observe that our final subsamples, which include households with at least one son/daughter aged 14 to 24 years, present younger individuals, a lower percentage of whites and workers in the formal sector, and a smaller average unemployment duration and individual labor income, in spite of a higher household labor income (Table 2). Moreover, in Table 3, we verify that our subsamples have a greater proportion of individuals with an elementary or high school level of education (up to 8 or up to 11 schooling years) and a lower percentage of individuals with higher education.

Indeed, by comparing the subsamples of 2004 and 2014, we observe that in this decade, the average number of schooling years and the percentage of individuals who completed high school and college increased. We also find increases in the proportion of workers with employed status and the formal sector. The average unemployment and inactivity decreased, and the individual and household labor income present significant real increased.

6 Descriptive analysis

Before presenting the estimation results of this study, in this section, we verify the relationship among the labor market statuses and transitions of mothers and sons/daughters of all households and of some subgroups through descriptive analyses. Moreover, we analyze the empirical wage offer distributions of sons/daughters and mothers. In the tables, e denotes employed, u denotes

Table 3: Frequencies of categorical variables for the full sample and the subsamples, for 2004 and 2014

Variables	Full sample		Subsamples	
	2004	2014	2004	2014
Household composition				
F, M, 14-24	38.37	36.08	80.86	79.84
M, 14-24	12.08	12.80	19.14	20.16
F, 14-24	1.85	2.10	-	-
F, M, <14	26.98	19.80	-	-
F, <14	0.53	0.32	-	-
M, <14	4.65	3.07	-	-
<14, 14-24	15.53	25.83	-	-
Educational Level				
Elementary	49.07	39.40	54.42	43.28
High school	25.15	33.06	28.52	36.88
College	25.78	27.55	17.05	19.84
Occupational skill				
Low	40.21	41.79	38.18	39.39
Median	23.29	26.45	23.18	26.80
High	36.50	31.75	38.64	33.81
Labor market situation				
Employed	42.49	48.65	42.81	48.52
Unemployed	5.58	2.73	6.69	3.49
Inactive	51.93	48.62	50.50	47.98
Number of households	39,099	40,451	9,654	8,153
Number of individuals	117,456	103,592	36,522	28,160

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.

Notes: Statistics in the first interview. Numbers are percentages. F: father, M: mother, 14-24: sons and daughters aged 14 to 24 years, and ¡ 14: sons and daughters aged up to 14 years. High-level occupational skill: managers, leaders and specialized public officials, artists and skilled workers; Medium-level occupational skill: technicians of medium level and administrative service workers; Low-level occupational skill: agricultural, hunting and fishing workers and industrial workers.

unemployed, and i denotes inactive or outside the labor force.

First, we calculated the stocks of households in each joint status ij, in which the son/daughter is in state i and the mother has the state j, in the first interview, that could have occurred from January 2004 to December 2004 or from January 2014 to December 2014, depending on when the household was first interviewed. These results are shown in Table 4. The stock of households in which both the son/daughter and the mother are employed is approximately 19% of the households in 2004 and 22% in 2014. The stocks of households in which the son/daughter is inactive, and the mother is employed, and vice versa are relatively high, respectively, 30% and 14% of the households in 2004 and 38% and 11% in 2004. In general, both members are inactive in 20-21% of the households.

Table 4: Household stocks in 2004 and 2014

Son/daughter	Mother	2004	2014
e	e	18.88	21.69
e	u	1.41	0.72
e	i	13.59	11.21
u	e	6.83	4.10
u	u	1.20	0.52
u	i	4.43	2.05
i	e	29.71	38.42
i	u	3.04	1.28
i	i	20.91	20.01

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Numbers are percentages. e: employed, u: unemployed, and i: inactive. Stocks calculated in the first interview.

The next table presents the labor market status and the mean and standard deviation of wages of the two analyzed members, conditional on the status of the other member, and for some subgroups. These statistics are cross-sectional components since we are calculating them at one point in time, for the first interview of the members and only for 2014. The first part of Table 5 shows these cross-sectional components of sons/daughters by their age group, conditional on the status of mothers. We define two age groups for sons/daughters: i) Under 16 years, who have a higher probability of being studying, and ii) Over 16 years, who have a higher chance of being active in labor market.

We observe that the vast majority of sons/daughters aged under 16 years in our sample is in inactive status, whereas their mothers are employed (about 53%) or also inactive (about 31%). However, if we consider the sons/daughters over 16 years, we observe higher proportions of employment and those who have employed mothers (about 29%) or inactive mothers (about 19%). Among these sons/daughters aged over 16 years, 23% present inactive status with an employed mother, and 15% are inactive with an inactive mother.

It is important to highlight that sons/daughters whose mother is employed have a higher average labor market income, which means that the better conditions of these two members in the labor market could be correlated. The labor income of sons/daughters aged over 16 years and whose mother is inactive is the highest, perhaps indicating some substitutability of these two members. Finally, the average wage of older sons/daughters is greater.

The second part of this table presents the statistics for mothers, conditional on the status of sons/daughters, and for two subgroups based on the schooling of mothers. We define eight schooling years (completed elementary school) as the threshold to determine the subgroups. Table 5 permits to verify that about 20-21% of mothers are employed, whereas their sons/daughters are also employed. It is important to highlight that 27% of mothers with up to 8 years of schooling are employed while their sons/daughters are inactive, but this proportion is 41% if we consider mothers with more than eight years of schooling. This fact evidence that the better conditions of mothers in the labor market could allow the children to postpone the entering in labor force.

The percentage of inactive mothers with employed sons/daughters is 15% among less educated mothers and 9% among mothers with more than eight years of schooling. The proportion of inactive mothers with sons/daughters with the same status is, respectively, 23% and 18%. Similar to the results for sons/daughters, the average labor income of mothers with more than eight years of schooling and whose son/daughter is inactive is the highest. These facts can highlight the joint nature of the decision-making process of sons/daughters and mothers and how the labor market outcomes of these two members can be intimately linked. Finally, as expected, more educated mothers have higher wages, independent of the status of their sons/daughters.

The next figure shows the densities of the empirical wage offer distribution, that is, the distribution of wages received by employed individuals in the second interview who were unemployed in the first interview, for 2014. These empirical individual wage distributions are inputs in our estimation process. Figure 4 presents this distribution for sons/daughters aged 14 to 24 years (Chart (a)) and for mothers (Chart (b)). We observe that the two distributions are distinct regarding skewness and kurtosis since the distribution of sons/daughters is more symmetric and light-tailed and is more similar to a Normal distribution, whereas the distribution for mothers seems to a Weibull distribution.

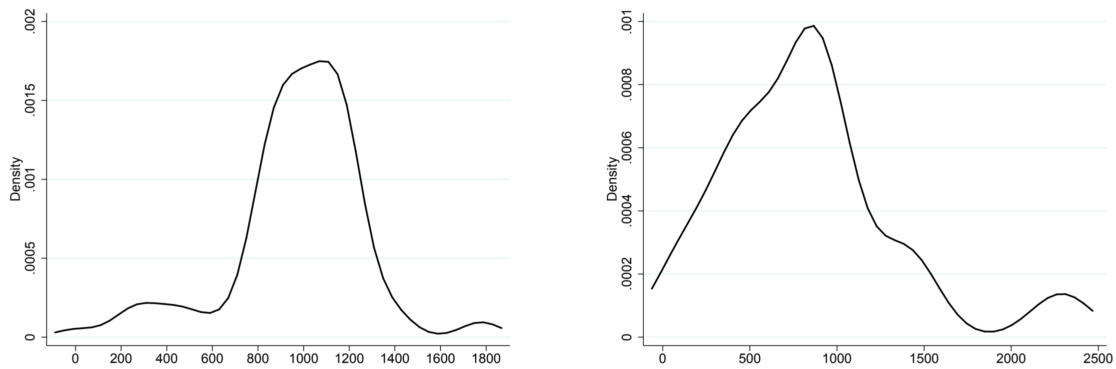
Next, we concern the flows of sons/daughters and mothers across labor market states between the first and second interviews, conditional on the initial state of the member. In the columns of Table 6, we observe the total percentage of sons/daughters that move across labor market states, and the same proportions by age group, in 2004 and 2014. In Table 7, we have the total percentage of mothers performing transitions and these proportions by schooling group. Seven labor market conditional transitions are verified: i) $e \to u$: transition from employment to unemployment, conditional on initial state e; ii) $e \to i$: transition from employment to inactivity, conditional on initial state e; iii) $e \to e'$: job-to-job transition, conditional on initial state e, that is, in the second interview the employed worker answered to have suffered a job

Table 5: Cross-sectional components: conditional status and wages, by age group of sons/daughters and by schooling of mothers, in 2014

Age son/daughter	Up to 16 years			More than 16 years		
	Status mother					
	e	u	i	e	u	i
Status son/daughter						
e	5.05	0.43	1.88	28.82	1.46	18.51
u	2.39	0.54	0.96	7.35	1.08	4.65
i	53.39	4.31	31.04	22.62	1.03	14.48
Wage son/daughter						
Mean	40	27	29	525	338	533
Standard deviation	165	104	151	813	515	811
Schooling mother	Up to 8 schooling years			More than 8 schooling years		
	Status son/daughter					
	e	u	i	e	u	i
Status mother						
e	19.67	5.92	27.17	20.80	5.12	41.43
u	1.33	1.04	2.47	0.81	0.71	1.92
i	15.33	4.25	22.82	9.17	2.23	17.80
Wage mother						
Mean	472	399	434	1,617	1,247	1,796
Standard deviation	624	475	611	2,618	1,945	3,066

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) for 2014. Notes: Status and wages in the first interview. e: employed; u: unemployed; i: inactive. Numbers in the first three rows are percentages. Wages in Brazilian Reais, adjusted by the National Consumer Price Index (INPC), calculated by the Brazilian Institute of Geography and Statistics (IBGE) of February 2016.

Figure 4: Empirical wage distributions of sons/daughters and mothers, for 2014



(a) Sons/daughters (b) Mothers

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Wages accepted in the second by the workers that were unemployed in the first interview. Wages in Brazilian Reais, adjusted by the National Consumer Price Index (INPC), calculated by the Brazilian Institute of Geography and Statistics (IBGE) of February 2016.

change in which there were at most thirty days, which by hypothesis was not followed by an unemployment period; iv) $u \to e$: transition from unemployment to employment, conditional on initial state u; v) $u \to i$: transition from unemployment to inactivity, conditional on initial state u; vi) $i \to e$: transition from inactivity to employment, conditional on initial state i; and vii) $i \to u$: transition from inactivity to unemployment, conditional on initial state i. This table is built to highlight transitions occurring in the labor market and the stable situations in which the member is inactive, unemployed and employed without a job change in the two interviews are not presented.

If we compare the transitions of Tables 6 and 7, we observe that the percentage of sons/daughters leaving employment for unemployment, inactivity or another job, conditional on being employed in the first interview, are higher than the percentage of mothers, for 2004 and 2014, which means that turnover is more frequent among employed sons/daughters. The opposite occurs for the transition between inactivity and employment, conditional on being inactive in the first interview, which is stronger among mothers. Between 2004 and 2014, the transitions of employed workers to unemployment decreased in general, both for sons/daughters and mothers, can be related to a more dynamic labor market.

Focusing on the transitions of sons/daughters by age group, we verify that the transitions from employment or unemployment to inactivity are more frequent among sons/daughters aged up to 16 years, in both years. As earlier argued, these youth are most likely to have not finished high school. Therefore, this larger move to inactivity may be related to entirely or partially attending school. However, the transitions from unemployment or inactivity to employment and from inactivity to unemployment are more frequent among sons/daughters aged over 16 years, who are most likely to have finished high school, and most of them may be entering the labor force.

It is important to highlight that between 2004 and 2014, all of the transitions of sons/daughters decreased, thus indicating the lesser labor market turnover and the better conditions in the Brazilian economy and labor market. The exception is the move from unemployment to inactivity, that is, the youth leaving the labor market, which increased by 61%. The motivation for estimating a household job search model that accounts for the transitions to inactivity also arises from these statistics.

Table 6: Transitions of sons/daughters, conditional on initial status and by age group, in 2004 and 2014

Transitions	2004			2014		
	Total	$\leq$ 16 years	$>$ 16 years	Total	$\leq$ 16 years	$>$ 16 years
e→u	3.60	4.36	3.52	1.88	2.11	1.87
e→i	5.98	18.72	4.68	5.81	16.28	5.09
u→e	12.76	6.96	13.67	9.42	2.00	10.89
u→i	26.09	50.67	22.24	41.90	67.39	36.85
i→e	4.98	2.70	8.19	3.48	1.27	6.22
i→u	6.87	3.04	12.30	3.15	1.36	5.38
e→e'	1.86	0.48	2.00	1.13	0.78	1.16

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Numbers are percentages. e: employed; u: unemployed; i: inactive; e': employed in another job.

Table 7: Transitions of mothers, conditional on initial status and by schooling of mothers, in 2004 and 2014

Transitions	2004			2014		
	Total	$\leq$ 8 years	$>$ 8 years	Total	$\leq$ 8 years	$>$ 8 years
e→u	1.03	1.11	0.93	0.39	0.44	0.36
e→i	4.66	5.90	3.04	3.58	4.10	3.26
u→e	16.50	18.43	12.67	7.36	8.58	6.14
u→i	27.59	26.18	30.38	38.69	30.13	47.37
i→e	7.96	8.23	7.33	7.81	8.35	7.21
i→u	4.34	4.11	4.90	1.78	1.85	1.69
e→e'	1.56	1.79	1.25	0.87	1.18	0.68

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Numbers are percentages. e: employed; u: unemployed; i: inactive; e': employed in another job.

However, if we focus on the transitions of mothers (Table 7), we observe that all of the transitions, except the move from unemployment to inactivity and from inactivity to unemployment, are more frequent among mothers with up to 8 years of schooling. It is also important to note that between 2004 and 2014, similar to sons/daughters, the turnover among mothers of both schooling groups seems to have decreased since we observe lower transitions of employed mothers to unemployment, from unemployment to employment and job-to-job. Moreover, the percentage of mothers moving from inactivity to unemployment decreases, whereas the proportion of mothers moving from unemployment to inactivity increases for both schooling groups, but mainly for more educated mothers, although we verify that the stock of inactive mothers has decreased over the period (Table 7).

7 Estimated parameters and model fit

7.1 Estimation results for 2004 and 2014

This section presents the estimation results based on the econometric model discussed in Section 3.3, performed separately for 2004 and 2014, and for subgroups of sons/daughters and mothers. We calibrate the values of leisure b_1 and b_2 (that are equal to the minimum wage in the data). As discussed above, we assume the CRRA form for the utility function, which allows estimations and simulations to be performed while considering the linear case (the parameter ρ of the utility function is equal to 1) or some level of risk aversion. The risk aversion is particularly relevant in simulations for the contribution of Y, some additional non-labor income or the labor income of fathers because an increase in Y could impact the reservation wages of sons/daughters and mothers.

Thus, Table 8 presents the estimated parameters or transition rates for 2004 and 2014 and for the parameters $\rho = 1$ and $\rho = 0.95$[17]. Despite being relevant for simulation results, we observe that we have only minor changes in the transition rates if we consider some level of risk aversion, and the main changes occur in the arrival rates if unemployed of sons/daughters, which are higher if the model is estimated under risk aversion.

We observe that the estimated destruction rates δ_1 and δ_2 decrease between 2004 and 2014, which we also observe in empirical transitions. The same occurs for the arrival rates if unemployed of sons/daughters and mothers, respectively, λ_1^0 and λ_2^0. However, the estimated arrival rate if employed of mothers increases in this period, which is not observed in the data.

It is important to note that the estimated encouragement rates α_1 and α_2 (move from inactivity to unemployment) decrease for both members, whereas the discouragement/dropout rates β_1 and β_2 increase in this period. These facts are confirmed by empirical transitions.

Next, Table 9 shows a comparison between the stocks, transition rates, and wages estimated with the household job search model and the empirical counterparts for 2004 and 2014 and for the parameters $\rho = 1$ and $\rho = 0.95$. We obtain a reasonable good fit for stocks, except the stock of households in which both members are employed and in which both are inactive. For 2004, the stock m_{ee} is overestimated and the stock m_{ii} is underestimated for both $\rho = 1$ and

[17]We arbitrarily choose this level of risk aversion.

Table 8: Transition rates for 2004 and 2014

Transition rates	2004		2014	
	$\rho = 1$	$\rho = 0.95$	$\rho = 1$	$\rho = 0.95$
δ_1	0.0364	0.0364	0.0199	0.0199
δ_2	0.0098	0.0098	0.0054	0.0054
λ_1^0	0.1814	0.1892	0.1621	0.1637
λ_2^0	0.2435	0.2435	0.1303	0.1303
λ_2^1	0.1354	0.1354	0.1512	0.1513
α_1	0.0734	0.0734	0.0389	0.0389
α_2	0.0418	0.0418	0.0242	0.0242
β_1	0.3792	0.3792	0.6491	0.6490
β_2	0.4384	0.4384	0.6100	0.6100

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Transitions rates are per month. We assume the CRRA form for the utility function, in which $\rho = 1$ is the linear case, and $\rho = 0.95$ is a concave case.

$\rho = 0.95$. The contrary occurs in estimates for 2014 that present an underestimated m_{ee} and an overestimated m_{ii}. For this year, we also have an overestimation of m_{ei} and an underestimation for m_{ie}. Since the fits of F_1 and F_2 and for the transitions $D_{ss'}$ are exact, the fits of stocks and distributions G_1 and G_2, which are unrestricted moments, do not fit as well.

For wages, we find a good fit for 2004 and 2014, and it is even better for sons/daughters. For the wages of mothers, the model does not fit as well, particularly in lower percentiles, but improve in the highest ones. Flabbi and Mabli (2012) find a very good fit for the husbands' wage distribution, but they also find a worse fit for the wives' wage distribution. Dey and Flinn (2008) have similar problems in fitting the cross-sectional moments of wives, and Flabbi (2010) and Bowlus (1997) obtain a better fit for the male wage distribution than for the female wage distribution. Once again, we find only minor changes in the estimated stocks and wages if we consider some level of risk aversion, and the main change occurs in the first percentile of the sons/daughters wages, which is higher if the model is estimated under risk aversion.

7.2 Estimation results for subgroups

We perform estimations using subgroups, in addition to the estimations with the general sample of households, based on the age group of sons/daughters and the schooling group of mothers. In these subgroup estimations, we assume the linear form of the utility function; that is, we do not consider any level of risk aversion.

Table 10 presents the transition rates for the estimations performed for two age groups of sons/daughters: i) Under 16 years, who have a higher probability of being studying, and ii) Over 16 years, who have a higher chance of being active in labor market. We verify that the estimated destruction rates are higher for both members if we consider the sons/daughters under 16 years of age.

Table 9: Model fit for 2004 and 2014

Model fit	2004			2014		
	Data	$\rho = 1$	$\rho = 0.95$	Data	$\rho = 1$	$\rho = 0.95$
Stocks						
m_{ee}	0.1855	0.3024	0.3017	0.2171	0.1532	0.1528
m_{eu}	0.0141	0.0133	0.0134	0.0059	0.0068	0.0068
m_{ue}	0.0629	0.0635	0.0637	0.0395	0.0186	0.0186
m_{ei}	0.1337	0.1362	0.1368	0.1131	0.1680	0.1683
m_{ie}	0.2997	0.3170	0.3175	0.3844	0.3053	0.3057
m_{uu}	0.0117	0.0049	0.0049	0.0051	0.0018	0.0018
m_{ui}	0.0442	0.0274	0.0273	0.0200	0.0200	0.0200
m_{iu}	0.0297	0.0094	0.0094	0.0141	0.0113	0.0113
m_{ii}	0.2185	0.1260	0.1255	0.2008	0.3149	0.3147
Transitions youth						
u→e	0.1319	0.1319	0.1319	0.1104	0.1104	0.1104
u→i	0.2916	0.2916	0.2916	0.4448	0.4448	0.4448
i→u	0.0708	0.0708	0.0708	0.0382	0.0382	0.0382
e→u	0.0357	0.0357	0.0357	0.0197	0.0197	0.0197
Transitions mother						
u→e	0.1766	0.1766	0.1766	0.0921	0.0921	0.0921
u→i	0.3178	0.3178	0.3178	0.4310	0.4310	0.4310
i→u	0.0409	0.0409	0.0409	0.0239	0.0239	0.0239
e→u	0.0097	0.0097	0.0097	0.0054	0.0054	0.0054
e→e'	0.0153	0.0153	0.0153	0.0115	0.0115	0.0115
Wages youth						
$P10$	5.2581	5.4588	5.6258	6.1964	6.0712	6.1964
$P25$	6.1054	5.7689	5.8941	6.6590	6.4986	6.4986
$P50$	6.3567	6.2798	6.2798	6.8596	6.8596	6.8596
$P75$	6.7244	6.6162	6.6162	7.0767	7.1243	7.1243
$P90$	7.0682	6.8675	6.9110	7.4062	7.3334	7.3334
Mean	6.5278	6.3807	6.4092	6.9610	6.9139	6.9214
Wages mother						
$P10$	5.4657	6.3130	6.3130	6.2584	7.0469	7.0469
$P25$	5.9766	6.7650	6.7650	6.5949	7.5934	7.5934
$P50$	6.3130	7.2003	7.2003	6.8462	7.8678	7.8678
$P75$	7.0752	7.5026	7.5026	7.3570	8.0830	8.0830
$P90$	7.8636	7.7344	7.7344	8.0830	8.2599	8.2599
Mean	7.0225	7.2977	7.2977	7.3967	7.9074	7.9074

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.

Notes: Transitions rates are per month. We assume the CRRA form for the utility function, in which $\rho = 1$ is the linear case and $\rho = 0.95$ is a concave case.

However, the arrival rates are higher for both unemployed members in the estimations for older sons/daughters, but the difference for mothers is small. We have problems in estimating the arrival rate for employed mothers in the subgroup of sons/daughters aged over 16 years and the discouragement/dropout rate of sons/daughters in the subgroup of younger sons/daughters, which present unfamiliar values, probably because of the sample size.

We also observe that the estimated encouragement rate for sons/daughters aged over 16 years is more than four times higher than the encouragement rate for younger children in 2004. For 2014, this difference is even greater. However, the discouragement/dropout rate for 2004 is approximately 59% higher among sons/daughters aged under 16 years. These facts are related to higher probability of fully or partially studying among the younger youth.

Table 10: Transition rates by age group of sons/daughters

Transition rates	Up to 16 years		More than 16 years	
	2004	2014	2004	2014
δ_1	0.0456	0.0312	0.0354	0.0190
δ_2	0.0120	0.0070	0.0086	0.0045
λ_1^0	0.0952	0.0637	0.2230	0.1826
λ_2^0	0.2272	0.1586	0.2587	0.1107
λ_2^1	0.0234	0.0320	0.9009	2.4197
α_1	0.0305	0.0181	0.1350	0.0656
α_2	0.0524	0.0349	0.0364	0.0185
β_1	0.7859	1.1613	0.3230	0.5610
β_2	0.4017	0.6919	0.4724	0.5535

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Transitions rates are per month. In subgroup estimations, we assume the CRRA form for the utility function, with $\rho = 1$.

The next table of this section presents the transition rates for the estimations performed for two education groups for mothers: i) Up to eight schooling years (completed elementary school) and ii) More than eight schooling years, which includes mothers with complete and incomplete high school and college educations. We verify in Table 11 that the estimated destruction rates are higher for both members and in both years, if we consider the subgroup of mothers with complete or incomplete elementary school, as expected, since low education workers may have relatively worse conditions in the labor market. However, in this subgroup, in 2004, unemployed and employed mothers present arrival rates that are, respectively, approximately 59% higher and 98% higher than those of the mothers in the subgroup with more than eight schooling years. This situation was reversed in 2014, and the arrival rates for mothers in the subgroup with more than eight schooling years surpassed the rates for less educated mothers.

We do not find significant differences in estimations for the education groups in the arrival rate of employed sons/daughters and the encouragement rate of mothers. However, we observe that the encouragement and the discouragement/dropout rates of sons/daughters are higher if the mothers have up to 8 schooling years in both years. Indeed, the discouragement rate of mothers is higher among the more educated, and the difference was particularly higher in 2014.

Table 11: Transition rates by education of mothers

Transition rates	Up to 8 schooling years		More than 8 schooling years	
	2004	2014	2004	2014
δ_1	0.0398	0.0253	0.0295	0.0144
δ_2	0.0105	0.0074	0.0089	0.0041
λ_1^0	0.1802	0.1633	0.1879	0.1598
λ_2^0	0.2782	0.1276	0.1746	0.1334
λ_2^1	0.1860	0.1336	0.0939	0.1757
α_1	0.0816	0.0478	0.0607	0.0324
α_2	0.0408	0.0238	0.0442	0.0247
β_1	0.3899	0.7065	0.3573	0.5964
β_2	0.4276	0.4988	0.4599	0.7276

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Transitions rates are per month. In subgroup estimations, we assume the CRRA form for the utility function, with $\rho = 1$.

Tables 23 and 24 in the Appendices show the fit of stocks and wages of the estimations for the subgroups based on the age of sons/daughters and schooling of mothers. We do a reasonable job fitting the stocks and wages, in spite of an underestimation of the stock m_{ii} and an overestimation of the stock m_{ee} for 2004 and the opposite for 2014.

8 Simulations

8.1 The impact of changes in the job arrival and job destruction rates

The first part of the simulations performed in this study addresses the impacts of increases and decreases in arrival and job destruction rates. We perform exercises in which we start from a given set of estimates of the model parameters and change only one parameter at a time. We aim to determine how variations in these parameters affect the labor market outcomes of sons/daughters and mothers, the unemployment and inactivity rates and wages, and the welfare of households.

As presented in subsection 3.3.7, which concerns the firms' maximization problem and the market equilibrium, in our model, the wages are endogenously determined. Our main estimations, presented above, are performed under this assumption[18]. The main advantage in determining wages endogenously is the possibility of accessing the total effect of policies that affect both workers and firms, such as the minimum wage.

[18] We also test for exogenous wages, aiming to analyze the impact that this procedure has on the results, and we do not find differences between the simulation results under exogenous and endogenous wages for both values of ρ. Thus, we proceed with the remaining simulations under endogenous wages.

We first simulate 10%, 20% and 30% decreases in destruction rates of both members while holding the other parameters fixed at their estimated values. Table 12 shows the results for 2004. Then, we simulate a 10%, 20% and 30% increase in the arrival rates of both members. These results are shown in Table 13 for 2004. The results of simulations for 2014 are similar to the results for 2004, and they are shown in the Appendices, Tables 25 and 26.

We observe that a decrease in job destruction rates of both members, that is, a reduction in search frictions, reduces the unemployment rate of both members, as expected. However, these changes also negatively impact the inactivity rate, which is not expected to occur because we observe an increase in inactivity rate for sons/daughters in the last decade when we analyze empirical data. Thus, the trends of the inactivity rates possibly are better explained by the changes in encouragement and discouragement/dropout rates during the period. These simulation results are similar for $\rho = 1$ and $\rho = 0.95$.

The average wages of sons/daughters and mothers become higher as a consequence of a decrease in the job destruction rates. Moreover, the average welfare and the welfare levels of employed, unemployed and inactive workers increase with lower job destruction rates.

The increases in arrival rates of both members, which are another source of the reduction in search frictions, also negatively impact the unemployment and inactivity rates for both years and values of ρ. These changes do not affect wages, but they rise the level of welfare of both members, regardless of whether they are employed, unemployed or inactive. However, comparing the effects of a percentage reduction in job destruction rates to a percentage increase in arrival rates, we verify that the former are stronger, perhaps evidencing that policies or actions that diminish this source of search friction could be more effective.

8.2 Counterfactual simulations

The second set of simulations results are counterfactual experiments in which we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping one or more specific parameters or distributions unchanged, and we run simulations using 2004 as a benchmark. The objective is to analyze if the new estimates converge to estimates obtained for 2014. Thus, we can draw conclusions about the contribution of these parameters or wage distributions to the trends in unemployment, inactivity, wages and welfare observed in this decade.

Tables 14-17 present the results of the counterfactual simulations for the stocks of households in each joint labor market state and the unemployment and inactivity of sons/daughters and mothers. Tables 14 and 15 are constructed for simulations under risk neutrality, that is, for the linear form of the utility function, while Tables 16 and 17 are constructed for simulations under risk aversion, which is particularly relevant for the simulations of the values of Y, as earlier discussed.

In Table 14, we replace the parameters and wage offer distributions of 2004 for the param-

Table 12: Simulations: decrease job destruction rates δ_1 and δ_2, in 2004

δ_1 and δ_2	$\rho = 1$				$\rho = 0.95$			
	Benchmark	10%	20%	30%	Benchmark	10%	20%	30%
Stocks								
m_{ee}	0.3024	0.3289	0.3597	0.3931	0.3017	0.3269	0.3555	0.3898
m_{eu}	0.0133	0.0130	0.0126	0.0120	0.0134	0.0130	0.0126	0.0120
m_{ue}	0.0635	0.0627	0.0614	0.0599	0.0637	0.0631	0.0621	0.0605
m_{ei}	0.1362	0.1335	0.1298	0.1247	0.1368	0.1340	0.1301	0.1250
m_{ie}	0.3170	0.3136	0.3080	0.3016	0.3175	0.3153	0.3115	0.3043
m_{uu}	0.0049	0.0043	0.0038	0.0032	0.0049	0.0043	0.0038	0.0032
m_{ui}	0.0274	0.0242	0.0210	0.0177	0.0273	0.0241	0.0209	0.0177
m_{iu}	0.0094	0.0083	0.0072	0.0061	0.0094	0.0083	0.0072	0.0061
m_{ii}	0.1260	0.1114	0.0966	0.0816	0.1255	0.1110	0.0963	0.0814
Unemployment rate								
Youth	0.1749	0.1610	0.1464	0.1324	0.1750	0.1618	0.1484	0.1338
Mother	0.0388	0.0351	0.0313	0.0275	0.0388	0.0351	0.0313	0.0275
Inactivity rate								
Youth	0.2895	0.2691	0.2473	0.2240	0.2895	0.2691	0.2473	0.2240
Mother	0.4524	0.4334	0.4118	0.3894	0.4524	0.4346	0.4150	0.3918
Wages youth								
$P10$	5.4588	5.4588	5.4588	5.4588	5.6258	5.6258	5.6258	5.6258
$P25$	5.7689	5.8941	5.8941	5.8941	5.8941	5.8941	5.8941	5.8941
$P50$	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798
$P75$	6.6162	6.6162	6.6162	6.6162	6.6162	6.6162	6.6718	6.6718
$P90$	6.8675	6.9110	6.9110	6.9110	6.9110	6.9110	6.9110	6.9110
Mean	6.3807	6.3847	6.3884	6.3993	6.4092	6.4161	6.4250	6.4322
Wages mother								
$P10$	6.3130	6.3130	6.3130	6.5644	6.3130	6.3130	6.3130	6.5644
$P25$	6.7650	6.9321	6.9321	6.9321	6.7650	6.9321	6.9321	6.9321
$P50$	7.2003	7.2003	7.3116	7.3116	7.2003	7.2003	7.3116	7.3116
$P75$	7.5026	7.5026	7.5860	7.5860	7.5026	7.5026	7.5860	7.5860
$P90$	7.7344	7.7344	7.7344	7.7344	7.7344	7.7344	7.7344	7.7344
Mean	7.2977	7.3217	7.3481	7.3775	7.2977	7.3218	7.3481	7.3775
Welfare youth								
Employed	1839	1896	1965	2048	1374	1415	1462	1521
Unemployed	1785	1838	1904	1984	1341	1382	1427	1485
Inactive	1799	1853	1919	2000	1348	1389	1434	1492
Welfare mother								
Employed	1971	2031	2103	2188	1466	1510	1559	1619
Unemployed	1486	1498	1511	1527	1134	1145	1155	1168
Inactive	1479	1490	1503	1518	1127	1138	1147	1159
Average welfare	1815	1872	1941	2024	1359	1401	1447	1507

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004.

Notes: We assume the CRRA form for the utility function, in which $\rho = 1$ is the linear case and $\rho = 0.95$ is a concave case. Benchmarks are the estimations present in Table 9.

Table 13: Simulations: increase arrival rates λ_1^0 and λ_2^0, in 2004

λ_1^0 and λ_2^0	$\rho = 1$				$\rho = 0.95$			
	Benchmark	10%	20%	30%	Benchmark	10%	20%	30%
Stocks								
m_{ee}	0.3024	0.3271	0.3491	0.3688	0.3017	0.3245	0.3448	0.3654
m_{eu}	0.0133	0.0131	0.0128	0.0125	0.0134	0.0131	0.0128	0.0125
m_{ue}	0.0635	0.0629	0.0623	0.0618	0.0637	0.0634	0.0631	0.0624
m_{ei}	0.1362	0.1343	0.1304	0.1280	0.1368	0.1348	0.1302	0.1279
m_{ie}	0.3170	0.3131	0.3095	0.3062	0.3175	0.3152	0.3130	0.3089
m_{uu}	0.0049	0.0045	0.0042	0.0039	0.0049	0.0045	0.0042	0.0039
m_{ui}	0.0274	0.0246	0.0225	0.0205	0.0273	0.0245	0.0226	0.0205
m_{iu}	0.0094	0.0082	0.0073	0.0064	0.0094	0.0082	0.0073	0.0064
m_{ii}	0.1260	0.1121	0.1018	0.0918	0.1255	0.1118	0.1020	0.0920
Unemployment rate								
Youth	0.1749	0.1624	0.1532	0.1448	0.1750	0.1636	0.1556	0.1466
Mother	0.0388	0.0354	0.0326	0.0301	0.0388	0.0354	0.0326	0.0301
Inactivity rate								
Youth	0.2895	0.2710	0.2548	0.2403	0.2895	0.2710	0.2547	0.2403
Mother	0.4524	0.4334	0.4187	0.4045	0.4524	0.4351	0.4223	0.4073
Wages youth								
$P10$	5.4588	5.4588	5.4588	5.4588	5.6258	5.6258	5.6258	5.6258
$P25$	5.7689	5.8941	5.8941	5.8941	5.8941	5.8941	5.8941	6.0053
$P50$	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798	6.3567
$P75$	6.6162	6.6162	6.6162	6.6162	6.6162	6.6162	6.6718	6.6718
$P90$	6.8675	6.9110	6.9110	6.9110	6.9110	6.9110	6.9110	6.9110
Mean	6.3807	6.3850	6.3977	6.4066	6.4092	6.4180	6.4351	6.4412
Wages mother								
$P10$	6.3130	6.3130	6.3130	6.3130	6.3130	6.3130	6.3130	6.3130
$P25$	6.7650	6.7650	6.7650	6.7650	6.7650	6.7650	6.7650	6.7650
$P50$	7.2003	7.2003	7.2003	7.2003	7.2003	7.2003	7.2003	7.2003
$P75$	7.5026	7.5026	7.5026	7.5026	7.5026	7.5026	7.5026	7.5026
$P90$	7.7344	7.7344	7.7344	7.7344	7.7344	7.7344	7.7344	7.7344
Mean	7.2977	7.2978	7.2978	7.2978	7.2977	7.2978	7.2978	7.2978
Welfare youth								
Employed	1839	1866	1887	1903	1374	1396	1415	1428
Unemployed	1785	1813	1833	1852	1341	1366	1384	1398
Inactive	1799	1827	1847	1866	1348	1372	1391	1404
Welfare mother								
Employed	1971	1989	2002	2013	1466	1483	1495	1504
Unemployed	1486	1507	1521	1532	1134	1154	1169	1177
Inactive	1479	1499	1512	1522	1127	1146	1160	1168
Average	1815	1844	1865	1884	1359	1383	1402	1415

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004.

Notes: We assume the CRRA form for the utility function, in which $\rho = 1$ is the linear case, and $\rho = 0.95$ is a concave case. Benchmark are the estimations present in Table 9.

eters and distributions of 2014, keeping only one parameter unchanged. We verify that the parameter that mostly contributes to the decreasing trend between 2004 and 2014 in youth unemployment is the job destruction rate, which diminishes in this period. It is important to highlight that the reduction in the job destruction rates in this decade can be associated with better economic conditions and labor market opportunities and less turnover. If this transition rate had remained the same as 2004, the unemployment rate among sons/daughters would have grown. The unemployment rate of mothers did not change significantly in this period, and the two factors that seem to have contributed to this stable rate are the decrease in job destruction rate for mothers, which seems to be compensated for by a reduction in arrival rates for mothers.

The increasing trend in the inactivity of sons/daughters seems to be determined by more than one factor. First, we observe that the decreasing encouragement rate is the factor that makes the main contribution to this trend because if this parameter remains unchanged, the inactivity would be almost the same as in 2004. The second most important parameter that contributes to the decreasing youth inactivity is the dropout rate, which increased in this period. It is important to discuss the main factors that can be related to the decreasing encouragement rate and the increasing dropout rate observed in this period. The primary factor that must be cited is the reduction in the cost of education for sons and daughters between 2004 and 2014, as a consequence of some public policies. Some programs, such as the ProUni (University for All Program), created in 2004 and that offers partial or total scholarships to private universities, the FIES (Student Financing Fund), a program that finances the costs of college at subsided lower rates for students, and the racial and social quotas established in some public universities, favor the access to and reduce the cost of education for sons and daughters intending to pursue higher education. Other programs such as the Bolsa Famlia Program (BFP), a cash transfer program based on the household income and composition whose benefits are conditional on school attendance and health care of children and teenagers, can reduce the cost of attending elementary and high school. As observed in Table 10, the encouragement rate decreases and the dropout rate increases in the subgroups of sons/daughters aged under and over 16 years.

Indeed, if the job destruction rate of sons/daughters that decreased in this period remained unchanged, the inactivity would be even higher than it was in 2014.

The inactivity of mothers seems to be explained by the same parameters. First, the decreasing encouragement and the increasing dropout rate collaborate in the same direction because if these parameters remain stable, the inactivity of mothers would be lower than it was in 2014, meaning that exogenous factors also affected the move from unemployment to inactivity of these household members. As observed in the estimation results for subgroups (Table 11), the encouragement rate decreased almost in the same magnitude in the subgroups of mothers with up to 8 schooling years and those with more than the elementary school. However, the dropout rate, i.e., the move from unemployment to inactivity, presented a greater rise among more educated mothers.

Table 14: Unemployment, inactivity and stocks between 2004 and 2014: the one-to-one contribution of parameters and distributions

$\rho = 1$	2004	2014	δ_1	δ_2	λ_1^0	λ_2^0	λ_2^1	α_1	α_2	β_1	β_2	F_1	F_2	Y
Stocks														
m_{ee}	0.302	0.153	0.099	0.109	0.165	0.205	0.154	0.216	0.196	0.207	0.180	0.152	0.154	0.154
m_{eu}	0.013	0.007	0.004	0.009	0.007	0.005	0.007	0.009	0.009	0.009	0.008	0.007	0.007	0.007
m_{ue}	0.064	0.019	0.022	0.013	0.018	0.025	0.019	0.027	0.024	0.026	0.022	0.019	0.019	0.019
m_{ei}	0.136	0.168	0.108	0.214	0.180	0.121	0.167	0.231	0.127	0.224	0.142	0.166	0.167	0.167
m_{ie}	0.317	0.305	0.360	0.213	0.296	0.403	0.307	0.236	0.388	0.247	0.356	0.308	0.307	0.307
m_{uu}	0.005	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
m_{ui}	0.027	0.020	0.023	0.025	0.019	0.014	0.020	0.028	0.015	0.027	0.017	0.020	0.020	0.020
m_{iu}	0.009	0.011	0.013	0.014	0.011	0.007	0.011	0.009	0.014	0.009	0.013	0.011	0.011	0.011
m_{ii}	0.126	0.315	0.369	0.400	0.302	0.218	0.314	0.241	0.226	0.250	0.260	0.314	0.314	0.314
Unemployment rate														
Youth	0.175	0.110	0.184	0.110	0.100	0.110	0.110	0.111	0.110	0.112	0.110	0.111	0.110	0.110
Mother	0.039	0.040	0.040	0.070	0.040	0.022	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Inactivity rate														
Youth	0.452	0.632	0.742	0.628	0.609	0.627	0.632	0.486	0.628	0.505	0.630	0.634	0.632	0.632
Mother	0.290	0.503	0.500	0.639	0.500	0.353	0.500	0.500	0.367	0.501	0.419	0.500	0.500	0.500

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: In these simulations, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping one parameter or distribution unchanged, and we run simulations using 2004 as a benchmark. In these simulations, we assume the CRRA form for the utility function, with $\rho = 1$.

Table 15: Unemployment, inactivity and stocks between 2004 and 2014: the joint contribution of parameters and distributions

$\rho = 1$	2004	2014	(δ_1, δ_2)	$(\lambda_1^0, \lambda_2^0)$	(α_1, α_2)	(β_1, β_2)	(F_1, F_2)	(F_1, F_2, Y)	$(\delta_1, \lambda_1^0, F_1)$	$(\delta_2, \lambda_2^0, \lambda_2^1, F_2)$	(α_1, β_1)	(α_2, β_2)
Stocks												
m_{ee}	0.302	0.153	0.070	0.221	0.275	0.243	0.152	0.151	0.106	0.161	0.267	0.220
m_{eu}	0.013	0.007	0.006	0.005	0.012	0.011	0.007	0.007	0.005	0.007	0.011	0.010
m_{ue}	0.064	0.019	0.015	0.024	0.034	0.030	0.019	0.019	0.021	0.019	0.035	0.026
m_{ei}	0.136	0.168	0.138	0.130	0.172	0.190	0.164	0.164	0.117	0.171	0.285	0.103
m_{ie}	0.317	0.305	0.251	0.388	0.299	0.286	0.309	0.310	0.352	0.306	0.178	0.431
m_{uu}	0.005	0.002	0.003	0.002	0.002	0.003	0.002	0.002	0.002	0.003	0.002	0.003
m_{ui}	0.027	0.020	0.030	0.014	0.021	0.023	0.020	0.020	0.023	0.020	0.036	0.012
m_{iu}	0.009	0.011	0.017	0.007	0.011	0.010	0.011	0.011	0.013	0.010	0.006	0.015
m_{ii}	0.126	0.315	0.471	0.209	0.174	0.206	0.316	0.316	0.360	0.304	0.179	0.179
Unemployment rate												
Youth	0.175	0.110	0.184	0.100	0.111	0.111	0.112	0.112	0.169	0.110	0.114	0.110
Mother	0.039	0.040	0.070	0.022	0.040	0.040	0.040	0.040	0.040	0.039	0.040	0.040
Inactivity rate												
Youth	0.452	0.632	0.738	0.604	0.484	0.501	0.637	0.637	0.726	0.619	0.363	0.626
Mother	0.290	0.503	0.639	0.353	0.367	0.419	0.500	0.500	0.500	0.495	0.501	0.294

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: In these simulations, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping more than one parameter or distribution unchanged, and we run simulations using 2004 as a benchmark. In these simulations, we assume the CRRA form for the utility function, with $\rho = 1$.

The job destruction rate of mothers, which decreased in this period, also contributed to the inactivity not being even greater. However, for mothers, an additional factor contributing to the inactivity is the arrival rate of unemployment, which decreased in the period according to the estimated transition rates (Table 8).

Table 16 is similar to Table 14 and shows the results of counterfactual simulations when only one parameter or distribution remains unchanged. However, we account for the risk aversion, which is particularly relevant in simulations for the contribution of Y, some additional non-labor income or the labor income of fathers because changes in Y could impact the reservation wages of sons/daughters and mothers. We verify that, contrary to expectations, the labor income of fathers contributed only marginally to the inactivity rate of sons/daughters and mothers. However, this result could be related to the implementation of a small risk aversion parameter.

We also perform counterfactual simulations in which more than one parameter or distribution is changed jointly. These results are presented in Table 15, under linear utility function, and in Table 17, under risk aversion. In Table 15, we observe that the decreasing unemployment rate of sons/daughters would not have changed if the vector $(\delta_1, \lambda_1^0, F_1)$, which reflects the labor market conditions for this member, remains the same. However, the increasing inactivity rate of this member is mostly explained by the exogenous factors that cause the move to or the permanence in the inactivity, reflected in the vector (α_1, β_1). Similarly, the decreasing inactivity of mothers was driven by the vector (α_2, β_2).

Finally, contrary to expectations, the labor market conditions of mothers (vector $(\delta_2, \lambda_2^0, \lambda_2^1, F_2)$) do not seem to be a main factor in determining the inactivity of sons/daughters.

Table 16: Unemployment, inactivity and stocks between 2004 and 2014: the one-to-one contribution of parameters and distributions

$\rho = 0.95$	2004	2014	δ_1	δ_2	λ_1^0	λ_2^0	λ_2^1	α_1	α_2	β_1	β_2	F_1	F_2	Y
Stocks														
m_{ee}	0.302	0.153	0.098	0.109	0.168	0.204	0.152	0.213	0.194	0.203	0.178	0.140	0.152	0.152
m_{eu}	0.013	0.007	0.004	0.009	0.007	0.005	0.007	0.009	0.009	0.009	0.008	0.007	0.007	0.007
m_{ue}	0.064	0.019	0.022	0.013	0.018	0.025	0.019	0.027	0.024	0.026	0.022	0.018	0.019	0.019
m_{ei}	0.136	0.168	0.107	0.213	0.182	0.121	0.166	0.227	0.126	0.221	0.141	0.173	0.166	0.166
m_{ie}	0.317	0.305	0.360	0.214	0.294	0.404	0.308	0.239	0.389	0.250	0.358	0.302	0.309	0.309
m_{uu}	0.005	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
m_{ui}	0.027	0.020	0.023	0.025	0.019	0.014	0.020	0.029	0.015	0.028	0.017	0.021	0.020	0.020
m_{iu}	0.009	0.011	0.013	0.014	0.011	0.007	0.011	0.009	0.014	0.009	0.013	0.012	0.011	0.011
m_{ii}	0.126	0.315	0.370	0.401	0.299	0.218	0.314	0.245	0.226	0.252	0.261	0.326	0.314	0.314
Unemployment rate														
Youth	0.175	0.110	0.185	0.110	0.097	0.111	0.111	0.114	0.111	0.114	0.111	0.113	0.111	0.111
Mother	0.039	0.040	0.040	0.070	0.040	0.022	0.040	0.040	0.040	0.040	0.040	0.043	0.040	0.040
Inactivity rate														
Youth	0.452	0.632	0.743	0.629	0.603	0.630	0.634	0.493	0.630	0.511	0.632	0.639	0.634	0.634
Mother	0.290	0.503	0.500	0.639	0.500	0.353	0.500	0.500	0.367	0.501	0.419	0.519	0.500	0.500

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: In these simulations, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping one parameter or distribution unchanged, and we run simulations using 2004 as a benchmark. In these simulations, we assume the CRRA form for the utility function, with $\rho = 0.95$.

Table 17: Unemployment, inactivity and stocks between 2004 and 2014: the joint contribution of parameters and distributions

$\rho = 0.95$	2004	2014	(δ_1, δ_2)	$(\lambda_1^0, \lambda_2^0)$	(α_1, α_2)	(β_1, β_2)	(F_1, F_2)	(F_1, F_2, Y)	$(\delta_1, \lambda_1^0, F_1)$	$(\delta_2, \lambda_2^0, \lambda_2^1, F_2)$	(α_1, β_1)	(α_2, β_2)
Stocks												
m_{ee}	0.302	0.153	0.070	0.224	0.271	0.238	0.149	0.149	0.107	0.160	0.261	0.218
m_{eu}	0.013	0.007	0.006	0.005	0.012	0.011	0.007	0.007	0.005	0.007	0.011	0.010
m_{ue}	0.064	0.019	0.015	0.024	0.034	0.030	0.019	0.019	0.021	0.019	0.036	0.026
m_{ei}	0.136	0.168	0.137	0.133	0.171	0.187	0.164	0.164	0.119	0.170	0.278	0.103
m_{ie}	0.317	0.305	0.251	0.385	0.302	0.290	0.312	0.312	0.351	0.306	0.183	0.433
m_{uu}	0.005	0.002	0.003	0.002	0.002	0.003	0.002	0.002	0.002	0.003	0.002	0.003
m_{ui}	0.027	0.020	0.030	0.014	0.021	0.023	0.020	0.020	0.023	0.020	0.037	0.012
m_{iu}	0.009	0.011	0.017	0.007	0.011	0.010	0.011	0.011	0.013	0.010	0.007	0.015
m_{ii}	0.126	0.315	0.472	0.206	0.175	0.208	0.317	0.317	0.359	0.305	0.185	0.180
Unemployment rate												
Youth	0.175	0.110	0.185	0.097	0.113	0.114	0.114	0.114	0.167	0.110	0.120	0.111
Mother	0.039	0.040	0.070	0.022	0.040	0.040	0.040	0.040	0.040	0.039	0.040	0.040
Inactivity rate												
Youth	0.452	0.632	0.739	0.598	0.488	0.508	0.640	0.640	0.723	0.621	0.375	0.628
Mother	0.290	0.503	0.639	0.353	0.367	0.419	0.500	0.500	0.500	0.495	0.501	0.294

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: In these simulations, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping more than one parameter or distribution unchanged, and we run simulations using 2004 as a benchmark. In these simulations, we assume the CRRA form for the utility function, with $\rho = 0.95$.

The last four tables of this section present a similar analysis for the contribution of parameters and wage distributions on wages of sons/daughters and mothers and household welfare. Tables 18 and 20 show the contribution one-to-one, under linearity of the utility function and risk aversion, respectively, and Tables 19 and 21 shows the joint contribution of parameters and distributions. Focusing on the tables constructed under risk neutrality, we observe that for the average wage of sons/daughters, the factor that contributes the most to the increasing trend in the period is the shifted to right wage offer distribution of these members, as expected; this contribution occurs in percentiles. For the increasing trend in wages of mothers, in addition to the shifted to right wage offer distribution of these members, the decreasing job destruction rate contributes to the higher average income in 2014.

For a higher average welfare of youth, the decreasing job destruction rate for mothers, the shifted to right wage offer distributions of the two members and the increasing income of fathers are the factors that contribute the most, as confirmed in Table 19 in when we keep the vector (F_1, F_2, Y) unchanged, in spite of an opposite contribution of decreasing arrival rate of mothers. Additionally, the better labor market conditions of mothers make a greater contribution to the welfare of sons/daughters than do their better labor market conditions.

The same pattern occurs for the welfare of mothers, for which the shifted to right wage offer distributions of the two members and the increasing income of fathers are the factors that contribute the most. Additionally, we highlight the relevance of their own better labor market conditions for their welfare, as reflected in vector $(\delta_2, \lambda_2^0, \lambda_2^1, F_2))$, mainly for the welfare of employed mothers.

Table 18: Wages and welfare between 2004 and 2014: the contribution of parameters and distributions

$\rho = 1$	2004	2014	δ_1	δ_2	λ_1^0	λ_2^0	λ_2^1	α_1	α_2	β_1	β_2	F_1	F_2	Y
Wages youth														
$P10$	5.459	6.071	6.071	6.071	6.071	6.071	6.071	6.196	6.071	6.196	6.071	5.258	6.071	6.071
$P25$	5.769	6.499	6.499	6.499	6.499	6.499	6.499	6.499	6.499	6.499	6.499	5.769	6.499	6.499
$P50$	6.280	6.860	6.860	6.860	6.860	6.860	6.860	6.860	6.860	6.860	6.860	6.196	6.860	6.860
$P75$	6.616	7.124	7.124	7.124	7.124	7.124	7.124	7.124	7.124	7.124	7.124	6.616	7.124	7.124
$P90$	6.868	7.333	7.333	7.333	7.333	7.333	7.333	7.333	7.333	7.370	7.333	6.868	7.333	7.333
Mean	6.381	6.914	6.912	6.912	6.915	6.914	6.914	6.922	6.913	6.928	6.914	6.351	6.914	6.914
Wages mother														
$P10$	6.313	7.047	7.214	6.846	7.214	7.214	7.047	7.214	7.214	7.214	7.214	7.214	6.564	7.214
$P25$	6.765	7.593	7.593	7.357	7.593	7.593	7.482	7.593	7.593	7.593	7.593	7.593	7.075	7.593
$P50$	7.200	7.868	7.868	7.693	7.868	7.868	7.868	7.868	7.868	7.868	7.868	7.868	7.412	7.868
$P75$	7.503	8.083	8.083	8.016	8.083	8.083	8.083	8.083	8.083	8.083	8.083	8.083	7.663	8.083
$P90$	7.734	8.260	8.260	8.204	8.260	8.260	8.260	8.260	8.260	8.260	8.260	8.260	7.801	8.260
Mean	7.298	7.907	7.910	7.780	7.909	7.909	7.887	7.909	7.909	7.909	7.909	7.909	7.453	7.909
Welfare youth														
Employed	1839	2677	2546	2306	2674	2876	2646	2715	2806	2728	2768	2512	2414	2268
Unemployed	1785	2501	2434	2126	2501	2689	2469	2556	2620	2568	2585	2410	2242	2091
Inactive	1799	2517	2456	2128	2516	2728	2485	2559	2660	2574	2614	2435	2245	2108
Welfare mother														
Employed	1971	3256	3165	2738	3266	3262	3216	3325	3235	3340	3251	3149	2738	2853
Unemployed	1486	1948	1842	1914	1936	1950	1917	1995	1896	2004	1929	1828	1901	1526
Inactive	1479	1941	1837	1908	1930	1937	1911	1990	1889	1998	1920	1822	1897	1519
Average welfare	1815	2569	2474	2187	2571	2776	2537	2630	2707	2642	2663	2459	2301	2159

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: In these simulations, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping one parameter or distribution unchanged, and we run simulations using 2004 as a benchmark. In these simulations, we assume the CRRA form for the utility function, with $\rho = 1$.

Table 19: Wages and welfare between 2004 and 2014: the contribution of parameters and distributions

$\rho = 1$	2004	2014	(δ_1, δ_2)	$(\lambda_1^0, \lambda_2^0)$	(α_1, α_2)	(β_1, β_2)	(F_1, F_2)	(F_1, F_2, Y)	$(\delta_1, \lambda_1^0, F_1)$	$(\delta_2, \lambda_2^0, \lambda_2^1, F_2)$	(α_1, β_1)	(α_2, β_2)
Wages youth												
$P10$	5.459	6.071	6.071	6.071	6.196	6.196	5.258	5.258	5.258	6.071	6.196	6.071
$P25$	5.769	6.499	6.499	6.499	6.499	6.499	5.769	5.769	5.769	6.499	6.582	6.499
$P50$	6.280	6.860	6.860	6.860	6.860	6.860	6.196	6.196	6.196	6.860	6.860	6.860
$P75$	6.616	7.124	7.124	7.124	7.124	7.124	6.616	6.616	6.616	7.124	7.170	7.124
$P90$	6.868	7.333	7.333	7.333	7.333	7.333	6.868	6.868	6.868	7.333	7.370	7.333
Mean	6.381	6.914	6.911	6.916	6.920	6.923	6.362	6.364	6.351	6.913	6.945	6.913
Wages mother												
$P10$	6.313	7.047	6.846	7.214	7.214	7.214	6.564	6.564	7.214	6.313	7.214	7.214
$P25$	6.765	7.593	7.357	7.593	7.593	7.593	7.075	7.075	7.593	6.765	7.593	7.593
$P50$	7.200	7.868	7.693	7.868	7.868	7.868	7.412	7.412	7.868	7.200	7.868	7.868
$P75$	7.503	8.083	8.016	8.083	8.083	8.083	7.663	7.663	8.083	7.503	8.083	8.083
$P90$	7.734	8.260	8.204	8.260	8.260	8.260	7.801	7.801	8.260	7.734	8.260	8.260
Mean	7.298	7.907	7.781	7.909	7.909	7.909	7.453	7.453	7.910	7.298	7.909	7.909
Welfare youth												
Employed	1839	2677	2197	2891	2851	2838	2269	1874	2449	2275	2794	2909
Unemployed	1785	2501	2085	2709	2686	2678	2167	1772	2389	2094	2657	2716
Inactive	1799	2517	2091	2746	2703	2695	2179	1785	2417	2099	2654	2769
Welfare mother												
Employed	1971	3256	2662	3282	3302	3348	2641	2246	3110	2415	3432	3244
Unemployed	1486	1948	1841	1972	1952	2021	1812	1418	1794	1923	2093	1916
Inactive	1479	1941	1835	1958	1947	2011	1808	1414	1789	1915	2088	1907
Average welfare	1815	2569	2113	2796	2770	2758	2208	1813	2423	2158	2733	2813

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: In these simulations, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping more than one parameter or distribution unchanged, and we run simulations using 2004 as a benchmark. In these simulations, we assume the CRRA form for the utility function, with $\rho = 1$.

Table 20: Wages and welfare between 2004 and 2014: the contribution of parameters and distributions

$\rho = 0.95$	2004	2014	δ_1	δ_2	λ_1^0	λ_2^0	λ_2^1	α_1	α_2	β_1	β_2	F_1	F_2	Y
Wages youth														
$P10$	5.459	6.071	6.071	6.071	6.196	6.196	6.196	6.196	6.196	6.196	6.196	5.459	6.196	6.196
$P25$	5.769	6.499	6.499	6.499	6.499	6.499	6.499	6.499	6.499	6.582	6.499	5.769	6.499	6.499
$P50$	6.280	6.860	6.860	6.860	6.860	6.860	6.860	6.860	6.860	6.860	6.860	6.280	6.860	6.860
$P75$	6.616	7.124	7.124	7.124	7.124	7.124	7.124	7.170	7.124	7.170	7.124	6.616	7.124	7.124
$P90$	6.868	7.333	7.333	7.333	7.370	7.333	7.333	7.370	7.333	7.370	7.333	6.868	7.333	7.333
Mean	6.381	6.914	6.918	6.917	6.928	6.922	6.921	6.942	6.920	6.945	6.922	6.368	6.922	6.921
Wages mother														
$P10$	6.313	7.047	7.214	6.846	7.214	7.214	7.047	7.214	7.214	7.214	7.214	7.214	6.564	7.214
$P25$	6.765	7.593	7.593	7.357	7.593	7.593	7.482	7.593	7.593	7.593	7.593	7.593	7.075	7.593
$P50$	7.200	7.868	7.868	7.693	7.868	7.868	7.868	7.868	7.868	7.868	7.868	7.868	7.412	7.868
$P75$	7.503	8.083	8.083	8.016	8.083	8.083	8.083	8.083	8.083	8.083	8.083	8.083	7.663	8.083
$P90$	7.734	8.260	8.260	8.204	8.260	8.260	8.260	8.260	8.260	8.260	8.260	8.260	7.801	8.260
Mean	7.298	7.907	7.910	7.780	7.909	7.909	7.887	7.910	7.909	7.909	7.909	7.912	7.453	7.909
Welfare youth														
Employed	1839	2677	1844	1688	1943	2080	1918	1978	2025	1977	2002	1788	1758	1658
Unemployed	1785	2501	1774	1573	1835	1963	1807	1880	1908	1881	1888	1732	1650	1547
Inactive	1799	2517	1785	1569	1839	1983	1812	1878	1930	1879	1902	1747	1647	1553
Welfare mother														
Employed	1971	3256	2266	1988	2350	2345	2309	2394	2320	2398	2334	2247	1984	2063
Unemployed	1486	1948	1369	1422	1445	1458	1426	1494	1409	1488	1437	1349	1409	1154
Inactive	1479	1941	1364	1416	1438	1446	1419	1489	1403	1482	1428	1343	1406	1148
Average welfare	1815	2569	1797	1609	1876	2015	1846	1923	1960	1922	1934	1759	1683	1587

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: In these simulations, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping one parameter or distribution unchanged, and we run simulations using 2004 as a benchmark. In these simulations, we assume the CRRA form for the utility function, with $\rho = 0.95$.

Table 21: Wages and welfare between 2004 and 2014: the contribution of parameters and distributions

$\rho = 0.95$	2004	2014	(δ_1, δ_2)	$(\lambda_1^0, \lambda_2^0)$	(α_1, α_2)	(β_1, β_2)	(F_1, F_2)	(F_1, F_2, Y)	$(\delta_1, \lambda_1^0, F_1)$	$(\delta_2, \lambda_2^0, \lambda_2^1, F_2)$	(α_1, β_1)	(α_2, β_2)
Wages youth												
$P10$	5.459	6.071	6.071	6.196	6.196	6.196	5.459	5.459	5.459	6.071	6.408	6.196
$P25$	5.769	6.499	6.499	6.499	6.499	6.582	5.769	5.769	5.769	6.499	6.582	6.499
$P50$	6.280	6.860	6.860	6.860	6.860	6.860	6.280	6.280	6.280	6.860	6.918	6.860
$P75$	6.616	7.124	7.124	7.124	7.124	7.170	6.616	6.616	6.616	7.124	7.170	7.124
$P90$	6.868	7.333	7.333	7.333	7.370	7.370	6.868	6.868	6.868	7.333	7.370	7.333
Mean	6.381	6.914	6.916	6.925	6.933	6.944	6.372	6.373	6.369	6.918	6.977	6.920
Wages mother												
$P10$	6.313	7.047	7.357	7.593	7.593	7.593	7.075	7.075	7.593	6.765	7.593	7.593
$P25$	6.765	7.593	7.693	7.868	7.868	7.868	7.412	7.412	7.868	7.200	7.868	7.868
$P50$	7.200	7.868	8.016	8.083	8.083	8.083	7.663	7.663	8.083	7.503	8.083	8.083
$P75$	7.503	8.083	8.204	8.260	8.260	8.260	7.801	7.801	8.260	7.734	8.260	8.260
$P90$	7.734	8.260	7.781	7.909	7.909	7.909	7.453	7.453	7.910	7.298	7.909	7.909
Mean	7.298	7.907	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Welfare youth												
Employed	1839	2677	1844	1688	1943	2080	1918	1978	2025	1977	2002	1788
Unemployed	1785	2501	1774	1573	1835	1963	1807	1880	1908	1881	1888	1732
Inactive	1799	2517	1785	1569	1839	1983	1812	1878	1930	1879	1902	1747
Welfare mother												
Employed	1971	3256	2266	1988	2350	2345	2309	2394	2320	2398	2334	2247
Unemployed	1486	1948	1369	1422	1445	1458	1426	1494	1409	1488	1437	1349
Inactive	1479	1941	1364	1416	1438	1446	1419	1489	1403	1482	1428	1343
Average welfare	1815	2569	1797	1609	1876	2015	1846	1923	1960	1922	1934	1759

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: In these simulations, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping more than one parameter or distribution unchanged, and we run simulations using 2004 as a benchmark. In these simulations, we assume the CRRA form for the utility function, with $\rho = 0.95$.

9 Conclusions

In this study, we investigate the labor market transitions of sons and daughters and their mothers by estimating a structural household job search model with on-the-job search and by performing counterfactual simulations. We contribute to the household job search literature by i) explicitly considering sons or daughters as decision-makers in a household job search model, which, to the best of our knowledge, it is still not performed in this literature, and ii) distinguishing and allowing for the unemployment and inactivity of mothers and sons and daughters and for different search behavior and job acceptance, depending on the situation of the other members in the labor market, non-labor income and labor income of fathers. Moreover, we develop and estimate a household job search model for Brazil.

We verify that the household job search model does a reasonable job of fitting the stocks and wages, which is expected since the model is highly parameterized.

In counterfactual experiments, we verify that the decreasing unemployment rate of sons and daughters would not have changed between 2004 and 2014 if the labor market opportunities and conditions of this member remained the same as it was in 2004. The increasing trend in the inactivity of sons/daughters is mostly determined by a decreasing encouragement rate and the increasing dropout rate observed among these members in the period. These exogenous factors that determine the move to or the permanence in the inactivity could be related to the lower cost of education through public policies, such as the PROUNI, FIES and Bolsa Famlia Program. The inactivity of mothers seems to be explained by the same parameters. The decreasing job destruction rate for mothers and the shifted to right wage offer distributions of the two members and the increasing income of fathers are the factors that mostly contribute to the higher average welfare of youth, whereas the increasing welfare of mothers is mostly determined by their own better labor market conditions.

Therefore, our results strengthen the argument about the relevance of household search behavior in the labor supply decisions of secondary earners in families and about how using individual job search models to understand aggregate unemployment and inactivity can be misleading.

Appendices

Table 22: Sample exclusions for individuals and households

Exclusions	Individuals		Households	
	Number	%	Number	%
Initial sample (all members in a household)	5,437,090	100	1,725,318	100
Exclusion 1: identification problems and composition				
Consistence problems* and households with other members**	2,682,354	49.3	727,787	42.2
HH with fathers/mothers aged below 14 years	2,681,320	49.3	727,499	42.2
HH without children 14-24	1,367,551	25.2	384,837	22.3
HH with two fathers or two mothers	1,358,235	25.0	382,600	22.2
HH without mothers	1,312,951	24.1	373,707	21.7
Exclusion 2: attrition				
HH observed only one time	1,156,953	21.3	325,523	18.9
HH in which members do not have the necessary observations	1,064,058.21	19.6	309,217	17.9
Final sample	1,064,058		309,217	

Source: Elaborated by the authors based on data from the Continuous National Household Sample Survey (PNADC) for 2012-2015.
Notes: HH: households; *duplicated identifiers and more than one head or spouse; **agregated and other members, domestic employees.

Table 23: Model fit of estimation for age group of sons/daughters

Model fit	Up to 16 years				More than 16 years			
	2004		2014		2004		2014	
	Data	Model	Data	Model	Data	Model	Data	Model
Stocks								
m_{ee}	0.0568	0.0481	0.0495	0.0161	0.2593	0.4121	0.3149	0.2203
m_{eu}	0.0056	0.0026	0.0014	0.0007	0.0190	0.0144	0.0085	0.0093
m_{ue}	0.0271	0.0244	0.0228	0.0079	0.0834	0.0810	0.0492	0.0234
m_{ei}	0.0245	0.0188	0.0139	0.0136	0.1963	0.1845	0.1710	0.2733
m_{ie}	0.4782	0.6255	0.5833	0.5049	0.1974	0.1905	0.2682	0.1988
m_{uu}	0.0067	0.0018	0.0026	0.0005	0.0145	0.0037	0.0066	0.0015
m_{ui}	0.0123	0.0085	0.0057	0.0065	0.0625	0.0335	0.0284	0.0285
m_{iu}	0.0591	0.0324	0.0253	0.0220	0.0128	0.0046	0.0075	0.0072
m_{ii}	0.3298	0.2378	0.2955	0.4278	0.1548	0.0757	0.1456	0.2377
Transitions youth								
u→e	0.0607	0.0607	0.0367	0.0367	0.1436	0.1436	0.1262	0.1262
u→i	0.5234	0.5234	0.6697	0.6697	0.2535	0.2535	0.3964	0.3964
i→u	0.0300	0.0300	0.0179	0.0179	0.1263	0.1263	0.0635	0.0635
e→u	0.0446	0.0446	0.0307	0.0307	0.0348	0.0348	0.0188	0.0188
Transitions mother								
u→e	0.1687	0.1687	0.1068	0.1068	0.1835	0.1835	0.0809	0.0809
u→i	0.2982	0.2982	0.4660	0.4660	0.3351	0.3351	0.4044	0.4044
i→u	0.0510	0.0510	0.0343	0.0343	0.0358	0.0358	0.0183	0.0183
e→u	0.0119	0.0119	0.0069	0.0069	0.0084	0.0084	0.0045	0.0045
e→e'	0.0061	0.0061	0.0069	0.0069	0.0208	0.0208	0.0142	0.0142
Wages youth								
$P10$	2.7577	4.3671	5.5046	5.3039	5.5757	5.7428	6.3151	6.3151
$P25$	4.7036	5.1556	5.9399	5.6717	6.1223	6.0110	6.7349	6.6136
$P50$	5.7021	5.8932	6.2422	6.0511	6.3967	6.3133	6.8431	6.8431
$P75$	6.1917	6.4213	6.7176	6.3256	6.7887	6.6743	7.1114	7.1114
$P90$	6.3686	6.7650	6.9134	6.5407	7.1481	6.9390	7.4137	7.2571
Mean	5.8126	6.0735	6.4214	6.1361	6.6027	6.4783	6.9764	6.9133
Wages mother								
$P10$	4.5045	5.6031	6.3782	6.3782	5.6031	6.9024	6.4145	7.3018
$P25$	5.6031	6.1139	6.6296	7.1404	6.1139	7.0694	6.6658	7.4130
$P50$	6.4504	6.4504	6.8302	7.6512	6.4504	7.2125	6.8665	7.5131
$P75$	6.9024	7.0694	7.3768	7.9877	7.0694	7.3377	7.4130	7.6041
$P90$	7.7233	7.3377	7.9877	8.1935	7.9384	7.5490	8.0795	7.6875
Mean	6.9972	6.7998	7.3185	7.6913	7.0878	7.2911	7.3685	7.5727

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.
Notes: Transitions rates are per month. In subgroups estimations, we assume the CRRA form for utility function, with $\rho = 1$.

Table 24: Model fit of estimation for education of mothers

Model fit	Up to 8 schooling years				More than 8 schooling years			
	2004		2014		2004		2014	
	Data	Model	Data	Model	Data	Model	Data	Model
Stocks								
m_{ee}	0.1801	0.3020	0.2206	0.1307	0.1950	0.3002	0.2142	0.1898
m_{eu}	0.0160	0.0124	0.0074	0.0081	0.0108	0.0165	0.0046	0.0062
m_{ue}	0.0622	0.0704	0.0391	0.0199	0.0642	0.0496	0.0397	0.0169
m_{ei}	0.1539	0.1265	0.1419	0.1639	0.0984	0.1689	0.0893	0.1809
m_{ie}	0.2554	0.3245	0.3093	0.2893	0.3772	0.2830	0.4466	0.3072
m_{uu}	0.0116	0.0051	0.0060	0.0025	0.0118	0.0045	0.0044	0.0013
m_{ui}	0.0519	0.0285	0.0250	0.0246	0.0306	0.0266	0.0159	0.0159
m_{iu}	0.0310	0.0088	0.0134	0.0148	0.0274	0.0112	0.0146	0.0084
m_{ii}	0.2379	0.1216	0.2373	0.3461	0.1846	0.1395	0.1706	0.2733
Transitions youth								
u→e	0.1293	0.1293	0.1089	0.1089	0.1374	0.1374	0.1118	0.1118
u→i	0.2987	0.2987	0.4719	0.4719	0.2768	0.2768	0.4185	0.4185
i→u	0.0784	0.0784	0.0467	0.0467	0.0589	0.0589	0.0319	0.0319
e→u	0.0390	0.0390	0.0250	0.0250	0.0290	0.0290	0.0143	0.0143
Transitions mother								
u→e	0.1996	0.1996	0.0948	0.0948	0.1293	0.1293	0.0894	0.0894
u→i	0.3067	0.3067	0.3707	0.3707	0.3405	0.3405	0.4878	0.4878
i→u	0.0399	0.0399	0.0235	0.0235	0.0433	0.0433	0.0244	0.0244
e→u	0.0104	0.0104	0.0073	0.0073	0.0088	0.0088	0.0041	0.0041
e→e'	0.0173	0.0173	0.0130	0.0130	0.0125	0.0125	0.0104	0.0104
Wages youth								
$P10$	5.1237	5.3750	6.1177	6.2178	5.5757	5.5757	6.1240	6.1240
$P25$	6.0110	5.7428	6.6697	6.5405	6.2223	6.0110	6.6761	6.4754
$P50$	6.3133	6.1223	6.8368	6.8368	6.5451	6.3967	6.8431	6.7349
$P75$	6.6743	6.5451	7.0651	7.1051	6.8914	6.7332	7.1869	6.9862
$P90$	7.0280	6.7887	7.2841	7.2508	7.3522	6.9845	7.4700	7.1869
Mean	6.4591	6.3006	6.9092	6.8931	6.7141	6.4995	6.9811	6.8097
Wages mother								
$P10$	4.3975	6.3435	5.8437	6.9423	5.6031	6.7017	6.4145	7.5131
$P25$	5.4962	6.7954	6.6322	7.1787	6.4504	7.2125	6.6658	7.8359
$P50$	6.0070	7.1056	6.7992	7.4531	7.0694	7.4489	7.1766	8.1322
$P75$	6.5948	7.3420	6.9423	7.6016	7.8003	7.6400	7.7644	8.2753
$P90$	6.9625	7.6164	7.2788	7.7308	8.3111	7.8718	8.3187	8.4389
Mean	6.4571	7.1969	6.9356	7.4632	7.5462	7.5053	7.5683	8.1119

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2004 and 2014.

Notes: Transitions rates are per month. In subgroups estimations, we assume the CRRA form for utility function, with $\rho = 1$.

Table 25: Simulations: decrease job destruction rates δ_1 and δ_2, in 2014

δ_1 and δ_2	$\rho = 1$				$\rho = 0.95$			
	Benchmark	10%	20%	30%	Benchmark	10%	20%	30%
Stocks								
m_{ee}	0.1532	0.1729	0.1969	0.2262	0.1528	0.1723	0.1830	0.2105
m_{eu}	0.0068	0.0069	0.0070	0.0070	0.0068	0.0069	0.0075	0.0076
m_{ue}	0.0186	0.0190	0.0192	0.0194	0.0186	0.0190	0.0186	0.0188
m_{ei}	0.1680	0.1708	0.1730	0.1734	0.1683	0.1711	0.1836	0.1862
m_{ie}	0.3053	0.3116	0.3166	0.3202	0.3057	0.3121	0.3081	0.3117
m_{uu}	0.0018	0.0017	0.0015	0.0013	0.0018	0.0017	0.0015	0.0013
m_{ui}	0.0200	0.0183	0.0165	0.0146	0.0200	0.0183	0.0172	0.0153
m_{iu}	0.0113	0.0103	0.0093	0.0082	0.0113	0.0103	0.0097	0.0086
m_{ii}	0.3149	0.2885	0.2599	0.2297	0.3147	0.2883	0.2707	0.2400
Unemployment rate								
Youth	0.1097	0.1000	0.0900	0.0800	0.1098	0.1001	0.0908	0.0806
Mother	0.0401	0.0362	0.0323	0.0284	0.0401	0.0362	0.0354	0.0313
Inactivity rate								
Youth	0.5030	0.4777	0.4494	0.4177	0.5030	0.4777	0.4716	0.4414
Mother	0.6315	0.6104	0.5859	0.5581	0.6316	0.6107	0.5884	0.5603
Wages youth								
$P10$	6.0712	6.0712	6.0712	6.1964	6.1964	6.1964	6.1964	6.1964
$P25$	6.4986	6.4986	6.4986	6.4986	6.4986	6.4986	6.4986	6.4986
$P50$	6.8596	6.8596	6.8596	6.8596	6.8596	6.8596	6.8596	6.8596
$P75$	7.1243	7.1243	7.1243	7.1243	7.1243	7.1243	7.1243	7.1243
$P90$	7.3334	7.3334	7.3334	7.3334	7.3334	7.3334	7.3705	7.3705
Mean	6.9139	6.9148	6.9156	6.9194	6.9214	6.9231	6.9298	6.9319
Wages mother								
$P10$	7.0469	7.2139	7.2139	7.2139	7.0469	7.2139	7.2139	7.3570
$P25$	7.5934	7.5934	7.5934	7.6935	7.5934	7.5934	7.5934	7.6935
$P50$	7.8678	7.8678	7.9448	7.9448	7.8678	7.8678	7.9448	7.9448
$P75$	8.0830	8.1455	8.1455	8.1455	8.0830	8.1455	8.1455	8.1455
$P90$	8.2599	8.2599	8.3125	8.3125	8.2599	8.2599	8.3125	8.3125
Mean	7.9074	7.9289	7.9523	7.9783	7.9074	7.9289	7.9548	7.9807
Welfare youth								
Employed	2677	2782	2911	3069	1939	2011	2067	2166
Unemployed	2501	2593	2706	2844	1829	1894	1951	2040
Inactive	2517	2611	2726	2866	1835	1901	1959	2049
Welfare mother								
Employed	3256	3374	3513	3675	2337	2419	2511	2618
Unemployed	1948	1964	1983	2006	1448	1460	1474	1487
Inactive	1941	1957	1976	1999	1442	1454	1467	1479
Average welfare	2569	2671	2795	2947	1869	1939	1999	2096

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2014.
Notes: We assume the CRRA form for utility function, in which $\rho = 1$ is the linear case and $\rho = 0.95$ is a concave case. Benchmark are the estimations present in Table 23.

Table 26: Simulations: increase arrival rates λ_1^0 and λ_2^0, in 2014

λ_1^0 and λ_2^0	$\rho = 1$				$\rho = 0.95$			
	Benchmark	10%	20%	30%	Benchmark	10%	20%	30%
Stocks								
m_{ee}	0.1532	0.1712	0.1891	0.2062	0.1528	0.1708	0.1880	0.2048
m_{eu}	0.0068	0.0069	0.0071	0.0071	0.0068	0.0069	0.0070	0.0071
m_{ue}	0.0186	0.0190	0.0192	0.0194	0.0186	0.0190	0.0193	0.0195
m_{ei}	0.1680	0.1707	0.1732	0.1749	0.1683	0.1705	0.1729	0.1746
m_{ie}	0.3053	0.3107	0.3143	0.3169	0.3057	0.3111	0.3153	0.3182
m_{uu}	0.0018	0.0018	0.0017	0.0016	0.0018	0.0018	0.0017	0.0017
m_{ui}	0.0200	0.0186	0.0173	0.0161	0.0200	0.0186	0.0173	0.0161
m_{iu}	0.0113	0.0103	0.0094	0.0087	0.0113	0.0103	0.0094	0.0087
m_{ii}	0.3149	0.2908	0.2688	0.2491	0.3147	0.2910	0.2690	0.2494
Unemployment rate								
Youth	0.1097	0.1013	0.0937	0.0873	0.1098	0.1015	0.0942	0.0878
Mother	0.0401	0.0366	0.0337	0.0311	0.0401	0.0366	0.0337	0.0311
Inactivity rate								
Youth	0.5030	0.4801	0.4592	0.4401	0.5030	0.4801	0.4592	0.4401
Mother	0.6315	0.6119	0.5925	0.5747	0.6316	0.6125	0.5938	0.5762
Wages youth								
$P10$	6.0712	6.0712	6.0712	6.1964	6.1964	6.1964	6.1964	6.1964
$P25$	6.4986	6.4986	6.4986	6.4986	6.4986	6.4986	6.4986	6.4986
$P50$	6.8596	6.8596	6.8596	6.8596	6.8596	6.8596	6.8596	6.8596
$P75$	7.1243	7.1243	7.1243	7.1243	7.1243	7.1243	7.1243	7.1243
$P90$	7.3334	7.3334	7.3334	7.3334	7.3334	7.3705	7.3705	7.3705
Mean	6.9139	6.9178	6.9183	6.9200	6.9214	6.9271	6.9297	6.9319
Wages mother								
$P10$	7.0469	7.0469	7.0469	7.0469	7.0469	7.0469	7.0469	7.0469
$P25$	7.5934	7.5934	7.5934	7.5934	7.5934	7.5934	7.5934	7.5934
$P50$	7.8678	7.8678	7.8678	7.8678	7.8678	7.8678	7.8678	7.8678
$P75$	8.0830	8.0830	8.0830	8.0830	8.0830	8.0830	8.0830	8.0830
$P90$	8.2599	8.2599	8.2599	8.2599	8.2599	8.2599	8.2599	8.2599
Mean	7.9074	7.9075	7.9074	7.9074	7.9074	7.9075	7.9075	7.9074
Welfare youth								
Employed	2677	2723	2758	2798	1939	1975	1999	2030
Unemployed	2501	2547	2583	2627	1829	1865	1892	1925
Inactive	2517	2565	2603	2647	1835	1872	1899	1933
Welfare mother								
Employed	3256	3275	3288	3307	2337	2354	2364	2380
Unemployed	1948	1968	1980	2000	1448	1466	1475	1493
Inactive	1941	1961	1971	1991	1442	1459	1467	1484
Average welfare	2569	2619	2659	2705	1869	1907	1936	1970

Source: Elaborated by the authors based on model estimation using data from the Monthly Employment Survey (PME/IBGE) for 2014.

Notes: We assume the CRRA form for utility function, in which $\rho = 1$ is the linear case and $\rho = 0.95$ is a concave case. Benchmark are the estimations present in Table 23.

References

[1] Albrecht, J., Anderson, A., and Vroman, S. Search by committee. *Journal of Economic Theory 145*, 4 (2010), 1386–1407.

[2] Becker, G. S. A theory of marriage: Part II. *Journal of Political Economy 82*, 2 (1974), S11–S26.

[3] Becker, G. S. *A Treatise on the Family.* NBR Books, 1981.

[4] Bellman, R. *Dynamic programming.* Princeton University Press, 1957.

[5] Bontemps, C., Robin, J., and VAN DEN BERG, G. J. An empirical equilibrium job search model with search on the job and heterogeneous workers and firms. *International Economic Review 40*, 4 (1999), 1039–1074.

[6] Bowlus, A. J. A search interpretation of male-female wage differentials. *Journal of Labor Economics 15*, 4 (1997), 625–657.

[7] Burdett, K., and Mortensen, D. Labor supply under uncertainty. Tech. rep., Northwestern University, Center for Mathematical Studies in Economics and Management Science, 1977.

[8] Burdett, K., and Mortensen, D. T. Wage differentials, employer size, and unemployment. *International Economic Review 39*, 2 (1998), 257–73.

[9] Cabanas, P., Komatsu, B., and MENEZES FILHO, N. O crescimento da renda dos adultos e as escolhas dos jovens entre estudo e trabalho. *INSPER Policy Paper*, 13 (2015).

[10] Camarano, A. A., Pazinato, M. T., Kanso, S., and Vianna, C. A transição para a vida adulta: novos ou velhos desafios? *Mercado de trabalho: conjuntura e análise* (2003), 53–66.

[11] Chiappori, P.-A., Dias, M. C., and Meghir, C. The marriage market, labor supply and education choice. NBER Working Paper 21004, 2015.

[12] Compte, O., and Jehiel, P. Bargaining and majority rules: A collective search perspective. *Journal of Political Economy 118*, 2 (2010), 189–221.

[13] Conti, G., Ginja, R., and Narita, R. Non-contributory health insurance and household labor supply: Evidence from Mexico. 15th IZA/SOLE Transatlantic Meeting of Labor Economists.

[14] Dey, M., and Flinn, C. Household search and health insurance coverage. *Journal of Econometrics 145*, 1 (2008), 43–63.

[15] Fang, H., and Shephard, A. Joint household labor supply and health care reform. *Work in Progress, University of Pennsylvania* (2014).

[16] Flabbi, L. Gender discrimination estimation in a search model with matching and bargaining. *International Economic Review 51*, 3 (2010), 745–783.

[17] Flabbi, L., and Flinn, C. Simultaneous search in the labor and marriage markets with endogenous schooling decisions.

[18] Flabbi, L., and Mabli, J. Household search or individual search: does it matter? evidence from lifetime inequality estimates.

[19] Flabbi, L., and Moro, A. The effect of job flexibility on female labor market outcomes: Estimates from a search and bargaining model. *Journal of Econometrics 168*, 1 (2012), 81–95.

[20] Garcia-Perez, J. I., and Rendon, S. Family job search and consumption. Work in progress, 2012.

[21] Gemici, A. Family migration and labor market outcomes. *Manuscript, New York University* (2011).

[22] Guler, B., Guvenen, F., and Violante, G. L. Joint-search theory: New opportunities and new frictions. *Journal of Monetary Economics 59*, 4 (2012), 352–369.

[23] Humphrey, D. D. Interpreting unemployment in terms of family units. *Journal of Political Economy 47*, 1 (1939), 82–99.

[24] Mankart, J., and Oikonomou, R. Household search and the aggregate labor market. *The Review of Economic Studies 50* (2016), 1–63.

[25] MENEZES FILHO, N. A., Cabanas, P. H. F., and Komatsu, B. K. Tendências recentes do mercado de trabalho brasileiro. *Boletim Mercado de Trabalho–Conjuntura e Análise*, 56 (2014).

[26] Ribas, R. P., and Soares, S. S. D. Sobre o painel da Pesquisa Mensal de Emprego (PME) do IBGE. IPEA Texto para discussão n. 1348, 2008.

[27] VAN DEN BERG, G., and Ridder, G. An empirical equilibrium search model of the labor market. *Econometrica 66*, 5 (1998), 1183–1222.

[28] Vieira, C. S., Menezes-Filho, N., and Komatsu, B. K. Como as mudanças no trabalho e renda dos pais afetam as escolhas entre estudo e trabalho dos jovens? *Pesquisa e Planejamento Econômico 46*, 3 (2016), 33–61.