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**Choques de renda, procura familiar por emprego e oferta
de trabalho**

**Income shocks, household job search and labor
supply**

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Income shocks, household job search and labor supply

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Resumo

As análises sobre taxas agregadas de emprego, desemprego e inatividade frequentemente ignoram a dinâmica dos membros das famílias no mercado de trabalho, a qual pode explicar *puzzles* na relação entre atividade econômica e participação no mercado de trabalho. A relevância das abordagens familiares para a oferta de trabalho está nas análises macroeconômicas sobre tendências agregadas, e também em análises microeconômicas do comportamento, decisões intrafamiliares e resultados de políticas. Apesar do consenso sobre as decisões conjuntas de oferta de trabalho dos membros da família, grande parte dos estudos são abordagens individuais e desconsideram filhos jovens como tomadores de decisão. Nesta tese, organizada em dois estudos, investigamos essas questões para o Brasil. No primeiro estudo, analisamos a decisão de ofertar trabalho de jovens entre 14 e 24 anos vivendo com os pais, em um exercício de forma reduzida. A tese colabora com a literatura empírica sobre os efeitos intra-familiares de políticas, ao testar se o salário mínimo que afeta a renda dos pais impacta a decisão final dos filhos de ofertar trabalho. Também testamos a hipótese de agregação da renda, ao verificar se a política tem efeitos distintos caso a pessoa elegível na família seja a mãe ou o pai. A estratégia de identificação é baseada em uma abordagem de *intention-to-treat*, e no uso do estimador de diferenças-em-diferenças. Outra inovação é o uso da PNADC (IBGE) para 2012-2016. Verificamos que a direção e a magnitude dos efeitos do salário mínimo dos pais, na oferta de trabalho dos filhos, dependem de quem é e de quantos são os membros elegíveis na família: o efeito é negativo, se a pessoa elegível é a mãe ou o pai, e é positivo, se ambos são elegíveis. Esses resultados reforçam o argumento em favor das abordagens intra-familiares, uma vez que a hipótese de *income-pooling* não parece ser válida neste contexto. No segundo estudo, investigamos como as decisões de oferta de trabalho poderiam determinar os resultados agregados de desemprego e inatividade dos membros secundários. Desenvolvemos e estimamos um modelo estrutural de busca por emprego familiar com *on-the-job search*. Estendemos o modelo de Dey e Flinn (2008), para permitir desemprego e inatividade de mães e filhos, sujeitos a choques em seus empregos e choques na renda dos pais. Esses choques podem determinar diferentes comportamentos de busca e aceitação de emprego, dependendo da

situação do outro membro no mercado de trabalho. O modelo é estimado com a PME (IBGE) para 2004-2014. Realizamos simulações contrafactuais e verificamos que a taxa de desemprego dos filhos, decrescente entre 2004 e 2014, não teria se alterado no período, caso as condições e oportunidades de mercado de trabalho dos filhos tivessem continuado as mesmas de 2004. Já a taxa de desemprego das mães não sofre grandes alterações no período. A tendência crescente na inatividade dos filhos é determinada por uma taxa de encorajamento decrescente e uma taxa de desistência crescente, que refletem fatores exógenos que levam jovens trabalhadores à inatividade. Esses fatores exógenos podem estar relacionados ao menor custo da educação no período. Concluimos que o uso de modelos individuais de busca por emprego para entender o desemprego e a inatividade agregados deve ser desencorajado, pois o comportamento de busca familiar importa para as decisões de oferta de trabalho dos membros secundários da família.

Palavras-chaves: Modelo de Busca por Emprego Familiar. Modelos Coletivos. Oferta de Trabalho. Salário Mínimo.

Abstract

Analyses about aggregate employment, unemployment, and inactivity rates frequently disregard labor market trends of specific household members, which may explain some puzzles in the relationship between economic activity and labor market participation. The relevance of family approaches of labor supply transcends the aggregate macroeconomic trends and addresses important micro-level analysis concerning the behavior and intrahousehold decisions of members and policy-relevant results. Despite the consensus about the joint labor supply decisions of household members, studies are typically at the individual level and disregard sons and daughters as decision-makers in a family. Therefore, in this thesis, we investigate these questions for Brazil, in two studies. In the first study, we analyze the labor supply decisions of sons daughters aged 14 to 24 years living with their parents, in a reduced form exercise. We collaborate to the empirical literature about intra-household impacts of policies, testing whether the minimum wage, which affects the income of parents, impacts the final labor supply decisions of sons and daughters. We also verify if the policy has distinct effects depending on whether the eligible person is the father or the mother, aiming to test the income-pooling hypothesis. Our identification strategy is based on an intention-to-treat approach, and in a differences-in-differences estimator. Another innovation is the use of the PNADC (IBGE) for 2012-2016. We find that the direction and magnitude of the minimum wage effects affecting fathers and mothers, on the labor supply of sons and daughters, depend on who is and how many eligible members there exist in the household: it is negative, whether the eligible person is the mother or the father, and it is positive, whether both are eligible. Therefore, our results strengthen the argument in favor of household approaches, since the income pooling hypothesis does not seem to be valid in this context. In the second study, we investigate how the decisions about labor supply could determine the aggregate results of unemployment and inactivity of the secondary household earners. We develop and estimate a structural household job search model with on-the-job search. We extend Dey and Flinn (2008) to allow for unemployment and inactivity of mothers and sons and daughters who are subject to shocks to their employment and income shocks to fathers. These shocks may

determine different search behavior and job acceptance, depending on the other household member's labor market situation. The model is estimated using the PME (IBGE) for 2004-2014. We perform counterfactual simulations, and we verify that the decreasing unemployment rate of sons/daughters would not have changed between 2004 and 2014 if the labor market opportunities and conditions of this member remain the same. The unemployment rate of mothers does not alter a lot 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 the inactivity could be related to the lower cost of education. We conclude that the use of individual job search models to understand aggregate unemployment and inactivity can be misleading, since the household search behavior matters in the labor supply decisions of secondary household earners.

Key-words: Household Job Search Model. Collective Models. Labor Supply. Minimum Wage.

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1 Introduction

A higher level of economic activity in Brazil in the last decade resulted in a stimulated labor market, leading to an unemployment rate that decreased from about 13% in 2003 to 5% in 2013, in the metropolitan regions. Despite increasing employment, falling unemployment and inactivity rates among adults, studies show that the participation rate of children aged 15 to 24 years declined and the proportion of children in full-time education increased (CABANAS; KOMATSU; MENEZES FILHO, 2015). The reason for this lower labor activity among youth can be the better job opportunities faced by fathers and mothers in the labor market. The improvements in employment opportunities and parental earnings lead to greater household income and welfare, and the final intrahousehold decision results in the son or daughter devoting entirely or partially to schooling and therefore leaving the labor force, even in a scenario of additional job opportunities for youth. Figure 1 is elaborated using data from the Monthly Employment Survey (PME) of the Brazilian Institute of Geography and Statistics (IBGE), for the period 2002 to 2015. It shows the proportion of fathers, mothers, and sons and daughters aged 14 to 24 years that are employed, unemployed and inactive, or out of the labor force. Chart (a) corroborates the increasing employment and decreasing unemployment and inactivity of parents in this period, whereas Chart (b) shows the growing trend in youth inactivity.

Figure 1 – Proportion of unemployed, employed and inactive individuals among the household members, 2002-2015

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME) for 2002-2015.

Note: Unemployed workers look for jobs, while inactive workers do not.

In addition, a household analysis about the aggregate unemployment and inactivity data in Brazil, in 2014, using data from PME (IBGE), shows that about 33% of unemployment and 20% of the inactivity rate arise from sons and daughters aged 14 to 24 years. These rates are, respectively, 22% and 28%, for mothers. Fathers contribute to 12% of the level of unemployment and only to 8% of the inactivity. The other members of the household are responsible for the residual percentages.

The analyses about aggregate employment, unemployment, and inactivity rates frequently disregard these labor market trends of specific of household members. However, the hidden labor market transitions of the different members in a family as well as the linked intrahousehold decision process, may explain some puzzles in the relationship between economic activity and labor market outcomes, which challenge policy-makers and researchers. In Brazil, for example, a lower aggregate unemployment rate, as seen in recent years through 2014, may be the result of a reduction in job search among youth that exceeds the increased job search among parents. Mankart and Oikonomou (2016) show that this is a persistent puzzle in data from the United States since the aggregate employment is procyclical, but the labor force participation is not correlated with economic activity.

In this context, Guner, Kulinova, and Esteban (2015) study transitions of husbands and wives in the labor market, between 1976 and 2013 in the United States, and conclude that the labor market transition of household members are critical to understanding trends in aggregate employment and cyclical movements in unemployment. Mankart and Oikonomou (2016) also analyze transitions of primary earners in families and develop a theoretical household job search model to explain the cyclical properties of aggregate employment and participation, and they find that primary earners are always in the labor force, but secondary earners have a countercyclical participation rate and a procyclical employment rate.

The relevance of family approaches in explaining labor market outcomes transcends the aggregate macroeconomic trends and addresses important micro-level analyses con-

cerning the behavior and intrahousehold decisions of members, policy-relevant results, and welfare. Since Becker's studies about social interactions, marriage, and the family (BECKER, 1981, 1974), the role of household-level decisions on labor market outcomes and the fact that a majority of workers make labor market decisions not in isolation but together with another member of the household have been a consensus. This view has strengthened even more since the growth of the literature on bargaining and collective models¹, which assumes individual preferences of different household members and a decision-making process within the household, and criticizes the unitary approach as a framework for answering policy questions.

Figure 2 shows how labor supply decisions of adolescents and household income are intimately related. It is elaborated using data from PME (IBGE) for 2014 and presents the distribution of sons and daughters aged 14 to 24 years who are employed, unemployed, and inactive, by decile of per capita household labor income in Brazil. We observe that the fraction of employed sons and daughters is increasing up to the seventh decile of family income and decreases thereafter, perhaps because the economic status of the household is high enough to reduce the need for sons and daughters to contribute to household income. The probability of a son or daughter being inactive shows a contrary trend, decreasing up to the seventh decile.

Despite the consensus about the joint labor supply decisions of household members and the relevance of household-level decisions on labor market outcomes, labor studies are still typically performed at the individual level, often due to theoretical, methodological, or data difficulties. Studies that account for sons and daughters as decision-makers with a power to influence the household decision process are even more seldom. In general, the literature incorporates children only through the preferences of their parents or as a family public good. Dauphin et al. (2011) is a study that uses a sample of households from the United Kingdom for 1982 to 1993 and a collective approach to provide theoretically consistent evidence that children aged 16 and over and living with parents play an active role in household decisions. They conclude that taking into account all the decision-makers

¹ See Chapter 2 of this thesis for a brief literature review of the bargaining and collective models.

Figure 2 – Distribution of employed, unemployed and inactive sons and daughters aged 14-24, by decile of per capita household labor income, for 2014

Source: Elaborated by the authors based on data from the Monthly Employment Survey (PME) for 2014. Note: We consider the first interview of sons and daughters that live with parents; the horizontal axis presents the deciles of per capita household labor income.

in a family is important for any policy that targets and affects specific members.

The puzzle and the facts presented above as well as the arguments concerning the relevance of household analysis, and the importance of sons and daughters as decision-makers are the general motivations for this thesis. Therefore, we aim to investigate these questions for Brazil in the period 2004 to 2016. The thesis studies are organized in two chapters, in addition to this introduction.

Firstly, in Chapter 2, we analyze the micro-level labor supply decisions of Brazilian sons daughters aged 14 to 24 years living with their parents, in a context of a positive shock which affects the labor income of fathers and mothers. We chose to analyze the income shocks that occur through the annual minimum wage adjustments in a reduced form exercise. We collaborate to the empirical literature about intra-household impacts of policies, testing whether the minimum wage, which affects the income of parents, impacts the final labor supply decisions of sons and daughters. We also verify if the policy has distinct effects depending on whether the eligible person is the father or the mother, aiming to test the income-pooling hypothesis of the unitary model. Our identification strategy is based on an intention-to-treat definition of treatment and control groups, and we use a differences-in-differences estimator. Another innovative aspect of this study is the use of

quarterly microdata from the Continuous National Household Sample Survey (PNADC) for the period between 2012 and 2016. We find that the direction and magnitude of the minimum wage effects, that affect fathers and mothers, on work decisions of sons and daughters depend on who is the eligible person and how many eligible members there exist in the household: it is negative, if the eligible person in the household is only the mother or only the father, and it is positive, whether both the father and the mother are eligible at the same time. On the other hand, if we analyze the effects on the probability of participating in the labor force (being employed or searching for jobs), only the negative effect of the eligible father remains and it is weaker, evidencing that employed sons and daughters may be leaving their jobs (moving to inactivity) or diminishing their working hours, possibly to dedicate time to study, but some of them, that are not working, start searching for jobs, reducing or nullifying the negative impact of this policy on labor supply of children. The household head status of fathers also determines effects favoring sons and daughters. Therefore, our results strengthen the argument in favor for applying collective approaches and showing that the income pooling hypothesis of family members does not seem to be valid in this context.

Given the evidence about the linkage between the labor supply decisions of sons and daughters and positive income shocks of fathers and mothers as well as the distinct impacts that these shocks could have depending on who is the eligible member in the household, we investigate how these intrahousehold decisions about labor supply of members could determine the aggregate results of unemployment and inactivity of the secondary household earners in Brazil. Then, in Chapter 3, we develop and estimate a structural household job search model with on-the-job search. We extend Dey and Flinn (2008) to allow for the unemployment and inactivity of mothers and sons and daughters who are subject to shocks to their employment and income shocks to fathers. These shocks may determine different search behavior and job acceptance, depending on the other household member's labor market situation. The model is estimated using data from the PME (IBGE) for 2004 and 2014. We consider these two years since we use the model to perform simulations of counterfactual scenarios in which the transition rates and other household income change

from 2004 to 2014. To the best of our knowledge, there are no studies that explicitly consider sons or daughters as decision-makers in the household job search literature. The counterfactual simulations of this study allow us to verify that decreasing unemployment rate of sons/daughters would not have changed between 2004 and 2014 if the labor market opportunities and conditions of this member remains the same of 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 this 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 of access to public and private universities, and cash transfer to poor households with teenagers, which increases schooling years and the attendance of sons and daughters in high-school. The inactivity of mothers seems to be explained by the same parameters. Contrarily to the expected, the labor income of fathers and the labor market conditions of mothers only marginally contribute to the inactivity rate of sons/daughters. However, 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 a higher average welfare of youth, while the welfare of mothers is mostly determined by their own better labor market conditions.

It is important to highlight that the labor market conditions of sons and daughters may be jointly determined with the decision to live with their parents or having their household. We only consider the sons and daughters still living with their parents, and we do not explicitly model this decision in our studies, which could generate selection bias in our results, if both observable and unobservable characteristics are associated with both decisions.

We address this issue in the chapters, discussing the potential bias and strategies that could be adopted to overcome it. However, Figure 3, constructed using data from the Brazilian National Household Sample Survey (PNAD/IBGE) for 1992-2015, shows the average proportion of sons and daughters aged 14 to 24 years living with parents in

Figure 3 – Proportion of sons and daughters living with parents, by age and economic growth

Source: Elaborated by the authors based on data from the Brazilian National Household Sample Survey (PNAD) for 1992-2015.

Note: The criterion to define the years of lower GDP growth is below 1,5%. Under this criterion, the years of low economic growth are: 1992, 1998, 1999, 2001, 2003, 2009, 2014, and 2015. The other years between 1992 and 2015 are considered of higher GDP growth.

years of lower economic growth (i.e. Gross Domestic Product (GDP) growth below 1,5%) and in years of higher economic growth. Based on this figure, we see that the decision of living with parents does not seem to be related to economic cycles since the curves almost overlap, but it is related to long-run structural factors, such as the increases in schooling and changes in cultural patterns.

Therefore, the main conclusions of this thesis are that (i) the minimum wage increases that benefit fathers and mothers have impacts on the labor supply decisions of sons and daughters and the magnitude and direction of the effects depend on who is the eligible member; (ii) the use of individual job search models to understand aggregate unemployment and inactivity can be misleading, because the household search behavior matters in the labor supply decisions of secondary earners in the family.

2 Minimum wage and the labor supply decisions of youth

2.1 Introduction

Since 1995, the Brazilian minimum wage, which is determined by the government at the national level, has shown gains in real terms. Starting in 2005, these gains increased even more. Between 2005 and 2016, the average annual growth of the minimum wage in real terms was approximately 4.5% (Figure 4).

Figure 4 – Minimum wage real growth in Brazil

Source: Elaborated by the authors based on data from the Ministry of Labor and Employment (MTE).
 Note: The values were adjusted by the National Consumer Price Index (INPC), calculated by the Brazilian Institute of Geography and Statistics (IBGE) of March 2016.

The minimum wage policy in Brazil has the potential to affect many economic variables. Barros (2007) argues that the minimum wage is the wage floor for formal employees and an official index of pension benefits and other public policies, such as unemployment insurance, but also can be a partial index for formal workers earning above the minimum wage and for many formal private contracts and court rulings, and even a reference for employers in the informal sector, who will not want to pay wages lower than the minimum wage, fearing decreases in worker productivity.

The degree of effectiveness of the minimum wage in Brazil may demonstrate the

potential impact of this policy on workers' welfare. In Figure 5, we analyze the effectiveness of the minimum wage among different members of a household, by plotting the wage densities of sons or daughters aged 14 to 24 years, mothers and fathers, with a labor income above the 1st and below the 99th percentiles, for 2015¹. A dashed line cuts the horizontal axis at the exact value of the minimum wage². We observe that the incidence of this policy among sons and daughters and mothers is higher than the density among fathers, who are the typical primary income earners in Brazilian households.

Figure 5 – The effectiveness of the minimum wage for youth, mothers and fathers in Brazil

Source: Elaborated by the authors based on data from the Continuous National Household Sample Survey (PNADC) for 2015.

Moreover, according to data from the Continuous National Household Sample Survey (PNADC) of the Brazilian Institute of Geography and Statistics (IBGE), in 2016, about 15% of sons or daughters aged 14 to 24 and 13% of mothers earned exactly one minimum wage, whereas only 6% of fathers receive a salary with this value. Other commonly used analysis for the relevance of this policy in a labor market is the Kaitz index, the ratio between the minimum wage and the median of wages whose value closer to one represents a higher incidence of the minimum wage³. Using data from PNADC (IBGE), we verify

¹ This procedure excludes outlier workers with much higher or lower incomes than the average.

² In 2015, the nominal value of the Brazilian minimum wage was R\$ 788.00.

³ The Kaitz index (KAITZ, 1970) was initially calculated as the ratio between the minimum wage and the median wage and weighted by the magnitude of the impact in specific industries (BOERI; OURS, 2013).

that the Kaitz index for sons and daughters aged 14 to 24 years, mothers and fathers, in 2016, are respectively, 0.88, 0.73 and 0.47, in the formal sector, and 1.76, 1.47 and 0.88, in the informal sector of the labor market⁴, meaning that the higher incidence of the policy occurs among youth in the formal sector and fathers in the informal sector⁵.

Given the high incidence of the minimum wage among Brazilian workers, mainly among specific members of a household, and the real increases of its value in the last decade, a household analysis about the effects of this policy can be informative about how it affects the intra-household allocation and the final labor supply decisions of members. In this study, we, therefore, aim to estimate the effects of the minimum wage policy that impacts the earnings of parents on the labor supply decisions of sons and daughters aged 14 to 24. Our analysis focuses on the effects on labor supply of sons and daughters in the intensive and extensive margins, but also on the complementary decisions about studying.

Evidence of cross-effects from income shocks within households in Brazil is found in Cabanas, Komatsu and Menezes Filho (2015), which verify that positive shocks to the income of an adult might affect labor supply and schooling choices for adolescents in the same household. Vieira, Menezes Filho and Komatsu (2016) also find that parental income growth, especially of mothers, might explain the increase in the proportion of teenagers who are dedicated exclusively to schooling and the reduction of the percentage of teenagers who are devoted exclusively to employment.

Since Becker's studies about social interactions, marriage, and the family (BECKER, 1981, 1974), the relevance of household-level decisions on labor market outcomes has been clear. Even before Becker's studies, an extensive literature applied the classical theory of consumer behavior to understand the work and leisure decisions of a family. However, although these studies address the household decisions and often take into account more than one member of a family, they have a unitary approach, considering the family as a

⁴ We consider only the employed members of a household to calculate the index. Formal are registered employees and professionals that contribute to social security.

⁵ The general Kaitz index for Brazil in 2015 is about 0.79, according to data from the PNADC for employed individuals, whereas it is 0.36 for the United States, and 0.62 for France in 2014, according to OECD (Available at http://www.oecd-ilibrary.org/employment/data/earnings/minimum-wages-relative-to-median-wages_data-00313-en).

decision-making unit⁶. Despite the consensus about the relevance of family approaches, labor studies are still typically performed at the individual level, often due to theoretical, methodological, or data difficulties.

The unitary model has been challenged in the last two decades both on theoretical and empirical grounds (DAUPHIN et al., 2011). Vermeulen (2002) argues that this approach presents some empirical and methodological problems. An important limitation identified by the author is the aggregation of individual non-labor income, or the income-pooling hypothesis, which disregards origin, destination, and the impacts of this income on labor supply decisions. Several studies have rejected this restriction, such as Lundberg, Pollak and Wales (1997) and Thomas (1990), for Brazil⁷.

Alternatively, studies aiming to criticize the unitary approach as a framework for answering policy questions, and to prove its theoretical and empirical limitations, comprise the literature on bargaining and collective models, in which individual preferences of household members and a decision-making process within the household are taken into account. In bargaining models, the intrahousehold bargaining may be cooperative (Manser and Brown (1980), McElroy and Horney (1981)) or non-cooperative (Lundberg and Pollak (1994)). The collective framework comes from the works of Chiappori (1988) and Apps and Rees (1988) and does not focus on a particular bargaining rule but assumes individual preferences for different household members and Pareto-efficiency for allocations. Studies, such as Rangel (2006), Maciel (2008), Fernandes and Scorzafave (2009), and Pedrozo (2010), implement collective models to examine the effects of changes in laws or policies on the labor supply of Brazilian couples.

Within this context, it is important to note the lack of household studies about the effects of the minimum wage policy, mainly in Brazil, despite the consensus about

⁶ See, for example, Kosters (1966), which develops a family labor supply model and uses empirical data on married couples to understand the income and relative price effects in labor supply equations, and Ashenfelter and Heckman (1974), which formulates and tests the theoretical restrictions on the labor supply functions of husbands and wives.

⁷ Other limitation identified by Vermeulen (2002) and rejected by Browning and Chiappori (1998) is the hypothesis of the symmetry of the Slutsky matrix. That is, a marginal change in the wages of a family member A would have the same effect on the labor supply of member B that the change in the wages of member B would have on the labor supply of member A.

the relevance of empirical investigations of intra-household allocation in policy analysis. The majority of studies only estimates the minimum wage impacts on the labor supply of a particular and representative member, the head of the household or a male worker, who would be the main decision-maker and who would determine the final household consumption and income allocation. This absence is mostly due to the theoretical and empirical tractability of models that consider the household as a decision unit, in which the different members take labor market decisions collectively.

The empirical analysis of intra-household impacts of policies is a more recent topic in the literature, and it is more widespread in policy evaluations of cash transfers and old-age pensions. These analyses investigate if the income-pooling hypothesis of the unitary model can be rejected, observing whether the impacts of these programs differently affect household members, mainly children, depending on the eligible or treated household member. Bertrand et al. (2003) and Duflo (2003), for example, analyze the effects of a reform in the South African pension program on children outcomes. The first article examines how this transfer affects the labor supply of prime-age individuals living with these elderly in extended families, and finds a drop in the working hours of these individuals, much larger when the pensioner is a woman, suggesting an imperfect pooling of resources. The second study evaluates the impact on children's nutritional status and verifies that pensions received by women had a larger impact on the anthropometric status of girls, but no similar effect is found for pensions earned by men. For Brazil, Ponczek (2011) estimates the effects of a reform of the pension system on children outcomes, and also finds these distinct effects related to the gender of the eligible person and concludes that families are not pooling their income, what contradicts the core of the unitary model.

In the first study of this thesis, we collaborate to the empirical literature about intra-household impacts of policies, testing whether the minimum wage, which affects the income of parents, impacts the final labor supply decisions of sons and daughters. We also verify if the policy has distinct effects depending on whether the eligible person is the father or the mother, aiming to test the income-pooling hypothesis. When the income of the father or mother increases, the family can, for example, decide about the son or

daughter supplying fewer or no working hours and entirely or partially dedicates his or her time to studying, since the opportunity cost of working of this member becomes higher with the improvement in household income.

Our empirical strategy is based on a differences-in-differences estimator and individual fixed effects. Our treatment group comprises the sons and daughters whose father or mother is eligible for receive a wage increase related to minimum wage adjustment, and the control group comprises the sons or daughters whose parents are both ineligible or are working in firms that do not follow the minimum wage law.

Another innovative aspect of this study is the use of quarterly microdata from the PNADC, for the period between 2012 and 2016. The PNADC is a panel in which a household is interviewed up to five times over the course of one year. The microdata was first released on May 7, 2015.

The main result of this study is that the direction and magnitude of the minimum wage effects, that affect fathers and mothers, on work decisions of sons and daughters depend on who is the eligible person and how many eligible members there exist in the household: it is negative, if the eligible person in the family is only the mother or only the father, and it is positive, whether both the father and the mother are eligible at the same time. On the other hand, if we analyze the effects on the probability of participating in the labor force (being employed or searching for jobs), only the negative effect of the eligible father remains and it is weaker, evidencing that employed sons and daughters may be leaving their jobs (moving to inactivity) or diminishing their working hours, possibly to dedicate time to study, but some of them that are not working start searching for jobs, reducing or nullifying the negative impact of this policy on labor supply of children. The household head status of fathers also determines effects favoring sons and daughters. Therefore, our results strengthen the argument for applying collective approaches and showing that the income pooling hypothesis of family members does not seem to be valid in this context.

We organize the study into eight sections in addition to this introduction, appendices,

and references. The second section consists of a brief literature review of the minimum wage policy in Brazil and its effects. The third section contains the empirical strategy, and the fourth section presents the database and sample description. The fifth section presents the descriptive analysis. The estimation results are shown in the sixth section, and the robustness checks are in the seventh section. Finally, the eighth section concludes the article.

2.2 The minimum wage policy in Brazil and its effects

In Brazil, the first law establishing the minimum wage was signed in 1940. This establishment aimed to satisfy basic needs such as food, housing, clothing, hygiene, and transportation of workers. The argument in favor of the minimum wage as an instrument providing well-being for workers was strengthened with the Constitution of 1988.

According to Foguel, Ulyssea and Corseuil (2014), in Brazil, until 1994, the minimum wage was used mostly for macroeconomic stabilization. Since 1995, its real value has systematically recovered, with annual adjustments. Between 1995 and 2014, the average annual growth of the minimum wage was 4.9% in real terms⁸.

In Brazil, the minimum wage is similar to that in most Organization for Economic Cooperation and Development (OECD) countries, since it is determined at the national level by the government and not by trade union agreements⁹. Since 2008, the criterion for adjusting the minimum wage is the incorporation of inflation in the last twelve months prior to the month of the adjustment, in order to preserve workers' purchasing power, plus the real adjustment due to GDP growth in the year $t - 2$ ¹⁰. This criterion does not apply to pensions and benefits, it became law only in 2011¹¹, and it was recently extended until 2019.

The determination of a criterion for adjusting the minimum wage as well as the definition of a period in which the adjustments occur can be a criticism to the assumption of exogeneity of this policy since it is possible that firms and workers anticipate their decisions because they already know the magnitude and the period of the adjustment. Thus, firms can adjust labor demand and dismiss workers and workers and households can decide about consumption, time allocation and labor market transitions, some months

⁸ The values are adjusted by the National Consumer Price Index (INPC), calculated by the Brazilian Institute of Geography and Statistics (IBGE).

⁹ A law that allows the existence of minimum wages defined by states and the Federal District was approved in 2000. These states' minimum wages would be applied to workers whose wages are not adjusted by the federal minimum wage, and it is not defined by convention or collective bargaining agreement. Currently, five Brazilian states (São Paulo, Rio de Janeiro, Paraná, Santa Catarina, and the Rio Grande do Sul) have state minimum wages for some specific occupational categories.

¹⁰ For example, the minimum wage adjustment in January 2014 would be the INPC variation in the previous twelve months plus the GDP growth in 2012.

¹¹ Law 12.382 of February 25, 2011.

before the adjustment.

As earlier discussed, the Brazilian minimum wage is a reference for many types of contracts and public transfers, and it is even a reference for informal employers who will not pay lower wages fearing productivity decreases. Figure 6 shows the wage density of employed individuals in the formal and informal sectors, for 2015¹². The dashed vertical lines represent the exact minimum wage value and up to four multiples¹³. We can observe spikes for the two sectors around the exact value, with a larger peak for the informal sector. We also verify spikes around the wage equal to twice the minimum wage.

Figure 6 – The effectiveness of the minimum wage in the formal and informal sectors in Brazil

Source: Elaborated by the authors based on data from the Continuous National Household Sample Survey (PNADC) for 2015.

Despite the high incidence of the minimum wage as labor income in both labor market sectors, only a small percentage of workers receiving one minimum wage belongs to households with per capita income in the first two deciles of the distribution, which we can observe in Figure 7. This figure presents the percentual distribution of workers receiving one minimum wage, per deciles of the per capita household labor income, for 2015. The chart allows observing the highest concentrations of workers on families whose per capita income is located in the fourth, fifth and seventh deciles.

¹² Wage density of workers with a labor income above the 1st and below the 99th percentile. This procedure excludes outlier workers with much higher or lower incomes than the average.

¹³ In 2015, the nominal value of the Brazilian minimum wage was R\$ 788.00.

Figure 7 – Distribution of workers receiving one minimum wage, by decile of per capita household labor income

Source: Elaborated by the authors based on data from the Continuous National Household Sample Survey (PNADC) for 2015.

Note: The horizontal axis of the chart presents the deciles of per capita household labor income.

The literature about the effects of the minimum wage policy in Brazil is extensive and has a variety of objectives. The earliest studies aimed to estimate the impacts on the average wage, on the rate of wages, or on wages of some specific sector, generally industry, the sector with a large number of workers with low qualifications¹⁴. The most recent literature focuses on changes in the entire wage distribution and on effects on specific quantiles of the wage distribution¹⁵. Other studies aim to estimate the impact of the minimum wage on inequality and poverty¹⁶. Despite of a consensus about the effect of the minimum wage on the reduction of income inequality, there are divergent results about the impacts on poverty, since the policy benefits poor individuals who remain employed but may harm those who have lost their jobs or who have moved to a worse job (ULYSSEA; FOGUEL, 2006).

Moreover, several theoretical and empirical approaches are applied to correctly isolate the impacts of the minimum wage on employment and the labor market transitions.

¹⁴ See, for example: Kingston (1954); Bacha, Mata and Modenesi (1972); Macedo and Garcia (1978); Bacha and Taylor (1978); Souza and Baltar (1979); Drobny and Wells (1983); Saboia (1985); Velloso (1990); Cacciamali, Portela and Freitas (1994); and Carneiro and Henley (1998).

¹⁵ Examples of studies that address this issue are: Fajnzilber (2001); Lemos (2004a, 2004b, 2004c, 2005a, 2005b); Cardoso (1993); Ramos and Reis (1993); Neri (1997); Hoffmann (1998); Camargo, Neri and Gonzaga (2001); Soares (2002); Barros, Corseuil and Cury (2001); and Barros et al. (2001).

¹⁶ See Saboia (2007); and Komatsu and Menezes-Filho (2015).

In this literature, it is also not possible to establish a consensus about the direction and magnitude of these effects, since the direction of the effect depends on the theoretical and methodological choices made by researchers. Fajnzylber (2001) focuses on the supply side effects and finds a reduction in the probability of being employed for formal employees and even greater reductions for informal workers. Foguel, Ulyssea and Corseuil (2014) does not find an increase in transitions to unemployment for formal workers, but they do find an increase in informality¹⁷. On the other hand, Lemos (2006) also uses PME data for 1982-2004 and panel estimation methods and verifies that increases in the minimum wage do not produce negative impacts on participation and hours of work in the formal and informal sector, and these results are robust to different estimation strategies and robustness tests. Foguel, Ulyssea, and Corseuil (2014) also do not find increases in transitions of formal workers to unemployment, but they find significant results for transitions to inactivity, especially among younger workers, and for an increase in informality in the short and medium term. Finally, Komatsu and Menezes-Filho (2015), using the same database for 2002-2014, verify that the unemployment and formalization rates are not affected. These authors conclude that the absence of effects may be related to an intrahousehold dynamic of labor supply, that is, for example, that the increase in the wages of household heads could reduce the labor supply of children and spouses, leading to a null aggregate effect on unemployment.

¹⁷ Other studies that find negative effects on employment are: Foguel (1998); Carneiro (2001); Lemos (2004a; 2004b; 2004c; 2005a; and 2005); and Neumark and Cunningham (2006).

2.3 Identification strategy

2.3.1 Model specification and estimation method

We do not apply a collective model for the labor supply of household members, but in this subsection, we present an extension performed by Chiappori, Fortin and Lacroix (2002) of the Browning and Chiappori (1998) model, which is the theoretical approach that motivates our study and from which our benchmark regression is derived.

In the extension performed by Chiappori, Fortin and Lacroix (2002), a household consists of two members with different utility functions. The authors assume egoistic individual preferences for the model identification, and the Second Theorem of Welfare Economics shows that any Pareto optimum can be decentralized and each household member solves the following individual maximization problem:

$$\max_{[h^i, C^i]} U^i(1 - h^i, C^i, z) \quad (2.1)$$

$$\text{subject to } w^i h^i + \phi^i \geq C^i, \text{ with } 0 \leq h^i \leq 1 \quad (2.2)$$

in which h^i is the labor supply of individual i , C^i is the consumption of a private and composed Hicksian good (price equals 1), w^i is the wage of individual i and z is the vector of preferences variables. ϕ^i is any function that represents the sharing rule, that is, the way which household members allocate the total non-labor income, so that $\phi^i = \phi^i(w_1, w_2, y, z, s)$, where y is the household non-labor income, s is a vector of distribution factors, variables that affect the bargaining power of household members and the intrahousehold decision process, but they do not have direct influence on the individual preferences or budget constraint (BROWNING; CHIAPPORI, 1998), and $\phi^1 = \phi$ and $\phi^2 = y - \phi$.

It is possible to interpret this decision-making process in two stages: first, the non-labor income is allocated between members of a household through the sharing rule, and, second, each member separately chooses a labor supply (and a private consumption) subject to a corresponding budget constraint.

Therefore, following Chiappori, Fortin and Lacroix (2002) and focusing on labor supply equations resulting from the second stage of the maximization problem, we allow sons and daughters are participating in the household bargaining process and deciding about supply labor. In a case of a family with a son or daughter, besides his/her parents, deciding on their labor supply, it is possible to describe the equation for the labor supply of this member as:

$$h^{sd} = H(w^{sd}, w^f, w^m, y, z^{sd}, s) \quad (2.3)$$

in which f denotes the father, m denotes the mother, and sd is the son or daughter; w^k is the wage of the member k , in which $k = f, m, sd$; y is the household non-labor income, z^k is the vector of preferences variables of the member k ; and s is a vector of distribution factors.

It is not the focus of this paper the estimation of the labor supply system of equations for all of the members of a household, but the estimation of the impacts that the minimum wage potentially received by mothers and fathers has on the labor supply of sons and daughters, in a reduced form exercise. Thus, we do not perform a structural estimation, nor present or test the restrictions to be derived from the labor supply behavior of members. In a future version of the study, we intend to reestimate the model, even in a structural approach.

Under the assumption that the restrictions of this theoretical approach are satisfied, we can assume a specific functional form for the labor supply equation. We follow Chiappori, Fortin and Lacroix (2002), who propose the semi-logarithmic form for the labor supply at the intensive margin (labor supply measured in working hours). This regression equation for son or daughter i in a household j can be written as:

$$\ln h_{ijt} = \gamma_0 + \gamma_1 MW_{jt} + \gamma_2 z_{ijt} + \alpha_i + \varepsilon_{ijt} \quad (2.4)$$

in which h_{ijt} denotes the working hours of son or daughter i in a household j and at time t ; MW_{jt} is a dummy that indicates if his/her household j has at least a member, that only can be the father, the mother, or both, that can be potentially affected by a minimum

wage increase¹⁸; z_{ijt} are the individual or household preferences variables; α_i are individual fixed-effects that can capture the relative bargaining power and other characteristics of sons and daughters that are fixed in time; $[\gamma_0, \dots, \gamma_2]$ is the set of parameters being estimated; and ε_{ijt} are the error term of the equation.

Additionally, we estimate the labor supply regarding the extensive margin, that is, concerning the probability of being employed. Accordingly, we use a linear probability model¹⁹. In this model, the variable emp_{ijt} assumes a value of one (1) if the son or daughter i in a household j is employed at time t and zero (0) otherwise. The regression equation can be written as:

$$\Pr(emp_{ijt} = 1 | MW_{jt}, z_{ijt}) = \beta_0 + \beta_1 MW_{jt} + \beta_2 z_{ijt} + \alpha_i + \varepsilon_{ijt} \quad (2.5)$$

in which $[\beta_0, \dots, \beta_2]$ is the set of parameters being estimated and other terms of this equation can be similarly defined as the terms of equation (2.4).

However, if MW_{jt} is correlated with unobservable characteristics of the son or daughter i , that is, if the eligibility of fathers and/or mothers for the minimum wage policy is not random (when MW_{jt} varies, ε_{ijt} also varies) it is not possible to separate the effect on h_{ijt} or on emp_{ijt} arising from the minimum wage policy and resulting from the variation in ε_{ijt} . In this case, $\mathbb{E}[\varepsilon_{ijt} | MW_{jt}] \neq 0$, there is a selection process, and the effect of the minimum wage policy cannot be consistently estimated by the Ordinary Least Squares (OLS) method.

Since we have a longitudinal database, it is possible to apply the difference-in-difference method (DD), an estimation method that allows controlling for non-observable individual characteristics that are invariant in time, that is, it allows isolating the minimum wage impact from other individual factors, observable and unobservable, that influence the labor supply behavior.

The DD method is based on the calculation of a double difference, in which the first difference is between periods, that is, before and after the treatment within the control

¹⁸ We assume that a shock may affect the father and the mother in a household at the same time.

¹⁹ We do not use non-linear models, such as probit or logit models, because they result in a violation of the common trend assumption, as explained by Ai and Norton (2003) and Puhani (2012).

and treatment groups. The second difference occurs between the two groups. The main hypothesis of the DD method is that the trajectory for the outcome of the treatment group would be similar to the trajectory for the outcome of the control group if the policy had not been implemented. Therefore, the DD method allows controlling for factors that are fixed in time.

It is possible to present the DD model through a linear regression, and assuming the existence of only two points in time, that is, before and after the treatment, equations (2.4) and (2.5) can be rewritten as:

$$\ln h_{ijt} = \gamma_1 MW_{jt} + \gamma_2 Post_i + \gamma_3 MW_{jt} Post_i + \gamma_4 z_{ijt} + \alpha_i + \varepsilon_{ijt} \quad (2.6)$$

$$\Pr(emp_{ijt} = 1 | MW_{jt}, z_{ijt}) = \beta_1 MW_{jt} + \beta_2 Post_i + \beta_3 MW_{jt} Post_i + \beta_4 z_{ijt} + \alpha_i + \varepsilon_{ijt} \quad (2.7)$$

in which $Post_i$ is a dummy equal to 1 in the period in which the shocks on minimum wage occurs; and $[\gamma_1, \dots, \gamma_4]$ and $[\beta_1, \dots, \beta_4]$ are the set of parameters being estimated. Assuming the hypothesis $\mathbb{E}[\varepsilon_{ijt} | MW_{jt}, z_{ijt}, Post_i] = 0$, the effect on the labor supply of son or daughter i of household j in the intensive and extensive margins, as a result of the minimum wage policy, can be measured through γ_3 and β_3 , respectively.

Our treatment and control definition, detailed in the next subsection, produces the intention-to-treat (ITT) effect. An intention-to-treat analysis is based on the initial treatment assignment and not on the treatment eventually received. The identification of the ITT effect relies on the estimation of the difference $\mathbb{E}[Y | T = 1] - \mathbb{E}[Y | T = 0]$, in which T is the variable that indicates if the individual or household is affected by the policy and Y is the outcome of interest under which we intend to estimate the impacts of a policy, and this effect could be scaled by some probability of treatment in order to arrive at the average treatment effect on the treated (ATT). Therefore, in a quasi-experimental design, the main identification hypothesis for the minimum wage effect is that conditional on observable characteristics and fixed and unobservable characteristics (DD method), the probability of treatment, or the likelihood of being affected by the minimum wage policy, of mothers and fathers belonging to the treatment and control groups, is identical,

meaning that this policy determines an exogenous shock in labor income.

2.3.2 Treatment and control groups

In our identification strategy, we use a difference-in-difference estimator with fixed-effects to estimate the intention-to-treat effect of the minimum wage that affects parental income on the labor supply of sons and daughters.

Therefore, it is necessary to construct a control group comparable to the treatment group. Our treatment group comprises the sons and daughters whose parents (father and/or mother) could be potentially affected by the minimum wage policy, that is, the fathers or mothers who were receiving less than the new minimum wage²⁰ but at least the old minimum wage at baseline.

We compare the labor supply of this intervention group to the labor supply of sons and daughters whose parents could be unaffected by this policy because either (i) they were ineligible, as their wage was already above the new minimum wage at baseline or (ii) they were eligible, since they were receiving a wage below the old minimum wage, but their firms did not comply, possibly because these firms are informal, so that their wages remained below the national minimum.

Thus, we select the intervention and control group based on baseline wages. We define the baseline as the fourth quarter of each year since minimum wage adjustments occur in January in this period and the post-intervention as the first quarter of the next year.

²⁰ The minimum wage values are R\$ 622.00 for 2012, R\$ 678.00 for 2013, R\$ 724.00 for 2014, R\$ 788.00 for 2015, and R\$ 880.00 for 2016.

2.4 The database and the sample

Quarterly longitudinal data was used from the Continuous National Household Sample Survey (PNADC) of the Brazilian Institute of Geography and Statistics (IBGE) for the period 2012-2016. The PNADC covers the entire Brazilian territory, excluding some special areas (IBGE). The database is a panel in which a household is surveyed one month and then excluded from the sampling process for the following two months before returning for the next interview. The process is repeated until the household is interviewed five times, once every quarter (IBGE). This microdata was first released on May 7, 2015, albeit incompletely. Some variables, such as non-labor income, are still being validated (IBGE).

In this study, we investigated the labor supply decisions of sons and daughters. Thus, the final sample consists of sons and daughters between 14 and 24 years whose families²¹ may have a father and a mother, or only one of these two members, and may have a variable number of children aged between 0 and 13 years.

We exclude households whose members have problems in their identifier codes²². The PNADC still has no longitudinal identifier code for individuals. Thus, we built an individual identifier code based on the household identifier and the individual's sex and birth date.

We exclude families with two fathers or two mothers, with no head²³, and households observed only at one point in time. The analyzed members (fathers, mothers, and sons and daughters) must be present at two points in time: the fourth quarter of each year, which is the baseline, and the first quarter of the next year, which is the post-intervention, since the adjustments take place in January each year in the analyzed period. Thus, we exclude households whose analyzed members do not have these two observations²⁴.

²¹ We excluded households with more than one family, using information about the number of heads and spouses in the household. Therefore, the terms “household” and “family” are substitutes.

²² Individuals with duplicated identifiers at one point in time.

²³ This is an evidence of error in collecting data, since it is not possible given the structure of the database.

²⁴ If at least one son or daughter, in addition to the father and mother, has these two observations, we keep the household.

Appendix A.1 (Table 40) reports the loss of observations with the applied exclusions, and tables 1 and 2 present a comparison between the full sample of the PNADC and our subsample of households after the exclusions. Table 1 presents the mean and standard deviation of continuous and binary variables, while Table 2 shows the frequencies of some categorical variables of these samples. We observe that the households in our subsample are larger and have younger and less experienced members, on average, according to expected, since these families must have at least one child aged 14 to 24 years. It is important to highlight that the individual labor income is lower, but the household labor income is higher among the workers in our subsample (Table 1).

The majority of families in our household (about 87%) has the presence of a mother and a father. The percentage of workers with high skill jobs is lower among the households in our subsample, possibly because one of the workers can be the younger son or daughter. Besides, the unemployment and inactivity rates are higher in our subsample.

Table 1 – Continuous variables of the full sample and subsample

Variables	Full sample		Subsample	
	Mean	Std. Dev.	Mean	Std. Dev.
Age	32	20	28	16
Male	49.57	50.00	49.76	50.00
White	47.45	49.93	45.93	49.83
Members	3	1	4	1
Number of children	1	1	1	1
Years of schooling	7	5	7	5
Experience	25	18	18	15
Formal	61.93	48.56	59.69	49.05
Hours of work	40	13	39	13
Individual income	2200	3509	1923	3310
Household income	3004	4974	3358	5308
Number of households	86,002		22,578	
Number of individuals	235,300		87,814	

Source: Elaborated by the authors based on data from the Continuous National Household Sample Survey (PNADC) for 2012-2015.

Notes: The full sample comprises all the households of the PNADC that have a head, spouse and sons and daughters as members, excluding the households with problems in the identifier code, no head or more than one head. We consider the first interview of members in 2015. Formal are registered employees and professionals that contribute to social security. Male, White and Formal are percentages. Experience in years. 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.

Table 2 – Frequencies of categorical variables of the full sample and subsample

Variables	Full sample	Subsample
Household composition		
F, M, 14-24	34.01	86.74
M, 14-24	4.53	11.62
F, 14-24	0.64	1.64
F, M, <14	28.73	-
F, <14	0.17	-
M, <14	1.78	-
<14, 14-24	30.14	-
Occupational skill		
Low	39.46	41.92
Median	46.18	46.17
High	14.36	11.91
Labor market situation		
Employed	58.90	55.64
Unemployed	7.94	10.10
Inactive	33.16	34.26
Number of households	86,002	22,578
Number of individuals	235,300	87,814

Source: Elaborated by the authors based on data from the Continuous National Household Sample Survey (PNADC) for 2012-2015.

Notes: The full sample comprises all the households of the PNADC that have a head, spouse and sons and daughters as members, excluding the households with problems in the identifier code, no head or more than one head. We consider the first interview of members in 2015. Numbers are percentages. Formal are registered employees and professionals that contribute to social security. High-level skill: managers, leaders and specialized public officials, artists and skilled workers; Medium-level skill: technicians of medium level and administrative service workers; Low-level skill: agricultural, hunting and fishing workers and industrial workers. F: father, M: mother, 14-24: sons and daughters aged 14 to 24 years, and < 14: sons and daughters aged up to 14 years.

2.5 Descriptive analysis of sons and daughters and their households

In this section, we present and compare some characteristics of the sons and daughters and their families belonging to the treatment and control groups. In Table 3, we find the mean of the variables of both groups as well as the statistic and the p-value of a test for differences in means (T-test).

We analyze individual, and household demographic variables since the composition and size of a family's workforce can be a determinant of job opportunities and conditions in the labor market. Moreover, schooling, skills, experience and tenure are relevant factors associated with labor returns and being in a formal job is a sufficient condition to receive a wage at least equal to minimum wage. Finally, we analyze two locational variables that aim to reflect the labor market opportunities associated with economic activity: i) the IRED dummy that indicates if a household is located in a municipality classified by the IBGE (Brazilian Institute of Geography and Statistics) as belonging to an Integrated Region of Economic Development, meaning that the municipality is a capital or is located in a Metropolitan region or other municipalities of an integrated area; and ii) a categorical variable for the geographic region where the family lives.

Firstly, we observe that there are significant differences in the averages of almost all the variables of the treatment and control groups, evidencing the need to include the exogenous set of variables in the estimation of the minimum wage effects, in a specification without fixed effects.

We verify that the average age of the sons and daughters is about 17 years in both groups and the majority is aged between 14 and 18 years. The socioeconomic conditions of the sons and daughters and their households belonging to the control group are on average better than the conditions of the treatment group, since the control group comprises the families whose father or mother already received a wage above the new minimum wage at baseline, in addition to the fathers and mothers in the informal sector. This fact is evidenced in a higher schooling of sons/daughters and mothers, a higher proportion of whites and household living in capital or municipalities with integrated economic activity.

Table 3 – Descriptive statistics of sons and daughters and their households of treated and control groups

Variables	Mean		T-test	
	Treated	Control	t	p-value
Age	17	17	-17.99	0.0000
Male	54.10	52.94	2.70	0.0070
White	31.15	55.23	-56.28	0.0000
Years of schooling	8	9	-41.69	0.0000
Formal	31.34	48.98	-20.19	0.0000
Experience	3	2	26.24	0.0000
Hours of work	8	10	-17.00	0.0000
Tenure	31	29	3.17	0.0020
Individual income	164	303	-24.69	0.0000
Members	4	4	11.72	0.0000
Schooling of mother	7	10	-74.80	0.0000
Number of children	1	1	21.89	0.0000
IREDD	33.80	41.71	-18.63	0.0000
Age group of sons/daughters				
14-18	74.65	67.92	16.76	0.0000
19-21	18.03	21.25	-9.13	0.0000
22-24	7.32	10.83	-13.15	0.0000
Occupational skill				
Low	50.12	41.21	10.36	0.0000
Median	44.67	51.06	-7.32	0.0000
High	5.21	7.73	-5.39	0.0000
Labor market situation				
Employed	24.26	30.69	-16.20	0.0000
Unemployed	15.24	10.96	15.90	0.0000
Inactive	60.51	58.35	5.07	0.0000
Geographic region				
North	15.13	6.26	42.54	0.0000
Northeast	40.23	18.07	66.90	0.0000
Southeast	26.26	48.93	-52.69	0.0000
South	10.20	19.68	-27.71	0.0000
Central West	8.18	7.08	5.00	0.0000
Number of observations	13,701	22,424		

Source: Elaborated by the authors based on data from the Continuous National Household Sample Survey (PNADC) for 2015.

Notes: We consider the first interview of members in 2015. Formal are registered employees and professionals that contribute to social security. High-level skill: managers, leaders and specialized public officials, artists and skilled workers; Medium-level skill: technicians of medium level and administrative service workers; Low-level skill: agricultural, hunting and fishing workers and industrial workers. IRED (Integrated Region of Economic Development) is an economic definition of IBGE to municipalities and includes the Brazilian municipalities that are capital or that belong to Metropolitan regions and other municipalities with integrated economic activity. Male, White, Formal, IRED and the values of the categorical variables are percentages. Experience in years and tenure in months. Individual 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.

We also find better labor conditions of sons and daughters of the control group, such as a higher participation in the labor market and a higher probability of being in the formal sector and working in jobs requiring a medium to high skill level, in addition to a greater individual labor income. It is also important to highlight that the majority of the treatment group is located in the Northeast region, but most of the control group is in the Southeast region.

Given the differences presented in Table 3, we include in the estimation regressions without fixed effects the demographic variables of sons/daughters and their households, the schooling of mother and the locational variables, in addition to dummies for years.

In the last table of this section, we analyze the households belonging to the treatment and control groups. It is important to highlight that our treatment group comprises the sons and daughters whose parents could be potentially affected by the minimum wage, that we compare to the sons and daughters whose both parents are potentially unaffected by this policy, and we define these groups based on baseline observations. Thus, in Table 4, we analyze if the eligibility to treatment is arising from the mother, the father or from both, and what percentage of these eligible members is really affected by minimum wage shocks in post-intervention (first quarter of years). We observe that in about 52% of the households in treatment, the eligible member is the mother and 39% of them are really affected by the minimum wage policy. We also verify that 9% of the households in treatment have both an eligible father and mother and in 48% of these families, at least one of these two members is affected by the policy.

Table 4 – The eligible person in households of the treatment group

Member	Elegibility in baseline		Affected by MW post intervention	
	Treatment	Control	Treatment	Control
Mother	7,176	-	38.6%	-
Father	5,322	-	32.2%	-
Mother and father	1,203	22,424	48.2%	5.5%
Total	13,701	22,424		

Source: Elaborated by the authors based on data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

2.6 Estimation results and discussion

This section presents the estimation results for the effects of the minimum wage policy, which affects the wage of fathers and mothers on the labor supply of sons and daughters aged 14 to 24 years. In all the estimations, we apply the difference-in-difference approach, which allows controlling for non-observable individual characteristics that are invariant in time. In regressions using the differences-in-differences method, the interaction term between the dummy for the post-intervention period (*Post*) and the dummy variable for treatment (*MW*) captures the effect of minimum wage²⁵.

2.6.1 General impacts of the minimum wage

Firstly, we present the general estimation results, for which we do not distinguish whether the father or the mother or both, is the eligible member in the household. In almost all the estimations, we also perform some specification tests. We test for: i) a specification under the hypothesis of strict exogeneity and randomness of the policy (No controls), without controls and individual fixed effects; ii) a specification with controls for demographic and socioeconomic characteristics of sons and daughters and household, education of mothers, locational variables, and dummies for years; and (iii) a specification that takes into account fixed effects in individual level, aiming to control for the unobservable characteristics of sons and daughters fixed in time, the most completed specification and the one chosen to perform subsample analyses and robustness checks. In almost all the regressions, we correct for the residual autocorrelation of sons and daughters in the same household through a cluster correction for households²⁶.

In addition to estimating the impacts of the minimum wage of parents on labor supply of sons and daughters, we start this subsection with Table 5, which shows the direct minimum wage effects on income of fathers and mothers and household income, and it allows to verify how this policy can affect the household welfare and the welfare

²⁵ In the regressions including fixed effects, the dummy variable *MW* is automatically omitted in a procedural step since the treatment status of the household is fixed in time.

²⁶ The exception is the multinomial logit estimations with fixed effects, for which cluster corrections are not allowed.

of members. We perform this estimation including fixed effects, and we observe that the minimum wage increases the wage of fathers and mothers, but the results are inconclusive for the household labor income, perhaps because other members may have left the labor market.

Table 5 – Differences-in-differences estimation results of the impacts of minimum wage on parents' and household labor income

Labor income	Father	Mother	Household
<i>Post</i>	-0.326*** (0.0184)	-0.673*** (0.0219)	-0.115*** (0.00957)
<i>MW * Post</i>	0.191*** (0.0300)	0.294*** (0.0388)	-0.00336 (0.0175)
Dummies for years	YES	YES	YES
Constant	6.673*** (0.0169)	6.205*** (0.0215)	7.812*** (0.00962)
Number of observations	72,250	72,250	72,250
R-squared	0.026	0.071	0.016

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. Specification with fixed effects and cluster correction for households.

The next table presents the general effects of the minimum wage of parents (the treatment variable is equal to one if the family has an eligible father, mother or both) on labor supply decisions of sons and daughters. We analyze the probability of being employed and the working hours. We find a positive and statistically significant effect of the minimum wage shock affecting parents on the probability of sons and daughters being employed, in all the specifications, but this impact is lower and about 1% if we consider the most completed specification that includes fixed-effects. Similarly, Table 6 shows a positive and significant impact of the minimum wage of parents on the working hours of sons and daughters, which varies between 3% and 4%. For the results under specification with control variables, we observe that being older and male, and belonging to bigger households are characteristics associated with higher probability of supply labor and with more working hours. On the other hand, the schooling of mothers and the location in the Northeast region and municipalities classified as IRED are factors that determine a lower labor supply.

In Table 7, we complement this first analysis about the minimum wage effects on the labor supply of sons and daughters, taking into account the probability of being employed or searching for a job, that is, the probability of being in the labor force. We verify that the effects remain positive but are no longer significant, meaning that is the decision on being employed the most affected.

In addition to estimations concerning the minimum wage effects on labor supply, we also perform some analysis for the decision about work and study, since sons/daughters probably allocate their time to these two activities, in a complementary way. Thus, we verify the effects of the minimum wage of parents on the school attendance of sons/daughters²⁷, and on a combination of the study and work decisions. This combination is reflected in a categorical variable, whose categories are: i) Study and work; ii) Study, meaning that the son/daughter only studies; iii) Work, meaning that the son/daughter only works; and iv) Neither, i.e., he/she does not study, neither works. Then, we use a multinomial logit model, in a difference-in-difference approach, to estimate the effects on the probability of belonging to one of the categories, relatively to the probability of belonging to the base category, Work.

Therefore, in Table 8, we present the general results of the school attendance and in Table 9, the results of the multinomial logit for the work/study decision. Additionally, we estimate the multinomial logit, considering both the sons/daughters who are employed or searching for a job on the work decision to construct the categorical variable of the multinomial logit (Table 10). The results in Tables 9 and 10 are marginal effects, and values above one mean an increase in the relative probability, while values below one mean a reduction.

We do not find significant effects on the probability of attending school. It is important to highlight that our baseline is the last quarter of each year and our post intervention is the first quarter of next year, but individuals can be interviewed in any month of the quarters. Thus, it is possible that the null effect of the minimum wage on attending school is related to the son/daughter being interviewed in a period when the

²⁷ We use the PME's question, in which individuals declare to attend school in any schooling level.

Table 6 – Differences-in-differences estimation results of the minimum wage effects on work decision of sons and daughters

Work decision	Probability of being employed			Working hours		
	No controls	Controls	FE	No controls	Controls	FE
<i>MW</i>	-0.0596*** (0.00669)	-0.0553*** (0.00640)		-0.218*** (0.0235)	-0.188*** (0.0221)	
<i>Post</i>	0.00568* (0.00332)	0.00357 (0.00424)	0.00623* (0.00330)	0.0382*** (0.0114)	0.0315** (0.0147)	0.0402*** (0.0113)
<i>MW * Post</i>	0.0109** (0.00546)	0.0123** (0.00551)	0.0109** (0.00548)	0.0328* (0.0184)	0.0379** (0.0186)	0.0327* (0.0185)
Age		0.0714*** (0.00101)			0.267*** (0.00365)	
White		0.00312 (0.00560)			0.00734 (0.0197)	
Male		0.0872*** (0.00506)			0.331*** (0.0178)	
Schooling of mother		-0.0120*** (0.000658)			-0.0434*** (0.00231)	
Number of children		-0.000693 (0.00451)			-0.00369 (0.0160)	
Members		0.00843** (0.00357)			0.0294** (0.0129)	
IREDD		-0.0511*** (0.00554)			-0.163*** (0.0196)	
Northeast region		-0.00825 (0.00839)			-0.0602** (0.0284)	
Southeast region		0.0221*** (0.00844)			0.104*** (0.0290)	
South region		0.0989*** (0.00952)			0.379*** (0.0330)	
Central West region		0.0544*** (0.0103)			0.204*** (0.0354)	
Dummies for years		YES	YES		YES	YES
Constant	0.307*** (0.00439)	-0.957*** (0.0246)	0.281*** (0.00314)	1.058*** (0.0156)	-3.681*** (0.0871)	0.965*** (0.0108)
Number of observations	72,250	72,250	72,250	72,250	72,250	72,250
R-squared	0.003	0.222	0.001	0.004	0.249	0.002

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; FE: specification with fixed effects. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. In all estimations, we perform cluster correction for households. IRED (Integrated Region of Economic Development) is an economic definition of IBGE to municipalities and includes the Brazilian municipalities that are capital or that belong to Metropolitan regions and other municipalities with integrated economic activity. The dummy for the North region is omitted.

Table 7 – Differences-in-differences estimation results of the minimum wage effects on work and search for jobs decision of sons and daughters

Probability of being employed or searching for jobs	No controls	Controls	FE
<i>MW</i>	-0.00935 (0.00752)	-0.0247*** (0.00704)	
<i>Post</i>	0.0236*** (0.00388)	0.00330 (0.00470)	0.0235*** (0.00385)
<i>MW * Post</i>	0.00554 (0.00660)	0.00806 (0.00666)	0.00571 (0.00663)
Age		0.0847*** (0.000955)	
White		-0.0212*** (0.00582)	
Male		0.0698*** (0.00521)	
Schooling mother		-0.0157*** (0.000687)	
Number of children		0.00653 (0.00464)	
Members		0.00359 (0.00363)	
IREDD		-0.0494*** (0.00583)	
Northeast region		-0.00400 (0.00891)	
Southeast region		-0.00244 (0.00900)	
South region		0.0565*** (0.00995)	
Central West region		0.00748 (0.0108)	
Dummies for years		YES	YES
Constant	0.416*** (0.00469)	-0.929*** (0.0257)	0.415*** (0.00376)
Number of observations	72,250	72,250	72,250
R-squared	0.001	0.244	0.003

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; FE: specification with fixed effects. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. In all estimations, we perform cluster correction for households. IRED (Integrated Region of Economic Development) is an economic definition of IBGE to municipalities and includes the Brazilian municipalities that are capital or that belong to Metropolitan regions and other municipalities with integrated economic activity. The dummy for the North region is omitted.

decision about studying is still not taken. In a future version of the study, we intend to estimate the impacts on other quarters.

We find a negative and significant impact of the minimum wage of parents on the probability of not studying or working relatively to the probability of only work, corroborating the positive effect on the probability of being employed of sons/daughters, presented in Table 6. On the other hand, if we take into account both the sons/daughters who are employed and those who are searching for a job to construct the categorical variable of the multinomial logit, this negative effect is no longer significant, which confirms that the decision about starting to work is the most affected, and not precisely the decision on participating in the labor force.

These first results support our initial assumption since we find statistically significant cross-effects of the minimum wage of mothers and fathers on the labor supply decisions of sons and daughters aged 14 to 24. However, contrary to the results found in the recent literature on the increasing labor income of adults and the decreasing labor supply of children, we find positive effects, meaning that the minimum wage that could potentially affect the labor income of parents determines an increase in labor supply of the analyzed sons and daughters. Therefore, we analyze this positive result carefully, and we test if the minimum wage policy has distinct effects depending on whether the eligible person is the father or the mother.

Table 8 – Differences-in-differences estimation results of the minimum wage effects on school attendance of sons and daughters

School attendance	No controls	Controls	FE
<i>MW</i>	-0.0187*** (0.00648)	-0.0130** (0.00574)	
<i>Post</i>	-0.0439*** (0.00346)	-0.0283*** (0.00411)	-0.0437*** (0.00344)
<i>MW * Post</i>	0.00210 (0.00539)	0.000144 (0.00543)	0.00187 (0.00541)
Age		-0.0810*** (0.000971)	
White		0.0190*** (0.00509)	
Male		-0.0387*** (0.00462)	
Schooling of mother		0.0135*** (0.000580)	
Number of children		0.00618 (0.00389)	
Members		-0.00589* (0.00317)	
IREDD		0.0171*** (0.00497)	
Northeast region		-0.00712 (0.00737)	
Southeast region		-0.0431*** (0.00738)	
South region		-0.0356*** (0.00822)	
Central West region		-0.0151* (0.00867)	
Dummies for years		YES	YES
Constant	0.770*** (0.00398)	2.110*** (0.0226)	0.762*** (0.00320)
Number of observations	72,250	72,250	72,250
R-squared	0.003	0.281	0.015

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; FE: specification with fixed effects. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. In all estimations, we perform cluster correction for households. IRED (Integrated Region of Economic Development) is an economic definition of IBGE to municipalities and includes the Brazilian municipalities that are capital or that belong to Metropolitan regions and other municipalities with integrated economic activity. The dummy for the North region is omitted.

Table 9 – Multinomial logit results of the minimum wage effects on study/work decision of sons and daughters

Study and/or work	No controls			Controls			FE		
	Study and work	Study	Neither	Study and work	Study	Neither	Study and work	Study	Neither
<i>MW</i>	0.865** (0.0500)	1.194*** (0.0558)	1.632*** (0.101)	0.900 (0.0599)	1.242*** (0.0773)	1.566*** (0.110)			
<i>Post</i>	0.891*** (0.0315)	0.866*** (0.0183)	1.260*** (0.0525)	0.882*** (0.0394)	0.822*** (0.0319)	1.149*** (0.0576)	0.591*** (0.0322)	0.536*** (0.0298)	1.145** (0.0649)
<i>MW * Post</i>	1.001 (0.0572)	0.954 (0.0338)	0.849*** (0.0536)	0.977 (0.0612)	0.924 (0.0476)	0.835*** (0.0558)	1.027 (0.0945)	0.892 (0.0807)	0.841** (0.0738)
Age				0.706*** (0.00724)	0.472*** (0.00550)	0.800*** (0.00816)			
White				1.152** (0.0639)	1.109* (0.0591)	0.955 (0.0553)			
Male				0.670*** (0.0340)	0.451*** (0.0220)	0.478*** (0.0246)			
Schooling of mother				1.088*** (0.00653)	1.163*** (0.00679)	1.060*** (0.00668)			
Number of children				1.095** (0.0498)	1.065 (0.0482)	1.047 (0.0497)			
Members				0.918*** (0.0282)	0.895*** (0.0276)	0.916*** (0.0287)			
IREDD				1.059 (0.0572)	1.471*** (0.0782)	1.323*** (0.0726)			
Northeast region				0.857* (0.0777)	0.933 (0.0839)	0.971 (0.0868)			
Southeast region				0.581*** (0.0505)	0.585*** (0.0496)	0.693*** (0.0602)			
South region				0.648*** (0.0594)	0.414*** (0.0376)	0.427*** (0.0423)			
Central West region				0.917 (0.0911)	0.644*** (0.0641)	0.725*** (0.0745)			
Dummies for years				YES	YES	YES			
Constant	1.178*** (0.0409)	4.295*** (0.123)	0.631*** (0.0257)	1,225*** (307.3)	4.045e+06*** (1.067e+06)	126.7*** (31.71)			
Number of observations	72,250	72,250	72,250	72,250	72,250	72,250	17,504	17,504	17,504

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016. Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; FE: specification with fixed effects. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. In the estimations with and without controls, we perform cluster correction for households. *Work* is the base outcome. IRED (Integrated Region of Economic Development) is a definition of IBGE to Brazilian municipalities that are capital or that belong to Metropolitan regions, and other municipalities with integrated economic activity. The dummy for the North region is omitted.

Table 10 – Multinomial logit results of the minimum wage effects on the study/work or search for jobs decision of sons and daughters

Study and/or work or search for jobs	No controls			Controls			FE		
	Study and work	Study	Neither	Study and work	Study	Neither	Study and work	Study	Neither
<i>MW</i>	0.897** (0.0430)	0.959 (0.0397)	1.188** (0.0828)	0.882** (0.0487)	1.003 (0.0551)	1.244*** (0.0965)			
<i>Post</i>	0.846*** (0.0259)	0.800*** (0.0157)	1.127** (0.0584)	0.819*** (0.0318)	0.808*** (0.0293)	1.100 (0.0668)	0.539*** (0.0257)	0.460*** (0.0230)	0.915 (0.0541)
<i>MW * Post</i>	1.019 (0.0474)	0.995 (0.0308)	0.917 (0.0694)	1.005 (0.0529)	0.978 (0.0475)	0.903 (0.0714)	1.045 (0.0807)	1.000 (0.0794)	0.977 (0.0891)
Age				0.691*** (0.00610)	0.468*** (0.00495)	0.774*** (0.00825)			
White				1.144*** (0.0542)	1.248*** (0.0590)	1.133** (0.0701)			
Male				0.773*** (0.0333)	0.571*** (0.0243)	0.613*** (0.0343)			
Schooling mother				1.087*** (0.00558)	1.166*** (0.00609)	1.078*** (0.00809)			
Number of children				1.082** (0.0403)	1.007 (0.0384)	0.980 (0.0479)			
Members				0.919*** (0.0242)	0.938** (0.0258)	0.935* (0.0329)			
IREDD				1.054 (0.0486)	1.380*** (0.0649)	1.258*** (0.0743)			
Northeast region				0.838** (0.0612)	0.910 (0.0679)	0.845* (0.0779)			
Southeast region				0.603*** (0.0436)	0.706*** (0.0515)	0.749*** (0.0680)			
South region				0.699*** (0.0541)	0.573*** (0.0458)	0.568*** (0.0597)			
Central West region				0.921 (0.0774)	0.871 (0.0768)	1.040 (0.113)			
Dummies for years				YES	YES	YES			
Constant	1.328*** (0.0398)	2.980*** (0.0779)	0.284*** (0.0133)	1,730*** (366.0)	1.196e+06*** (281,107)	44.48*** (11.34)			
Number of observations	72,250	72,250	72,250	72,250	72,250	72,250	20,832	20,832	20,832

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; FE: specification with fixed effects. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. In the estimations with and without controls, we perform cluster correction for households. *Work* is the base outcome. IRED (Integrated Region of Economic Development) is a definition of IBGE to Brazilian municipalities that are capital or that belong to Metropolitan regions, and other municipalities with integrated economic activity. The dummy for the North region is omitted.

2.6.2 Eligible fathers and mothers

In this subsection, we present the results of estimations that separately take into account the effects of the minimum wage faced by: (i) households in which the eligible person is only the mother, (ii) families in which the eligible person is only the father, (iii) households in which the father and the mother are both eligible.

Firstly, in Table 11, the results of the minimum wage impacts on the work decision of sons and daughters are organized in three parts: i) the effects on the probability of being employed; ii) the effects on working hours; iii) the effects on the probability of being employed or searching for jobs, that is, participating in the labor force. The results in the second column of this table are estimated under a specification that takes into account these disaggregated effects in the same equation, through three dummies. We can describe, for example, the equation for the working hours, as follow²⁸:

$$\ln h_{ijt} = \gamma_1 MW_{jt}^m + \gamma_2 MW_{jt}^f + \gamma_3 MW_{jt}^{fm} + \gamma_4 Post_i + \gamma_5 MW_{jt}^f Post_i + \gamma_6 MW_{jt}^m Post_i + \gamma_7 MW_{jt}^{fm} Post_i + \gamma_8 z_{ijt} + \alpha_i + \varepsilon_{ijt}$$

in which f denotes father and m means mother; h_{ijt} is the working hours of son or daughter i in a household j and in time t ; MW_{jt}^f and MW_{jt}^m are dummies that indicate if the eligible person in the household is, respectively, the father or the mother; MW_{jt}^{fm} indicates if both the father and the mother can be potentially affected by the minimum wage; z_{ijt} are the individual or household preferences variables; α_i are individual fixed-effects that can capture the relative bargaining power and other characteristics of sons and daughters that are fixed in time; $Post_i$ is a dummy equal to 1 for the post-intervention period, in which the shocks on minimum wage occurs; $[\gamma_1, \dots, \gamma_8]$ is the set of parameters estimated; and ε_{ijt} are the error term of the equation.

We observe that, when we consider the disaggregated effects of the minimum wage of eligible fathers and mothers, we find significant impacts on the probability of being employed and on the working hours of sons and daughters. However, the effects of the

²⁸ The equation for the probability of being employed and for the probability of being employed or searching for jobs can be similarly defined.

policy if the eligible person is only the father or only the mother are negative, whereas the effect remains positive in households in which both parents are eligible for minimum wage increases. In households in which only the mother is eligible, we observe a decrease of about 5% in the probability of being employed and a decline of about 17% on working hours, and, for fathers, we find reductions of 11% and 36%, respectively.

For the probability of being employed or searching for jobs, only the negative effect if the father is the eligible member remains and it is weaker (about 8%), meaning that when we include the decision on searching for jobs, the effects of the minimum wage of parents decrease or become non-significant. This fact can evidence that employed sons and daughters may be leaving their employments (moving to inactivity) or diminishing their working hours, possibly to dedicate time to study, but some of them that are not working, start searching for jobs, negatively impacting or nullifying the negative impact of this policy on labor supply of children.

We perform F-tests for the equality between the particular coefficients of eligible mothers (a), fathers (b), and fathers and mothers (c). We find a significant test statistic for the comparison between (b) and (c) and between (a) and (c), meaning that the minimum wage effect on households in which both parents are eligible is statistically different from the effect on families in which only one person is eligible, but the presence of an eligible mother is not significantly distinct from the presence of an eligible father.

Thus, similarly to Ponczek (2011), Bertrand et al. (2003) and Duflo (2003), the eligible person seems to matter to our results and the positive effect found in tables 6 and 7 seems to be a result of the positive effect in households with eligible father and mother that exceed the negative effect found in families with only eligible person. The positive effect found in families with eligible father and mother may be associated with lower household income since both primary earners in the household would be receiving a minimum wage at baseline. Perhaps, in these poorer families, the positive income shocks are not enough to allow sons and daughters leave the labor force and the minimum wage increases can be additional opportunities for these children.

Table 11 – Differences-in-differences estimation results of the minimum wage of eligible mothers and fathers and heads and spouses: effects on work decision of sons and daughters

Probability of being employed	Same equation	Separated equations			Household status	
		Father	Mother	Both	Head	Spouse
<i>Post</i>	0.00640* (0.00329)	0.00574* (0.00328)	0.00586* (0.00330)	0.00521 (0.00328)	0.00470 (0.00333)	0.00471 (0.00335)
$MW_m * Post_m(a)$	-0.0486* (0.0294)		0.0153** (0.00678)		0.00134 (0.0248)	0.0110 (0.0155)
$MW_f * Post_f(b)$	-0.111* (0.0670)	0.00228 (0.00787)			-0.158* (0.0849)	0.0173 (0.0333)
$MW_{fm} * Post_{fm}(c)$	0.181** (0.0745)			0.0230 (0.0142)	0.192** (0.0864)	-0.0261 (0.0417)
Dummies de ano	YES	YES	YES	YES	YES	YES
Constant	0.295*** (0.00383)	0.286*** (0.00359)	0.288*** (0.00343)	0.295*** (0.00382)	0.297*** (0.00380)	0.298*** (0.00380)
Test F: a=b	0.72	-	-	-	3.25	0.03
Test F: b=c	4.47	-	-	-	4.20	0.37
Test F: a=c	6.48	-	-	-	4.47	0.70
Working hours						
<i>Post</i>	0.0407*** (0.0113)	0.0384*** (0.0112)	0.0390*** (0.0113)	0.0367*** (0.0112)	0.0349*** (0.0114)	-0.0448*** (0.00352)
$MW_m * Post_m(a)$	-0.169* (0.0944)		0.0465** (0.0230)		-0.0429 (0.0817)	0.00945 (0.0145)
$MW_f * Post_f(b)$	-0.361* (0.196)	0.00623 (0.0260)			-0.516** (0.245)	-0.000991 (0.0337)
$MW_{fm} * Post_{fm}(c)$	0.595*** (0.222)			0.0695 (0.0479)	0.619** (0.251)	-0.00998 (0.0447)
Dummies de ano	YES	YES	YES	YES	YES	YES
Constant	1.017*** (0.0132)	0.985*** (0.0124)	0.995*** (0.0117)	1.019*** (0.0132)	1.026*** (0.0131)	1.028*** (0.0131)
Test F: a=b	0.79	-	-	-	3.38	0.01
Test F: b=c	5.56	-	-	-	5.31	0.39
Test F: a=c	7.66	-	-	-	6.29	0.82
Probability of being employed or searching for jobs						
<i>Post</i>	0.0235*** (0.00384)	0.0237*** (0.00384)	0.0230*** (0.00384)	0.0231*** (0.00382)	0.0232*** (0.00391)	0.0230*** (0.00390)
$MW_m * Post_m(a)$	0.00297 (0.0418)		0.00934 (0.00828)		-0.00928 (0.0357)	-0.00175 (0.0198)
$MW_f * Post_f(b)$	-0.0822* (0.0470)	0.00269 (0.00952)			-0.117* (0.0607)	-0.00434 (0.0448)
$MW_{fm} * Post_{fm}(c)$	0.0744 (0.0653)			-0.00443 (0.0181)	0.118* (0.0640)	-0.0274 (0.0591)
Dummies de ano	YES	YES	YES	YES	YES	YES
Constant	0.418*** (0.00457)	0.411*** (0.00430)	0.420*** (0.00408)	0.418*** (0.00457)	0.419*** (0.00454)	0.419*** (0.00454)
Test F: a=b	1.85	-	-	-	2.34	0.00
Test F: b=c	2.25	-	-	-	3.63	0.06
Test F: a=c	0.54	-	-	-	3.01	0.17
Number of observations	48,126	57,245	60,725	48,126	45,696	45,696

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; *m* denotes eligible mother, *f* denotes eligible father, and *fm* denotes eligible father and mother. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. Specification with fixed effects and cluster correction for households.

Using the specification with disaggregated effects of eligible fathers and mothers in the same equation, we also analyze the minimum wage effects on school attendance and the work/studying decision of sons/daughters. We continue not finding significant effects for the school attendance (Table 12), but we observe an increase in the probability of studying and working relatively to the probability of only working, when both are eligible (Table 13). However, in Table 14, we add the decision on searching for jobs to the decision on working to construct the categorical variable, and this effect is no longer significant.

In tables 11-14, we also consider the distinct effects of eligible fathers and mothers in three different regression equations. It is important to note that in this approach, we assume that different factors determine the work decision of sons and daughters if they have a household with an eligible father or an eligible mother, which means that these labor decisions are essentially distinguishable by the eligibility of members. In these analyses, we find results that are similar to the general results presented in subsection 2.6.1. We find a positive and significant effect on the probability of being employed and in working hours, only when the mother is the eligible member (Table 11), but the effect is not significant for the probability of being employed or searching for jobs. We also find a decrease in the probability of only studying and in the probability of Neither, relatively to the probability of only working, if the eligible member is the mother and an increase in the probability of studying and working, relatively to the probability of only working, if both are eligible (Table 13). However, if we consider the decision on searching for jobs, jointly with the decision on working (Table 14), we observe only an increase in the probability of only studying when both are eligible.

Thus, we can conclude that the choice of the specification for the distinct effects of eligible mothers and fathers is relevant for the sign and significance of the results found.

Additionally and following Ponczek (2011), we check if the distinct effects depending on what is the eligible person and how many eligible members do exist in households arise from the position of the member in the family. Since the definition of household head in the database research questionnaire is the person who has the higher income or the person

who mainly decide in the family, in the last part of tables 11-14, we have the results of estimations in which we interact dummies for the household head or spouse statuses with the treatment effect.

Table 12 – Differences-in-differences estimation results of the minimum wage of eligible mothers and fathers and heads and spouses: effects on school attendance of sons and daughters

School attendance	Same equation	Separated equations			Status of eligible person	
		Father	Mother	Both	Head	Spouse
<i>Post</i>	-0.0437*** (0.00343)	-0.0438*** (0.00340)	-0.0438*** (0.00342)	-0.0439*** (0.00339)	-0.0448*** (0.00351)	-0.0448*** (0.00352)
$MW_m * Post_m(a)$	-0.00857 (0.0219)		-0.00365 (0.00675)		-0.00686 (0.0252)	0.00945 (0.0145)
$MW_f * Post_f(b)$	-0.0170 (0.0232)	0.0101 (0.00723)			-0.0192 (0.0294)	-0.000991 (0.0337)
$MW_{fm} * Post_{fm}(c)$	0.0336 (0.0348)			0.00814 (0.0143)	0.0336 (0.0336)	-0.00998 (0.0447)
Dummies de ano	YES	YES	YES	YES	YES	YES
Constant	0.771*** (0.00403)	0.769*** (0.00370)	0.764*** (0.00352)	0.771*** (0.00402)	0.771*** (0.00402)	0.771*** (0.00402)
Test F: a=b	0.07	-	-	-	0.10	0.08
Test F: b=c	0.90	-	-	-	0.75	0.02
Test F: a=c	0.67	-	-	-	0.93	0.17
Number of observations	48,126	57,245	60,725	48,126	45,696	45,696

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; *m* denotes eligible mother, *f* denotes eligible father, and *fm* denotes eligible father and mother. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. Specification with fixed effects and cluster correction for households.

Table 13 – Multinomial logit estimation results of the minimum wage of eligible mothers and fathers and heads and spouses: effects on study/work decision of sons and daughters

Study and/or work	Same equation			Status of eligible person					
				Head			Spouse		
	Study and work	Study	Neither	Study and work	Study	Neither	Study and work	Study	Neither
<i>Post</i>	0.591*** (0.0322)	0.536*** (0.0298)	1.145** (0.0649)	0.587*** (0.0326)	0.539*** (0.0306)	1.174*** (0.0681)	0.589*** (0.0328)	0.539*** (0.0306)	1.179*** (0.0685)
<i>MW_m * Post_m(a)</i>	0.752 (0.339)	1.335 (0.612)	1.258 (0.585)	1.799 (0.940)	1.508 (0.702)	1.401 (0.656)	1.179 (0.292)	1.319 (0.313)	0.926 (0.214)
<i>MW_f * Post_f(b)</i>	0.313 (0.281)	0.461 (0.404)	1.719 (1.300)	0.440 (0.409)	0.784 (0.708)	2.667 (2.341)	6.09e-06 (0.00321)	3.33e-06 (0.00176)	0.551 (441.4)
<i>MW_{fm} * Post_{fm}(c)</i>	7.023* (7.245)	2.273 (2.303)	0.485 (0.442)	3.305 (3.210)	1.675 (1.570)	0.336 (0.306)	289,472 (1.528e+08)	479,680 (2.532e+08)	2.685 (2,150)
Test χ^2 : a=b	0.76			1.75			0.00		
Test χ^2 : b=c	2.78			1.15			0.00		
Test χ^2 : a=c	2.98			0.30			0.00		
Number of observations	11,694	11,694	11,694	11,034	11,034	11,034	11,034	11,034	11,034
Study and/or work	Separated equations								
	Father			Mother			Both		
	Study and work	Study	Neither	Study and work	Study	Neither	Study and work	Study	Neither
<i>Post</i>	0.589*** (0.0318)	0.538*** (0.0297)	1.149** (0.0646)	0.589*** (0.0320)	0.535*** (0.0297)	1.149** (0.0649)	0.587*** (0.0316)	0.537*** (0.0296)	1.153** (0.0646)
<i>MW_m * Post_m(a)</i>				0.999 (0.113)	0.831* (0.0925)	0.769** (0.0825)			
<i>MW_f * Post_f(b)</i>	0.952 (0.133)	0.868 (0.116)	0.888 (0.111)						
<i>MW_{fm} * Post_{fm}(c)</i>							1.670** (0.414)	1.395 (0.319)	1.042 (0.231)
Number of observations	13,498	13,498	13,498	14,512	14,512	14,512	11,694	11,694	11,694

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.
Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; *m* denotes eligible mother, *f* denotes eligible father, and *fm* denotes eligible father and mother. *Work* is the base outcome of the multinomial logit. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. Specification with fixed effects.

Table 14 – Multinomial logit estimation results of the minimum wage of eligible mothers and fathers and heads and spouses: effects on the study/work or search for jobs decision of sons and daughters

Study and/or work/search jobs	Same equation			Status of eligible person					
				Head			Spouse		
	Study and work	Study	Neither	Study and work	Study	Neither	Study and work	Study	Neither
<i>Post</i>	0.539*** (0.0257)	0.460*** (0.0230)	0.915 (0.0541)	0.530*** (0.0258)	0.454*** (0.0232)	0.912 (0.0550)	0.531*** (0.0260)	0.454*** (0.0232)	0.918 (0.0557)
<i>MW_m * Post_m(a)</i>	0.792 (0.310)	1.097 (0.462)	0.958 (0.407)	0.960 (0.359)	1.352 (0.527)	0.723 (0.327)	1.266 (0.269)	1.457* (0.313)	1.071 (0.271)
<i>MW_f * Post_f(b)</i>	0.402 (0.330)	0.513 (0.428)	4.015 (4.578)	0.546 (0.457)	0.911 (0.777)	1.339e+06 (9.299e+08)	1.62e-06 (0.00175)	6.32e-07 (0.000681)	1.322e+06 (1.456e+09)
<i>MW_{fm} * Post_{fm}(c)</i>	4.084 (3.790)	2.584 (2.464)	0.249 (0.308)	2.723 (2.366)	1.700 (1.502)	8.72e-07 (0.000605)	515,254 (5.546e+08)	2.067e+06 (2.225e+09)	4.32e-07 (0.000476)
Test χ^2 : a=b	0.56			0.38			0.00		
Test χ^2 b=c	1.87			0.91			0.00		
Test χ^2 : a=c	2.04			1.21			0.00		
Number of observations	13,656	13,656	13,656	12,892	12,892	12,892	12,892	12,892	12,892
Study and/or work/search jobs	Separated equations								
	Father			Mother			Both		
	Study and work	Study	Neither	Study and work	Study	Neither	Study and work	Study	Neither
<i>Post</i>	0.537*** (0.0254)	0.460*** (0.0228)	0.914 (0.0536)	0.537*** (0.0256)	0.459*** (0.0229)	0.920 (0.0543)	0.535*** (0.0253)	0.459*** (0.0227)	0.919 (0.0537)
<i>MW_m * Post_m(a)</i>				1.020 (0.0965)	0.951 (0.0933)	0.881 (0.0984)			
<i>MW_f * Post_f(b)</i>	1.027 (0.116)	0.969 (0.111)	1.121 (0.142)						
<i>MW_{fm} * Post_{fm}(c)</i>							1.310 (0.263)	1.458* (0.295)	0.952 (0.235)
Number of observations	13,498	13,498	13,498	14,512	14,512	14,512	11,694	11,694	11,694

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; *m* denotes eligible mother, *f* denotes eligible father, and *fm* denotes eligible father and mother. *Work* is the base outcome of the multinomial logit. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05:

, p-value<0.01: *. Specification with fixed effects.

We verify that in estimations in which the eligible member is the household head, the negative impacts of the minimum wage of fathers on the probability of being employed, on working hours, and even on the probability of being employed or searching for jobs of sons/daughters, remain significant and they even gets higher, whereas the effects of the minimum wage of mothers disappear. The effects in households in which both members are eligible remain positive and significant, but the magnitude is almost the same. On the other hand, in estimations in which the eligible member is a spouse, only the positive effects if both are eligible remain significant, clearly because the other eligible person is the head. Therefore, we conclude that the household head status only determines an effect favoring sons and daughters that live with eligible fathers.

Also, we found an increase in the probability of only studying, relatively to the probability of only working or searching for jobs, if the mother is eligible, related to the spouse status in the family (Table 14).

2.6.3 Subgroup analyses

By conducting some subgroup analyses, we try to understand whether the effects of the minimum wage of parents could be higher among some groups of sons and daughters. All the analyses are performed using the specification with fixed-effects, and with separated impacts depending on the eligible person in the family, through three dummies for fathers, mothers and both.

We define two age groups: 14-17 (sons and daughters most likely to be in high school), 18-24 (sons and daughters who might have finished high school and could be in the labor market or pursuing higher education). Allegretto, Dube, and Reich (2011) argue that the minimum wage effects for younger teenagers, who are less skilled and experienced, are distinct from those for older teens. The other two subgroups are defined based on the gender of children (son or daughter), and on the age of fathers and mothers.

First, Table 15 shows the subgroups estimates of the effects on work decisions and school attendance of sons and daughters. We observe that the negative effect if the

Table 15 – Differences-in-differences estimation results for subsamples: minimum wage effects on work decision and school attendance of sons and daughters

Prob. being employed	Age group of sons/daughters		Gender (son/daughter)		Age of father/mother	
	14-17	18-24	Male	Female	Age <= 45	Age >45
<i>Post</i>	0.00324 (0.00379)	0.00922 (0.00597)	0.01000** (0.00480)	0.00240 (0.00433)	0.00533 (0.00380)	0.0110** (0.00448)
<i>MW_m * Post_m</i>	-0.0681* (0.0409)	0.0143 (0.0369)	-0.0283 (0.0302)	-0.0714 (0.0520)	-0.0575* (0.0335)	-0.0422 (0.0273)
<i>MW_f * Post_f</i>	-0.0840 (0.0557)	-0.0966 (0.109)	-0.0923 (0.0667)	-0.129 (0.112)	-0.132 (0.0871)	-0.0989 (0.113)
<i>MW_{fm} * Post_{fm}</i>	0.176** (0.0705)	0.102 (0.118)	0.144* (0.0763)	0.221* (0.124)	0.199** (0.0944)	0.169 (0.119)
Dummies for years	YES	YES	YES	YES	YES	YES
Constant	0.141*** (0.00433)	0.497*** (0.00699)	0.141*** (0.00433)	0.497*** (0.00699)	0.279*** (0.00439)	0.338*** (0.00525)
Working hours						
<i>Post</i>	0.0279** (0.0124)	0.0514** (0.0213)	0.0575*** (0.0167)	0.0220 (0.0146)	0.0373*** (0.0130)	0.0549*** (0.0153)
<i>MW_m * Post_m</i>	-0.231* (0.124)	0.0204 (0.142)	-0.135 (0.0952)	-0.205 (0.170)	-0.186* (0.106)	-0.144 (0.0921)
<i>MW_f * Post_f</i>	-0.272 (0.172)	-0.391 (0.330)	-0.267 (0.201)	-0.452 (0.318)	-0.416 (0.255)	-0.347 (0.327)
<i>MW_{fm} * Post_{fm}</i>	0.555** (0.216)	0.470 (0.374)	0.490** (0.234)	0.700* (0.364)	0.619** (0.280)	0.553 (0.350)
Dummies for years	YES	YES	YES	YES	YES	YES
Constant	0.440*** (0.0143)	1.771*** (0.0248)	1.198*** (0.0194)	0.813*** (0.0172)	0.953*** (0.0151)	1.181*** (0.0180)
School attendance						
<i>Post</i>	-0.0400*** (0.00338)	-0.0379*** (0.00648)	-0.0397*** (0.00477)	-0.0482*** (0.00480)	-0.0414*** (0.00392)	-0.0457*** (0.00469)
<i>MW_m * Post_m</i>	0.0204 (0.0147)	-0.0522 (0.0540)	0.00332 (0.0244)	-0.0220 (0.0378)	-0.00577 (0.0223)	-0.0205 (0.0423)
<i>MW_f * Post_f</i>	-0.00329 (0.0185)	-0.0659 (0.0605)	0.000847 (0.0247)	-0.0362 (0.0391)	-0.0142 (0.0260)	-0.00186 (0.0359)
<i>MW_{fm} * Post_{fm}</i>	0.00338 (0.0263)	0.101 (0.0874)	0.0142 (0.0395)	0.0551 (0.0582)	0.0261 (0.0373)	0.0282 (0.0613)
Dummies for years	YES	YES	YES	YES	YES	YES
Constant	0.947*** (0.00389)	0.540*** (0.00778)	0.736*** (0.00557)	0.811*** (0.00570)	0.795*** (0.00454)	0.725*** (0.00568)
Number of observations	28,078	20,048	25,656	22,470	36,897	24,651
R-squared	0.021	0.010	0.012	0.019	0.015	0.015

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; *m* denotes eligible mother, *f* denotes eligible father, and *fm* denotes eligible father and mother. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. Specification with fixed effects and cluster correction for households.

Table 16 – Multinomial logit estimation results for subsamples: minimum wage effects on study/work decision of sons and daughters

Study and/or work	Age group of sons/daughters					
	14-17			18-24		
	Study and work	Study	Neither	Study and work	Study	Neither
<i>Post</i>	0.396*** (0.0498)	0.386*** (0.0487)	1.121 (0.157)	0.760*** (0.0497)	0.672*** (0.0472)	1.086 (0.0708)
<i>MW_m * Post_m</i>	1.981 (1.696)	3.111 (2.674)	3.452 (3.624)	0.573 (0.343)	0.849 (0.533)	0.840 (0.469)
<i>MW_f * Post_f</i>	1.67e-06 (0.00133)	2.41e-06 (0.00191)	1.086e+06 (8.471e+08)	0.406 (0.408)	0.428 (0.444)	0.987 (0.851)
<i>MW_{fm} * Post_{fm}</i>	992,423 (7.863e+08)	351,007 (2.781e+08)	4.24e-07 (0.000331)	5.523 (6.676)	3.227 (4.016)	1.203 (1.268)
Number of observations	4,964	4,964	4,964	6,114	6,114	6,114
Study and/or work	Gender (son/daughter)					
	Male			Female		
	Study and work	Study	Neither	Study and work	Study	Neither
<i>Post</i>	0.616*** (0.0424)	0.554*** (0.0395)	1.045 (0.0763)	0.568*** (0.0506)	0.527*** (0.0473)	1.273*** (0.116)
<i>MW_m * Post_m</i>	0.894 (0.467)	1.941 (1.244)	1.801 (1.069)	0.455 (0.412)	0.757 (0.580)	0.659 (0.537)
<i>MW_f * Post_f</i>	0.350 (0.423)	0.386 (0.466)	1.544 (1.441)	0.178 (0.276)	0.747 (1.019)	2.586 (3.481)
<i>MW_{fm} * Post_{fm}</i>	7.072 (9.555)	2.228 (3.114)	0.356 (0.405)	14.30 (26.25)	2.121 (3.392)	0.637 (1.023)
Number of observations	6,560	6,560	6,560	5,134	5,134	5,134
Study and/or work	Age of father/mother					
	Age <= 45			Age >45		
	Study and work	Study	Neither	Study and work	Study	Neither
<i>Post</i>	0.544*** (0.0350)	0.514*** (0.0336)	1.081 (0.0722)	0.646*** (0.0463)	0.532*** (0.0395)	1.083 (0.0800)
<i>MW_m * Post_m</i>	0.881 (0.443)	1.507 (0.797)	1.724 (1.047)	0.383 (0.290)	1.749 (1.181)	1.530 (0.977)
<i>MW_f * Post_f</i>	0.425 (0.382)	0.646 (0.578)	2.037 (1.832)	1.492 (1.573)	0.716 (0.743)	2.015 (1.875)
<i>MW_{fm} * Post_{fm}</i>	5.046 (5.354)	1.820 (1.939)	0.402 (0.446)	2.858 (3.852)	0.974 (1.243)	0.428 (0.498)
Number of observations	8,726	8,726	8,726	6,184	6,184	6,184

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016. Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; *m* denotes eligible mother, *f* denotes eligible father, and *fm* denotes eligible father and mother. *Work* is the base outcome of the multinomial logit. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. Specification with fixed effects.

mother is eligible and the positive effect if both parents are eligible, on the probability of being employed and on working hours, occur only for the less skilled and experienced group of sons and daughters aged 14 to 17, and with parents up to 45 years. Thus, we can conclude that the positive shock on the income of mothers determines the decreases in mainly the labor supply of younger sons and daughters, who have a higher probability of attending school, and sons and daughters whose parents have greater job opportunities and probability to be active in the labor market.

We also verify significant and positive effects for male and female, both on the probability of being employed and on working hours, in households in which the father and the mother can be potentially affected by the minimum wage shocks.

In these estimations with subgroups, we do not find significant effects on the probability of attending school and on decisions about work and study (Table 16).

2.7 Robustness checks

In this last section of the study, we verify the problems related to the definition of our treatment and control groups, and we present some robustness checks, with intent to analyze whether the effects remain the same in magnitude and significance when we redefine these groups. Table 17 shows the results for the impacts on the probability of being employed, working hours and school attendance, whereas Table 18 presents the results of the multinomial logit for the work/study decision.

We first check the estimation results by excluding from the control group the fathers and mothers whose wage is equal to the minimum wage in multiples, up to five multiples. These workers can also show an increase in labor income between the baseline and post-intervention. We find that all the results remain almost the same, and vary only marginally from the results in the first columns of Table 11-13.

The second check is to verify whether the heterogeneity of sons and daughters in the control group determines results that could be different when we redefine the group. As detailed in section 2.3.2, the control group includes (i) the sons and daughters whose parents are ineligible because their wage is already above the new minimum baseline wage (Higher wage), and (ii) the sons and daughters whose parents are eligible since they receive a wage below the old minimum wage, although their firms do not comply (Informal). Then, we separate the control group from the (i) Higher wage and (ii) Informal, keeping the treatment group unaffected. We verify that the results for the control group that comprises the sons and daughters whose parents are receiving a wage above the new minimum wage in the baseline are very similar to the general results presented in tables 11-13. On the other hand, the positive effect on the probability of being employed and working hours if both parents are eligible is found for both control groups, which also occurs to the increasing probability of studying and working, relatively to the probability of only working (Table 18).

Table 17 – Robustness checks for control groups and treatment definition: effects on work decision and school attendance of sons and daughters

Prob. being employed	Without multiples	Elegibles and ineligible		Higher wage $\leq 1.5MW$	ΔMW
		Informal	Higher wage		
<i>Post</i>	0.00650* (0.00332)	-0.00539 (0.0119)	0.00809** (0.00372)	0.00965* (0.00559)	0.00635* (0.00329)
$MW_m * Post_m(b)$	-0.0488* (0.0294)	-0.0343 (0.0319)	-0.0508* (0.0295)	-0.0511* (0.0299)	-0.000964* (0.000544)
$MW_f * Post_f(a)$	-0.111* (0.0670)	-0.0953 (0.0676)	-0.113* (0.0673)	-0.113* (0.0675)	-0.00219* (0.00130)
$MW_{fm} * Post_{fm}(c)$	0.181** (0.0744)	0.163** (0.0754)	0.184** (0.0747)	0.183** (0.0750)	0.00354** (0.00143)
Dummies de ano	YES	YES	YES	YES	YES
Constant	0.294*** (0.00384)	0.295*** (0.00991)	0.285*** (0.00441)	0.304*** (0.00581)	0.295*** (0.00383)
Working hours					
<i>Post</i>	0.0410*** (0.0114)	0.0135 (0.0383)	0.0418*** (0.0129)	0.0512*** (0.0197)	0.0407*** (0.0113)
$MW_m * Post_m(b)$	-0.169* (0.0944)	-0.135 (0.103)	-0.172* (0.0949)	-0.176* (0.0961)	-0.00333* (0.00174)
$MW_f * Post_f(a)$	-0.361* (0.196)	-0.324 (0.199)	-0.364* (0.196)	-0.370* (0.197)	-0.00699* (0.00377)
$MW_{fm} * Post_{fm}(c)$	0.596*** (0.222)	0.550** (0.226)	0.602*** (0.223)	0.601*** (0.224)	0.0115*** (0.00422)
Dummies de ano	YES	YES	YES	YES	YES
Constant	1.015*** (0.0132)	0.959*** (0.0323)	0.991*** (0.0154)	1.064*** (0.0204)	1.016*** (0.0132)
School attendance					
<i>Post</i>	-0.0438*** (0.00345)	-0.0406*** (0.00808)	-0.0472*** (0.00426)	-0.0507*** (0.00573)	-0.0438*** (0.00342)
$MW_m * Post_m(b)$	-0.00849 (0.0219)	-0.0151 (0.0235)	-0.00355 (0.0220)	-0.00243 (0.0224)	-0.000142 (0.000390)
$MW_f * Post_f(a)$	-0.0169 (0.0233)	-0.0225 (0.0247)	-0.0123 (0.0234)	-0.0117 (0.0237)	-0.000196 (0.000393)
$MW_{fm} * Post_{fm}(c)$	0.0334 (0.0348)	0.0434 (0.0366)	0.0268 (0.0350)	0.0294 (0.0355)	0.000466 (0.000592)
Dummies de ano	YES	YES	YES	YES	YES
Constant	0.771*** (0.00407)	0.755*** (0.00879)	0.787*** (0.00491)	0.748*** (0.00615)	0.771*** (0.00404)
Number of observations	47,276	8,758	33,336	20,662	48,126

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; *m* denotes eligible mother, *f* denotes eligible father, and *fm* denotes eligible father and mother. *Without multiples*: we exclude the eligible parents with wage equal to multiples of the MW from the control group; *Informal*: the control group comprises only the parents that were receiving a wage below the old minimum wage at baseline; *Higher wage*: the control group includes only the parents whose wage was already above the new minimum wage at baseline; *Higher wage $\leq 1.5MW$* : the control group comprises only the parents whose wage was already above the new minimum wage up to 1.5 times the MW value at baseline; ΔMW : the treatment variable is an interaction between *MW* and the absolute increase in MW value. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. Specification with fixed effects and cluster correction for households.

Table 18 – Robustness checks for control groups and treatment definition: effects on study/work decision of sons and daughters

Study and/or work	Without multiples			Elegibles and ineligible					
				Informal			Higher wage		
	Study and work	Study	Neither	Study and work	Study	Neither	Study and work	Study	Neither
<i>Post</i>	0.585*** (0.0322)	0.534*** (0.0300)	1.130** (0.0646)	0.534*** (0.0805)	0.519*** (0.0784)	1.428** (0.207)	0.586*** (0.0391)	0.500*** (0.0350)	1.086 (0.0798)
<i>MW_m * Post_m(b)</i>	0.761 (0.343)	1.340 (0.615)	1.275 (0.592)	0.833 (0.393)	1.380 (0.662)	1.009 (0.488)	0.759 (0.343)	1.432 (0.660)	1.326 (0.619)
<i>MW_f * Post_f(a)</i>	0.317 (0.285)	0.462 (0.406)	1.742 (1.317)	0.347 (0.315)	0.476 (0.423)	1.378 (1.059)	0.316 (0.284)	0.494 (0.434)	1.811 (1.372)
<i>MW_{fm} * Post_{fm}(c)</i>	6.944* (7.164)	2.264 (2.294)	0.479 (0.437)	6.346* (6.607)	2.198 (2.249)	0.605 (0.557)	6.963* (7.189)	2.119 (2.149)	0.460 (0.420)
Number of observations	11,454	11,454	11,454	2,464	2,464	2,464	7,722	7,722	7,722
Study and/or work	Higher wage $\leq 1.5MW$			ΔMW					
	Study and work	Study	Neither	Study and work	Study	Neither			
<i>Post</i>	0.514*** (0.0454)	0.449*** (0.0406)	1.002 (0.0904)	0.591*** (0.0321)	0.536*** (0.0297)	1.140** (0.0644)			
<i>MW_m * Post_m(a)</i>	0.361 (0.325)	0.551 (0.485)	1.963 (1.491)	0.982 (0.0155)	0.988 (0.0155)	1.010 (0.0140)			
<i>MW_f * Post_f(b)</i>	0.867 (0.395)	1.596 (0.741)	1.437 (0.675)	0.995 (0.00799)	1.006 (0.00842)	1.004 (0.00866)			
<i>MW_{fm} * Post_{fm}(c)</i>	6.098* (6.305)	1.900 (1.931)	0.425 (0.388)	1.031* (0.0185)	1.010 (0.0183)	0.987 (0.0164)			
Number of observations	4,914	4,914	4,914	11,694	11,694	11,694			

Source: Elaborated by the authors based on model estimation using data from the Continuous National Household Sample Survey (PNADC) for 2012-2016.

Notes: *MW*: dummy variable for treatment; *Post*: dummy variable for baseline or post-intervention period; *m* denotes eligible mother, *f* denotes eligible father, and *fm* denotes eligible father and mother. *Work* is the base outcome of the multinomial logit. *Without multiples*: we exclude the eligible parents with wage equal to multiples of the *MW* from the control group; *Informal*: the control group comprises only the parents that were receiving a wage below the old minimum wage at baseline; *Higher wage*: the control group includes only the parents whose wage was already above the new minimum wage at baseline; *Higher wage $\leq 1.5MW$* : the control group comprises only the parents whose wage was already above the new minimum wage up to 1.5 times the *MW* value at baseline; ΔMW : the treatment variable is an interaction between *MW* and the absolute increase in *MW* value. Standard deviation in parentheses; p-value<0.10: *, p-value<0.05: **, p-value<0.01: ***. Specification with fixed effects.

We also define the control group, considering only parents who already received above the new minimum wage at baseline and up to 1.5 times the value of the minimum wage. The results are very close to those estimated using the control group Higher wage.

Finally, we estimate the effects of the minimum wage using the interaction between the treatment dummy and the difference between the new minimum wage and the old minimum wage (ΔMW) as the treatment variable. We verify that the direction and significance of the effects do not change.

2.8 Concluding remarks

In this study, we show that a positive shock associated with the minimum wage policy, affecting parental income determines the decrease of about 5% in the probability of being employed and a decline of about 17% on the working hours of sons and daughters if the eligible person is the mother. However, if the eligible person is the father, these effects are of about 11% and 36%, respectively. Moreover, we find a positive effect in households in which both the father and the mother are eligible at the same time. This last result could be associated with a lower income level in these families, since both primary earners in the household would be receiving a minimum wage at baseline, and, in these poorer families, the positive income shocks would not be enough to allow sons and daughters leave the labor force.

On the other hand, if we analyze the effects on the probability of being employed or searching for jobs, that is, participating in the labor force, only the negative effect of the eligible father remains, and it is weaker (about 8%), meaning that when we include the decision on searching for jobs, the effects of the minimum wage of parents decrease or become non-significant. This fact can evidence that employed sons and daughters may be leaving their employments (moving to inactivity) or diminish their working hours, possibly to dedicate time to study, but some of them that are not working start searching for jobs, reducing or nullifying the negative impact of this policy on labor supply of children.

Additionally, we conclude that the household head status only determines an effect favoring sons and daughters that live with eligible fathers. For sons and daughters that live with eligible mothers that are spouses, we found an increase in the probability of only studying, relatively to the probability of only working or searching for jobs. Finally, we verify that the negative effect if the mother is eligible and the positive effect if both parents are eligible, on the probability of being employed and on working hours, occur only for less skilled and experienced group of sons and daughters aged 14-17, who have a higher probability of attending school, and among children who live with a father or mother up to 45 years that has greater job opportunities and probability to be active in

the labor market.

These results support our initial hypothesis that wage increases of parents determine the income and substitution effects, which impact the sons and daughters' decisions about labor. Moreover, the direction and magnitude of the effect depend on who is the eligible person and how many eligible members there exist in the household, strengthening the argument in favor for applying collective approaches and showing that the income polling hypothesis of family members does not seem to be valid in this context.

Although these results seem robust, assuming that our identification strategy is such that we isolate the effects of the minimum wage policy, we need to highlight some shortcomings and avenues for future analyses. First, the decision to live with parents can be an economical choice for sons and daughters, as mentioned in the introduction of this study, and the household composition can be endogenous (ROSENZWEIG; WOLPIN, 1993). If the sample of sons and daughters aged 14 to 24 living with parents presents observable and unobservable characteristics correlated to the household welfare and economic conditions of members, then our estimations can have a selectivity bias. In future agenda, we intend to control for the probability of sons and daughters living with parents using the Heckman selection model (HECKMAN, 1976).

In this study, we assume that the anticipated decisions of firms and workers and their households, in face of minimum wage adjustments that occur following a determined criterion and in the same period every year, do not occur, which is a strong hypothesis that can be relaxed in future versions, estimating and comparing the minimum wage impacts in different quarters. Moreover, since we are using the last quarter of each month as our baseline and the first quarter of the next year as our post-intervention, this larger interval allows capturing some of these anticipated decisions, causing an underestimation of the impacts. Indeed, in spite of the decisions about labor supply of children can occur before the first quarter of each year, if part of them are related to allocating time to schooling and the school semester in Brazil starts on February, in most schools, these decisions are possibly taken in the first quarter.

It is also important to highlight that we are estimating the impacts of the minimum wage of parents on the labor supply of children, ignoring labor demand effects that can affect the decisions of these members. Firms can adjust their labor demand and dismiss workers and given the effectiveness of the minimum wage among younger workers, the sons and daughters can be the most affected, reducing the probability of being employed and causing an overestimation of the impacts. However, if this effect on labor demand occurs, distinct effects of eligible mothers, fathers, or both, should not be found. Moreover, even when we consider the impacts on the probability of being employed or searching for jobs, the negative effect of the eligible father remains, in spite of being weaker, meaning that some sons and daughters leave the labor force, probably to fully or partially studying and not because of dismissal.

Other empirical limitations include the lack of correcting the selection bias arising from the sample exclusions and the absence of tests of alternative models for non-linear difference-in-difference, as in Blundell and Dias (2009) and Athey and Imbens (2006)..

Moreover, Ponczek (2011) suggests a possible caveat related to the intent-to-treat approach when the take-up rates, that is, the rates at which an individual participates in a policy for males and females, or mothers and fathers in our case, are significantly different from one another. In this case, all the uneven impacts on males and females could be driven by differences in the take-up rates. The author shows that we can test whether that is the case by determining the effects of the true treatment and by comparing them with the intent-to-treat effects. This study does not perform this test, but it is a task for our future agenda.

Despite all the limitations, the results of this study allow for inferring the role of intra-household analyses about the effects of the minimum wage policy of fathers and mothers on work and study decisions of sons and daughters.

3 Household job search and labor supply of secondary earners in the family

3.1 Introduction

Recent studies show 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 (MENEZES FILHO; CABANAS; KOMATSU, 2014). Cabanas, Komatsu and Menezes Filho (2015) shows that while unemployment is low and the overall level of economic activity is high in Brazil, the rate of children aged 15 to 24 years in activity decreased and the proportion of children in full-time education increased. They argued that this result is related to a high dependence of labor market decisions of young sons/daughters on household income. Also, Vieira, Menezes Filho and Komatsu (2016) shows that parental income increases, especially for mothers, may explain the increase in the proportion of sons/daughters that only study and the reduction in the proportion that 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 willing to work or who made an attempt to find a job among the individuals in working age, is the aggregate result of unemployment rates of several demographic and socioeconomic groups. Similarly, the total inactivity rate, that is, the proportion of individuals out of the labor market which do not search for jobs among the individuals in 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 8 and 9 show, respectively, the unemployment rate and the inactivity rate among individuals aged 14 years or over, for the period 2004 to 2014, separately calculated 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 regions¹.

We observe that the unemployment rate decreases until 2013 for all the analyzed members (Figure 8). However, the inactivity among youth shows growing trend in the period, whereas the inactivity rate among fathers is almost constant and among mothers is decreasing, mainly after 2010 (Figure 9). The increasing inactivity among sons and daughters can be related to a growing number of children in full or partial time education, as discussed in Cabanas, Komatsu and Menezes Filho (2015).

Figure 8 – Evolution of the unemployment rate among households members

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

Note: Unemployment rate, calculated using the first interview of individuals, is the proportion of unemployed individuals willing or searching for jobs, among the individuals aged more than 14 years.

Therefore, a lower aggregate unemployment rate, as seen in Brazil in recent years, may be the result of better labor market opportunities for parents, since these members do not seem to have moved to inactivity, but also of reduced job search of youth. Indeed, since the labor market decisions of members in a family are jointly taken in an intrahousehold decision process, as viewed in the first study of these thesis, the better labor market opportunities of parents at a time period could strengthen the transition of sons and daughters to inactivity at that moment and in future periods, resulting in a unemployment

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

Figure 9 – Evolution of the inactivity rate among households 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 out of the labor market, which do not search for jobs.

rate even smaller. 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, whether the increasing unemployment among parents is compensated by a decreasing search for jobs of 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 since the aggregate employment is procyclical, but the labor force participation is not correlated with economic activity.

Figure 10 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 the analyzed members had real increases in labor income in this period, related to economic growth, improvements in labor market conditions, and also to the minimum wage real increases. Thus, the inactivity rate growth among

youth occurs in a context of improvements in labor market opportunities even for sons and daughters. Also, we observe that the father is the primary income for a household, whereas the mother presents the second highest individual labor income.

Figure 10 – 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), 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 about the labor market trends of different members in a family as well as the relationship between income of adults and labor supply decisions of sons and daughters, as viewed in Chapter 2, 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 the regression approach is an inappropriate one to use with an inherently dynamic phenomenon.

Thus, we use a dynamic framework that takes into account that labor market decisions are frequently taken 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 unemployment and inactivity of mothers and sons and daughters who are subject to employment shocks to them and income shocks to fathers. These shocks may determine different individual

levels of job search effort, depending on the job status and the wage of the other family member. Modeling inactivity as a distinct state from the unemployment is relevant not only because of the higher move of sons and daughters out of the labor force in recent years, contrarily to mothers whose inactivity diminished, but also due to the fact point out by some authors, as Guner, Kulikova and Valladares-Esteban (2015), show 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 perform simulations of counterfactual scenarios. These counterfactual simulations allow verifying the relevance of the parameters, wage offer distribution and other household income changes in explaining the trends in unemployment and inactivity of members.

The main contributions of this study are: 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 unemployment and inactivity of mothers and sons and daughters, and also for different search behavior and job acceptance, depending on the situation of the other member in the labor market, non-labor income and labor income of fathers; iii) we estimated a household job search model for Brazilian data.

Our counterfactual simulations allow verifying the decreasing unemployment rate of sons/daughters would not have changed between 2004 and 2014 if the labor market opportunities and conditions of this member remain the same. The unemployment rate of mothers does not alter a lot 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 the 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 schooling years 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 subgroup analysis, we verify that the dropout rate presents a greater rise among more educated mothers. Contrarily to the expected, the labor income of fathers and the labor market conditions of mothers only marginally contributes 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 a higher average welfare of youth. The welfare of mothers is 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 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. Descriptive analysis is in the sixth section, while the estimation results are in the seventh one. The eighth section has the simulations results and the last section, a discussion about the limitations of this study and the directions for improvements in this research.

3.2 Household job search models: a brief literature review

In Macroeconomic literature, the importance of looking at unemployment phenomena at the household rather than individual level was firstly recognized by Humphrey (1939). Moreover, since Becker's theory of the family (BECKER, 1981, 1974), the relevance of household-level decisions in impacting labor market outcomes has been clear. However, the empirical literature on this field usually does not apply models that can replicate equilibrium unemployment, as in the job search models (FLABBI; MABLI, 2012).

Burdett and Mortensen (1977) is 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 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 a health insurance coverage which 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 take into account the earning process and job status of the other member. They also indicate that the household job search model generates different equilibrium decisions in comparison 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 taken 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 the equilibrium 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 on-the-job search and allowing for labor supply decisions of spouses, by adding part-time and full-time labor supply. They use data from the United States for the period 2001 to 2003 and estimate the model using 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 model 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 a decrease in the wives' reservation wages implied by the husbands' labor market status.

Other contributions to the household model literature are found in 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 receive 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 which takes place before entering both markets, but they focus only on adults 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), that 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. Besides, not only wealth but also the employment situation of the partner allows 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 on the United States data for the period 1996 to 1999 and for the households in which the individuals have at least high school.

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 the compensation packages comprise of a wage and a menu of insurance offerings. The authors allow 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 relatively to the formal sector. They model the choices of the members of couples (heads and spouses). The authors aim to understand to which extent the increase in informality in Mexico is associated with the free access to health care associated with SP. Also, 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% to 4,2% of the median wage. They conclude that the expansion of the health coverage

at least until 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 seldom account for the possibility to distinguish unemployment from inactivity, and none of them is estimated for Brazilian data.

3.3 Household search model

3.3.1 Basic assumptions

In this study, we extend the Dey e Flinn (2008) model², in which the economy consists of a continuum of stable households. Time is continuous, households are infinitely lived and take labor market decisions to maximize their lifetime expected income. A household is comprised of 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 they pool income, like in a unitary model of the household. We consider the shocks that may affect member 1 or member 2, which may be in one of the following states: employed (e), unemployed (u) or inactive/out of the labor force (i)³.

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, that can be justified by market completeness⁴. Thus, the instantaneous utility of a household that comprises a father, a mother, and a son/daughter has the 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

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).

³ Unemployed workers look for jobs, while inactive workers do not.

⁴ Dey e 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.

where: w_1 is the labor income of the son/daughter, w_2 is the labor income of the mother⁵, b_1 is the non-labor income of the son/daughter, b_2 is the non-labor income of the mother⁶, and Y includes additional household non-labor income and the labor income of the father⁷. In particular, we assume 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:

$$\lim_{\rho \rightarrow 1} g(I, \rho) = I$$

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

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 concave utility function. In this context, an increase on Y would imply a more than proportional decrease in 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 a shock affects the household in a period, but both members respond to this same shock. Dey and Flinn (2008) discuss the advantages and drawbacks of using a continuous time framework. These authors point out that despite being 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 impact

⁵ 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.

⁶ We do not distinct 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. In a future version of the study, we intend to do that, if the addition of hyphotesis about this values is not too restrictive.

⁷ 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, that affects the father income may increase the opportunity cost of supplying labor of other household members.

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 simplicity⁸. Jobs may be exogenously destroyed at the rate δ_1 for the sons/daughters and the rate δ_2 for the mothers. The job destruction moves the household member from the 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 intensify effort $e_1 \geq 0$ in searching for a job. The disutility or cost of searching is a convex function $C_1(e_1)$. Likewise, the mother also chooses the level of search effort $e_2 \geq 0$ and this costs her $C_2(e_2)$, also a convex function.

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 wage offer distribution faced by mothers as $F_2(w_2)$.

Unemployed son/daughter or mother that exert effort in job search improve their chance of getting a job (respectively, at the rate $\lambda_1^0 e_1$ and $\lambda_2^0 e_2$), even if the other member does not suffer job destruction. If the member is inactive, to exert job search effort means to begin searching for a job, that is, to become unemployed.

If both members are unemployed, each one of them may become inactive or may choose a level of job search effort that maximizes his/her net earning free of search disutility. 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 , while mothers encourage at a rate α_2 .

⁸ Contrarily to Dey and Flinn (2008) and Fang and Shephard (2014), we do not allow for on-the-job search of the two analyzed members. However, we decide to simplify, since the household model alone generates sufficient heterogeneity in the reservation wages.

3.3.2 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. Firstly, 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 if the mother should accept them or not, 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 do 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

$$\begin{aligned} rW_{eu}(w_1, 0) = & \max_{e_2 \geq 0} \left[\frac{(w_1 + b_2 + Y)^\rho}{\rho} - C_2(e_2) + \right. \\ & \delta_1(W_{uu}(0, 0) - W_{eu}(w_1, 0)) + \beta_2(W_{ei}(w_1, 0) - W_{eu}(w_1, 0)) + \\ & \left. \lambda_2^0 e_2 \int \max[W_{ee}(w_1, x) - W_{eu}(w_1, 0), 0] dF_2(x) \right] \end{aligned}$$

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 if the mother must accept or reject them, 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. The job search effort e_2 implies disutility or job search cost $C_2(e_2)$. In addition, the unemployed mother may be discouraged and moves 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 do 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

$$\begin{aligned} rW_{ue}(0, w_2) = & \max_{e_1 \geq 0} \left[\frac{(b_1 + w_2 + Y)^\rho}{\rho} - C_1(e_1) + \right. \\ & \beta_1(W_{ie}(0, w_2) - W_{ue}(0, w_2)) + \delta_2(W_{uu}(0, 0) - W_{ue}(0, w_2)) + \\ & \lambda_1^0 e_1 \int \max[W_{ee}(x, w_2) - W_{ue}(0, w_2), 0] dF_1(x) + \\ & \left. \lambda_2^1 \int \max[W_{ue}(0, x) - W_{ue}(0, w_2), 0] dF_2(x) \right] \end{aligned}$$

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 which exerts some effort in job search, improving the probability of getting a job. The unemployed son/daughter may also be discouraged.

- Both the son/daughter and the mother are unemployed

$$\begin{aligned} rW_{uu}(0, 0) = & \max_{e_2 \geq 0} \left[\max_{e_1 \geq 0} \left[\frac{(b_1 + b_2 + Y)^\rho}{\rho} - C_1(e_1) - C_2(e_2) + \right. \right. \\ & \beta_1(W_{iu}(0, 0) - W_{uu}(0, 0)) + \beta_2(W_{ui}(0, 0) - W_{uu}(0, 0)) + \\ & \lambda_1^0 e_1 \int \max[W_{eu}(x, 0) - W_{uu}(0, 0), 0] dF_1(x) + \\ & \left. \left. \lambda_2^0 e_2 \int \max[W_{ue}(0, x) - W_{uu}(0, 0), 0] dF_2(x) \right] \right] \end{aligned}$$

This fifth value function is similar to the fourth, but the mother is also in the unemployment state and can move to employment or to inactivity. Moreover, we have a dual maximization process since the unemployed son/daughter and mother exert different levels of effort searching for a job.

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

$$\begin{aligned} rW_{ui}(0, 0) = & \max_{e_1 \geq 0} \left[\frac{(b_1 + b_2 + Y)^\rho}{\rho} - C_1(e_1) + \right. \\ & \beta_1(W_{ii}(0, 0) - W_{ui}(0, 0)) + \alpha_2(W_{uu}(0, 0) - W_{ui}(0, 0)) + \\ & \left. \lambda_1^0 e_1 \int \max[W_{ei}(x, 0) - W_{ui}(0, 0), 0] dF_1(x) \right] \end{aligned}$$

For this sixth value function, we have the situation in which the son/daughter is unemployed, that is, he/she exerts some effort level in the job search and receives job offers, and the mother is in the inactive state so do not search for jobs nor receive job offers.

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

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

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

$$rW_{iu}(0, 0) = \max_{e_2 \geq 0} \left[\frac{(b_1 + b_2 + Y)^\rho}{\rho} - C_2(e_2) + \right. \\ \left. \alpha_1(W_{uu}(0, 0) - W_{iu}(0, 0)) + \beta_2(W_{ii}(0, 0) - W_{iu}(0, 0)) + \right. \\ \left. \lambda_2^0 e_2 \int \max[W_{ie}(0, x) - W_{iu}(0, 0), 0] dF_2(x) \right]$$

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

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

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.

3.3.3 Optimal levels of effort

The optimal levels of job search effort $e_{1k} \geq 0$ for sons/daughters and $e_{2k} \geq 0$ for mothers maximize the difference between the expected return of job search and the job search cost, where $k = e, u, i$ denotes the state of the other member in the labor market. By solving the right-hand side of value functions for each job search effort, we can have these optimal levels. Firstly, by solving the right-hand side of the sixth value function for e_{1i} and the right-hand side of the fourth value function for e_{1e} , we have:

$$e_{1i} = \arg \max_{e_{1i} \geq 0} [-C_1(e_{1i}) + \lambda_1^0 e_{1i} \int \max[W_{ei}(x, 0) - W_{ui}(0, 0), 0] dF_1(x)] \\ e_{1e}(w_2) = \arg \max_{e_{1e} \geq 0} [-C_1(e_{1e}) + \lambda_1^0 e_{1e} \int \max[W_{ee}(x, w_2) - W_{ue}(0, w_2), 0] dF_1(x)]$$

Next, by solving the right-hand side of the eighth value function for e_{2i} and the right-hand side of the second value function for e_{2e} we have:

$$e_{2i} = \arg \max_{e_{2i} \geq 0} [-C_2(e_{2i}) + \lambda_2^0 e_{2i} \int \max [W_{ie}(0, x) - W_{iu}(0, 0), 0] dF_2(x)]$$

$$e_{2e}(w_1) = \arg \max_{e_{2e} \geq 0} [-C_2(e_{2e}) + \lambda_2^0 e_{2e} \int \max [W_{ee}(w_1, x) - W_{eu}(w_1, 0), 0] dF_2(x)]$$

Finally, by solving the right-hand side of the fifth value function for e_{1u} and e_{2u} , we have:

$$e_{1u} = \arg \max_{e_{1u} \geq 0} [-C_1(e_{1u}) + \lambda_1^0 e_{1u} \int \max [W_{eu}(x, 0) - W_{uu}(0, 0), 0] dF_1(x)]$$

$$e_{2u} = \arg \max_{e_{2u} \geq 0} [-C_2(e_{2u}) + \lambda_2^0 e_{2u} \int \max [W_{ue}(0, x) - W_{uu}(0, 0), 0] dF_2(x)]$$

The next step is calculating the first-order conditions for the expressions above. We can, for example, perform this calculations for the effort levels of member 1, for e_{1i} , e_{1u} and $e_{1e}(w_2)$. Then, we have:

$$C'_1(e_{1i}) = \lambda_1^0 \int \max [W_{ei}(x, 0) - W_{ui}(0, 0), 0] dF_1(x)$$

$$C'_1(e_{1u}) = \lambda_1^0 \int \max [W_{eu}(x, 0) - W_{uu}(0, 0), 0] dF_1(x)$$

$$C'_1(e_{1e}(w_2)) = \lambda_1^0 \int \max [W_{ee}(x, w_2) - W_{ue}(0, w_2), 0] dF_1(x)$$

where $C(e)$ is a convex search cost function that can be given by $C(e) = \frac{C^0 e^\gamma}{\gamma}$, in which (C^0, γ) are parameters that are estimated using Method of Moments, detailed in next sections, and $C^0 > 0$ and $\gamma > 1$. The calculations for the effort levels of member 2 are symmetric. Then, we denote:

$$\lambda_1^0 \int \max [W_{ei}(x, 0) - W_{ui}(0, 0), 0] dF_1(x) = A_i^1$$

$$\lambda_1^0 \int \max [W_{eu}(x, 0) - W_{uu}(0, 0), 0] dF_1(x) = A_u^1$$

$$\lambda_1^0 \int \max [W_{ee}(x, w_2) - W_{ue}(0, w_2), 0] dF_1(x) = A_e^1(w_2)$$

Therefore, since $C(0) = 0$, $C' > 0$ and $C'' > 0$, there is only one solution for $e_{1e}(w_2)$, $e_{2e}(w_1)$, e_{1i} , e_{2i} , e_{1u} and e_{2u} . We can rewrite the first-order conditions defined above, and

describe the optimal levels of job search effort as:

$$\begin{aligned} C'_1(e_{1i}) &= C_1^0 e_{1i}^{\gamma_1-1} = A_i^1 \implies e_{1i}^* = \left(\frac{A_i^1}{C_1^0} \right)^{\frac{1}{\gamma_1-1}} \\ C'_1(e_{1u}) &= C_1^0 e_{1u}^{\gamma_1-1} = A_u^1 \implies e_{1u}^* = \left(\frac{A_u^1}{C_1^0} \right)^{\frac{1}{\gamma_1-1}} \\ C'_1(e_{1e}(w_2)) &= C_1^0 e_{1e}^{\gamma_1-1} = A_e^1(w_2) \implies e_{1e}^*(w_2) = \left(\frac{A_e^1(w_2)}{C_1^0} \right)^{\frac{1}{\gamma_1-1}} \end{aligned}$$

3.3.4 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 which 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.

3.3.5 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, and 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

$$\begin{aligned}
m_{ee}G_{ee}(w_1, w_2)[\delta_1 + \delta_2 + \lambda_2^1 \bar{F}_2(w_2)] = \\
\lambda_1^0 m_{ue} \int^{w_2} \max(F_1(w_1) - F_1(\hat{w}_{ee-ue}(w_2)), 0) e_{1e}^*(w_2) g_{ue}(w_2) dw_2 + \\
\lambda_2^0 m_{eu} \int^{w_1} \max(F_2(w_2) - F_2(\hat{w}_{ee-eu}(w_1)), 0) e_{2e}^*(w_1) g_{eu}(w_1) dw_1
\end{aligned}$$

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

$$\begin{aligned}
m_{eu}G_{eu}(w_1, 0)[\delta_1 + \beta_2] + \\
\lambda_2^0 m_{eu} \int^{w_1} \bar{F}_2(\hat{w}_{ee-eu}(w_1)) e_{2e}^*(w_1) g_{eu}(w_1) dw_1 = \\
\delta_2 m_{ee}G_{ee}(w_1, \bar{w}_2) + \alpha_2 m_{ei}G_{ei}(w_1, 0) + \\
\lambda_1^0 e_{1u}^* m_{uu} \max(F_1(w_1) - F_1(\hat{w}_{eu-uu}), 0)
\end{aligned}$$

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

$$\begin{aligned} m_{ei}G_{ei}(w_1, 0)[\delta_1 + \alpha_2] = \\ \beta_2 m_{eu}G_{eu}(w_1, 0) + \\ \lambda_1^0 e_{1i} m_{ui} \max((F_1(w_1) - F_1(\hat{w}_{ei-ui}), 0) \end{aligned}$$

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

$$\begin{aligned} m_{ue}G_{ue}(0, w_2)[\delta_2 + \lambda_2^1 \bar{F}_2(w_2) + \beta_1] + \\ \lambda_1^0 m_{ue} \int^{w_2} [\bar{F}_1(\hat{w}_{ee-ue}(w_2)) e_{1e}^*(w_2) g_{ue}(w_2) dw_2 = \\ \delta_1 m_{ee}G_{ee}(\bar{w}_1, w_2) + \alpha_1 m_{ie}G_{ie}(0, w_2) + \\ \lambda_2^0 e_{2u}^* m_{uu} \max((F_2(w_2) - F_2(\hat{w}_{ue-uu}), 0) \end{aligned}$$

- The son/daughter and the mother are both unemployed

$$\begin{aligned} m_{uu}[\beta_1 + \beta_2 + \lambda_1^0 e_{1u}^* \bar{F}_1(\hat{w}_{eu-uu}) + \lambda_2^0 e_{2u}^* \bar{F}_2(\hat{w}_{ue-uu})] = \\ \delta_1 m_{eu}G_{eu}(\bar{w}_1, 0) + \delta_2 m_{ue}G_{ue}(0, \bar{w}_2) + \\ \delta_1 m_{ei} \mathbf{1}(W_{uu}(0, 0) > W_{ui}(0, 0)) G_{ei}(\bar{w}_1, 0) + \\ \delta_2 m_{ie} \mathbf{1}(W_{uu}(0, 0) > W_{iu}(0, 0)) G_{ie}(0, \bar{w}_2) + \\ \alpha_1 m_{iu} + \alpha_2 m_{ui} \end{aligned}$$

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

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

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

$$\begin{aligned} m_{ie}G_{ie}(0, w_2)[\delta_2 + \alpha_1 + \lambda_2^1 \bar{F}_2(w_2)] = \\ \lambda_2^0 e_{2i}^* m_{iu} \max((F_2(w_2) - F_2(\hat{w}_{ie-iu}), 0) + \\ \beta_1 m_{ue}G_{ue}(0, w_2) \end{aligned}$$

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

$$m_{iu}[\alpha_1 + \beta_2 + \lambda_2^0 e_{2i} \bar{F}_2(\hat{w}_{ie-iu})] = \\ \delta_2 m_{ie} \mathbf{1}(W_{iu}(0, 0) > W_{uu}(0, 0)) G_{ie}(0, \bar{w}_2) + \beta_1 m_{uu} + \alpha_2 m_{ii}$$

- The son/daughter and the mother are both inactive

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

3.3.6 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 $W_{ue}(0, \underline{w}) = W_{uu}$.

3.3.7 Firms and market equilibrium

We assume that wages of sons/daughters and mothers are determined in separated markets, 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:

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

3.4 Estimation

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

$$\Theta = (F_1, F_2, \delta_1, \delta_2, \alpha_1, \alpha_2, \beta_1, \beta_2, \lambda_1^0, \lambda_2^0, \lambda_2^1, C_1^0, C_2^0, \gamma_1, \gamma_2, b_1, b_2)$$

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 Maximum Likelihood estimator, the most common in empirical applications of the Burdett and Mortensen (1998) model. Dey and Flinn (2008) present the advantages and drawbacks in implementing a maximum likelihood estimator in a two-agent case when using a continuous time framework⁹. 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. Firstly, 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 minimum and maximum support for each value function. In this version, for simplicity, we establish effort levels e_1 and e_2 equal to one and the job search effort costs $C_1(e_1)$ and $C_2(e_2)$ equal to zero. Thus, it is not necessary to set guesses for the parameters of the cost function $C_1^0, C_2^0, \gamma_1, \gamma_2$. We are also calibrating the values of leisure b_1 and b_2 ;

⁹ These authors argue that an alternative to using a maximum likelihood estimator would be to assume a discrete framework, but, as earlier discussed, the arbitrariness of the choice of the decision period and time aggregation imposes serious problems since it impacts estimation and inference.

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 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 $\tilde{D}_{ss'}^1$ and $\tilde{D}_{ss'}^2$ from the data, where $s, s' = e, u, i$ and s denotes 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 $(\delta_1, \delta_2, \alpha_1, \alpha_2, \beta_1, \beta_2, \lambda_1^0, \lambda_2^0, \lambda_1^1, \lambda_2^1)$. We also can use the cross or household moments, that is, the moments from unemployment to employment conditional on the other member being employed earning w . We use at least four such conditions that identify the cost

function parameters $(C_1^0, C_2^0, \gamma_1, \gamma_2)^{10}$. The durations are exponentially distributed. Thus we construct transitions from the model for the son/daughter ($D_{ss'}^1$) and for the mother ($D_{ss'}^2$) as follow:

- Transitions to unemployment:

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

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

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

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

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

- Transitions out-of unemployment:

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

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

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

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

where $a_1 = \int \lambda_1^0 \sum_{k=e,u,i} e_{1k}^*(w_2) \bar{F}_1(\hat{w}_{ek-uk}(w_2)) \frac{m_{uk}}{m_u} dG_{2u}(w_2) + \beta_1$ and

$$a_2 = \int \lambda_2^0 \sum_{k=e,u,i} e_{2k}^*(w_1) \bar{F}_2(\hat{w}_{ke-ku}(w_1)) \frac{m_{ju}}{m_u} dG_{1u}(w_1) + \beta_2$$

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

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

- Conditional transitions from unemployment to employment:

¹⁰ As earlier discussed, in this version, we calibrate $e_1 = e_2 = 1$ and $C_1(e_1) = C_2(e_2) = 0$.

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

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

where $a_1(w) = \lambda_1^0 \bar{F}_1(\hat{w}_{ee-ue}(w))e_{1e}^*(w) + \beta_1$ and

$$a_2(w) = \lambda_2^0 \bar{F}_2(\hat{w}_{ee-eu}(w))e_{2e}^*(w) + \beta_2$$

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, the marginal distributions and the 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.

3.5 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 as schooling.

The sample used in descriptive analysis and in estimations of the household job search model is selected from the original sample of households and it comprises the 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 zero¹¹. The households can or cannot have children aged 0 to 13 years. Thus, we exclude the households in which the sons/daughters live alone, since we do not model the decision of children to leave the parents' house, and the households with children aged over 24 years¹².

We exclude the households whose members have problems in the identification code or some inconsistent information throughout the panel¹³. We build the individual identifier code 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 19 shows, by household composition, the percentage of households in 2004

¹¹ For the 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 which 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 that do not live with mothers and on the decisions of mothers that do not live with sons/daughters aged 14-24.

¹² Camarano et al. (2003) show that in Brazil, the average age of children that leave their parents' house and become a head of a family is 26 years. Thus, we consider 24 years as a general threshold, both for children that become a head or a spouse.

¹³ Inconsistency problems include the presence of more than one head or the absence of a head, which is not possible based on the PME's questionnaire.

Table 19 – 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 first and second columns are percentages. Statistics in the first interview. i: inactivity and u: unemployment. Durations 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.

and 2014 as well as the average unemployment and inactivity duration, and the average household labor income in 2014. This table is constructed aiming to highlight the most important differences among the families for 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 we exclude of 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 about 50% of the total sample of families in 2004 and about 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, both in 2004 and in 2014. Also, if we compare the households that comprise 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, since these families potentially have more members in labor force, followed by the families with 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 are using 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 observations¹⁴. In Appendices A.2, Table 41, we show all the performed exclusions and the respective decrement of individuals and families.

Table 20 – 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 that 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.

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 20 and 21 some descriptive statistics for the full sample of households¹⁵, and for the selected subsamples, after apply the selection criteria

¹⁴ 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 suffer attrition.

¹⁵ For which we only exclude the households with problems in the identification code and the families with members who are not head, spouse or children.

listed above, for 2004 and 2014.

We observe that our final subsamples, which comprise 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 20). Moreover, in Table 21, we verify that our subsamples have a greater proportion of individuals with the 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.

Table 21 – 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.

Indeed, comparing the subsamples of 2004 and 2014, we observe that, in this decade, the average schooling years and the percentage of individuals with 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 increases.

3.6 Descriptive analysis

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

Firstly, 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 can be 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 22. The stock of households in which both the son/daughter and the mother are employed is about 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 2014. In general, both members are inactive in 20-21% of the households.

Table 22 – 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 23 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) Up to 16 years, the teenagers that have a higher probability of being studying, and ii) More than 16 years, which have a higher chance of being active in labor market.

We observe that the vast majority of sons/daughters aged up to 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 aged more than 16 years, we observe higher proportions of employed, which have employed mothers (about 29%) or inactive mothers (about 19%). Among these sons/daughters aged more than 16 years, 23% present inactive status, whereas the mother is employed, and 15% are inactive, while the mother is also inactive.

It is important to highlight that sons/daughters whose mother is employed have a higher average labor market income, meaning that the better conditions of these two members in the labor market could be correlated. The labor income of sons/daughters aged more than 16 years and whose mother is inactive is the highest, perhaps evidencing 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 23 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 schooling years are employed while their sons/daughters are inactive, but this proportion is of 41% if we consider the 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 schooling years. The proportion of inactive mothers with sons/daughters with the same status is, respectively, 23% and 18%. Similarly to the results for sons/daughters, the average labor income of mothers with more than eight schooling years 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, independently of the status of their sons/daughters.

Table 23 – 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.

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 that were unemployed in the first interview, for 2014. These empirical individual wage distributions are inputs in our estimation process. Figure 11 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, light-tailed and is more similar to a Normal distribution, while the distribution for mothers seems to a Weibull distribution.

Figure 11 – Empirical wage distributions of sons/daughters and mothers, for 2014

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.

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 24, 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 25, we have the total percentage of mothers performing transitions, and these proportions by schooling group. Seven labor market conditional transitions are verified, namely: i) $e \rightarrow u$: transition from employment to unemployment, conditional on initial state e ; ii) $e \rightarrow i$: transition from employment to inactivity, conditional on initial state e ; iii) $e \rightarrow e'$: job-to-job transition, conditional on initial state e , that is, in the second interview the employed worker answered to have suffered a job change there were

at most thirty days, which by hypothesis was not followed by an unemployment period; iv) $u \rightarrow e$: transition from unemployment to employment, conditional on initial state u ; v) $u \rightarrow i$: transition from unemployment to inactivity, conditional on initial state u ; vi) $i \rightarrow e$: transition from inactivity to employment, conditional on initial state i ; and vii) $i \rightarrow u$: 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 Table 24 and 25, we observe that the percentage of sons/daughters leaving the employment to unemployment, inactivity or another job, conditional on being employed in the first interview, are higher than the percentage of mothers, for 2004 and 2014, meaning that the turnover among employed sons/daughters is more frequent. The opposite occurs for the transition between inactivity and employment, conditional on being inactive in the first interview, stronger among mothers. Between 2004 and 2014, the transitions of employed workers to unemployment decreased in general, both for sons/daughters and mothers, what 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. On the other hand, the transitions from unemployment or inactivity to employment, and from inactivity to unemployment are more frequent among sons/daughters aged more than 16 years, which 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 the transitions of sons/daughters decreased, evidencing 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, that increased

61%. The motivation for estimating a household job search model that takes into account the transitions to inactivity also arises from these statistics.

Table 24 – Transitions of sons/daughters, conditional on initial status and by age group, in 2004 and 2014

Transitions	2004			2014		
	Total	≤ 16 years	> 16 years	Total	≤ 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 25 – Transitions of mothers, conditional on initial status and by schooling of mothers, in 2004 and 2014

Transitions	2004			2014		
	Total	≤ 8 years	> 8 years	Total	≤ 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.

On the other hand, if we focus on the transitions of mothers (Table 25), we observe that all the transitions, except the move from unemployment to inactivity and from the inactivity from unemployment, are more frequent among mothers with up to 8 years of schooling. It is also important to note that between 2004 and 2014, similarly to sons/daughters, the turnover among mothers of both schooling groups seems to have been 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 25).

3.7 Estimated parameters and model fit

3.7.1 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 also for subgroups of sons/daughters and mothers. In this version of the study, all the estimations are carried out considering the job search levels e_1 and e_2 equal to one and the job search effort costs $C_1(e_1)$ and $C_2(e_2)$ equal to zero, for simplicity. We are also calibrating the values of leisure b_1 and b_2 (that are equal to the minimum wage in the data). As earlier discussed, we assume the CRRA form for the utility function, which allows performing estimations and simulations considering the linear case (the parameter ρ of the utility function is equal to 1) or taking into account 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 since an increase on Y could impact the reservation wages of sons/daughters and mothers.

Thus, Table 26 presents the estimated parameters or transition rates, for 2004 and 2014, and for the parameters $\rho = 1$ and $\rho = 0.95$ ¹⁶. Despite being relevant for simulation results, we observe that we only have minor changes in the transition rates if we take into account some level of risk aversion, and the main changes occur in the arrival rates if unemployed of sons/daughters, that 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, what 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 . On the other hand, 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

¹⁶ We arbitrarily choose this level of risk aversion.

from inactivity to unemployment) decrease for both members, whereas the discouragement/dropout rates β_1 and β_2 are increasing in the period. These facts are confirmed by empirical transitions.

Table 26 – 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.

Next, Table 27 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 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, both for $\rho = 1$ and $\rho = 0.95$. The contrary occurs in estimates for 2014, that present m_{ee} underestimated and m_{ii} overestimated. For this year, we also have an overestimation of m_{ei} and an underestimation for m_{ie} . Since the fit of F_1 and F_2 and for the transitions $D_{ss'}$ are exact, the fit of stocks and distributions G_1 and G_2 , unrestricted moments, do not fit so well.

For wages, we find a good fit for 2004 and 2014, even better for sons/daughters. For wages of mothers, the model does not fit so well, especially 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

Table 27 – 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						
P_{10}	5.2581	5.4588	5.6258	6.1964	6.0712	6.1964
P_{25}	6.1054	5.7689	5.8941	6.6590	6.4986	6.4986
P_{50}	6.3567	6.2798	6.2798	6.8596	6.8596	6.8596
P_{75}	6.7244	6.6162	6.6162	7.0767	7.1243	7.1243
P_{90}	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
Wage mother						
P_{10}	5.4657	6.3130	6.3130	6.2584	7.0469	7.0469
P_{25}	5.9766	6.7650	6.7650	6.5949	7.5934	7.5934
P_{50}	6.3130	7.2003	7.2003	6.8462	7.8678	7.8678
P_{75}	7.0752	7.5026	7.5026	7.3570	8.0830	8.0830
P_{90}	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.

Flabbi (2010) and Bowlus (1997) obtain a better fit of the male wage distribution than the female wage distribution. Once again we only find minor changes in the estimated stocks and wages if we take into account some level of risk aversion, and the main change occurs in the first percentile of the sons/daughters' wages, that is higher if the model is estimated under risk aversion.

3.7.2 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 schooling group of mothers. In these subgroups estimations, we assume the linear form of the utility function, that is, we do not consider any level of risk aversion.

Table 28 presents the transition rates for the estimations performed for two age groups of sons/daughters: i) Up to 16 years, the teenagers that have a higher probability of being studying, and ii) More than 16 years, which 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 aged up to 16 years.

On the other hand, the arrival rates are higher for both unemployed members, in 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 more than 16 years, and the discouragement/dropout rate of sons/daughters in the subgroup of younger sons/daughters, which present unfamiliar values, probably because of sample size.

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

Table 28 – 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 subgroups 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. We verify in Table 29, 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 labor market. However, in this subgroup, in 2004, unemployed and employed mothers present arrival rates that are, respectively, about 59% higher and 98% higher, than 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 overcome 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 is particularly higher in 2014.

Table 29 – 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 subgroups estimations, we assume the CRRA form for the utility function, with $\rho = 1$.

Tables 42 and 43 in Appendices A.2 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.

3.8 Simulations

3.8.1 The impact of changes in parameters

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 some 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, as well as 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 assumption¹⁷. The main advantage in determining wages endogenously is the possibility of accessing the total effect of policies that affect both the workers and firms, such as the minimum wage.

We firstly simulate 10%, 20% and 30% decreases in destruction rates of both members, while holding the other parameters fixed at their estimated values. Table 30 shows the results for 2004. Then, we simulate a 10%, 20% and 30% increase in arrival rates of both members. These results are shown in Table 31, for 2004. The results of simulations for 2014 are similar to the results for 2004, and they are shown in Appendices A.2, Tables 44 and 45.

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, since 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 changes in encouragement and discouragement/dropout rates,

¹⁷ We also test for exogenous wages, aiming to analyze the impact this procedure has on 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.

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 consequence of a decrease in job destruction rates. Moreover, the average welfare, as well as, the welfare level of employed, unemployed and inactive workers increase with lower job destruction rates.

The increases in arrival rates of both members, another source of 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, if employed, unemployed or inactive. However, comparing the effects of a percentual reduction in job destruction rates to a percentual 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.

Table 30 – 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								
P_{10}	5.4588	5.4588	5.4588	5.4588	5.6258	5.6258	5.6258	5.6258
P_{25}	5.7689	5.8941	5.8941	5.8941	5.8941	5.8941	5.8941	5.8941
P_{50}	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798
P_{75}	6.6162	6.6162	6.6162	6.6162	6.6162	6.6162	6.6718	6.6718
P_{90}	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								
P_{10}	6.3130	6.3130	6.3130	6.5644	6.3130	6.3130	6.3130	6.5644
P_{25}	6.7650	6.9321	6.9321	6.9321	6.7650	6.9321	6.9321	6.9321
P_{50}	7.2003	7.2003	7.3116	7.3116	7.2003	7.2003	7.3116	7.3116
P_{75}	7.5026	7.5026	7.5860	7.5860	7.5026	7.5026	7.5860	7.5860
P_{90}	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. Benchmark are the estimations present in Table 27.

Table 31 – 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								
P_{10}	5.4588	5.4588	5.4588	5.4588	5.6258	5.6258	5.6258	5.6258
P_{25}	5.7689	5.8941	5.8941	5.8941	5.8941	5.8941	5.8941	6.0053
P_{50}	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798	6.2798	6.3567
P_{75}	6.6162	6.6162	6.6162	6.6162	6.6162	6.6162	6.6718	6.6718
P_{90}	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								
P_{10}	6.3130	6.3130	6.3130	6.3130	6.3130	6.3130	6.3130	6.3130
P_{25}	6.7650	6.7650	6.7650	6.7650	6.7650	6.7650	6.7650	6.7650
P_{50}	7.2003	7.2003	7.2003	7.2003	7.2003	7.2003	7.2003	7.2003
P_{75}	7.5026	7.5026	7.5026	7.5026	7.5026	7.5026	7.5026	7.5026
P_{90}	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 27.

3.8.2 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, remaining 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 conclude about the contribution of these parameters or wage distributions to the trends in unemployment, inactivity, wages and welfare observed in this decade.

Tables 32-35 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 32 and 33 are constructed for simulations under risk neutrality, that is, for the linear form of the utility function, while tables 34 and 35 are constructed for simulations under risk aversion, which is particularly relevant for the simulations of the values of Y , as earlier discussed.

In Table 32, we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, keeping only one particular 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 the period. It is important to highlight that the reduction in the job destruction rates in this decade can be associated with the better economic conditions and labor market opportunities and lesser 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 does not alter a lot 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, that seem to be compensated 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. Firstly, we observe that the decreasing encouragement rate is the factor with the main contribution to this trend since if this parameter remains unchanged,

the inactivity would be almost the same of 2004. The second most important parameter contributing to diminishing the youth inactivity is the dropout rate, that increase 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 subsidized lower rates for students, in addition to racial and social quotas established in some public universities, favor the access and reduce the cost of education for sons and daughters intending to have higher education. Other programs such as the Bolsa Família 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 be reduced the cost of attending elementary and high school. As earlier observed in Table 28, the encouragement rate decreases and the dropout rate increases both in the subgroup of sons/daughters aged up to 16 years and more than 16 years.

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

The inactivity of mothers seems to be explained by the same parameters. Firstly, the decreasing encouragement and the increasing dropout rate collaborate in the same direction, since if these parameters remain stable, the inactivity of mothers would be lower than it is in 2014, meaning that exogenous factors also affected the move from unemployment to inactivity of these household members. As earlier observed in the estimation results for subgroups (Table 29), the encouragement rate decreases almost in the same magnitude both in the subgroup of mothers with up to 8 schooling years and with more than the elementary school. However, the dropout rate, the move from unemployment to inactivity, presents a greater rise among more educated mothers.

Table 32 – 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 33 – 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 that decreases in this period also contributes to the inactivity not being even greater. On the other hand, for mothers, an additional factor contributing to the inactivity is the arrival rate if unemployed, which decreases in the period according to the estimated transition rates (Table 26).

Table 34 is similar to Table 32, showing the results of counterfactual simulations when only one parameter or distribution remains unchanged. However, we take into account 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, since changes on Y could impact the reservation wages of sons/daughters and mothers. We verify that, contrarily to the expected, the labor income of fathers only marginally contributes to the inactivity rate of sons/daughters and mothers. However this result could be related to a little risk aversion level implemented.

We also perform counterfactual simulations jointly changing more than one parameter or distribution. These results are in Table 33, under linear utility function, and in Table 35, under risk aversion. In Table 33, we observe that the decreasing unemployment rate of sons/daughters almost would not have changed if the vector $(\delta_1, \lambda_1^0, F_1)$ that reflects the labor market conditions for this member remains the same. On the other hand, 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 is driven by the vector (α_2, β_2) .

Finally, contrary to the expected, 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 determining the inactivity of sons/daughters.

Table 34 – 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 35 – 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 36 and 38 show the contribution one-to-one, under linearity of the utility function and risk aversion, respectively, while Tables 37 and 39 shows the joint contribution of parameters and distributions. Focusing on tables constructed under risk neutrality, we observe that for the average wage of sons/daughters, the factor that mostly contributes to the increasing trend in the period is the shifted to right wage offer distribution of these members, as expected, and the contribution occurs in the 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 also collaborates for a 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 mostly contribute, which is confirmed in Table 39 in when we remain unchanged the vector (F_1, F_2, Y) , in spite of an opposite contribution of decreasing arrival rate of mothers. Additionally, the better labor market conditions of mothers have a greater contribution to the welfare of sons/daughters than 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 mostly contribute. Additionally, we highlight the relevance of their own better labor market conditions for their welfare, reflected in vector $(\delta_2, \lambda_2^0, \lambda_2^1, F_2)$, mainly for the welfare of employed mothers.

Table 36 – 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														
P_{10}	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
P_{25}	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
P_{50}	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
P_{75}	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
P_{90}	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														
P_{10}	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
P_{25}	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
P_{50}	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
P_{75}	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
P_{90}	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 37 – 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 38 – 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 39 – 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 $\rho = 0.95$.

3.9 Concluding remarks, limitations and future research

In this study, we aim to investigate the labor market transitions of sons and daughters and their mothers, through the estimation of a structural household job search model with on-the-job, and performing simple and counterfactual simulations. We verify that the household job search model does a reasonable job in fitting the stocks, despite overestimates m_{ee} and underestimates m_{ii} for 2004, and the opposite for 2014. For wages, we find a good fit for 2004 and 2014, even better for sons/daughters. For wages of mothers, the model does not fit so well, especially in lower percentiles, but improve in the highest ones.

In subgroup analysis, we observe that the estimated encouragement rate for sons/daughters aged more than 16 years is more than four times higher than the encouragement rate for younger children. On the other hand, the discouragement/dropout rate for 2004 is about 59% higher among sons/daughters aged up to 16 years. These facts are related to higher probability of fully or partially studying among the younger youth. The encouragement and dropout rates of sons/daughters are higher if the mothers have up to 8 schooling years, in both years, and the discouragement rate of mothers is higher among the more educated ones. Indeed, the destruction rates are higher for both members and in both years, in estimations for the subgroup of households with less educated mothers.

In simulations with percentual changes in parameters, we verify that the effects of a percentual reduction in job destruction rates of both members are greater than the effects of increases in arrival rates of both members, perhaps evidencing that policies or actions that diminish this source of search friction could be more effective.

Finally, in the counterfactual experiments in which we replace the parameters and wage offer distributions of 2004 for the parameters and distributions of 2014, remaining one or more specific parameters or distributions unchanged, we find that the decreasing unemployment rate of sons/daughters would not have changed between 2004 and 2014 if the labor market opportunities and conditions of this member, reflected in the vector of parameters $(\delta_1, \lambda_1^0, F_1)$, remains the same. The unemployment rate of mothers does not

alter a lot 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 the inactivity could be related to the lower cost of education for sons and daughters, as a consequence of some public policies, such as the PROUNI, FIES and Bolsa Família Program. The inactivity of mothers seems to be explained by the same parameters, but in subgroup analysis, we verify that the dropout rate presents a greater rise among more educated mothers. Contrarily to the expected, the labor income of fathers and the labor market conditions of mothers only marginally contributes to the inactivity rate of sons/daughters.

On the other hand, 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 a higher average welfare of youth. The welfare of mothers is largely determined by their better labor market condition.

It is important to highlight that, for reasons of tractability and simplicity, we have made some assumptions in this version. Firstly, we assume the household unitary model, under which we have full income pooling. 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 (FLABBI; MABLI, 2012). 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.

Second, households do not differ regarding observable characteristics or value of leisure, as is considered in Fang and Shephard (2014). According to these authors, 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. Instead, we have estimated the model in different subsamples of households by education

of mothers and age group of sons/daughters.

Indeed, we do not allow for endogenous job creation, relegating our approach to a partial equilibrium context. Moreover, contrary to Fang and Shephard (2014) and Flabbi and Mabli (2012), we do not allow for endogenous quit to non-employment when the other member gets a job, which the data in developing countries rejects. But we do allow for endogenous entry from inactivity to unemployment when the other member of the family loses his/her jobs.

Finally, in the empirical approach, we also make some choices, that can be view as limitations of this version, and that can be taken into account in the study. Firstly, we do not exclude the households in which the father is not present, but we do not model marriage formation and dissolution. Secondly, we can estimate the standard individual model in samples of households that do not have the spouse or when the mother is the head of the family.

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A Appendices

A.1 Appendices Chapter 2

Table 40 – Sample exclusions for individuals and households

Exclusions	Individuals		Households	
	Number	%	Number	%
Initial sample (all members in a household)	3,688,922	100	873,734	100
Exclusion 1: identification problems and composition				
Consistence problems*	3,575,762	96.9	857,359	98.1
HH with other members**	1,826,313	49.5	536,843	61.4
HH without children 14-24	686,200	18.6	147,777	16.9
HH with two fathers or two mothers	685,782	18.6	147,694	16.9
Exclusion 2: attrition				
HH observed only one time	616,264	16.7	129,767	14.9
HH whose members do not have the necessary observations	585,429	15.9	126,110	14.4
Final sample	585,429		126,110	

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.

A.2 Appendices Chapter 3

Table 41 – 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 42 – 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 43 – 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 44 – 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 45 – 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.