Cohabitation and Female Labor Supply: Evidence from Brazil *

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Abstract

This paper explores the relationship between cohabitation and labor supply, with a specific focus on how this connection influences women's decision-making and outcomes in the workforce. To assess the impact of cohabitation on labor force participation, we estimated Goussé, Jacquemet, and Robin's (2017) model of the marriage market and labor supply using data from the Continuous Brazilian National Household Survey (PNADC) from 2013 to 2019. Although the PNADC does not directly inquire about individuals' marital status, we used information about their roles within the household to construct a proxy for marriage. Our findings indicate a significant trend of positive assortative mating, revealing a preference for partners with similar traits who adhere to traditional gender roles and avoid deviations from these norms. Furthermore, we observe that lower workforce participation among women is primarily associated with domestic responsibilities rather than being solely influenced by bargaining power or personal preferences. Overall, our results shed light on the intricate relationship between cohabitation, family structure, and women's engagement in the labor market.

Keywords: Marriage Market; Labor Supply; Gender Gap

JEL codes: J12 J22 J16

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1 Introduction

The convergence of men's and women's roles in society has marked a significant economic and social advance in recent decades, evidenced by transformations such as the increase in women's competitive participation in the labor market, the reversal of the gender education gap, and the rise in labor force participation among married women. Despite these advancements, women's labor force participation remains lower and more intermittent than men's (Blau and Kahn, 2007; Eckstein, Keane, and Lifshitz, 2019). Data from the Brazilian Institute of Geography and Statistics (IBGE) reveal a persistent gender gap in labor market participation of approximately 20% in recent years, with a greater gap for married women. One prominent hypothesis in the literature to explain why women persist with lower labor force participation suggests that the gender gap in labor market outcomes is currently driven more by household factors rather than market discrimination (Bertrand, Kamenica, and Pan, 2015). Hence, there exists a form of family penalty affecting women's participation in the labor market (Kleven, Landais, and Leite-Mariante, 2024).

Marriage is a key demographic event in the life cycle, as it leads to the formation of a new partnership. In the economics of the family approach, the marriage event is important because it creates a new unit of analysis for economic problems—a new family. Within this new unit, time allocation decisions shift from individual optimization problems to collective choice problems. In the household, decisions are now made collectively by the family members, taking into account each individual's preferences and collective well-being (Browning, Chiappori, and Weiss, 2014; Becker, 1973; Becker, 1974). The link between marriage and the labor market comes from the optimal time allocation decisions made within the household, as the amount of time allocated to various activities, such as work and household chores, is influenced by both the decision to get married and the choice of partner (Grossbard, 1984; Calvo, Lindenlaub, and Reynoso, 2024).

Understanding family dynamics is essential for understanding labor supply dynamics, particularly in the context of gender disparities. A significant portion of the gender gap can be traced back to familial factors. According to Kleven, Landais, and Leite-Mariante (2024), family formation through marriage serves as the primary driver for gender inequality in labor market outcomes, particularly in low-income countries like Brazil, even more so than the impact of child penalties in these regions. Within this context, our study aims to explore marriage (and divorce) as events that may impose a labor market penalty on women and contribute to

the persistent gender gap. Specifically, we will investigate how new cohabitations (considered proxies for marriage in Brazilian household survey data) correlate with labor market participation for both men and women within the household context. Focusing on Brazil, a country characterized by significant gender disparities in labor force participation and household time allocation, our research seeks to fill the gap in evidence regarding the effect of marriage on this dynamic.

The analysis of female labor supply dynamics within the context of marriage demands a sophisticated framework due to the interdependence of decisions like labor supply, household production, and fertility within the family unit. Motivated by this, we will employ Goussé, Jacquemet, and Robin's (2017) dynamic model of the marriage market and labor supply, which will allow us to decompose the dynamics of labor supply and marriage. In our case, we adjusted the model estimates using Brazilian PNADC data for the 2013-2019 period and conducted counterfactual exercises to explore disparities in labor supply. By providing useful tools to better understand the mechanisms linked with labor supply and marriage decisions, the model can help identify which components are most closely associated with patterns of labor supply observed in the data.

We quantify unions and dissolution of cohabitation rates, analyze assortative mating patterns, and decompose the dynamics of labor supply and cohabitation in Brazil. Our findings reveal a strong preference for positive assortative mating and indicate that cohabitation likelihood is influenced by social norms, with marriage tendencies adhering to traditional gender norms related to wages, age, and education. Additionally, we discovered that domestic chores, rather than bargaining power, preferences, or the gender wage gap, primarily contribute to lower labor supply among women.

This work contributes to various branches of literature. Firstly, we add to the literature on gender gaps in labor supply and earnings (Kleven, Landais, and Leite-Mariante, 2024; Costa Dias, Joyce, and Parodi, 2021; Goldin, 2014; Blau and Kahn, 2017; Bertrand, Kamenica, and Pan, 2015). We provide evidence of the state of the gender gap in the labor market in Brazil, especially concerning the gap between married and single individuals, and demonstrate the effect of time constraints and the burden of domestic tasks on this differential. Additionally, we contribute to the literature on applications of bargaining-search-matching models of labor supply and the marriage market (Goussé, Jacquemet, and Robin, 2016; Shimer and Smith, 2000; Chiappori, Salanié, and Weiss, 2017; Chiappori, Dias, and Meghir, 2018; Chiappori, Iyigun, and Weiss, 2009; Lundberg and Pollak, 1993). In our case, we estimate the model of

Goussé, Jacquemet, and Robin (2017) and adjust the estimates and parameters of the model to Brazilian data. This model adjustment enables us to conduct contractual analyses focusing on policy implications for Brazil. Finally, we also contribute to studies on assortative mating patterns (Greenwood et al., 2016; Eika, Mogstad, and Zafar, 2019; Schwartz and Mare, 2005; Greenwood et al., 2014; Mare, 2016; Gihleb and Lang, 2020; Calvo, Lindenlaub, and Reynoso, 2023). We observe a positive trend of assortative mating in cohabitations in Brazil, with a higher probability of marriage for couples with similar characteristics.

This paper consists of seven sections in addition to this introduction. Section 2 provides a concise literature review on family and marriage penalties on female labor supply. Sections 3 and 4 present the data used and descriptive statistics of the sample. In Section 5, we introduce the estimated structural model. Section 6 presents the results of the model estimation, while Section 7 conducts counterfactual exercises using the estimated model. Finally, Section 8 presents the concluding remarks of the paper.

2 Related Literature

Several empirical studies have established a close relationship between female labor supply and family background, attempting to understand why more women persist outside the labor market. One hypothesis that emerges to explain women's lower labor force participation rates, particularly for those who are married, is that women bring personal glass ceilings from home to the workplace (Bertrand et al., 2015). Despite educational advancements and reduced barriers to participation, the gender gap in labor market outcomes is increasingly driven by household factors rather than market-induced ones. This suggests that less traditional factors, such as gender identity norms within a family and household arrangements, may influence the gender gap in labor market outcomes.

A well-established hypothesis is that parenthood contributes to widening gender gaps in the labor market (Bertrand, Goldin, and Katz, 2010; Kleven, Landais, and Søgaard, 2019; Cortés and Pan, 2021). There is evidence that labor market trajectories for men and women diverge after the birth of their first child, with women not fully recovering their previous trajectory in the medium term. Generally, the negative effects of children on careers are larger for women relative to men and constitute one of the most relevant components of the persistent gender gap.

Conversely, this disparity in the career paths of men and women in the labor market can also be linked to other household-related phenomena, such as marriage. Grossbard-Schechtman and Neideffer (1997) illustrate that marriage exerts a constraining effect on women's labor supply. Herold and Wallossek (2023) investigated the marriage penalty using an event study approach. They found that the marriage earnings gap primarily results from both the extensive margin and the intensive margin but did not find a decrease in wages, indicating no decrease in productivity. Kleven, Landais, and Leite-Mariante (2023) found that in Brazil and China, the impact of marriage on the gender gap is more significant than the impact of having children. This could be associated with the timing of motherhood/fatherhood and marriage in these countries, which on average occur in very close proximity. However, even when controlling the sample to separate these two effects, the marriage penalty persists in the short term.

Although the literature on the effects of marriage on labor market outcomes is still scarce, we can associate this subject with several other topics that have been better explored. There exists a well-established body of literature that argues that marriage follows the comparative advantage theory. Individuals marry to specialize in what they each do best. In general, women specialize in domestic activities, such as taking care of the home and dependents (the elderly and children), while men are responsible for paid work (Becker, 1985, 1991). However, there is evidence suggesting that this theory, by itself, falls short of explaining the remaining gender gaps (Siminski and Yetsenga, 2022).

The cyclical analysis of the labor market also shows how married women's labor supply is influenced by their marital status and their partner's situation in the labor market. The added worker effect theory (Lundberg, 1985) has revealed that married women typically serve as secondary earners in the household, indicating a weaker connection to the labor market compared to their partners. There is a temporary increase in married women's labor supply when their husbands become unemployed. Attanasio et al. (2005) explored how female labor supply serves as a safety net for families during economic downturns in household earnings. According to their findings, women tend to increase their labor supply when faced with a decrease in income or their husband's unemployment, acting as a mechanism for household insurance. This perspective strengthens the concept of married women as additional workers within marriage, underscoring the close relationship between their labor supply, marital status, and their partner's employment status in the labor market.

The increase in women's labor force participation has been accompanied by a decline in marriage rates and a rise in assortative mating, where people tend to marry those with similar

characteristics or from the same socioeconomic background (Schwartz and Mare, 2005). The characteristics of couples can influence household-related decisions, such as labor supply. The complementarity and substitutability within a couple play a role in the allocation of time between work, domestic production, and leisure, thereby affecting labor market participation and outcomes.

Generally, the literature indicates that women with higher education tend to be more selective in the marriage market, seeking partners with more valuable characteristics. This selectivity often leads to more stable marriages (Neeman et al., 2008; Schwartz and Mare, 2005; Greenwood et al., 2016). Calvo et al. (2023) show that complementarities in preferences for domestic production within a couple are associated with a higher degree of assortative mating, which can narrow gender inequalities in labor market sorting. Overall, this pattern of positive assortative mating tends to amplify earnings inequality among couples (Greenwood et al., 2014, 2016; Eika, Mogstad, and Zafar, 2019).

In Brazil, Hakak and Firpo (2017) identify positive assortative mating as a significant factor contributing to household income inequality. Their analysis reveals that this positive sorting effect is more pronounced among individuals with higher educational attainment compared to those with lower levels of education. Additionally, the observed decline in the Gini coefficient can be partially attributed to recent decreases in the wage gap and an increase in female labor force participation (Firpo and Hakak, 2022).

Additionally, partner selection can also be related to the incidence of social norms on labor and marriage market decisions (Bertrand, 2011; Blau and Kahn, 2017). A widely accepted gender norm is that "the husband should earn more than the wife." If the probability of a woman's income exceeding her husband's income is high, she is less likely to participate in the labor force (Bertrand, Kamenica, and Pan, 2015; Hwang, Lee, and Lee, 2019). Consequently, women tend to reduce their labor supply to avoid gender role reversals in earnings. It is possible to expect that individuals sort spouses according to these norms.

The analysis of female labor supply has traditionally focused on married women and treated family conditions as exogenous. Nevertheless, labor force participation and marital decisions are jointly made (Eckstein and Wolpin, 1989; Grossbard and Neuman, 1988; Fernández and Wong, 2014). A growing body of literature has emerged using dynamic models for women's life cycle choice problems. The search-matching-and-bargaining framework has gained widespread use in applied macroeconomics to gain insight into long-term changes such

as declining marriage rates and rising female labor supply within households. Notable studies employing this framework include those by Aiyagari et al. (2000), Goussé et al. (2017a, b), Greenwood, Guner, and Knowles (2003), Caucutt et al. (2002), and Gould and Paserman (2003). Since labor market decisions are made within a married couple, the bargaining process between income sharing and time spent in domestic and caregiving tasks, coupled with societal gender norms, can either hinder or facilitate women's participation in the labor force.

3 Data

The Continuous Brazilian National Household Survey (PNADC), conducted by the Brazilian Institute of Geography and Statistics (IBGE), is a valuable data source for understanding the labor market in Brazil. The survey consists of five interviews per quarter and produces labor market statistics at the household level. It covers the period 2012-2023. In this study, the sample is composed of individuals between 18 and 60 years old living in households with up to one spouse, for the years 2013-2021. To enable longitudinal analysis, an advanced methodology is used, based on Ribas and Soares' (2008), to pair individuals over the interviews, addressing attrition challenges.

PNADC does not contain any questions regarding marital status. However, it is possible to make an approximation of this status based on respondents' self-declarations about their household role. We assume cohabitation when a respondent declares the presence of both a head and a spouse in a given interview and use it as a proxy for marriage unit. Our analysis focuses on individuals who are either household heads or spouses living in single-family households, regardless of the presence of children or other household members. We have two primary samples categorized by interview-marriage-status-level: one comprises single individuals, and the other consists of couples interviewed each year. For the latter group, we managed to identify the spouse at the time of cohabitation, resulting in a database organized at the couple level. Meanwhile, for singles, the database remains organized at the individual level. Table 1 summarizes our sample by cohabitation status aggregated per year.

Table 1: Single and Married Sample Overview by Gender, 2013-2021

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Single Men	7912	8490	8810	9223	9192	9595	9735	5285	5900
Single Women	14351	15131	15511	15526	15623	16033	16067	8835	9831
Couples	39760	40631	41209	40530	40927	41258	40401	19822	22191
Women	47672	49121	50019	49753	50119	50853	50136	25107	28091
Men	54111	55762	56720	56056	56550	57291	56468	28657	32022
Total Sample	101783	104883	106739	105809	106669	108144	106604	53764	60113

Source: Author's own elaboration based on PNADC (IBGE) data

We used the first and second interviews from the PNADC dataset to track individuals overtime. Household roles transitions serve as a proxy for changes in cohabitation status. Therefore, if a household that previously did not have a spouse begins to declare the presence of one in the last interview, we assume the formation of a new cohabitation. Conversely, if the presence of a spouse is no longer reported in the second interview, dissolution is inferred. Consequently, we delineate four potential trajectories for each household: (1) single household in both interviews, (2) formation of cohabitation, (3) dissolution of cohabitation, and (4) cohabitation maintained across both interviews. Table 2 counts these transitions in the sample. [1]

Table 2: Cohabitation Transitions Count, 2013-2021

	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Stay Single	21328	22678	23402	23940	24011	24833	25037	13837	15408
Formation	946	990	912	892	806	845	804	208	302
Dissolution	1203	1213	1155	931	958	974	939	429	417
Stay in cohabitation	78306	80002	81270	80046	80894	81492	79824	39290	43986

Source: Author's own elaboration based on PNADC (IBGE) data

Opting for this definition of the family unit entails certain analytical constraints. We are unable to account for mobility between households and the changes of roles during such transitions. Consequently, some family configurations and mobility scenarios are omitted,

[1] Within these four marital trajectory possibilities, we accommodate for intra-household role changes within the same household across interviews. Figure A4 outlines the definitions and possibilities of cohabitation transitions.

such as the transition from being a child in one household to becoming a spouse in another. Nevertheless, given the constraints of our research design and available data, this approach represents the most viable method for investigating cohabitation/marriage dynamics. Despite these limitations, we can still derive valuable insights into how shifts in family composition — such as the introduction or departure of a spouse — impact individuals' time allocation and labor supply choices.

Our primary variables of interest encompass the number of worked hours, wages, educational level[2], age, marital (cohabitation) status, and domestic work hours. However, it's worth noting that the domestic time use variable provided by PNADC is not adequately representative of domestic and caregiving activities, as highlighted by De Jesus, Turra, and Wanjman (2023). Generally, the available time use variable is highly misleading regarding the actual time devoted to these activities. To mitigate this discrepancy, we have chosen to calibrate the domestic time use variable using the estimates computed by De Jesus, Turra, and Wanjman (2023) to adjust for the unpaid household services time use recorded household surveys for Brazil.

4 Stylized Facts

4.1 Labor Market Outcomes

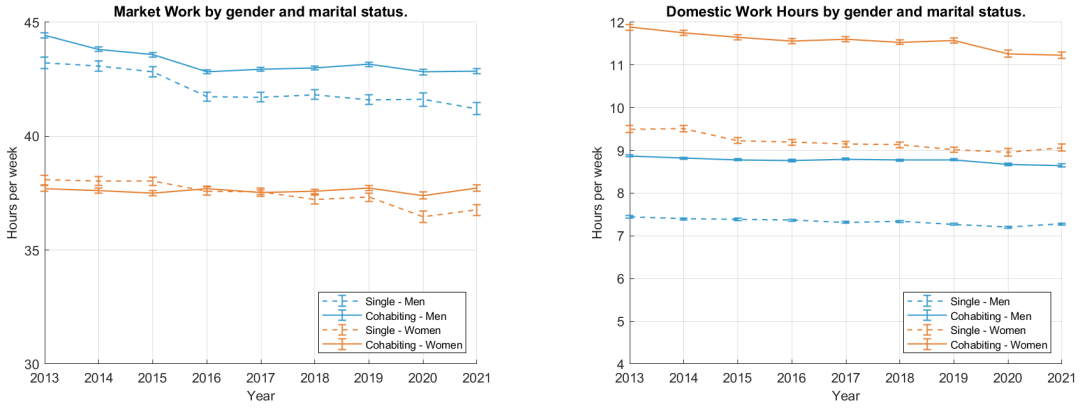
In this section, we present the trends and composition of our main variables of interest for demographic groups defined by gender and marital status. We analyze the composition and evolution of each variable throughout the period 2013-2021. Overall, the 2013-2018 period is stable for most of the analyzed variables, with minors composition changes and neither extreme changes in the observed trends, with exception for the pandemic period.

Figure **??** illustrate the worked hours of men and women according to their cohabitation status, indicating that women's number of worked hours are consistently lower than men's, regardless of being single or cohabiting. Cohabiting men are the demographic group that works the highest number of hours on average, followed by single men. Women, both cohabiting and single, have a lower average of working hours, with now clear difference between marital groups.

[2]Three educational groups are defined according to the classification presented in Table A1.

Men working hours are closest to the national standard work scheduled of 44 hours per week, while for women, the average is further from this benchmark.

This does not necessarily reflect any kind of precarization, but it can result in lower wages if women are not in higher-paying jobs. Additionally, Goldin (2014) associates the profile of hours worked by men and women with the remaining gender gap in the labor market, arguing that men's higher wages are linked to their availability to work longer hours and less flexible schedules. The average is not a sufficient measure to draw this type of conclusion, but it shows us that there is a different composition between the groups regarding the number of hours worked. Moreover, we also see that inequality is greater among cohabiting individuals than among singles, which may indicate some form of greater labor penalty for women due to marriage (cohabitation).



(a) (b)

Figure 1: Market and Domestic Work Time Use by Gender and Marital Status

Disparities are also observed on the number of unpaid domestic work hours. As this variable is a calibration based on others authors estimation for demographic groups, figure 1b is an auxiliary tool for analyzing the composition of the groups during this period for our dataset. It evidences that, overall, women spend more time on household chores than men, and cohabiting individuals spend more time on these tasks than singles. Again, the cohabitation gender gap is higher than the single individuals gap.

There is also a considerable gender gap on wages for the demographic groups as presented by Figure 2. Males wages are, on average, higher then females, specially for those who are cohabiting. Again, we observe earning differences between cohabiting and single men, while

this is not true for women, as they have very close wage means for both marital groups.

Combined with the analysis of the number of hours worked, this shows that married women are in a relatively worse position in the labor market compared to married men. They work fewer hours on average and are also paid less. One possible explanation for this is that women spend more time on other types of "non-productive" activities, such as household chores and caregiving. The proposed model estimation on the following sections aims to better understand this dynamic.

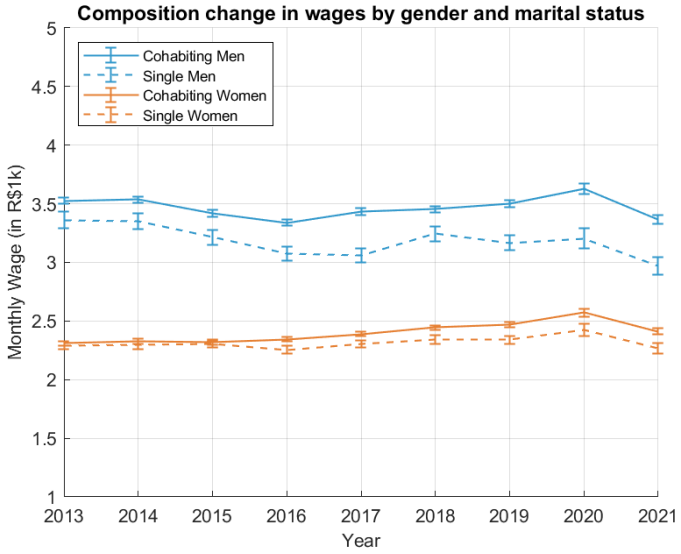
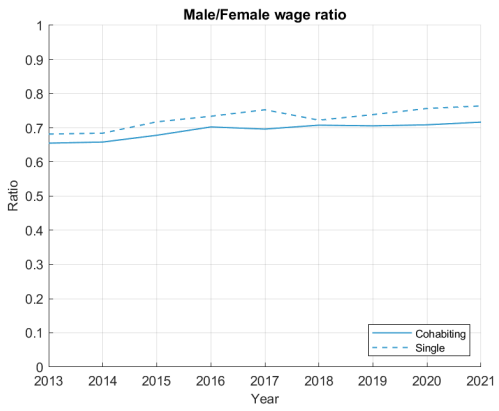
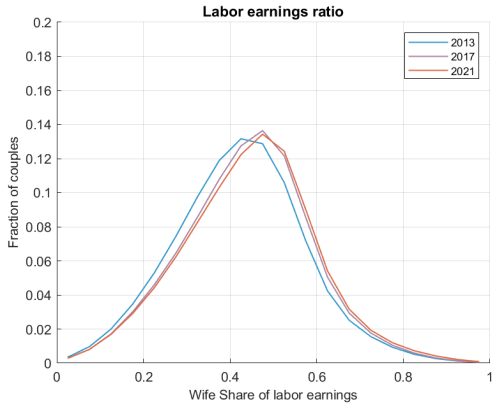


Figure 2: Mean Market Work Hours by Gender and Marital Status

Figure 3a illustrates the mean wage gap by marital status. It summarizes the male-female wage ratio separately for singles and cohabiting groups. On average, women earn about 70% of what men earn, with similar ratios for both married and single individuals.



(a) $\frac{w_f}{w_m}$



(b) $\frac{w_f}{w_m+w_f}$

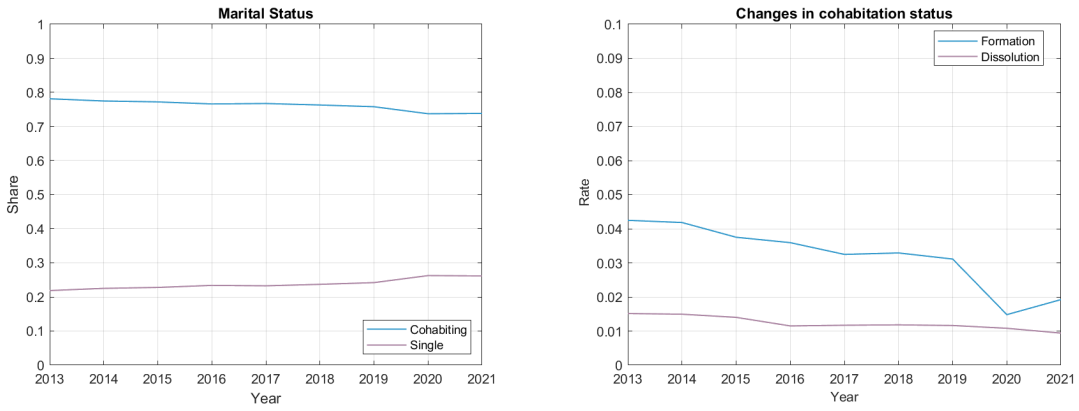
Figure 3: Gender Wage Gap and Sample Distribution according to Wife Share of Labor Earnings

Finally, it is interesting to examine the distribution of couples according to their relative labor earnings share. As shown in Figure 3, couples' labor earnings are concentrated around a ratio of 0.5. This indicates that, on average, couples tend to have similar incomes, a phenomenon known as earnings homophily. This pattern suggests that individuals may have a preference for partners with similar earning potential, indicating a trend toward more positive assortative mating.

Additional statistics on age and education are presented in Appendix 2A.

4.2 Marital Composition and Transitions

We now provide some evidence about the sample marital composition and illustrate the observed marital transitions. Figure 4a illustrates the proportion of cohabiting individuals by sex in our sample over the years. Overall, there is a slight decline in the proportion of cohabiting individuals from 2013 to 2021. The most significant change in the cohabiting population is observed in 2020, with a noticeable drop in the proportion of cohabiting individuals.



(a) Cohabitation proportion

(b) Formation and dissolution rates

Figure 4: Proportion of married and single individuals and rate of cohabitation transitions, 2013-2021

Regarding the analysis of new cohabitation and divorce flows, Figure 4 presents these flows for the 2013 to 2021. The formation and dissolution of cohabitation rates are calculated with respect to the not-cohabiting and cohabiting population in that period, respectively. Both formation and dissolution's exhibit a low rate, which is associated with the definition of the variables and the short-term horizon of my analysis. The dissolution rate remains more stable throughout the entire period. On the other hand, we observe a declining trend in the union rate over the years analyzed. This decrease is even more pronounced during the Covid-19 pandemic period. This sharp decline can be associated with social distancing measures and the reduction in social interactions during this period.

Overall, these statistics offer valuable insights into the factors influencing the labor and marriage markets, providing motivation for the model described below. Due to the need for a stable period for optimal model estimation, we will restrict our analysis to the period from 2013 to 2018, leaving the pandemic years for future analysis

5 Methodology

In order to evaluate the relationship between marriage and labor supply, we employ Goussé, Jacquemet et Robin (2017) model (GJR) of marriage market and labor supply as described

below. In our estimation, cohabitation flows and stocks replace marriage information.

5.1 Marriage Market

In GJR model, population is segmented by gender, and each individual differs by their unique set of characteristics - named types: education, wage (productivity) and age. Male and female types are labeled by i and j. Let $l_m(i)$ and $l_f(j)$ be the density functions of male and female types in the population, thus $L_m = \int l_m(i)di$ and $L_f = \int l_f(j)dj$ denote the total numbers of men and women in the population. Similarly, $n_m(i)$, $n_f(j)$, N_m, N_f are the corresponding notations for the single-sub populations. Finally, $m(i,j)$ is the density function of couples and $M = \int\int m(i,j)didj$ is the total number of couples observations.

Marriage and divorce flows per unit of time and individuals type are denoted by $MF(i,j)$ and $DF(i,j)$. λ_m and λ_f are the rate in which men and women meet other single individuals in the marriage market by unit of time, with $N_m N_f$ as the number of potential meetings being. They assume that $\lambda_m N_m = \lambda_f N_f$). The meeting function is a Cobb-Douglas function and λ has constant returns to scale in the meeting function $\lambda N_f N_m$

There is an utility match specific component that generates heterogeneity in match decisions denoted by z. When there is a match between a male single i and a female single j, a bliss shock z is drawn. This shock is updated every period following a Poisson process with parameter δ with a probability δ of generating a new z'. The shocks are i.i.d. and have the same G distribution.

Marriage then depends on these three variables, (i,j,z). α_{ij} is the non-degenerated equilibrium probabiility of a marriage between a male type i and a female type j upon meeting. Defining the willingness to marry conditional do the individuals types and the bliss shock as $WtM(i,j,z) = 1$ if yes and $= 0$ if no depends on (i,j,z), the marriage probability given i, j upon a meeting is: $\alpha_{ij} = Pr\{WtM(i,j,z) = 1|i,j\}$. When the bliss shock ceases to satisfy the matching rule (with probability $1 - \alpha_{ij}$) and $WtM(i,j,z') = 0$, divorce occurs.

5.2 Preferences and Home Production

Individuals instantaneous flows of utility are drawn from: private consumption c_0, leasure e and an home-produced public good q. The production of a household public good q is the externality of the union that can make the marriage preferable to remaining single. The production function differs by marriage status: for singles it's difined as $q = F_i^0(d)$ and for married couples: $q = zF_{ij}(d_m, d_f)$ where d, d_m and d_f are the time allocated domestically with the production of the public good for singles, married men and married women, respectively.

The amount of hours available for an individual in a week equals to 1. Thus, labor supply is obtained through residual by $h = 1 - e - d$. Both wages and income are given by w_i and w_j. $R, R_{m,f}$ are the budget expenditures allocated to private consumption and leisure by singles and married males and females.In this framework, budget constraints are then defined. For a single of type i:

$$c + w_i e = w_i(1 - d) \equiv R \tag{1}$$

and for a married couple of male-female type (i, j):

$$c_m + w_i e_m = w_i(1 - d_m) - t_m \equiv R_m \qquad c_f + w_j e_f = w_j(1 - d_f) - t_f \equiv R_f \tag{2}$$

where t_m, t_f are intrahousehold transfers that can be positive or negative

Households are subject to a living cost C_{ij} and it's budged is balanced $c_m + c_f + C_{ij} = w_i h_m + w_j h_f$ which implies that $t_m + t_f = C_{ij}$. C_{ij} can be interpreted as a fixed cost of home production.

Setting $U_i(c, e, q)$ as the utility function of an individual type i (or j), the indirect utility function is:

$$\psi_i(R, q, d) = \max_{c,e} U_I(c, e, q) \quad st.\ c + w_i e \leq R,\ c \geq 0,\ 0 \leq e \leq 1 - d \tag{3}$$

5.3 Marriage Contracts

In GJR model, marriages are not long-term commitments and the model's friction comes from marriage and divorce. A marriage contract of a couple type (i, j), for a current shock z, specifies a utility level for both spouses, u_m and u_f, and two promised values $V_m^1(z')$ and $V_f^1(z')$ for any realization of z' if the match continues. If V_i^0 and V_j^0 denote the value of being single and r is

the discount rate, W_m and W_f are the present values of a marriage contract given any choice of $(u_m, u_f$ that follows the Bellman equation:

$$rW_m = u_m + \delta \int \left[\max\left\{V_i^0, V_m^1(z')\right\} - W_m\right] dG(z') \tag{4}$$

If $V_m^1(z') < V_i^0$, divorce occurs, otherwise, the match is maintained.

Marriage utilities u_m and u_f depend on controls d_m, d_f t_m and t_f as:

$$u_m = \psi_i \left[w_i(1-d_m) - t_m, q, d_m\right] \quad u_f = \psi_j \left[w_j(1-d_f) - t_f, q, d_f\right] \tag{5}$$

The optimal choices of controls are given by the maximization solution of the following Nash bargaining problem:

$$max_{c,t_m,t_f} \quad \left[W_m - V_i^0\right]^{\beta} \left[W_f - V_j^0\right]^{1-\beta} \quad s.t. \;\; C_{ij} = t_m + t_f \tag{6}$$

and the participation constraint:

$$WtM(i,j,z) = 1 \Leftrightarrow V_m^1(z) - V_i^0 \geq 0 \;\; and \;\; V_f^1(z) - V_j^0$$

Individuals have two sources of bargaining power: from their outside option and from their bargaining coefficients β and $1-\beta$. The equation $W_m = V_m^1(z)$ must satisfy the option-value equation:

$$(r+\delta)\left[V_m^1(z) - V_i^j\right] = u_m + \delta \int \left[V_m^1(z') - V_i^0\right]^+ dG(z') - rV_i^0 \tag{7}$$

denoting $x \equiv max\left\{x, 0\right\}$ and with a symmetric expression for $V_f^1(z)$.

The present value of single-hood is:

$$rV_i^0 = \psi_i(w_i, 1) + \lambda \int \int [V_m^1(i,j,z) - V_i^0] \cdot WtM(i,j,z) n_f(j) dG(z) dj \tag{8}$$

where $u_i^0 = \max_{d \leq 1} \psi_i \left[w_i(1-d), F_i^0(d)\right]$

5.4 Steady State

In steady state, we have equal flows in and out the single and marriage stocks of each type (i,j):

$$\delta(1-\alpha_{ij})m(i,j) = \lambda n_m(i) n_f(j) \alpha_{ij} \tag{9}$$

. Replacing $m(i,j)$ in the following restrictions:

$$l_m(i) = n_m(i) + \int m(i,j)dj \quad and \quad l_f(j) = n_f(j) + \int m(i,j)di \tag{10}$$

we have the equilibrium number of couples of type (i,j):

$$m(i,j) = \frac{\lambda}{\delta}\frac{\alpha_{ij}}{(1-\alpha_{ij})}n_m(i)n_f(j) \tag{11}$$

and it is also possible to determine the equilibrium number of singles of each type by solving the fixed-point system:

$$n_m(i) = \frac{l_m(i)}{1 + \frac{\lambda}{\delta}\int n_f j \frac{\alpha(i,j)}{1-\alpha(i,j)}dj} \tag{12}$$

$$n_f(j) = \frac{l_f(j)}{1 + \frac{\lambda}{\delta}\int n_m i \frac{\alpha(i,j)}{1-\alpha(i,j)}di} \tag{13}$$

5.5 Equilibrium

The model assumes that the indirect utility is of the form:

$$\psi_i(R,q,d) = q\frac{R - A_i}{B_i} \tag{14}$$

where $A_i = a_{0i} + a_{1i}w_i + \frac{1}{2}a_{2i}w_i^2$
and $lnB_i = b_i lnw_i$. The denominator is normalized as $B_i(1) = 1$ so the numerator can be interpreted as a nominal utility level. The left hand side of the equation (14) does not depend on d because d is assumed to be small enough so the constraint $e \leq 1 - d$ is never binding. Using Roy's identity, demands for leisure and consumption follow:

$$e = A_i' + \frac{B_i'}{B_i}(R - A_i) \quad and \quad c = R - w_i e \tag{15}$$

The equilibrium solution satisfy both Recursivity and Transferability properties

5.5.1 Recursivity

According to the model, first domestic production inputs are determined independently, followed by transfers and values. Fixing transfers and continuum values, the inputs d_m and d_f are delivered from first order conditions of the Nash Bargaining problem:

$$\frac{1}{w_i}\frac{\partial lnF_{ij}^1(d_m,d_f)}{\partial d_m} = \frac{1}{w_j}\frac{\partial lnF_{ij}^1(d_m,d_f)}{\partial d_f} = \frac{1}{R_m - A_i + R_f - A_j}$$

where the denominator is the net total private expenditure, that is, the family left income from $w_i + w_j$ after the home production spending $w_i d_m + w_j d_f + t_m + t_f$. We can define, thus, $d_m^1(i,j)$ and $d_f^1(i,j)$ and write X_{ij} and F_{ij}^1 as the equilibrium solutions values of $R_m - A_i + R_f - A_j$ and $F_{ij}^1(d_m^1, d_f^1)$

5.5.2 Transferability

The Transferability property says that the match surplus is shared between spouses and the matching requires a positive surplus. As proven by GJR (2017), the first-order conditions of the bargaining problem requires the followings rend-sharing conditions:

$$B_i[V_m^1(z) - V_i^0] = \beta S_{ij}(z) \ , \quad B_j[V_f^1(z) - V_f^0] = (1-\beta) S_{ij}(z) \tag{16}$$

and the match surplus solves:

$$(r+\delta) S_{ij}(z) = z F_{ij}^1 X_{ij} - B_i r V_i^0 - B_j r V_j^0 + \delta \int S_{ij}(z')^+ dG(z') \tag{17}$$

that is, the difference in utility flows from single hood to marriage added of a continuum value of the expected effect of changes in the bliss shock z.

Denoting the integrated surplus as $\bar{S_{ij}} = \int S_{ij}(z')^+ dG(z')$, integrating (17) we solve $\bar{S_{ij}}$ as:

$$(r+\delta)\bar{S_{ij}} = F_{ij}^1 X_{ij} \mathcal{G}\left(\frac{B_i r V_i^0 + B_j r V_j^0 - \delta \bar{S_{ij}}}{F_{ij}^1 X_{ij}}\right) \tag{18}$$

with $\mathcal{G}$ as the decreasing and invertible on the support function $\mathcal{G}(s) \equiv \int (z-s)^+ dG(z)$ and $\mathcal{G}' = -(1-G)$.

The matching probability becomes

$$\alpha_{ij} \equiv Pr\left\{S_{ij}(z) > 0\right\} = 1 - G\left(\frac{B_i r V_i^0 + B_j r V_j^0 - \delta \bar{S_{ij}}}{F_{ij}^1 X_{ij}}\right) \tag{19}$$

$$= 1 - G\left[\mathcal{G}^{-1}\left(\frac{(r+\delta) S_{ij}(z)}{F_{ij}^1 X_{ij}}\right)\right] \tag{20}$$

with (19) coming from (17) and (19) resulting from (18). Finally, the value of single-hood becomes:

$$B_i r V_i^0 = B_i u_i^0 + \lambda\beta \int \bar{S_{ij}} n_f(j) dj \ , \quad B_j r V_j^0 = B_j u_j^0 + \lambda(1-\beta) \int \bar{S_{ij}} n_m(i) di \tag{21}$$

for male and female types individuals.

5.5.3 Transfers

The equilibrium value of transfers can be determined using the known present values as the solution of the static Nash Bargaining problem:

$$\max_{t_m, t_f} = [u_m - rV_i^0]^{\beta}[u_f - rV_j^0]^{(1-\beta)}$$

using $B_i u_m + B_j u_f = qX_{ij} = zF_{ij}^1 X_{ij}$

$$B_i u_m = B_i rV_i^0 + \beta[zF_{ij}^1 X_{ij} - B_i rV_i^0 - B_j rV_j^0] \tag{22}$$

We can obtain net private incomes as a share of private expenditures $X_i j$ dividing equation (22) by $q = zF_{ij}$:

$$R_m - A_i = w_i(1 - d_m^1) - t_m - A_i = \beta_{ij}(z)X_{ij} \tag{23}$$

$$R_f - A_j = w_j(1 - d_f^1) - t_f - A_j = [1 - \beta_{ij}(z)]X_{ij} \tag{24}$$

and the collective sharing rule β_{ij} comes from (22)

$$\beta_{ij}(z) = \beta + \frac{(1-\beta)B_i rV_i^0 - \beta B_j rV_j^0}{zF_{ij}^1 X_{ij}} \tag{25}$$

that is, the sum of the bargaining coefficient β and the marriage advantage in the marriage market.

5.5.4 Equilibrium

The model equilibrium is characterized by the following functions of the types (i, j): $\bar{S_{ij}}$, $B_i rV_i^0$, $B_j rV_j^0$, $n_m(i)$, $n_f(j)$ and $\alpha_{i,j}$; that are obtained by the fixed-point system of equations 4.11, (18), (19), (21) for $\lambda \equiv \lambda(N_m, N_f)$. To calculate the equilibrium, following GJR(2017), using Chebyshev grid to compute the equilibrium and Clenshaw-Curtis quadrature to approximate the integrals, the system is then solved by iterating the fixed-point operator.

5.6 Estimation

5.6.1 Parameters specification

The meeting rate λ will follow a standard Cobb-Douglas specification:

$$\lambda = \xi(N_m N_f)^{-\frac{1}{2}}$$

The indirect utility for consumption and leisure for male and females types are defined as:

$$A_i = a_{0i} + a_{1i}w_i + \frac{1}{2}a_{2i}w_i^2 \quad and \quad lnB_i = b_i lnw_i \tag{26}$$

All parameters may depend on x_i and a_{2m} and a_{2f} are set constant given gender. Leisure expenditure follows (15):

$$w_i e_m = a_{1i}w_i + a_{2m}w_i^2 + b_i(R_m - A_i) \ , \quad R_m = w_i(1 - d_m) - t_m \tag{27}$$

given domestic time d_m and transfers t_m. Consumption then is defined as:

$$c_m = R_m - w_i e_m = a_{0i} - \frac{1}{2}a_{2m}w_i^2 + (1 - b_i)(R_m - A_i) \tag{28}$$

Equivalent equations follow for females type j.

We use Stone-Geary functions for domestic production for couples and singles, respectively:

$$F_{ij}^1(d_m, d_f) = Z_{ij}(d_m - D_i^1)^{K_m^1}(d_f - D_j^1)^{K_f^1} \tag{29}$$

$$F_i^0(d_m) = (d_m - D_i^0)^{K_m^0} \quad F_j^0(d_f) = (d_f - D_j^0)^{K_f^0} \tag{30}$$

Z_{ij} measures the quality of the public good produced by the household. These functions imply complementarities between the inputs and $K_m^1 = K_f^1 \to 0$ corresponds to a Leontieff technology production function with $d_m = D_i^0$ and $d_f = D_j^0$. To simplify the estimation, C_{ij} is considered to be linear in x_i and x_j.

We have then time used in home production for singles:

$$d_m^0 = D_i^0 + \frac{K_m^0}{1 + K_m^0}\left(1 - D_i^0 - A_i/w_i\right) \tag{31}$$

and for couples:

$$d_m^1 = D_i^1 + K_m^1 X_{ij}/w_i \tag{32}$$

with equivalent equations for married and single females, replacing i for j and m for f.

The net private expenditure is:

$$X_{ij} = \frac{w_i(1 - D_i^1) + w_j(1 - D_j^1) - C_{ij} - A_i - A_j}{1 + K_i^1 - K_j^1} \tag{33}$$

and the equilibrium domestic productions for singles and couples are:

$$F_i^0 = \left[\frac{K_m^0}{1+K_m^0}\left(1 - D_i^0 - A_i/w_i\right)\right]^{K_m^0}, \quad F_j^0 = \left[\frac{K_f^0}{1+K_f^0}\left(1 - D_j^0 - A_j/w_j\right)\right]^{K_f^0} \tag{34}$$

and

$$F_{ij}^1 = Z_{ij}\left(\frac{K_m^1}{w_i}\right)^{K_m^1}\left(\frac{K_f^1}{w_j}\right)^{K_f^1} X_{ij}^{K_m^1+K_f^1} \tag{35}$$

Finally, assuming that the distribution of match-specific shocks z log-normal and assuming zero mean:

$$\mathcal{G}(s) = \int (z-s)^+ dG(z) = -s\Phi\left(-\frac{lns}{\sigma}\right) + e^{\frac{\sigma^2}{2}}\Phi\left(-\frac{lns}{\sigma} + \sigma\right) \tag{36}$$

where Φ is the standard normal CDF and σ is the standard deviation of z

5.6.2 Estimation

We use household PNADC data to estimate the model. We split the sample into 6 time-periods: 2013, 2014, 2015 ,2016, 2017 and 2018. The structural parameters are estimated for the initial years of the database, 2013-2018. As it is a reasonably stable period, steady-state conditions apply. We observe data on labor supply, education, wages and ages. We calibrate our model with domestic time use base on De Jesus (2013) and inferred leisure time use by $e = 1 - d - h$. For our estimation, we selected only labor-active individuals [3] [4]

On the first step of the estimation procedures, meetings rates and matching probabilities are estimated using reduced forms specifications. All the densities are estimated using a grid of values for i and j comprising three education categories, 10 chebyshev nodes for wages, and 5 chebyshev nodes for the ages. Marriage and divorce flows are calculated for each education combination. Marriage and divorce flows per couple type (i, j) are given by:

$$MF(i,j) = \lambda n_m(i) n_f(j) \alpha_{i,j} \tag{37}$$

[3] We conducted an estimation allowing for zero income, and this adjustment did not substantially alter the parameter estimation.

[4] We're excluding data from 2019-2021 due to the Covid-pandemic during this years. We aim for a stable timeframe to ensure that steady-state conditions apply.

$$DF(i,j) = m(i,j)\delta(1-\alpha_{i,j}) \tag{38}$$

We can link λ and α_{ij} to the flows, defining the marriage rate and the divorce rate as:

$$MR(i,j) \equiv \frac{MF(i,j)}{n_m(i)n_f(j)}$$

$$DR(i,j) \equiv \frac{DF(i,j)}{m(i,j)}$$

Eliminating $\alpha_{i,j}$ from the equations yields:

$$\frac{MR(i,j)}{\lambda} + \frac{DR(i,j)}{\delta} = 1 \tag{39}$$

Using the following Cobb-Douglas specification for the meeting rate λ:

$$\lambda = \xi(N_m N_f)^{-\frac{1}{2}}$$

and rewriting the equation, we can estimate ξ and δ by OLS:

$$MR_{i,j} = \beta_0 + \beta_1 DR_{i,j} + \varepsilon$$

where $\beta_0 = \lambda$ and $\beta_1 = -\frac{\lambda}{\delta}$

With the estimates, we can calculate different match probabilities α_{ij} using marriage and divorce flows. Considering equal flows in an out marriage, the matching probability follow:

$$\alpha_{i,j} = \frac{\delta m(i,j)}{\delta m(i,j) + \lambda n_m(i) n_f(j)} \tag{40}$$

The parameters of preferences and domestic production, the Nash bargaining parameter β and the match dispersion σ are then estimated by nonlinear least squares, using time uses, wages and education as explanatory variables. Finally, public good quality Z_{ij} is estimated using a standard minimum distance considering it as a flexible high-order polynomial in x_i and x_j.

6 Results

6.1 Reduced Form Estimates

The model parameters were estimated for the aggregated years period 2013-2018. Using the reduced form strategy, we obtained estimations for ξ, δ and λ. We estimated ξ=0.0541, δ = 0.0164 and very similar meetings rates ($\lambda N_f \approx \lambda N_m$), for each period of time, according to the single's stock on those years [5].

6.2 Sorting

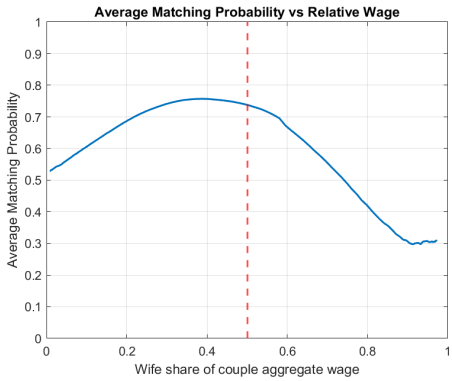
Marriage probabilities are recovered from equation40, using the parameters estimated so far and stock densities obtained directly from the data. We estimated α_{ij} for each possible combination of singles and couples. Table 3 summarizes the marriage probability between types: wages and age quantiles and educational levels. It can be interpreted as a measure of the degree of assortative mating in our data.

Our analysis reveals three main results, which remain consistent across different years. On table 3, we highlight the findings for 2013, 2015 and 2018. First, we observe a distinct pattern of sorting across pairs, indicating that the selection process is not uniform. Different groups exhibit different preferences and behaviors when selecting partners, reflecting diverse sorting mechanisms. Second, our findings indicate a general trend of positive assortative mating. Individuals tend to prefer partners who are similar to themselves in terms of wages, age, and educational level. This preference for similarity suggests that individuals prioritize compatibility and shared characteristics when forming couples. This is evidenced by the higher values of α_{ij} along the diagonals of Table 3.

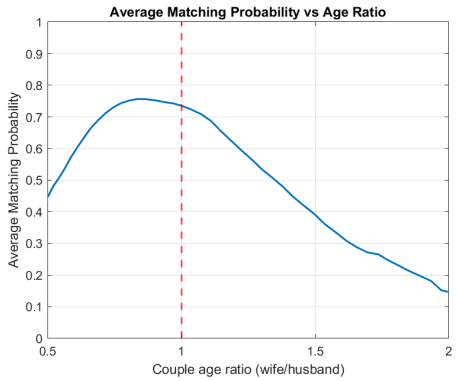
[5] Table A2 presents the estimates for the meeting rates over the years

Table 3: Average Matching Probability by Wages Quartiles, Age Quartiles and Education Groups, 2013, 2015 and 2018

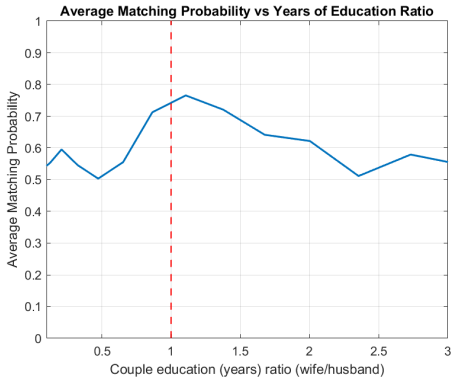
Panel A: Wage													
		Female											
		2013				2015				2018-19			
		Q4	Q3	Q2	Q1	Q4	Q3	Q2	Q1	Q4	Q3	Q2	Q1
Male	Q4	0.64	0.54	0.52	0.47	0.65	0.52	0.50	0.44	0.68	0.52	0.50	0.43
	Q3	0.48	0.56	0.56	0.51	0.49	0.54	0.54	0.50	0.50	0.54	0.54	0.48
	Q2	0.45	0.56	0.56	0.52	0.46	0.54	0.54	0.50	0.47	0.54	0.54	0.49
	Q1	0.36	0.47	0.48	0.48	0.35	0.45	0.46	0.46	0.34	0.44	0.45	0.44
Panel B: Age													
		Female											
		2013				2015				2017			
		Q4	Q3	Q2	Q1	Q4	Q3	Q2	Q1	Q4	Q3	Q2	Q1
Male	Q4	0.41	0.41	0.41	0.40	0.40	0.38	0.38	0.37	0.39	0.37	0.37	0.36
	Q3	0.30	0.76	0.76	0.77	0.27	0.75	0.75	0.75	0.23	0.70	0.70	0.70
	Q2	0.30	0.76	0.76	0.77	0.27	0.75	0.75	0.75	0.23	0.70	0.70	0.70
	Q1	0.29	0.75	0.75	0.75	0.26	0.73	0.73	0.74	0.23	0.69	0.69	0.69
Panel C: Education													
		Female											
		2013				2015				2017			
		Low	Medium	High		Low	Medium	High		Low	Medium	High	
Male	Low	0.45	0.37	0.32		0.45	0.35	0.30		0.50	0.37	0.27	
	Medium	0.28	0.44	0.46		0.28	0.43	0.45		0.28	0.45	0.45	
	High	0.06	0.30	0.50		0.07	0.31	0.51		0.06	0.30	0.54	



(a) Wage



(b) Age



(c) Years of Schooling

Figure 5: Projected Aggregated Matching Probability on Sample's Couples Characteristics

To illustrate the relationship between the patterns of pairs, we projected the average matching probability conditional to the types (i, j) for all the couples in our sample the estimations of α_{ij} based on their set of characteristics[6]. Figure 5 presents the relationship between the average matching probability and the relative characteristics of couples in terms of education, salary, and age [7]. The first panel 5a shows that the probability of marriage increases as the woman's share of the couple's income [8] grows, reaching a peak when the woman and her spouse have approximately equal incomes, and then decreases beyond this point. These results corroborate the findings of Bertrand et al. (2015) concerning gender norms, demonstrating

[6]We use a Discrete Cosine Transform (DCT) on the joint matching probabilities to obtain a function that gives the projected matching probability for each couple in the sample, following GJR (2017) estimation procedures

[7]present the distribution of the sample among these measures in Section 3 of the appendix

[8]Wife share of couple's income: $\frac{wage_f^1}{wage_m^1 + wage_f^1}$

that women become less attractive in the marriage market when they earn more than their partners. Regarding age (on panel 5b), we observe a similar pattern. Generally, the probability of a match is higher for couples with greater age similarity, peaking when the woman's age is equivalent to the man's, and α_{ij} decreases significantly after this point. When it comes to education (panel 5c), the patterns are less clear due to the discrete nature of years of schooling. However, similarly, we observe a higher matching probability when the number of years of education is similar between the individuals. These patterns of assortative mating may be linked to social norms and partner preferences in society, as well as reflect the demographic composition of the population concerning the defined types.

6.3 Structural Parameters

Table 4 presents our estimation of the structural parameters of the model. Initially, all parameters were estimated using data aggregated over the period 2013-2018. Columns (1) to (20) refer to preferences parameters and columns (23) to (43) to home production parameters. We also present the estimates for β and σ.

The estimates of the preference parameters considering education, age, and gender show distinct patterns among these groups. Parameters a and b demonstrate the effect of age and education on preferences for leisure and consumption. Overall, we observe similar patterns for men and women. Analyzing the coefficients a_0, we see that the higher the education, the greater the value placed on leisure. Additionally, when controlling for education, analyzing the parameters a_1 shows that women, on average, demand more leisure than men. The coefficients b indicate the income effect on the demand for leisure. We note that the higher the education, the greater the income effect. On the other hand, this effect decreases with age.

Regarding the home production parameters D, for married and single individuals, we do not observe a clear pattern concerning the effect of education and age on the demand for home production, nor a gender difference. Also, the cost of home production C increases with age, particularly for women, and it is higher for individuals with higher education levels. Finally, we estimate $\beta = 0.48$, which represents a very balanced power between spouses.

Table 4: Estimated Parameters

	Parameter	Estimate		Parameter	Estimate
1	$a_{0f}[Ed = Low]$	-22.8770 (0.0011)	23	$D_f^0[Ed = Low]$	-0.0269 (0.0003)
2	$a_{0m}[Ed = Low]$	-27.2517 (0.0072)	24	$D_m^0[Ed = Low]$	-0.1100 (0.0006)
3	$a_{0f}[Ed = High]$	-36.3739 (0.0024)	25	$D_f^0[Ed = High]$	-0.0449 (0.0002)
4	$a_{0m}[Ed = High]$	-30.2427 (0.0067)	26	$D_m^0[Ed = High]$	-0.1107 (0.0005)
5	$a_{0f}[Age]$	0.3384 (0.0009)	27	$D_f^0[Age]$	-0.0012 (0.0001)
6	$a_{0m}[Age]$	0.0446 (0.0028)	28	$D_m^0[Age]$	0.0010 (0.0002)
7	$a_{1f}[Ed = Low]$	0.3969 (0.0002)	29	K_f^0	0.3232 (0.0343)
8	$a_{1m}[Ed = Low]$	0.321 (0.0002)1	30	K_m^0	0.2341 (0.0384)
9	$a_{1f}[Ed = High]$	0.3872 (0.0002)	31	$D_f^1[Ed = Low]$	-0.3351 (0.0004)
10	$a_{1m}[Ed = High]$	0.3189 (0.0002)	32	$D_m^1[Ed = Low]$	0.1025 (0.0002)
11	$a_{1f}[Age]$	0.0038 (0.0001)	33	$D_f^1[Ed = High]$	-0.2868 (0.0005)
12	$a_{1m}[Age]$	0.0037 (0.0001)	34	$D_m^1[Ed = High]$	0.1049 (0.0002)
13	a_{2f}	-0.0000 (0.0000)	35	$D_f^1[Age]$	0.0100 (0.0002)
14	a_{2m}	-0.0000 (0.0000)	36	$D_m^1[Age]$	-0.0005 (0.0001)
15	$b_f[Ed = Low]$	0.4217 (0.0516)	37	K_f^1	0.0413 (0.0172)
16	$b_m[Ed = Low]$	0.3284 (0.0342)	38	K_m^1	0.0152 (0.0048)
17	$b_f[Ed = High]$	0.8194 (0.0742)	39	$C[constant]$	36.0219 (0.0770)
18	$b_m[Ed = High]$	0.5208 (0.0375)	40	$C[Age_f]$	8.1299 (0.1416)
19	$b_f[Age]$	-0.0190 (0.0104)	41	$C[Age_m]$	6.3811 (0.0771)
20	$b_m[Age]$	-0.0066 (0.0143)	42	$C[Ed_f = Low]$	-0.4223 (0.1474)
21	β	0.4822 (0.0778)	43	$C[Ed_m = Low]$	-0.5440 (0.0158)
22	σ	0.2849 (0.0331)			

Notes: Standard errors in parentheses

6.4 Model Fit to PNADC Data

Using the parameters, we simulated steady-state trajectories for the 2013-2018 period for our main variables of interest. Figure 6 illustrates the model's predicted labor supply and domestic time use trends over the years. Examining the Brazilian data from PNADC, we observe that the model captures the general trends well, but it doesn't precisely replicate the actual data in terms of varying labor supply levels. In our estimated model, it's noticeable that it underestimates the labor supply of cohabiting women and overestimates that of single women. Concerning men, the model underestimates both time allocations, implying a preference for a similar, lower allocation for both single and cohabiting men, which is lower than observed and

lower than predicted for single women. However, the estimated hours don't exhibit significantly different trend patterns from those observed in the data. The second panel in Figure 6 portrays the model's fit compared to the observed data for the estimation of hours spent in unpaid domestic work. For this variable, we observe that the model fits better for most categories, including single and cohabiting men and single women. However, the model overestimates the time allocation of cohabiting women for these activities.

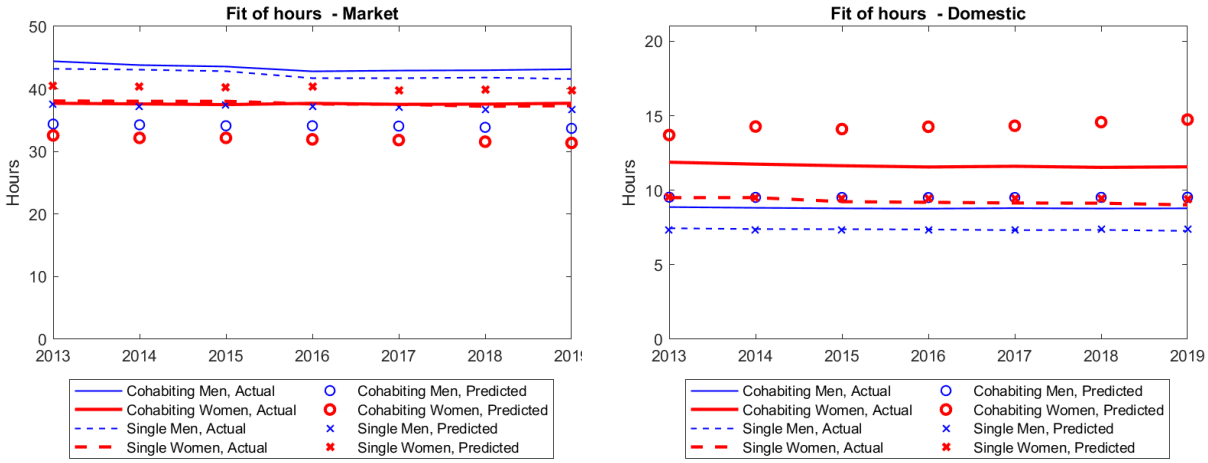
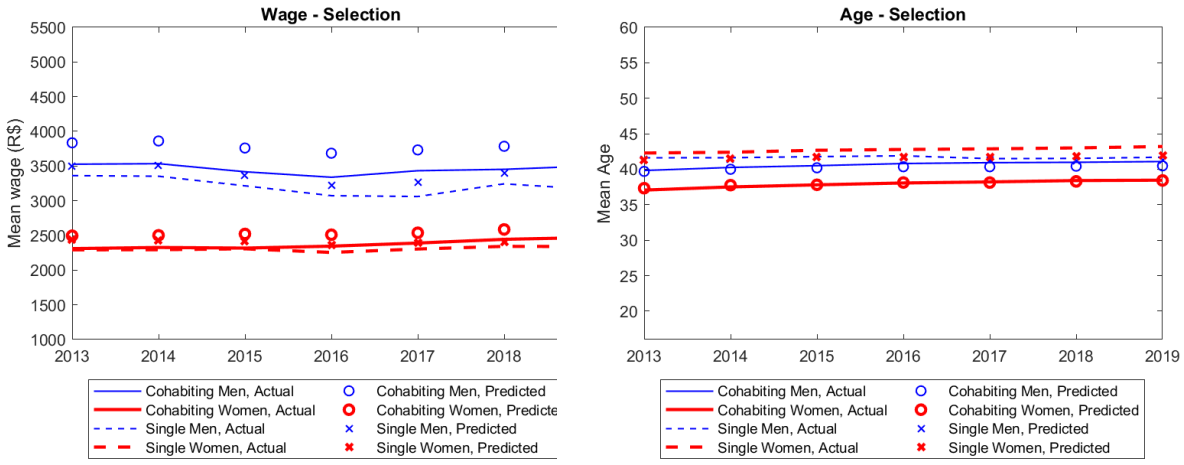


Figure 6: Prediction of Time Use - Market and Domestic Hours - by gender and marital status

Next, we conducted an analysis of how the model predicts the population composition in terms of the exogenous variables included: salary, education, and age, which define the types of couple pairs. For all these variables, the model shows a good fit to the observed data. As shown in Figure 7, the model slightly overestimates the salaries of both single and cohabiting men but closely follows the trend and maintains consistent levels across categories compared to the data. For the education categories, shown in figure 8, and the average age of the sample (figure 7), the model's predictions align well with the observed values.



(a) Wages (b) Age

Figure 7: Model Prediction of Average Wages and Age by Gender and Marital Status

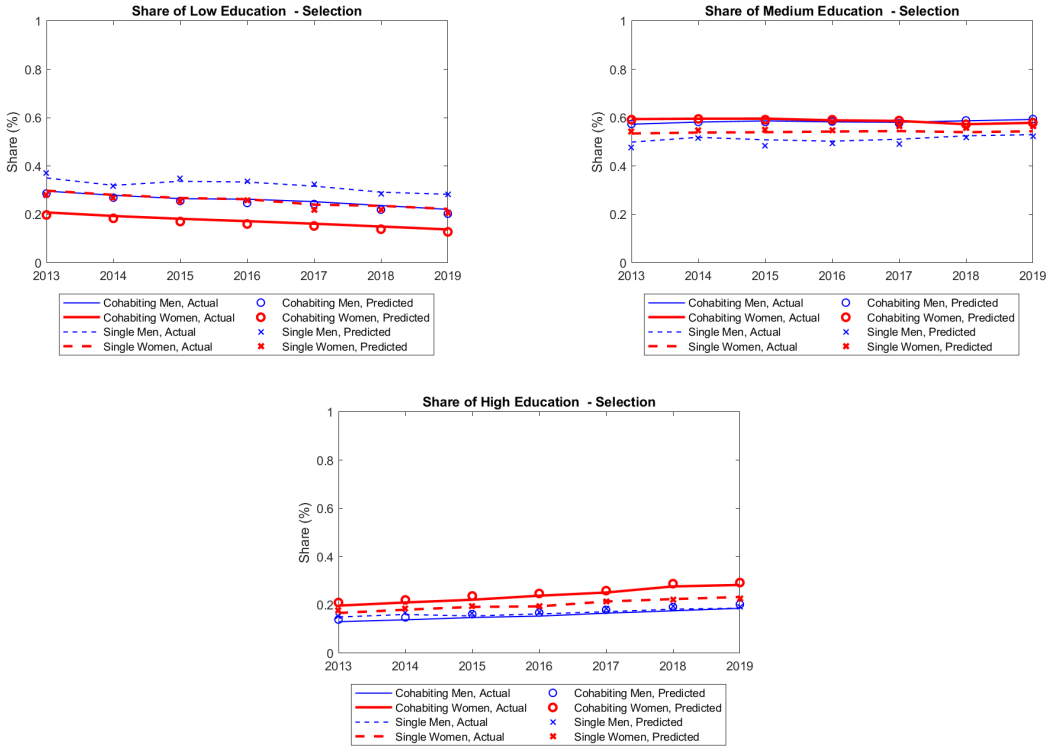


Figure 8: Model Prediction of Sample Educational Composition by Gender and Marital status

Finally, we undertake an analysis to assess the model's efficacy in capturing the income

distribution among couples. Illustrated in Figure 9, we depict the sample distribution of the wife's share of labor earnings and the gender wage gap. The GJR model, fitted on Brazilian data, projects an income distribution skewed to the left of the origin, potentially indicative of lower income among female partners within couples. However, both the predicted and actual distributions exhibit relative similarity, with concentrations around 0.4 share. Additionally, we investigate how the gender wage gap behaves within the model's estimates. Figure 10 illustrates the gender wage gap (considering the average female wage relative to that of males) observed in Brazilian data alongside with model predictions. It is noteworthy that the model predicts a slightly smaller wage gap compared to observed data, yet discrepancies are not substantial.

Figure 9: Predict wife share of total labor earnings

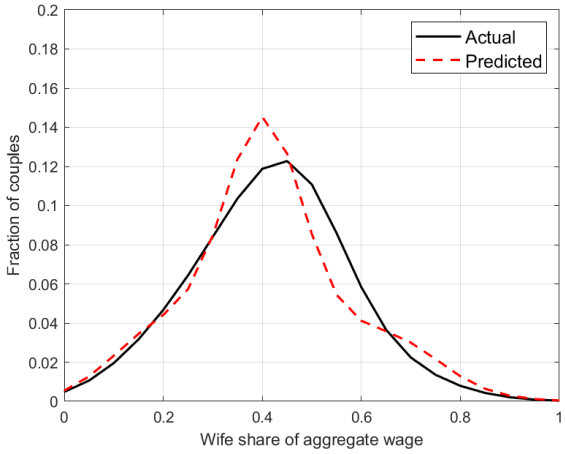
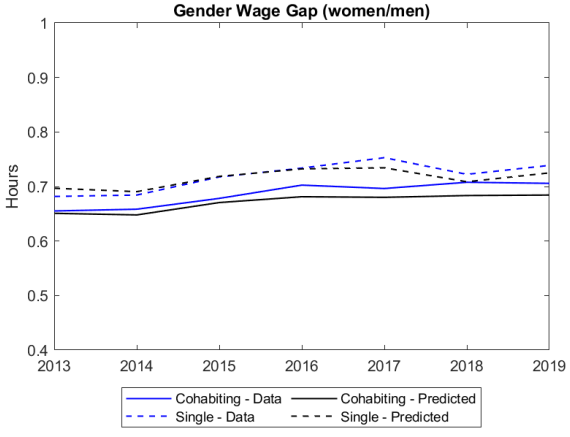


Figure 10: Predict gender gap

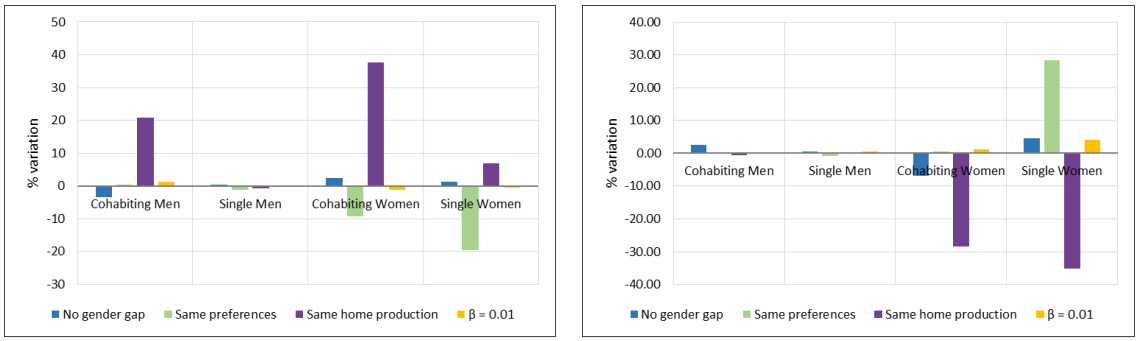


Although the predicted model does not perfectly fit the data, it accurately captures the trends and does not significantly differ in level for most variables. This fit is sufficient to perform simulation exercises on the data to analyze how labor allocation responds to changes in model components, which will be discussed in the following section.

7 Counterfactual Exercises

Our aim is to comprehend the factors associated with the differential in labor supply between men and women. In this section, we will explore some hypotheses already investigated in the literature to explain this gap. Based on the estimation of the GJR model (2017), we conduct counterfactual exercises to try to understand the effect of changes in the model's parameters and components on the observed patterns.

We will explore four hypotheses and their implications for individuals' time allocation. The first simulation considers the absence of a wage differential between men and women. To achieve this, we equate the wages of women with those of men with similar age and educational levels. The aim of this exercise is to ascertain whether the decision regarding time allocation among work, leisure, and home production comes from a characteristic of the labor market: the gender wage gap. We also investigate if labor supply decisions result from preferences. We simulate time allocation decisions replacing women's preferences parameters by men's. Subsequently, we will assess the effects on labor supply of decisions regarding time allocation in domestic activities. For this purpose, we replace the home production parameters of women with those of men. Finally, we evaluate the effect of changes in individuals' bargaining power by altering the coefficient of β to $\beta = 0.01$, representing a drastic decrease in bargaining power for men relative to women.



(a) Labor Supply (b) Domestic Time

Figure 11: Variation on Labor Supply from Counterfactual Simulations

Figures 11 presents the results of these simulations regarding labor supply. We observe a more pronounced change in time allocation when altering preferences and home production. When we impose same home production for men and women, we note both an increase in labor supply for cohabiting men and women as well as for single women, and a significant reduction in time spent on domestic activities for cohabiting and single women. Setting equal preferences for men and women, in turn, it leads to a reduction in female supply, specially for single women. We also see an increase in time spend on domestic activities for the latter. We also observe a slight change in time allocation when we equalize the wages of men and women based on their characteristics. In this simulation, there is an increase in the number of hours worked among women and a decrease in labor supply among cohabiting men. Regarding domestic work, there is a slight increase in the number of hours allocated by cohabiting men and a reduction for cohabiting women. Changing the bargaining power β does not bring relevant changes in the decision regarding time allocation compared to the baseline estimates.

The primary result derived from these simulations is the impact of time spent on domestic activities on women's labor supply. Overall, we observe that this differential between men and women arises mainly from a time constraint faced by women, rather than from differences in preferences or labor market structures that remunerate men and women differently. This supports the hypothesis that the labor supply differential between men and women is primarily due to family and household factors, specifically the intra-household allocation of time between market work and unpaid domestic activities.

8 Conclusion

In this paper, we investigate the relationship between labor supply and cohabitation in Brazil. Due to the absence of aggregated data at the household or individual level that identifies marriage for the country, we undertook an effort to reconstruct families from the PNADC (Continuous National Household Sample Survey) and identify marital transitions between panel interviews. From this dataset, we calculated the rates of union formation and dissolution within our sample, examined assortative mating tendencies, and broke down the dynamics of labor supply and cohabitation in Brazil. We employ the dynamic model of the marriage market and labor supply by Goussé, Jacquemet, and Robin (2017) and adjust model estimates on Brazilian data from the PNADC. We perform counterfactual exercises to investigate how components of the model influence disparities in labor supply.

We observe a strong pattern of positive assortative mating, indicating that individuals tend to prefer partners who share similar characteristics. Moreover, cohabitation chances appear to be influenced by prevailing social norms, with couples seeking out partners who align with these norms and avoiding scenarios that deviate from traditional gender expectations, such as marriages where the woman is older or earns more than the man. Our estimation results further highlight the complex interplay between labor market dynamics and gender roles. Specifically, we find that the lower labor supply among women is primarily associated with the burden of domestic responsibilities, rather than being solely influenced by bargaining power or individual preferences. Our analysis also reveals that, despite the prevalence of a gender wage gap, this wage disparity does not exert a significant impact on women's decisions regarding their labor force participation.

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Appendix A

A1 Categorical Variables

Table A1: Categorical variables created from PNADC data, IBGE

Variables	Categories	Years of Schooling
Educational group	Incomplete Elementary Education	up to 8
	Complete High School	9 to 15
	Complete Higher Education (complete or incomplete)	16

A2 Descriptive Statistics

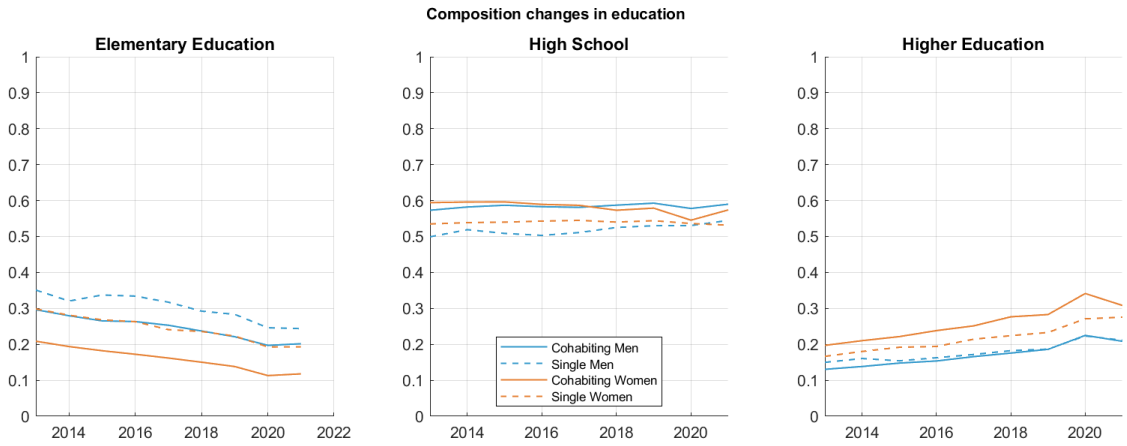

Figure A1: Sample Composition by Educational Level Group, 2013-2021

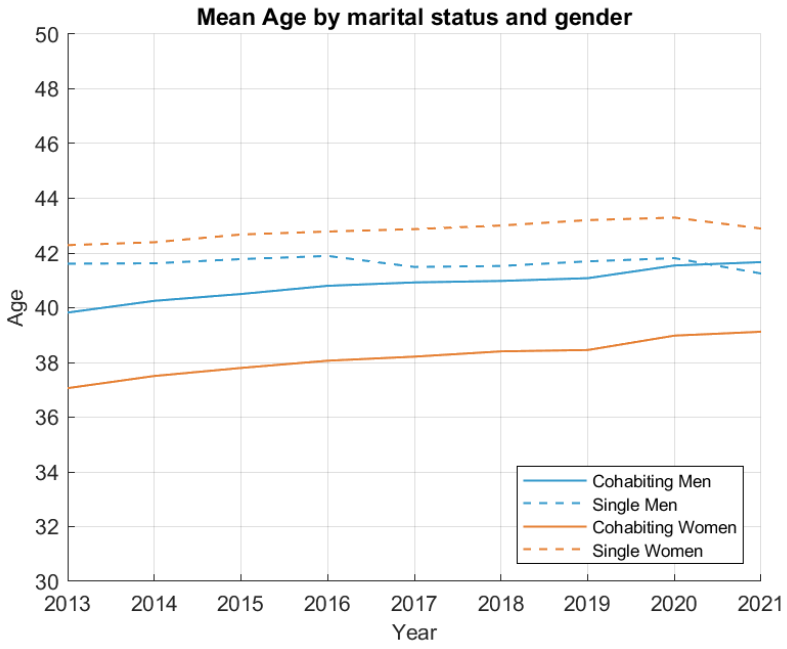

Figure A2: Sample Composition by Age Group, 2013-2021

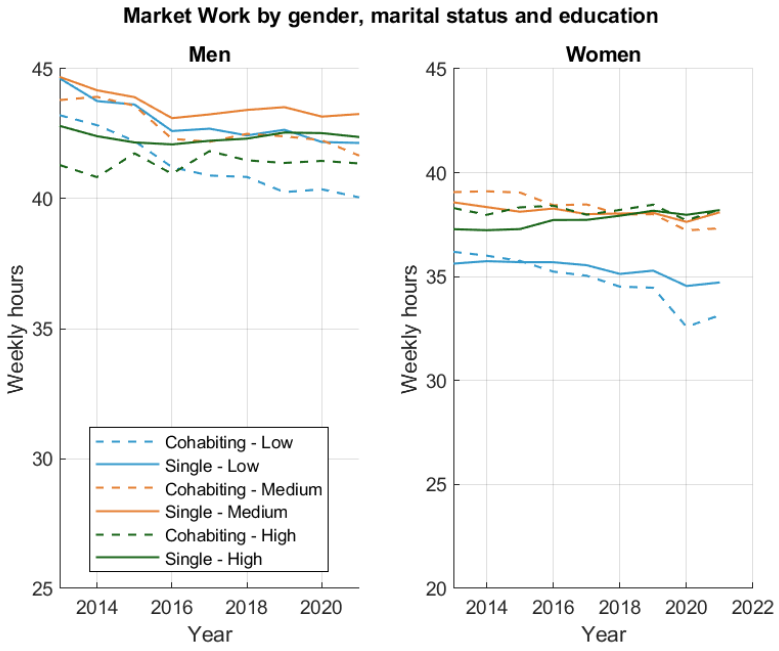

Figure A3: Average Hours of Work by Education Group, 2012-2021

A3 Cohabitation Transitions

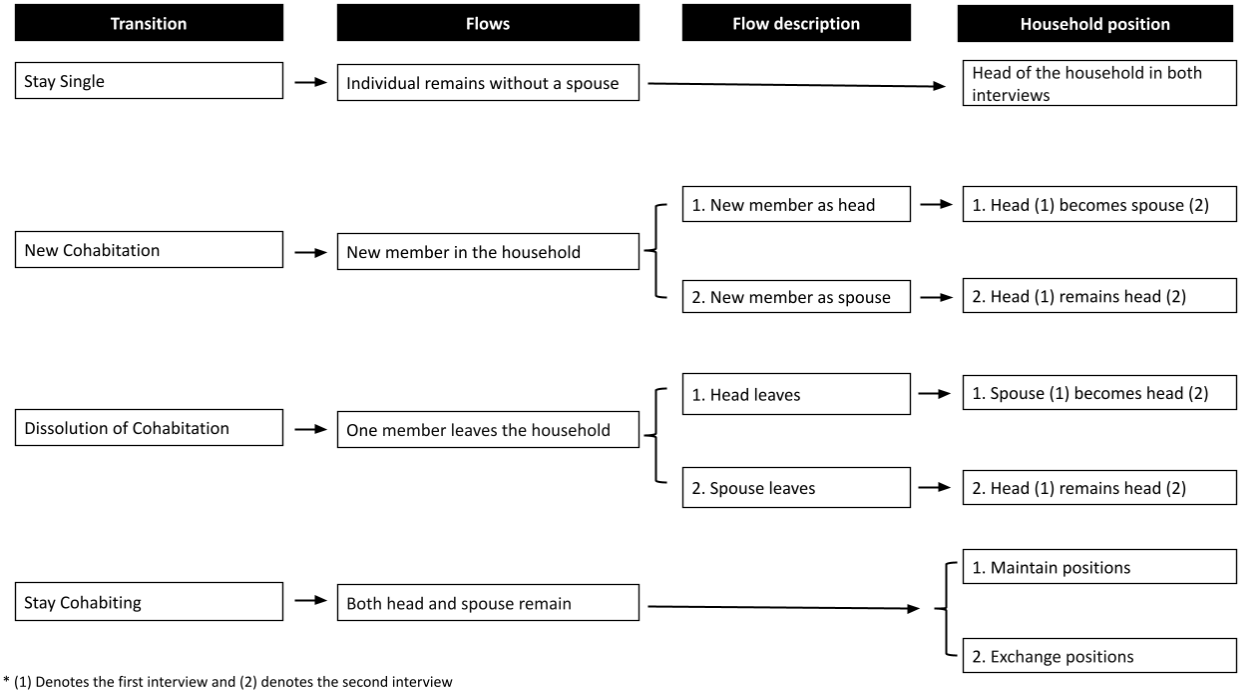

Figure A4: Definition of Cohabitation Transitions based on PNADC observations

A4 Parameters Estimates

Table A2: Estimated Meeting Rates for Men and Women, 2013-2018

Meeting Rates	2013	2014	2015	2016	2017	2018
λN_f	0.5073	0.4770	0.4624	0.4517	0.4511	0.4358
λN_m	0.5073	0.4770	0.4624	0.4517	0.4511	0.4358

$^{*}\ 10^{-5}$

A5 Sample Distribution

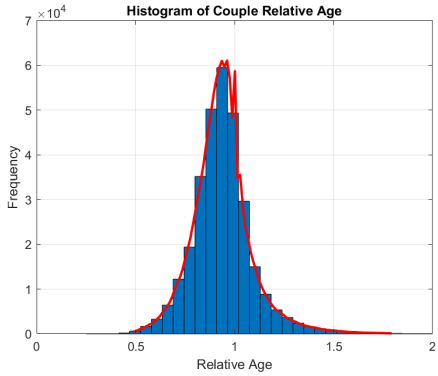

Figure A5: Distribution of the sample by relative age of the couple (woman/man)

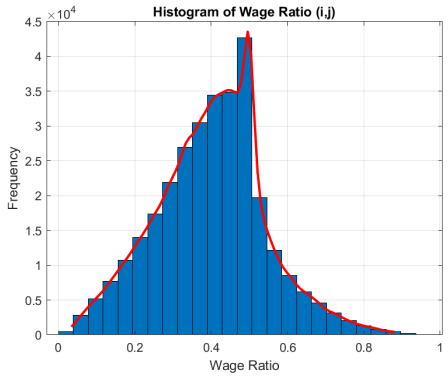

Figure A6: Distribution of the sample by relative wage of the couple (woman/man+woman)

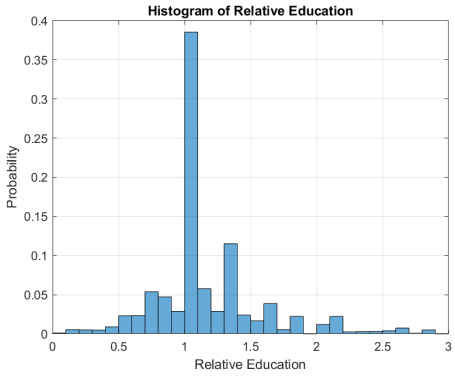

Figure A7: Distribution of the sample by relative years of schooling of the couple (woman/man)