Labor Force Participation and Job Search of Households

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Abstract

In the household of a married couple, an increase in the husband’s wage leads to a rise in the number of days the wife remains out of the labor force. If only one of the couple is employed, a wage increase for the employed partner lengthens the spouse’s unemployment duration. Moreover, if both are employed, their wages move in the same direction. To explain these stylized facts, I construct an equilibrium model of the labor market in which a married couple jointly chooses market participation and search for and separation from a job. Calibration shows that the model can correctly account for the facts. The unified framework with endogenous market participation and frictional search is necessary to correctly predict the correlations in spouses’ labor market outcomes. Using the benchmark model, I do the policy experiments of unemployment insurance (UI) and the earned income tax credit (EITC). I show that generous UI can increase the employment-population ratio by mitigating married females’ disincentive to participate in the market. I also show that the EITC increases the employment of single parents but it decreases the employment of workers who belong to other types of households. In the sense of welfare, the EITC enhances welfare for all single parents, but it reduces welfare of some married parents by reducing the value of working wives.

Keywords: Joint Search, Directed Search, Labor Force Participation, Unemployment

JEL Codes: J22, J31 J64, H24

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1 Introduction

Around 50 percent of the households in the US are households headed by a married couple and more than a half of them consist of two working spouses. The labor market choices of married couples affect the efficiency and the inequality of the whole economy. In this paper, I document stylized facts of married couples’ labor market participation, unemployment, and wages. I construct an equilibrium model of search to analyze the joint decisions of married couples in the labor market and calibrate the model to explain the stylized facts. Finally, I use the model to analyze the effects of unemployment insurance and the earned income tax credit on employment and welfare.

There are three stylized facts on married couples’ labor market outcomes, which I document with the family level data from the Panel Study of Income Dynamics (PSID) from 2001 to 2015 and the Merged Outgoing Rotation Group (MORG) in the Current Population Survey (CPS) from January 2001 to September 2018. The first pattern that I observe in the data is that as husband’s wages increase, the number of days his wife stays out of the labor market per year increases. The second fact is documented in the literature, which shows that if one in a couple household is employed and the other is not, an increase in the employed worker’s wage lengthens the spouse’s unemployment duration.\footnote{See Guler, Guvenen and Violante (2012). The authors estimated the elasticity of the unemployment duration of a married, unemployed worker with respect to the partner’s wage as 0.33 using data from the Survey of Income and Program Participation (SIPP) 1996. Their model is a two-state model, so they use some criteria to exclude those who are not likely to be searching for jobs: people who had ever been enrolled in school during the sample period had a unemployment duration longer than 52 weeks, or reported themselves as non-participants for more than a quarter of the sample period. However, the durations they found must be in-between non-employment durations and unemployment durations unless the criteria are perfect.} The last pattern that I found is that if both in a couple are employed, their wages move in the same direction. The facts clearly indicate that married couples jointly make decisions on labor force participation, search, and wage acceptance. It is crucial to model these joint decisions and investigate how they generate the above facts. As reviewed later in this introduction, there is a large body of literature on female labor participation, but they do not include unemployment or search decisions of the households. There is also a relatively smaller recent
literature on joint search, but it does not model the participation decision. Incorporating both the participation decision and the search decision is necessary to understand the above facts. The model in this paper does so.

The correlations in the spouses’ labor market outcomes are worth attention because they are captured in multiple, important channels. The facts documented above tell that a married worker’s earnings affect market participation, unemployment duration, and wage of the partner. The effect of the husband’s earnings on a married woman’s labor force participation shows the impact of the joint decisions of couples on the size of the US workforce. The correlation between earnings of a married worker and his or her partner’s unemployment duration shows that the joint decisions of couples affect the efficiency, or speed, of the matching process of the labor market. Finally, the comovements of the spouses’ wage rates witness the impact of the presence of married couples on the income inequality across families.

The model economy constructed in this paper consists of married and single workers. Each worker can take one of the three labor market states - employment, unemployment, and non-participation. The benefit of non-participation is an increase in time to spend on housework. Since workers are time constrained and want to consume market-goods and home-goods with a balance, households adjust employment statuses of their members. Specifically, the incentive for a household to have the second working partner decreases as the first working partner’s wage increases. The model distinguishes husbands and wives depending on relative home-productivity. In principle, one with higher relative home-productivity between two partners in a couple can be the wife. However, in the baseline calibration, I assume that female halves are wives in all couples to capture the actual difference in hours spent on housework between married men and married women. This will help match the fact that married couples with one labor market participant and one non-participant mostly

\[ \text{Married females participate less in the labor market than males and spend more time on domestic tasks than males even when the employment status of the two are the same. Data on prime-age married couples in PSID 2001-2015 shows that the average number of hours spent in housework reported by female respondents is 60-150% larger than that reported by male respondents when they are in equal employment status. Therefore, the model will securely assume that females expend more time on housework, meaning they produce more than males if they have equal employment status.} \]
have the male half of the couple participate in the labor market.

The frictional labor market and risk-averse workers are important ingredients of the model. A worker can be rejected by the firm which he or she applies to, when there are competing applicants. If workers are risk-averse, their household income will affect application decisions. Specifically, an unemployed worker would apply to a firm with a smaller expected number of applicants although those firms pay low wages, when he or she is in dire need of income. However, when his or her need is not urgent, the worker would search for a better paying job even though the probability of employment is lower.

In equilibrium, a married worker’s labor market outcome affects the partner’s choices regarding labor market participation, search for and separation from a job through income sharing. A key feature of the equilibrium regarding participation margin is that there is a threshold in husband’s wage where his wife prefers non-participation to unemployment. This channel will relate wife’s labor force participation to husband’s wage rate as observed in the data. The second feature of the equilibrium is regarding the job search. A married worker searches for a higher wage rate as the partner’s wage increases. Lastly, an employed, married worker’s choice on the job separation depends not only on the worker’s wage but also on his or her partner’s wage. A married worker is more likely to separate from a given job as the partner’s wage increases.

Equipped with the above features of the equilibrium, the benchmark model correctly predicts the effects of a wage increase of a married worker on the partner’s labor market outcome. First, it predicts that an increase in husband’s wage rate by one standard deviation from the average causes his wife not to participate in the market for 1.3 more weeks per year. This number is close to the data, which is 1.5. Second, the benchmark model predicts the elasticity of non-employment duration with respect to the partner’s wage to be 0.32 which is the closest to the data what Guler, Guvenen and Violante (2012) found, 0.33, when applying one of the sample restrictions that GGV used. Lastly, the model generates a few more features that are not reported here.

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3 The restriction is to eliminate workers who appeared to be non-employed for more than 52 weeks at least once. The estimate from my model simulation varies between the range 0.13-0.47 depending on how
positive correlation in spouses’ wages in two-earner households. The correlation coefficient
of the spouses’ wages in the model is 0.06, while it is 0.03 in the data.\footnote{If I separate two genders, the elasticities of wage of a married worker with respect to his or her partner’s wage are 0.03 for men and 0.12 for women. In the data, they are 0.06 and 0.02, respectively. Unlike in the data, wives’ wages in the model are more elastic than husbands’ wages. Because home production is an outside option of employment and a wife has a higher relative home productivity than her husband, her search policy increases with a steeper slope than the husband’s. One discrepancy of the model is, therefore, that working wives earn higher wages than husbands on average. This is the opposite of what is in the data. In reality, there are several factors which may bring down the wages of wives such as career interruptions during child baring periods, over-time premium, occupational and establishment-segregation, and any type of discriminations. Since the model abstracts away from all of these factors, it does not create lower wages for females than males. Wives in the model provide less amount of labor at higher price than husbands.}

Combining endogenous market participation and frictional job search is necessary to
correctly predict the correlations in the married couples’ labor market outcomes. First,
without endogenous participation, a model does not generate enough response for wife’s
market participation to the husband’s wage rate. A counterfactual model with the exogenous
participation can explain only a half of the response for wife’s number of non-participating
weeks to the husband’s wage observed in the data. Also, ignoring endogenous participation
results in an over-estimation of the effects of search in determining non-employment duration.
A model without the participation choice cannot disentangle the effect of not searching from
the effect of searching for a higher wage. Second, without search frictions, a model does
not generate any response for unemployment duration to the partner’s wage rate. In a
counterfactual model of the competitive labor market, a married worker’s wage rate is shown
to be uncorrelated with the partner’s non-employment duration.

Considering the endogenous participation, frictional search and unemployment in a uni-
ified model becomes more important when studying government policies. For example, any
policy that changes the value of employment such as changes in tax regimes influences not
only the decisions regarding whether to participate in the labor market or not, but also the
decisions to search for a job. So do the policies affecting the value of unemployment such as
unemployment insurance. This is because workers make decisions regarding participation,
unemployment, and wages altogether. These choices of workers can be captured only when

the samples are restricted.
the model allows both endogenous participation and search. Therefore, to correctly assess government policies regarding employment, a researcher should not artificially close either channel.

Based on the calibrated model, I analyze the effects of unemployment insurance (UI) on the distribution of workers over three labor market states. The model shows that an increase in generosity of UI can raise the employment-population ratio. There are mainly two opposite forces that UI imposes on employment. First, there is a negative effect. A generous UI increases the value of unemployment relative to the value of employment. It raises the wage rates that workers search for, which increases the unemployment relative to the employment. On the other hand, there is a positive effect. The value of unemployment relative to the value of non-participation increases, which encourages more workers to participate in the market. Since an unemployed worker has a greater job-finding rate than a non-participant, an increase in the labor force participation rate will have a positive effect on the employment-population ratio. It is unclear which one of the two effects dominates, and it depends on the size of the unemployment benefit. Specifically, in the benchmark model, the amount of UI benefit and the employment-population ratio are in a hump-shaped relationship. A small amount of UI does not create enough incentive for non-participating wives to enter the market, but it still increases the duration of each unemployment. Therefore, the unemployment rate increases, and the employment rate decreases. However, as the amount of the benefit increases, wives start responding through the participation channel. Since the positive gap in the job finding probabilities between an active searcher and a non-participant outweighs the decrease in the job finding probability of each unemployed worker, the employment-population ratio increases after the provision of UI.

Finally, I analyze the effects of the earned income tax credit (EITC) on the employment and the welfare of households with children. The model shows that the EITC increases the employment rate of single parents but decreases that of married parents. In the sense of welfare, the EITC enhances the welfare of all single parents and 48% of married parents. For
single parents, the policy increases consumption of the employed without affecting consumption of the non-employed. Therefore, it increases both the employment rate and the welfare of single parents. However, the EITC creates disincentives for married workers to work. If a married couple were made of two working partners, then their household income would be too high to be eligible for the benefit. Therefore, the program makes households with two working partners strictly worse off because they pay taxes and not receive the credit, which discourages married mothers from working. After the provision of the EITC, all married mothers in the model choose to stay out of the labor market so that they receive the benefits which are higher than their tax liabilities. Despite the benefits, the program decreases the welfare of a half of married parents because it distorts married workers’ behaviors by reducing the value of having working wives.

This paper contributes to the literature regarding joint search in two ways. First, it combines endogenous participation decision and frictional job search; second, it documents the positive correlation between spouses’ wage rates in two-earner households. The literature on joint search has not factored in non-participation, even though a large fraction of married women choose not to participate in the labor market. Also, despite the large fraction of two-earner couples, the literature of joint search has been quiet about how this type of models explains working spouses’ interactions. The closest models were developed in GGV and Pilossof and Wee (2018). Through the reservation wage strategies in joint-random search models, they explain why married workers’ wages are higher than wages of singles on average. GGV also documented a positive correlation between the unemployment duration of married workers and the partner’s wage rate through the reservation wage strategy that is increasing in partner’s wage rate. However, they do not examine how spouses’ wages are correlated. Also, both papers do not allow workers to exit the labor market.

In examining the married workers’ market participation decisions, this paper is related to the literature studying the household’s joint decision on female labor force participation. This traditional framework typically assumes competitive labor market as opposed to the
search models which focus on the unemployment of married households. For example, [Mincer (1962)] describes how an increase in husband’s earnings reduces the wife’s incentive to work and raises the demand for leisure. [Guner, Kaygusuz and Ventura (2012)] and [Chakraborty, Holter and Stepanchuk (2015)] build household models where couples jointly choose labor supply in the extensive and intensive margin. A recent paper of [Mankart and Oikonomou (2017)] considers existence of unemployment as well as non-participation, however, focuses only on decisions regarding participation and abstracts away from the choices made by the workers who are already in the labor market but unemployed.

This paper also relates to the previous research that have analyzed the flows of workers in the labor market in a model with three labor market states which are employment, unemployment, and non-participation. Analyzing the decisions of couple households, the current paper generates separate flows for married men and women. As a result, it reproduces married females’ flow from unemployment to non-participation (UO) as high as 30%, which accurately reflects the data. [Elsby, Hobijn and Sahin (2015)] examined the influence of stock-flow analysis on the three states of the labor market. The margins of participation are accountable for around 33% of cyclical unemployment rates. [Garibaldi and Wasmer (2005)] have created a framework with risk-neutral workers factoring in home production and Nash bargaining between firms and workers. [Krusell et al. (2011)] created another framework for the general equilibrium of a similar type but factoring in risk-averse workers and the decisions they made regarding savings. They match the distribution of workers over the three states of the labor market, but they do not match the massive movement from unemployment into non-participation (UO). A large flow of UO creates the most significant gap between these pieces of research and the actual data. They also pointed out that the majority of UO flow comprises married females, which rationalizes the approach I take in this paper.

This paper further adds to the literature regarding unemployment insurance by showing that a generous UI can increase the employment-population ratio by encouraging workers to participate more in the labor force. Encouragement is possible only when there are non-
participants. The view I take regarding UI is related to the "entitlement effect" mentioned in Mortensen (1977) and Atkinson and Micklewright (1991). They note that changes in government policy on UI would influence the flows between unemployment and non-participation. The closest form of UI analysis was conducted in Mankart and Oikonomou (2017), which is based on married couple households and the competitive wage rates. Also, they allow workers to save. In their model, the higher tax rates collected for UI reduces incentives to work and leads workers to quit their jobs, which offsets the positive effect of UI. My model considers firms’ optimal responses. Instead of letting workers quit after an increase in the tax rate, firms offer higher wages to prevent workers from quitting. Choi and Valladares-Esteban (2015) also look at how UI influences couple households. Their main finding is that UI offers more benefits single workers only, as married workers are already insured against unemployment as they share income with their partner.

The rest of the paper is organized as follows. Section 2 provides stylized facts in the US economy that are related to the joint decisions of couple households. Section 3 builds the model and Section 4 calibrates and discusses the results with counterfactuals. In Section 5, I conduct the policy analyses of unemployment insurance. Section 6 concludes.

2 Facts

I use data from Panel Study of Individual Dynamics (PSID) 2001-2015 to observe the participation decisions of married women. PSID family level data is suitable for my purpose because it is based on matched husband-wife pairs if the respondents are married and living with the spouse. Also, it provides detailed information about the labor market outcomes of workers, for example, the number of weeks a worker stays out of the labor force. I chose the initial year to be 2001 because this was when the strong increasing trend in the female labor force participation rate stopped. Also, in the PSID, the questionnaires and, therefore, the set of variables, have remained quite stable ever since.
I impose sample restrictions to make the data well aligned with the model I will develop. The data contained approximately 36,000 family-level observations over 8 survey years because PSID is a biannual survey. Therefore, declaring the data to panel, the number of meaningful observations increases to about 288,000. Because I focus on the couple households in prime age, I deleted data with the husband or the wife younger than 25 or older than 54, which reduces the sample size to about 120,500. This also eliminates all households with no wife. Next, I relabeled two spouses in each household from “Head and Spouse” to “Husband and Wife” by exchanging the identity if the person who is originally assigned as the head is female.

I build a longitudinal data set by recognizing each wife’s identity using the 1968 family number and person number in the family. An assumption I rely on here is that the identity of a wife remains the same if her age is consistent over time. To get rid of the effects of unobservable heterogeneities across wives, which are correlated with the husband’s wage and the wife’s propensity to work, I will control for the individual fixed effects in the regression.

To observe the correlation in the wages of married couples, I examine Merged Outgoing Rotation Group (MORG) January 2001 - September 2018. Households in the Current Population Survey (CPS) are interviewed for 4 months, not interviewed for the next 8 months, and then reinterviewed for 4 more months. Therefore, households in 4th and 16th months are those about to rotate out of interviews. These households are called ORG and asked additional questions such as hourly wage and usual hours worked. MORG is the data set created by sandwiching ORG in each month. Because CPS provides a unique number for each person, it is suitable to conduct a panel study using the difference in the wage rates between the two points in time.

To restrict samples, first, I remove observations of workers who are younger than 25 or older than 54, which reduces the unweighted sample size from about 7.9 million to 3 million. Next, since CPS is individual-level data, I match the household head and the spouse in each household to form household-level data. I relabel workers into husbands and wives using
gender information. In this process, all individuals who are not a husband nor a spouse are deleted, and also household heads with no spouse are deleted. This produces about 830 thousand observations of couple-level data. Since the regression is to see the correlation in changes in spouses’ wages in two-earner households, I finally keep the observations with positive wages for both the husband and the wife. The final sample size is therefore about 36,000. When conducting the panel regressions, I only keep those who appeared in the data twice, which means that the household satisfies the sample restriction criteria in both rounds. There are 4,788 female workers and 4,780 male workers who appeared twice with prime age, a positive own wage rate and a positive partner’s wage.

2.1 Labor Force Participation of the Married Female

Marriage creates a sharp disparity between men and women in the sense of market participation. Figure 1 shows how marriage creates a gap in the labor force participation rates (LFPR) across genders. The LFPR of single men and women are close to each other while those of married men and women exhibit a considerable gap.

I find a new fact about the relationship between a wife’s market participation and the husband’s annual labor income by investigating PSID 2001-2015. That is, a wife spends more
weeks out of the labor force as the husband’s labor income increases. The key variables here are, therefore, labor income of husbands and wives’ number of non-participating weeks. In 2010 dollars, the average wage rate of husbands is $56,577 with the standard deviation 96,296. Wives spend about 10 weeks out of the labor force on average with standard deviation 19.4.

To investigate how a husband’s wage affects the wife’s market participation, I do the following fixed effects regression.

\[ Wife \; Weeks \; OLF_{it} = \beta_0 + \beta_1 X_{it} + u_i + \epsilon_{it}, \]  

(1)

where \( i \) accounts for the identity of the worker and \( t \) for the calendar year. The key control variable is the deviation of the husband’s labor income from the mean which is scaled by the standard deviation. That is, if the husband-\( i \)’s annual labor income in year \( t \) is \( w_{it} \), his average labor income over all years is \( \bar{w}_i \), and their standard deviation is \( sd_i \), then the variable I take is \( \frac{w_{it} - \bar{w}_i}{sd_i} \). I will refer this variable as the standard wage. I convert incomes in this way because labor incomes are highly dispersed in the data, while they should not be in the model I will develop in the next section. Changes in the actual income can be comparable to the changes in income in the model, only after controlling for the standard dispersions. Control variables \( X_{it} \) in the regression equation (1) include total wealth of the family, age and age squared of both partners, industry where the husband belongs to, whether the wife finished Bachelor’s degree, year dummy, the number of children in the family, whether they have children under age 5 and whether the family has children under age 2.

I run the regression twice; with and without a restriction on the data. Column (2) of Table 1 reports the result when I restrict the data to the wives who have ever changed their participation statuses. That is, I exclude the wives who are out of the labor force year-round in all years and the wives who participate in the market all the time. Column (1) reports the

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5One of the reasons of the large standard deviation is that some husbands reported large losses in their labor income.
result without this restriction. The two coefficients are different because of heterogeneities between wives such as labor market attachment, expected earnings from the market, etc.

Table 1: Husband’s Labor Income and Wife’s Market Participation*

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<tr>
<td>Standard Wage of Hd</td>
<td>2.93</td>
<td>1.61</td>
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<td>(0.001)</td>
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* Source: PSID 2001-2015

Fact 1. Wives stay out of the labor force for longer as husbands’ labor income increases.

The results of the estimation show that an increase in husband’s labor income has a positive impact on the number of weeks the wife is out of the labor force. The coefficient tells that when a husband’s labor income increases by one standard deviation of his historical wage and salary distribution, the wife stays out of the labor market for about 4 more weeks per year.

2.2 Unemployment Duration of a Married Worker

Fact 2. Unemployment duration of a married worker is increasing in the partner’s wages.

Guler, Guvenen and Violante (2012) documented that estimated the elasticity of the unemployment duration with respect to partner’s wage is 0.33 (S.E. 0.07). That is, doubling the wage rate of the employed half of the couple makes the non-employed half’s duration of search 33% longer. Since the authors’ model is a two-state model, however, they used some criteria to exclude those who are not likely to be searching for jobs. For example, they dropped people who were ever enrolled for school during the sample period, had a non-employment duration longer than 52 weeks, or reported themselves as non-participants for more than quarter of the sample period. Since they do not explicitly distinguish an unemployed worker from a non-participant, however, the durations they found are likely to be mixtures of non-employment durations and unemployment durations.
2.3 Wage Rates of Couples

It is a well-established fact that spouses’ wages are positively correlated conditional on that both are employed. However, without controlling for the unobservable heterogeneities, the correlation has been viewed as a result of the “positive mating” (See Mare (1991) and Nakosteen and Zimmer (2001).) In contrast, I am interested in how changes in a worker’s wage affect the partner’s wage overtime for the same person. For this purpose, I use the longitudinal data constructed from MORG. I found that a positive correlation in hourly wages of couples exists even after considering individual fixed effects.

**Fact 3.** Spouses’ wage rates are positively correlated.

In the households that appeared twice in the data with a year gap, the changes in the wages of the husband and of the wife are positively correlated with the correlation coefficient being 0.03. To see the effect of the partner’s earnings for a married male and female separately and control for the unobservable characteristics of workers, I estimate two log-linear models with longitudinal data.

\[
\log(\text{Wife’s (Husband’s) hourly wage})_{it} = \beta_0 + \beta_1 X_{it} + u_i + \epsilon_{it}.
\]

The subindex \(i\) stands for the identity of the wife (husband) and \(t\) is the time defined by the year-month pair. The key explanatory variable I am interested in is log of the partner’s hourly wage. The control variables also include a dummy variable that indicates which industry the worker is in, a year dummy, a race dummy, whether the worker has a Bachelor’s degree, age, age squared, the number of children under age 5 in the household. The coefficient of log of the partner’s wage rate is significant and positive for both genders.

<table>
<thead>
<tr>
<th>Table 2: Results of the Fixed Effects Regressions</th>
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<tr>
<td>log (Partner’s Wage)</td>
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3 The Model

3.1 Environment

Time is continuous and lasts forever. The economy consists of a continuum of single-person households and couple households of fixed positive measures. Each worker earns wage income and engages in home production to consume both market- and home-goods. The share of time spent on housework is denoted by $h_x$, where $x \in \{e, u, o\}$ is the worker’s labor market status and the share spent on market work as $m_x$. The instant utility is a function of two types of consumptions $v(c_m, c_h)$, where $c_m$ is the level of market-goods consumption and $c_h$ is the level of home-goods consumption. The utility is assumed to be increasing and concave in each type of goods. Each worker spends some portion of time on market-work and the rest on housework. Relative to an employed worker a non-employed worker can spend more time on home production. Among the non-employed, those who are actively searching for jobs spend time on the search activity and, hence, has less time on home production than a worker not participation in the labor market. Therefore, concerning the hours spent on housework, the following inequalities hold: $h_o > h_u > h_e$.

In a couple household, there is a husband and a wife. In principle, any one can be a husband or a wife, depending on the couple’s relative home-productivity. A partner with a higher relative home-productivity than the other partner should be called a wife in the model. Since all workers are assumed to be equally productive in the market, the absolute difference in home-productivity between the husband and the wife directly implies the relative difference. All husbands are homogeneous, and their home-productivity is normalized to 1. Therefore, a husband produces $1 \times h$ out of $h$ non-market hours. On the other hand, a wife produces $a \times h$ out of the same number of non-market hours, so that wives’ relative home-productivity with respect to husbands is $a$ which is greater than 1. Although it can be the technology of home-production which arises the difference in the output from home, it can alternatively be understood as the amount of time a worker spends on home production.
The latter expression means that a wife spends $a$ times more hours on housework than a husband, given that they physically stay home for the same number of hours a day. For terminological simplicity, however, I will still refer to $a$ as home-productivity, even though I allow the second interpretation. In the baseline calibration, I am assuming that female halves are wives in all couples, which can be easily modified to have households with male wives.

While a worker is employed by a firm, he or she gets paid the posted wage rate as long as he or she is employed. The non-employed on the other hand, are assumed to earn a flow of income $b_o$. This is the money that workers can earn without being hired by firms. Workers may directly participate in the goods market by, for example, selling in the second-hand market or selling some outputs from home. In the benchmark calibration, this will be used to equalize the consumption of an unemployed single man to 60% of the consumption of an employed single man.

The rest of this section will mostly be devoted to the problem of couple households because the single person household’s problem follows standard models in the literature of directed search. Since all workers of the same sex are identical, there are no wage differentials among single men (women).

### 3.1.1 Income-Pooling Couple Household

A couple household consists of a husband and a wife. Since the couple split all resources in the household equally and do not divorce, their common objective is to maximize the value of the household. Home-produced goods are local public in each household. For example, when the husband of the household cleans around the house, the husband and the wife will both enjoy the result of the cleaning service together without splitting the results. Therefore, each worker who belongs to a household in the joint labor market status $(x, x')$ consumes $h_x + ah_{x'}$ units of home-produced goods. In contrast, market-goods are rivalrous. When the

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3.1.2 The Labor Market

Each non-employed worker becomes able to search for a job at the Poisson rate $\lambda_x$. The rate depends on the worker’s labor market status $x \in \{u, o\}$. Since the unemployed actively engage in search and spend time on that, they can apply for a job more often than the non-participant: $\lambda_u > \lambda_o$. Workers who are already employed do not search for jobs. When a worker gets the opportunity to apply, he/she chooses the wage rate $w$ makes the optimal tradeoff between the probability of getting hired and the wage rate.

On the demand side of the market, there is a continuum of potential firms that competitively enter the labor market as long as entry gives the positive expected lifetime profit. A firm pays a flow cost $k$ to enter the market and chooses a wage rate $w$ to post. The firm is committed to the posted wage, once a worker is hired at that wage. A matched faces exogenous job separation at the rate $\delta$.

The set of the firms that have posted the wage rate $w$ and the applicants who seek jobs that pay that wage rate are typically referred to as a submarket $w$ in the literature. This makes sense because they are the only ones who supply and demand jobs at the wage rate $w$. Adding more job-searchers or vacancies at another wage rate $w’$ does not affect their transactions of labor. The ratio between the measure of the vacancies and the measure of type-$i$ applicants in the submarket $w$ is denoted by $\theta(w)$ and known as the tightness of the submarket.

In the economy, there is a frictional matching function $M : \mathbb{R}_+^2 \rightarrow \mathbb{R}_+$, which determines the number of matches created in each submarket, depending on the number of job searchers and the number of vacancies. $M$ is increasing and concave in both arguments and has constant returns to scale. Thus, $M(v, u) = uM(v/u, 1) = uM(\theta, 1)$ and $M(v, u) = vM(1, \frac{1}{\theta})$. The same matching technology applies in every submarket. Since every worker in the same submarket is equally likely to be matched, the job-finding probability of each applicant in
submarket $w$ is:

$$p(\theta(w)) = M(\theta(w), 1).$$

A vacancy in submarket $w$ is filled with a worker with the probability:

$$q(\theta(w)) = M\left(1, \frac{1}{\theta(w)}\right) = \frac{p(\theta(w))}{\theta(w)}.$$

### 3.1.3 State of the Economy

The aggregate state of the economy consists of the distribution of single female households, single male households, and married couple households. For singles, the distribution is defined over the three labor market statuses and the wages of the employed. For couples, the distribution is defined over nine joint labor market statuses and the wages of the employed. The distribution can potentially affect the decisions of firms and workers. To see why, I compare two states of the economy; one in which the employment rate and wages are high on average, and the other in which they are low. In the first state, hiring firms would infer that the applicant’s partner is more likely to be employed, and employed at a higher wage rate if employed than in the latter case, which would increase the potential applicant’s expected rate of quitting.

### 3.2 Household’s Problem

#### 3.2.1 Single-Person Household

I present a single-person household’s problem first. If the worker is not employed, he or she chooses a labor market status between unemployment and non-participant. He or she also chooses the wage to search for. Denoting the home-productivity of a worker of sex $s$ by $\alpha_s$,
the flow value of the non-employed worker, \( N^s \), is the following:

\[
 rN^s = \max \left\{ \max_{w \in W} \left[ v(b_o, \alpha_s, h_u) + \lambda_u p(\theta(w))(V^s(w) - N^s) \right], \right. \\
\left. \max_{w \in W} \left[ v(b_o, \alpha_s) + \lambda_o p(\theta(w))(V^s(w) - N^s) \right] \right\}. 
\]

(2)

The first inner maximization is the search problem in the case that the worker chooses to participate and the second inner maximization is the search problem when the worker chooses to search while being out of the labor force. In the first inner maximization, \( v \) is the instant utility the worker gets. The level of home-goods consumption depends on the worker’s gender. \( \lambda_u p(\theta(w)) \) is the probability with which the worker gets hired given that the worker searches for the wage \( w \). \( V^s(w) \) is the value of a single person household of sex-\( s \) who is employed at the wage rate \( w \). In the second inner maximization, the terms have similar meanings to those in the first inner maximization, except that they are for a worker staying out of the labor force. The value function \( V^s \) is given by:

\[
rV^s(w) = \max_{d \geq \delta} v(w, \alpha_s, h_u) + d(N^s - V^s(w)) - c(d).
\]

An employed worker chooses the rate \( d \) to separate from the job. Because nature destroys a job at the rate \( \delta \), the choice of \( d \) is bounded below by \( \delta \). Raising the job separation rate above \( \delta \) generates costs \( c(d) \) that are increasing and convex in \( d \). The cost prevents workers from quitting the job at an infinite rate although they find quitting profitable, and makes the value function of a firm continuous to helps the computation \cite{Hoffmann2015}.

The assumption is also reasonable because workers are usually asked to give advanced notice to an employer before they actually stop coming to work. Most people follow the rule to avoid burning bridges and maintain their credibility in the labor market.

The outer maximization in (2) determines the optimal choice between unemployment \((u)\) and non-participation \((o)\). It is noteworthy that, in equilibrium, there will be no wage dispersion between single workers of the same gender. Since all of them solve the same
maximization problem, they all choose either $u$ or $o$. As a result, any dispersion in wage rates and the non-employment status of married workers of the same gender is a consequence of having a partner and the partner’s status.

The rest of this subchapter will be devoted to characterizing the couple household’s problem. I denote the function of the flow value of a couple household with the husband’s labor market status $x \in \{e, u, o\}$ and the wife’s $x’$ by $V_{xx’}$. Nine value functions are defined for the couple household. As in GGV, I denote a couple consists of two employed workers a dual-employed couple, a couple with only one employed worker an employed-non-employed couple, and a couple with two non-employed workers a dual-non-employed couple.

3.2.2 Dual-Employed Couple Household

First, consider a household with two employed workers. Each of them spends $h_e$ hours on home-production and, therefore, consumes $(1 + a)h_e$ units of home-produced goods. The consumption of market goods depends on the wage rates of the two. If the husband’s wage rate is $w$ and the wife’s is $w’$, each worker consumes $(w + w’)/2$ units of market-goods. Therefore, each member in this household enjoys the flow utility of $v((w + w’)/2, (1 + a)h_e)$, which will be denoted by $v_{ee}(w, w’)$. The dual-employed household chooses the rates of job separation of the husband and the wife, which is denoted by $d_i$, where $i = 1$ is for the husband and $i = 2$ for the wife. The Bellman equation for the dual-employed household is the following:

$$rV_{ee}(w_1, w_2) = \max_{d_1 \geq \delta, d_2 \geq \delta} \left[ v_{ee}(w_1, w_2) + d_2(V_{en}(w_1) - V_{ee}(w_1, w_2)) + d_1(V_{ne}(w_2) - V_{ee}(w_1, w_2)) - c(d_1) - c(d_2) \right].$$

3.2.3 Employed-Non-employed Couple Household

Next, consider the household where the wife is not employed, but the husband is employed at a wage rate $w$. If the wife is actively searching for a job, her flow output from housework
is \( ah_u \). This is smaller than what she can produce when out of the labor force, \( a \), because she spends part of her time to search for a job; that is, \( h_u \) is less than 1. Each worker in a household \((e, u)\) household consumes \((w + b_o)/2\) market goods and \( h_e + ah_u \) home goods. The instant utility of each worker is \( v((w + b_o)/2, h_e + ah_u) \), which will be denoted by \( v_{eu}(w) \). Likewise, a household \((e, o)\) where the husband’s wage rate is \( w \), the instantaneous utility is \( v((w + b_o)/2, h_e + ah_u) \) which is written as \( v_{eo}(w) \). Such a household also chooses the job separation rate for the husband. For the wife, the household chooses whether to participate in the market and what wage rate to search for.

Relative to staying out of the labor force being unemployed gives a worker a higher chance to able to search for a job. That is, \( \lambda_u > \lambda_o \). Therefore, some workers will find unemployment better than non-participation. However, the opposite may be true for others because those who are out of the labor force produce more home-goods than those who are participating in the market. Which one of the two dominates depends on the partner’s earnings.

In an employed-non-employed household, the couple chooses the wife’s market participation, the rate at which the husband leaves the job and the wage rate the wife searches for. The Bellman equation for the household’s value function, \( V_{en} \), is:

\[
rV_{en}(w_1) = \max \left\{ \max_{d_1 \geq \delta, w_2 \in W} \left[ v_{eu}(w_1) + d_1(V_{nn} - V_{en}(w_1)) - c(d_1) + \lambda_u p(\theta(w_2))(V_{ee}(w_1, w_2) - V_{en}(w_1)) \right], \right.
\]
\[
\left. \max_{d_1 \geq \delta, w_2 \in W} \left[ v_{eo}(w_1) + d_1(V_{nn} - V_{en}(w_1)) - c(d_1) + \lambda_o p(\theta(w_2))(V_{ee}(w_1, w_2) - V_{en}(w_1)) \right] \right\}
\]

If the husband is non-employed and the wife employed, the analysis is similar. The value function in that case is denoted by \( V_{ne} \).

According to the above maximization problems, the marginal benefit of increasing the rate of job separation is constant over the gap between the value of quitting and non-quitting, while the marginal cost \( c'(\cdot) \) is increasing in the rate. When choosing the optimal rate of job separations, there can be two cases. If the marginal benefit is smaller than \( c'(\delta) \) the solution for \( d_1 \) will be \( \delta \). If the marginal benefit of job separation is greater than \( c'(\delta) \), the job separation rate is chosen to be greater than \( \delta \) and is increasing in the marginal benefit.
of quitting versus not quitting.

The rate of job separation is weakly decreasing in own wage rate for any given partner’s employment status, $x$, and wage rate. It is intuitive that workers are less likely to quit positions that are paying higher wage rates. Mathematically, since $c(\cdot)$ is increasing and convex, $d_1$ is chosen to satisfy the following complementary slackness condition:

$$
(V_{nx}(\cdot) - V_{ex}(w_1, \cdot) - c'(d_1))(d_1 - \delta) = 0.
$$

In the above equation, $V_{ex}$ is the only term that depends on the current wage rate, $w_1$, and is increasing in $w_1$. When $w_1$ is small, it may be better for the worker to quit the job, so he/she chooses the rate of quitting greater than $\delta$ to equalize the marginal benefit and the marginal cost of job separation. The higher the wage rate, the greater the gap in values between non-employment and employment. Therefore, the rate of job separations also increases as $w_1$ increases for a fixed partner’s status. If $w_1$ is sufficiently high that the value of quitting is smaller than the value of continuing, $(V_{nx}(\cdot) - V_{ex}(w_1, \cdot) - c'(d_1))$ is always negative, in such case, $d_1 = \delta$ must hold.

In the choice of the search target, there is a tradeoff between the targeted wage rate and the job-finding rate. A higher wage position is always preferred but may be more challenging to secure than a lower wage position. Because workers can enter and exit the labor market, the household also chooses whether or not the non-employed member engages in the job search. The choice of search target depends on the employed partner’s wage rate. As the wage of the employed member increases, market-goods or money has less relative importance to home-goods. This is due to the decreasing marginal utility of the market goods and the complementarity between the two goods. Therefore, the gap between the value of unemployment and non-participation becomes lower as the working party’s wage rate increases. Once the gap becomes negative, the non-employed worker starts to choose to exit the labor market rather than being unemployed and searching intensively for a job offer.
3.2.4 Dual-Non-employed Couple Household

Lastly, consider the household with two non-employed participants. Since the household does not earn wages, the instant utility depends only on the joint employment status \((x, x')\). In this case, the instant utility will be denoted by \(v_{xx'}\). For example, if both workers are unemployed, each worker in the household enjoys instant utility \(v(b, (1 + a)h_u)\), which will be denoted by \(v_{uu}\).

When both partners are not employed, the household chooses the search target and the labor market status for each worker. The Bellman equation for the dual-non-employed household is as follows:

\[
rV_{nn} = \max_{w_1, w_2, x, x'} v_{xx'} + \lambda_x p(\theta(w_1))(V_{en}(w_1) - V_{nn}) + \lambda_{x'} p(\theta(w_2))(V_{ne}(w_2) - V_{nn})
\]

Because all households have the same preferences and face the same market opportunities, only one pair of states will be chosen by all dual-non-employed households.

3.3 Firm’s Expected Revenue from a Match

The revenue of a firm depends on the wage rate and the expected span of the match. As long as the wage rate is lower than the output value, keeping the employment relation is always beneficial for the firm. Because the job separation rates depend on the worker’s gender, marital status, and the partner’s state given that he or she is married, the firm’s revenue of hiring a worker also depends on these characteristics of the worker. For instance, the flow revenue is denoted as \(R^m(w)\) for hiring a non-married man and as \(R^f(w)\) for employing a non-married woman. Denoting the job separation policy of a single worker of gender-\(s\) by
the firm’s flow revenue is the following:

\[ rR^s(w) = y - w - d^s(w)R^s(w). \]

When hiring a married worker, the firm’s problem gets more complicated because it has to anticipate what will happen to the worker’s partner. The flow revenue of employing a married type-\(i\) worker whose household labor market status is \((x, x')\) is denoted by \(R^i_{x,x'}\). If \((x, x') = (e, e)\), then the revenue is the function of two wage rates. If only one of the two is employed, the revenue is the function of one wage rate. For example, consider a vacancy filled with a husband of a couple household where the wife is employed at \(w'\). The flow revenue of the firm is as follows:

\[ rR^1_{ee}(w, w') = y - w - d^1_{ee}(w, w')R^1_{ee}(w, w') + d^2_{ee}(w, w')(R^1_{en}(w) - R^1_{ee}(w, w')) \]

As can be observed above, the revenue depends on the wage rate the firm pays, the job separation rate of the two workers in the household, and the continuation value after the partner quits her job.

When employing a husband at a wage rate \(w\) whose partner is not employed, on the other hand, the firm has to consider the partner’s search target. That is,

\[ rR^1_{en}(w) = y - w - d^1_{en}(w)R^1_{en}(w) + \lambda_xp_2(w^*)(R^1_{ee}(w, w^*) - R^1_{en}(w)) \]

where the wife’s employment status \(x\) and the wage rate searched \(w^*\) follow the wife’s participation policy and the search policy. If the employee, which is the husband, is going to leave the firm with a high probability after his wife becomes employed at wage rate \(w^*\), then the revenue of the firm will decrease in the partner’s job-finding rate.
3.4 Distribution of Applicants and the Distribution of the Economy

Two kinds of distributions are of relevance. One is the distribution of applicants in each submarket, \( w \), and the other is the distribution of households in the model economy over the joint labor market status and the wage rates.

The distribution of applicants in submarket \( w \) is denoted by \( \Psi(w) \) with sub- and super-indexes showing the individual state of the workers. For example, \( \Psi^s(w) \) is the ratio between the number of single type-\( s \) applicants to the number of all applicants in submarket \( w \). For the married participants, more information is needed: \( \Psi^j_x(w) \) for \( x \in \{u, o\} \) is the ratio between the number of married type-\( j \) applicants whose partner is non-employed within the state \( x \in \{u, o\} \) to the number of all applicants in submarket \( w \). If the partner is employed, \( \Psi^j_e(w|w') \) denotes the ratio of the married type-\( j \) workers whose partner is employed at the wage rate no greater than \( w' \). For notational simplicity, I will refer the whole distribution of a submarket by \( \Psi \) with no indexes.

The distribution of the households in the model economy is denoted by \( F \). For the singles of type-\( s \), there are two numbers and one function of wage rate: \( F^s_{u}, F^s_{o}, F^s_e(w) \). The last one denotes the measure of single workers who are employed at the wage rate no greater than \( w \). A married household takes one of 9 joint labor market states: \( (e, e) \), \( (e, u) \), \( (e, o) \), \( (u, e) \), \( (o, e) \), \( (u, u) \), \( (u, o) \), \( (o, u) \) and \( (o, o) \). For the dual-non-employed states \( (u, u) \), \( (u, o) \), \( (o, u) \) and \( (o, o) \), \( F_{(x,x')} \) is a number, and for the 4 employed-non-employed states \( (e, u) \), \( (e, o) \), \( (u, e) \) and \( (o, e) \), \( F_{(x,x')} \) is a function of one wage rate. The distribution of \( (e, e) \) households \( F_{(e,e)} \) is a function of two wage rates, one for the husband and the other one for the wife. I will refer to the whole distribution of the economy by \( F \) with no indexes.

3.5 Value of a Vacancy and the Tightness Function

Firms in the model cannot discriminate workers by marital status, gender, or partner’s earnings. Therefore, firms try to anticipate the composition of the job searchers in each submarket when they post vacancies because the composition determines the expected span
of a match. Although the impossibility of discrimination adds challenges to the computa-
tion, I allow it to avoid unreasonable assumptions such as job postings indexed by gender.
After vacancies are created, and workers apply in the submarket, matches are created under
frictions.

As described in Section 3.1, the matching function $M$ determines the vacancy-filling probability, $q$, as a function of the tightness in each submarket. In the submarket $w$, the
value of a vacancy is the expected flow revenue taking into the distribution of applicants $\Psi$’s of $w$ into account. The value of a vacancy in the submarket $w$ is

$$J(w) = \sum_{s \in \{f,m\}} \Psi^s(w) R^s(w) + \sum_{x \in \{u,o\}, j \in \{1,2\}} \Psi^1_u(w) R^{1u}_e(w)$$

$$+ \int_{w' \in W} R^{1e}_{ee}(w, w') d\Psi^1_e(w|w') + \int_{w' \in W} R^{2e}_{ee}(w', w) d\Psi^2_e(w|w').$$

For example, if there are only husband applicants with unemployed wives in submarket $w$, then

$$J(w) = R^{1u}_{eu}(w).$$

If, on the other hand, there are husband applicants with wives employed at the wage rate $w'$ and wife applicants with unemployed husbands, and the ratio between the two are 1:2, then

$$J(w) = \frac{1}{3} R^{1e}_{ee}(w, w') + \frac{2}{3} R^{2e}_{ue}(w).$$

Because firms enter the market competitively, they expect zero profits in each submarket. That is, the equilibrium tightness satisfies $q(\theta(w)) J(\theta(w)) - k \leq 0$ and $\theta(w) \geq 0$ in line with complementary slackness.

### 3.6 Equilibrium

A steady state search equilibrium consists of household’s value functions $V_m, V_f$ and $V_{xx'}$ for $(x, x') \in \{e, n\}^2$, job separation policy functions $d_m, d_f$ and $d^i_{xx'}$, search policy functions $g_m,$
$g_f$ and $g_{xx'}^i$, participation policy functions $z_m$, $z_f$ and $z_{xx'}^i$, for $i \in \{1, 2\}$ and $(x, x') \in \{e, n\}^2$, the revenue functions $R^m$, $R^f$, $R^1_{ex}$ and $R^2_{xe}$ for $x \in \{e, n\}$, and the value function of a vacancy $J$, tightness function $\theta$, the distribution of applicants in each submarket $\Psi$, and the distribution of the economy $F$ that satisfy the following conditions: i. the value functions satisfy the household’s Bellman equations; ii. the policy functions maximize the household’s value in each state; iii. the vacancy value function is consistent with the revenue functions and $\Psi$; iv. $\Psi$ is consistent with the distribution $F$ and the household’s policy functions; v. firms have zero expected profit in each submarket that they enter; vi. the distribution of the economy is time-invariant.

In submarkets with a positive number of applicants, $\Psi$ must be consistent with the distribution of the households in the model economy and the household policy functions. For the empty submarkets, I restrict the beliefs off-the-equilibrium as follows. If $w$ is off-the-equilibrium wage rate, firms believe that applicants in submarket $w$ enter that market in error and that everyone has the same probability of making this error. Therefore, firms take the distribution of all non-employed workers when thinking of the distribution of applicants in off-the-equilibrium submarkets. The only difference is that firms give $\lambda_u$ weights to the unemployed and $\lambda_o$ to non-participants to take the difference of offer arrival rates into account.

4 Calibration

4.1 Preferences and Home-Technology

In this subsection, I determine the forms and parameters of instantaneous utility, matching, and the cost of a job separation functions. For the instantaneous utility, I take evidences in [Attanasio and Weber (1995)] to assume that market- and home-goods are gross complements. I use a CRRA utility function with risk aversion parameter $\sigma$. One notable difference from the usual CRRA utility function in my model is that I add an adjustment term in each type
of consumption. To understand the adjustment, consider a worker in a couple household who consumes $c_m$ units of market goods and $c_h$ units of home-produced goods. Each partner’s utility is the following:

$$v(c_m, c_h) = \frac{(c_m + \xi_m)(c_h + \xi_h)^{1-\eta}1^{1-\sigma} - 1}{1 - \sigma} - \frac{(\xi_m \xi_h)^{1-\eta}1^{1-\sigma} - 1}{1 - \sigma}.$$ 

\(\xi_m\) and \(\xi_h\) is the adjustment used to make the utility positive and increasing in both types of consumption. For the matching function, I use the telephone matching function which determines the job-finding probability of an applicant and the vacancy-filling probability of a firm as the following:

$$p(\theta) = (1 + \theta^{-\mu})^{-1/\mu},$$
$$q(\theta) = p(\theta)/\theta,$$

where \(\theta\) is the submarket tightness defined by the ratio of the number of vacancies and the number of applicants. \(\mu\) is the parameter of the function related to the elasticity of the matching function. I take \(\mu\) as 0.6 to match the matching function elasticity with respect to the number vacancies to be around 0.7. I assume the separation cost to be a quadratic function depending on the rate of separation the worker chooses:

$$c(d) = A(d - \delta)^2,$$

where \(A\) is a scale parameter. To make the costs small enough I take \(A\) as 10\% of the period utility of a dual-unemployed household.

Recall that the number of hours spent on home production is denoted by $h_x$, where $x$

---

7In calibration, I use $\xi_m = \xi_h = 0.01$.
8To understand the micro-foundation for the matching function, see Stevens (2007).
9Blanchard and Diamond (1989) estimated the elasticity as 0.6. Accounting for endogeneity, Borowczyk-Martins, Jolivet and Postel-Vinay (2012) proposed 0.68. In the telephone matching function, the elasticity with respect to $v$ is $\theta^{-\mu}/(1 + \theta^{-\mu})$, where $\theta = v/u$. In the calibrated equilibrium, the average tightness faced by applicants is 0.32. With $\mu = 0.6$, the average elasticity is 0.67.
stands for the labor market status of the worker, where it takes one of the values in the set \{e, u, o\}. If each worker spends 8 hours a day engaging in sleeping, eating and personal care activities such as brushing teeth, he or she has $16 \times 7$ hours to be divided between market work and housework per week. Normalizing $h_o$ to be 1, I let 1 unit of time in the model to be 112 hours per week. To determine $h_u$, I refer to the results of a survey\[10\] noted in Faberman et al. (2017). In the survey, the unemployed disclose that they spend about 11 hours per week on job search activities; as such, I set $h_u$ as 0.9\[11\]. I assume that employed workers spend 40 hours on market work, which implies that $h_e$ is 0.65.

To determine parameter $a$, the women’s relative home-productivity, I use the ratio of the number of hours devoted to housework between wives and husbands. In PSID, respondents disclose how many hours per week they usually spend on housework. There is a considerable gap between the amount of time that husbands and wives spend on housework. For example, husbands who were out of the labor force for 52 weeks did housework for about 14 hours per week while wives in the same state spent 24 hours per week on housework. Husbands who worked 40 hours per week spend about 7 hours on housework, while wives who worked for the same number of hours spend about 14 hours. In any other choices of employment status and working hours I have attempted to condition the comparison on, wives spend 70-100% more hours on home-production out of every hour that they do not engage in market work. To capture this apparent difference between genders, I set $a = 2$.

I set $\lambda_u$ to be 1 to allow for the unemployed to get a chance to apply for a firm every period with probability 1. Lastly, the cost of posting a vacancy $k$ is set to the market productivity of each worker per month. Setting a model period as two weeks, the cost of posting a vacancy is 2.

\[10\]Their data come from a supplement to the Survey of Consumer Expectations (SCE), administered by the Federal Reserve Bank of New York.

\[11\]This is because $1 - 11/(16 \times 7) \approx 0.9$. 

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4.2 Procedure

I first choose a random initial distribution of the economy by creating a large number of households with random labor market status and wages. I then guess the function of the tightness depending on the wage rates. Workers who are chosen to be non-employed in the initial state decide where to search. An offer is presented to each worker at a Poisson rate $\lambda_x$ depending on non-employment status. After applying to jobs, workers are hired with the probability determined by the tightness function. At this stage, the labor market status of each worker and the distribution of the economy are updated.

According to the household’s policy functions and the updated distribution, firms develop expectations on the duration of prospected candidates who would stay in the firm after the match. The expected span of a match directly affects the firm’s expected profits in each submarket and, therefore, updates the tightness function by competitive entry of firms.\footnote{Suppose, for some $w$, there exists at least one category of workers who are willing to enter the submarket $w$ in some household employment status and partners’ wage. About these non-empty submarkets, firms correctly expect the composition of applicants in that submarket and will subsequently enter if they anticipate a positive profit. The tightness is, therefore, chosen to satisfy the firm’s competitive entry.

On the other hand, if both measures are zero, firms would believe that the applicants entered the submarket by mistake, and the probability of making the mistake is the same for every worker. Therefore, firms consider the distribution of all non-employed workers, married and singles, unemployed and non-participants, and set the expected value of employment in empty submarkets. This determines the tightness function off the equilibrium path.}

Equipped with the new tightness function, workers adjust their search, job separation, and participation policies. The job separation shock hits employed workers at the rate they choose, and unemployed workers engage in the search and matching process. The distribution of workers is updated.

4.3 Targets

Parameters that play important roles and are not chosen outside of the model are $\eta$ and $\lambda_o$. I choose those parameters to match the selected data moments. The probability of search of non-participants, $\lambda_o$, is chosen to match the labor force participation rates of wives.

The utility elasticity of market-goods, $\eta$, determines the threshold of husband’s wage to be
the wife prefers non-participation to unemployment. I choose $\eta$ so that it makes both the unemployment rate and non-participation rate positive.

Table 3: Model Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r$</td>
<td>5% annual discount rate</td>
<td>0.002</td>
</tr>
<tr>
<td>$\delta$</td>
<td>2.5% monthly exogenous job separations</td>
<td>0.013</td>
</tr>
<tr>
<td>$b_o$</td>
<td>consumption of unemployed=0.6×employed, for single male</td>
<td>0.1</td>
</tr>
<tr>
<td>$\lambda_u$</td>
<td>5% unemployment rate of husbands</td>
<td>1</td>
</tr>
<tr>
<td>$\lambda_o$</td>
<td>70% labor force participation rate of wives</td>
<td>0.18</td>
</tr>
<tr>
<td>$\eta$</td>
<td>positive unemployment rate of wives</td>
<td>0.34</td>
</tr>
</tbody>
</table>

4.4 Results

At the equilibrium, all husbands and 67% of wives participate in the market. Husbands’ unemployment rate is 5.6% while wives’ unemployment rate is 1.3% because, in most households, husband’s income is high enough for the wife to prefer exiting the labor market completely. In Table 4, I provide the distribution of couple households over joint labor market status. The model moments match data quite closely, but there are discrepancies in the composition of employed-non-participants households, employed-unemployed households, and dual-non-employed households. The model predicts zero household in $(o,e)$ state, while in the data there are about 3% in $(o,e)$ state. This is because of the assumption that all couples have female wives in the model, which may not hold in reality. If I include couples with the male wives, the model will fit even better. Also, because too many wives choose out of the labor force, there are not a lot of wives who are unemployed. Especially, when their husbands are employed, wives prefer non-participation to unemployment so that all of the employed-unemployed households are in $(u,e)$ state rather than $(e,u)$ state. Lastly, the data has a lot more dual-non-employed households than the model. This is highly related to their compositions. In the model, all of them are in $(u,u)$ state while in the data, all of the four combinations are observed. Especially, about two-thirds of dual-non-employed households
are in $o,o$ state. Since they are searching for job offers, they will stay non-employed for long, which makes the proportion of dual-non-employed households high. In the model, only one dual-non-employed state can be chosen because households are homogeneous, and the one chosen is $(u,u)$. Since workers are costly searching for job offers, households do not stay in dual-non-employed state for long.

The benchmark model reproduces the labor market flows of married workers by gender pretty well. The model generates a high flow from U to O of married women, which cannot be captured in a single households’ model with three labor market states\(^{13}\). My model accounts for the role of families in determining married workers’ labor market statuses to reproduce the high UO flows that are most frequently observed in the pool of married women. In particular, in the simulated equilibrium, unemployed wives choose to exit the labor market when their husbands get new well-paying jobs. It should be noted, however, that a high UO flow of married female does not necessarily generate enough aggregate flows from U to O. This is because, in the benchmark case, most of the unemployed married workers are male. Nonetheless, the benchmark model explains a high UO flows among married females, which can potentially generate a high aggregate UO flows if there are sufficient unemployed married females. For example, the fact that women have a higher job separation rate than men\(^{14}\) can play a role to support a higher unemployment rate of married females than what is produced in my model. If the fraction of married women in the unemployment pool increases, their flow of married women from U to O will be more effective in determining the aggregate UO flow. For husbands, there is no flow into or out of non-participation because they always participate in the market, which creates a difference between the model and the data moments. As I have noted before, this difference is related to the assumption on the relative home-productivity which depends only on gender. Another discrepancy comes from the model over-predicting UE flows, which underestimates UU flows among married women. This is because wives choose to engage in search only when the family is in the

\(^{13}\)See Krusell et al. (2011).
\(^{14}\)The fact is found in Frederiksen (2008).
dual-non-employed state, and therefore, the family is in a dire need of money.

Table 4: Distribution of Married Household

<table>
<thead>
<tr>
<th>labor market status</th>
<th>(e, e)</th>
<th>(e, o) ∪ (o, e)</th>
<th>(e, u) ∪ (u, e)</th>
<th>(n, n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>data (%)</td>
<td>65.0</td>
<td>26.4</td>
<td>5.3</td>
<td>3.3</td>
</tr>
<tr>
<td>model (%)</td>
<td>66.5</td>
<td>27.9</td>
<td>4.6</td>
<td>1.0</td>
</tr>
</tbody>
</table>

15 Source: American Community Survey by Census Bureau

Table 5: Labor Market Flows

<table>
<thead>
<tr>
<th>Data 16</th>
<th>Married Men (To)</th>
<th>Married Women (To)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(From)</td>
<td>E</td>
<td>U</td>
</tr>
<tr>
<td>E</td>
<td>0.982</td>
<td>0.010</td>
</tr>
<tr>
<td>U</td>
<td>0.302</td>
<td>0.575</td>
</tr>
<tr>
<td>O</td>
<td>0.100</td>
<td>0.056</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Married Men (To)</th>
<th>Married Women (To)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(From)</td>
<td>E</td>
<td>U</td>
</tr>
<tr>
<td>E</td>
<td>0.977</td>
<td>0.023</td>
</tr>
<tr>
<td>U</td>
<td>0.382</td>
<td>0.618</td>
</tr>
<tr>
<td>O</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

16 Numbers are from Mankart and Oikonomou (2017), which is based on prime age workers in CPS 1994-2014.

In couple households, workers search for higher wage rates when their partners are employed, compared to when partners are not employed. Husbands and wives in dual-non-employed households apply for the lowest wage rate in support of the wage distribution. However, as one of them begins to earn the lowest wage rate, the other searches for a higher wage rate. The search policy of a worker with employed partner slowly but monotonically increases in spouse's wage rate in the support of the wage distribution (as described in Figure 2) where the positive slope comes from the insurance provided by partner's wage income. A job-searcher can bear a higher risk of not being employed when his or her partner's wage rate is higher.
Figure 2: Search Policy of Married Workers with Employed Partner

Figure 3 shows the separation policy of a husband with an employed wife. The husband’s separation policy function decreases as his own wage rate increases until the rate hits the lower bound $\delta$. Also, it weakly increases in the wife’s wage rate because the husband has a higher incentive to quit his current job as the wife’s wage increases. This happens due to the husband wanting to search for a better job as his wife is earning enough to feed the family for the period of the husband’s unemployment. Although the shape of a wife’s separation policy remains similar, the intuition behind the separation policy is different. A wife quits to exit the labor market because she finds it profitable to resign from her current job and produce more home goods if the husband’s wage rate is high enough. The difference between the non-employment states that are chosen by husbands and wives derives from the difference in home-productivity or in willingness to engage in home production. Due to the difference in home-productivity, a wife’s search is more costly than the husband’s, it is chosen less by households.

The function of market tightness in relation to the wage rate is shown in Figure 4. It does not monotonically decrease in the wage bill because the retention rates of the workers are increasing in the wage rate. Submarkets with low wage rates can get tighter as the posted wage rate increases. This is because the positive effects of increases in the retention rates
can dominate the negative effects of an increase in the wage payment. Symmetrically, the
tightness decreases in the posted wage rate when the effects of saving wage bill dominate.
If the wage rate reaches around 0.92, applicants of both genders in any household states do
not want to separate from the job even after the partner gets employed at the wage rate he
or she would optimally search for. Therefore, in those submarkets, all matches are expected
to remain for $\frac{1}{\delta}$ periods.

The model generates correlation between the non-employed wives’ market participation
and husbands’ wage rates. Figure 5 shows how wives determine their non-employment status
depending on husbands’ wage rates: A wife actively searches for job offers while not employed
if the husband is not employed or employed at a wage rate lower than a threshold. Since
the lowest wage rate in the support of the wage distribution is greater than the threshold in
the simulated equilibrium, wives prefer ‘u’ to ‘o’ only when their husbands are not employed.

**Accounting for Fact 1.** As husband’s wage is higher, the wife stays out of the labor
force longer.

The benchmark model predicts that the number of weeks in which a wife stays out of
the labor force increases by 2.81 (S.E. 0.10) weeks when the husband’s wage increases by
Figure 4: Submarket Tightness

Figure 5: Wives’ Non-employment State
one standard deviation\footnote{To obtain this coefficient, I use the data generated from the benchmark model simulation. The explanatory variable is $\frac{\text{the husband’s annual (26 periods) income} - \text{his average annual income}}{\text{standard deviation of his annual income}}$ and the dependent variable is twice the number of periods from 0 to 26 in which the wives stay out of the labor force because the number has to be the number of weeks.} This is closer to the coefficient in column (1) than in column (2) of Table 1. The closest coefficient is what is derived after restricting the data on the wives who ever changed their labor force participation\footnote{Wives who do not change their labor market participation is around 48% of all wives in the data. Among them, around 2/3 are always participating in the market and the rest are always out of the market. These behaviors seem to be related to strong heterogeneities such as labor market attachment, expected earnings, expected probability of divorce, etc, all of which the model abstracts from.}

**Accounting for Fact 2.** Unemployment duration is increasing in the partner’s wage.

Since the model has both unemployment and non-participation, I look at non-employment durations altogether with some restrictions instead of unemployment durations. The benchmark model predicts the elasticity of non-employment duration to be 0.32 which is close to what is found in GGV, 0.33, when applying one of the sample restriction that GGV applied. That is to remove the workers who have at least one non-employment duration that is longer than 52 weeks during the sample period. However the elasticity strongly depends on the way I restrict the samples.

To compare with GGV, I focus on the last 208 periods of the model simulation which is equivalent to 8 years\footnote{The SIPP data on which GGV’s estimation is based covers only 4 years, but their sampling frequency is one-week while my model period is two-week. By doubling the number of years investigated, I allow the same number of chances for workers to change their employment status.}. Data generated by this process is pictured in Figure 6. The OLS estimate of $\beta_1$ in the following regression is 0.47 (S.E. 0.04), where $i$ account for each non-employment spell in the selected data. However, if I dropped workers with at least one non-employment spell longer than 52 periods which is one of the authors’ sample restriction, the coefficient drops to 0.32 (S.E.0.04) which is very close to the GGV’s estimate. If I further drop workers who were out of the labor force for more than 1/4 of the sample period, the coefficient drops further to 0.13 (S.E. 0.03). The elasticity of non-employment duration with respect to the partner’s wage seems sensitive to how the samples are restricted.
Lastly, I investigate the results regarding the wages. In the equilibrium, there is no dispersion among singles in the sense of non-employment status and wage rates. However, married workers show wage dispersion resulting from differences in the employment history of both partners. To illustrate, consider two households in which both husband and wife are not employed. They would take the same joint labor market status between $(u,u)$, $(u,o)$, $(o,u)$ and $(o,o)$, and two husbands (wives) search for the same wage rate. However, once one of the two wives is employed, her husband would change his search target and market status. If, in the next period, two husbands become employed, they will be earning different wages.

**Accounting for Fact 3.** Spouses’ wages are positively correlated in two-earner households.

Figure 7 presents the distribution of the wage rates of dual-employed households. The two wage rates in $(e,e)$ households are positively correlated with the correlation coefficient between log wages being 0.06. I estimate the correlation of spouses’ wages using the OLS with the data generated by the model simulation to compare to the estimation in Section 2.3 with the actual data. Table 6 shows that both a husband’s and a wife’s wage rate are
significantly increasing in the partner’s wage rate.

**Table 6:** Correlation in Partners’ Wages

<table>
<thead>
<tr>
<th>log (Partner’s Wage)</th>
<th>log(Wage of a Wife)</th>
<th>log(Wage of a Husband)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.12 (0.002)</td>
<td>0.03 (0.0004)</td>
<td></td>
</tr>
</tbody>
</table>

However, the size of the coefficients on the log of the partner’s wage, which is 0.12 for wives and 0.03 for husbands, is reverse of what are in the data. The same coefficients from fixed effects regressions in Section 2.2 are 0.02 and 0.06, respectively. Unlike in the data, wives’ wages in the model are more elastic than husbands’ wages. Because home production is an outside option of employment and a wife has a higher relative home productivity than her husband, her search policy increases with a steeper slope than the husband’s. One discrepancy of the model is, therefore, that working wives earn higher wages than husbands on average. This is the opposite of what is in the data. In reality, there are several factors which may bring down the wages of wives such as career interruptions during child baring periods, over-time premium, occupational and establishment-segregation, and any type of discriminations. Since the model abstracts away from all of these factors, it does not create lower wages for females than males. Wives in the model provide less amount of labor at
higher price than husbands.

One more noticeable feature in Figure 7 is the wage ladders\(^{20}\). Getting wage ladders is a typical result of search models with on-the-job search. If workers were allowed to keep searching for better wage offers even when they are employed, then their current wage becomes a ladder through which they can progress to a higher paying job, which results in a non-degenerate wage distribution. In my model, a partner’s income plays the role of a ladder. Consider a household that consists of two unemployed workers. Because they need paid jobs quickly, they would search for the lowest wage rate which is relatively easy to find. After one of them becomes employed, however, the other would want to search for a better paying job.

4.5 Counterfactuals

In the model, both participation and search are necessary to explain the facts observed in Section 2. To address the necessities of each factor, I examine how the results would change if I shut down each channel.

4.5.1 Importance of Participation Choice

I have shown that ignoring endogenous participation results in over-estimation of the elasticity of unemployment duration with respect to the partner’s wage as addressed in Section 4.4. Moreover, endogenous participation is also necessary to generate the quantitatively plausible relationship between a married woman’s market participation and her husband’s wage. To confirm the argument, I construct a model without the participation choice, where market participation is now a random process. To match the distribution of households in the benchmark model, the process is assumed as following; whenever a husband is not employed, he is unemployed. However, when a wife is non-employed, she is out of the labor force with probability 0.95 and unemployed with probability 0.05.

\(^{20}\text{See Menzio and Shi (2010)}\)
The equilibrium of this model also has some dependency correlation between the number of weeks in which a wife does not participate in the market and the husband’s labor income through the increasing search policy. However, it does not generate enough response as shown in Table 7. An increase in a husband’s wage income by one standard deviation would make the wife stay out of the labor force about 4 more days which is a lot smaller than what is observed in the data with and without the restriction.

**Table 7: Comparison to the Exogenous Market Participation**

<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>Exogenous Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>log(Husband’s Wage)</td>
<td>2.81 (0.10)</td>
<td>0.53 (0.09)</td>
</tr>
</tbody>
</table>

4.5.2 Importance of Frictional Search

Search frictions are necessary for a model to generate a relationship between a married worker’s non-employment duration and the partner’s wage. Without search frictions, non-employment duration of a married worker would not be correlated with the partner’s labor market outcome.

To support this argument, I construct a model which abstracts away from search frictions and assumes that the labor market is competitive. To have workers to enter and exit the labor market, I consider an environment with productivity shocks. Specifically, I assume that a worker’s productivity is i.i.d., purely transitory and uniformly distributed on the interval \([w, \bar{w}]\). By choosing the utility elasticity of market goods, \(\eta\), and the lower and upper bounds of productivity, the model can mimic the equilibrium outcome of the benchmark case in terms of the distribution of the households over the joint employment states.

There are two properties in the equilibrium of this frictionless model. First, because of shared income, a worker has a stronger disincentive of work as the partner’s wage (productivity) increases. Second, non-participation is a lot more common for wives than husbands because of the difference in the relative productivities. This model has the most ingredi-
ents of the benchmark model except for search and unemployment, and therefore, gives the same prediction regarding the wives’ response in the market participation to the husband’s wage. It also creates the positive correlation between spouses’ wages through the reservation wage strategies of workers. However, the model does not create correlation between worker’s non-employment and the partner’s wage. The elasticity of non-employment duration of a married woman with respect to the husband’s wage rate is statistically insignificant. It is estimated to be 0.003 (S.E. 0.008). The same is true for a married man’s non-employment duration. Estimate is 0.005 (S.E. 0.01)\[21\]

5 Unemployment Insurance

In this section, I study the consequences of unemployment insurance (UI). The government levies proportional income tax from the employed and pay UI to the unemployed. Whether a worker is actively searching for jobs or not is assumed to be an observable state. The unemployment insurance is given only for the unemployed and not for the people outside of the labor market. To increase the level of UI, the government increases the tax rate to balance its budget.

There are positive and negative effects of UI on the employment-population ratio. By raising the value of unemployment relative to non-participation, UI will increases the labor force participation rates. At the same time, UI raises the wage rate searched by each unemployed worker, because he or she is now better insured against the lack of earnings while unemployed. The latter may reduce the job-finding rates of the unemployed.

Now with the new level of UI and tax rate, firms and workers endogenously adjust their expectations and behaviors according to the higher UI and tax rates. Workers not only search for higher wages but also may want to quit their jobs because of the higher tax rate. These two effects offset each other. However, in my model, there are firms adjust as well.

\[21\]If I combine two genders, the elasticity becomes even negative. The negative correlation is less informative though, because it comes from the difference between sexes. In the simulation, wives usually earn more and do not participate in the market longer.
Knowing that workers have become more likely to quit, firms profitably offer higher wage rates to retain workers. An increase in the wage rates will decrease the matching rate of an unemployed worker. However, the size of the drop is much smaller than the difference in the application probability between an unemployed worker and non-participants: \( \lambda_u - \lambda_o \). Overall, more workers can be employed in the new equilibrium than in the old equilibrium.

I study the effect of the UI with fixed size of monetary benefit with an indefinite duration. Since there is minimum amount of income \( b_o \) that is given to the workers out of the labor force, the amount the government has to pay is \( b - b_o \) to make the income of the unemployed \( b \). The UI is given only to the unemployed, which changes incentives and disincentives of dropping from the market when a worker is non-employed. UI increases the value of unemployment relative to the value of non-participation. It is assumed that the government can distinguish people who are actively searching for jobs and those who are not. Therefore, a non-employed worker has to engage in job search activity that requires time and effort to be eligible for the benefit.

Figure 8 compares the tightness functions with and without the UI of 12% of the worker’s market productivity. Higher tax rates imposed to fund UI reduce the workers’ incentive to work so that the retention rates drop after the provision of UI. This induces less entry of firms, which makes the labor market less tight than before the provision of UI. However, the decrease in the tightness is not uniform through all submarkets. If the wage rate paid is high enough, workers still would not want to separate.\(^{22}\) However, overall, market tightness drops. Moreover, as the value of unemployment increases by the UI provision, workers increase their search targets, as depicted in Figure 9. Without endogenous participation, this would reduce employment and raise unemployment. However, the UI that is only given

\(^{22}\)There is a discontinuity point that is come from the formation of the firms’ beliefs. In the computed equilibrium, firms consider the distribution of applicants in empty submarkets in the same way as the distribution of all non-employed workers in the economy. If a submarket, say \( \tilde{w} \) is entered only by workers who do not want to separate from a job, the expected length of a match is \( 1/\delta \). Other submarkets that are close to \( \tilde{w} \) and not entered by any workers would have shorter expected lengths of a match, if that wage rate is off the equilibrium path and if there are some workers who would want to quit the job if he or she is by any change employed at that wage rate.
to the active searchers encourages market participation in my model prevents a decrease in the employment-population ratio. Figure 9 can also be interpreted as the firm’s choices of posting vacancies. After an increase in the income tax rate, which reduces workers’ incentive to work, firms post higher wage rates rather than letting workers quit.

Table 8 shows how the equilibrium distribution of couple households varies according to the changes in UI. Its effect on the employment rate is not monotone. As generosity of UI increases, the employment rate draws a hump-shape. A small amount of UI does not create enough incentive for non-participating wives to enter the market, but it still increases the duration of each unemployment. Therefore, the unemployment rate increases,
and the employment rate decreases. However, as the amount of the benefit increases, wives start responding through participation margin. Since the positive gap in the job finding probabilities between an active searcher and a non-participant outweighs the decrease in the job finding probability of each unemployed worker, the employment-population ratio increases after the provision of UI. However, as the level of benefit becomes higher, the effect of lengthening the unemployment durations offsets the effect of having more workers in the market and, therefore, the employed population starts to drop. After the participation rate reaches one, the UI’s encouraging market participation no longer has an effect; a larger UI increases the unemployment rate and decreases the employment-population ratio. This result of an increase in the employment rate through generous UI cannot be generated by models with no endogenous participation.

Since there are singles and couples in the model, the effects of UI for different types of households are comparable. In the sense of welfare, I use the definition in Mukoyama (2013). A worker \(i\) is said to be better-off by the policy if his or her present value of the consumption path after the policy is greater than the present value of the before the policy. In this case, worker \(i\) is also called a ‘winner’. In the welfare analysis, the model shows that single households get benefitted more than married households. This is the similar result to Choi and Valladares-Esteban (2015) which show that the unemployment insurance benefits the single person households more than couple households because of the lack of intra-household insurance for singles.

\[ \sum_{t=0}^{T} \beta^t (\mu_i + 1) \left[ ((c_{it}^o + \xi)^{\eta}(h_{it}^o + \bar{h}))^{(1-\eta)} \right]^{(1-\sigma)} = \sum_{t=0}^{T} \beta^t ((c_{it} + \xi)^{\eta}(h_{it} + \bar{h}))^{(1-\eta)}^{(1-\sigma)} \]

where \(c_{it}^o\) and \(h_{it}^o\) are market- and home-goods consumption of a worker in household \(i\) at time \(t\) without the policy, and \(c_{it}\) and \(h_{it}\) are those with the policy. In words, \(\mu_i\) is the percentage change of each period’s composite goods consumption that makes worker \(i\)’s present value at time 0 without the policy equal to his or her present value at time 0 under the policy.
Table 8: Distribution of Couple Households (%)

<table>
<thead>
<tr>
<th>UI ((b - bo))</th>
<th>0</th>
<th>0.04</th>
<th>0.08</th>
<th>0.12</th>
<th>0.16</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-Pop Ratio</td>
<td>82.8</td>
<td>81.6</td>
<td>81.2</td>
<td>91.1</td>
<td>88.4</td>
</tr>
<tr>
<td>((e, e))</td>
<td>66.5</td>
<td>64.1</td>
<td>63.2</td>
<td>82.6</td>
<td>77.5</td>
</tr>
<tr>
<td>((e, o) \cup (o, e))</td>
<td>27.9</td>
<td>30.3</td>
<td>30.7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>((e, u) \cup (u, e))</td>
<td>4.6</td>
<td>4.7</td>
<td>5.2</td>
<td>16.9</td>
<td>21.8</td>
</tr>
<tr>
<td>((u, u) \cup \cdots \cup (o, o))</td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>(\tau)</td>
<td>0</td>
<td>0.3</td>
<td>0.4</td>
<td>1.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Percentage of winners in couple HHs</td>
<td>-</td>
<td>89.07</td>
<td>92.03</td>
<td>80.1</td>
<td>79.70</td>
</tr>
<tr>
<td>Percentage of winners in single HHs</td>
<td>-</td>
<td>92.43</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

6 The Earned Income Tax Credit

In this section, I use the model to study the effects of the EITC on the employment and welfare of households. Since the program focuses on the employment and welfare of working families with children, the analysis here will also focus on households with children.

6.1 Introduction to the Earned Income Tax Credit

The EITC is designed to reduce poverty and to encourage work of low-income families. It is a refundable tax credit which functions as a negative income tax. After introduced in 1975, this program has become the largest cash transfer for low-income families. The federal government allocated $31.9 billion in 1999, in 1999 dollars and $60 billion in 2010 through the federal EITC.\(^{24}\) What make this program even more important is that a considerable portion of households is eligible for the benefit. For example, in 2008, 21.3% of the US households were eligible.\(^{25}\)

As shown in Table 9, the amount of credit a household is eligible depends on household income, the number of children and filing status; single or married and filing jointly. For each household, the credit increases proportionally to household income until the credit reaches the maximum level. After reaching the maximum amount, the credit remains flat until the

\(^{24}\)See Hotz, Mullin and Scholz (2006) and Athreya, Reilly and Simpson (2014).
\(^{25}\)See Athreya, Reilly and Simpson (2014).
household income enters the phase-out region. In the phase-out region, the benefit decreases at a fixed rate until it becomes zero.

Table 9: Earned Income Tax Credit 2018*

<table>
<thead>
<tr>
<th>Number of Children</th>
<th>Phase-in rate</th>
<th>Phase-in ends at</th>
<th>Maximum Credit</th>
<th>Phase-out rate</th>
<th>Phase-out ends at</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Filing Status Single</td>
<td></td>
<td></td>
<td>Married Filing Jointly</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>7.65%</td>
<td>$6,780</td>
<td>$519</td>
<td>7.65%</td>
<td>$15,270</td>
</tr>
<tr>
<td>1</td>
<td>34%</td>
<td>$10,180</td>
<td>$3,461</td>
<td>15.98%</td>
<td>$40,320</td>
</tr>
<tr>
<td>2</td>
<td>40%</td>
<td>$14,290</td>
<td>$5,716</td>
<td>21.06%</td>
<td>$45,802</td>
</tr>
<tr>
<td>&gt;2</td>
<td>45%</td>
<td>$14,290</td>
<td>$6,431</td>
<td>21.06%</td>
<td>$49,194</td>
</tr>
</tbody>
</table>


To understand the size of the credit relative to usual income, I compare the numbers in Table 1 to the median personal income of the U.S. workers. The median personal income in 2016 was $31,099\textsuperscript{26} which is $32,133 in June 2018 dollar. Therefore, the maximum EITC in a single-filing household head with two children is 17.8% and phase-out begins at 58.1% of the median income.

6.2 Introducing the EITC to the Model

The government levies a flat rate income tax $\tau$ to fund the EITC. Implementing the policy in the model, I keep the size of the credit relative to the median personal income remained the same as the actual program. That is, the maximum credit in a single household head with two children is 17.8% and phase-out begins at 58.1% of the median income of workers in the model. For married couples, phase-out begins at 76% of the median individual income\textsuperscript{27}.

\textsuperscript{26}Source: The U.S Census Bureau

\textsuperscript{27}In the US, taxpayers who are married but filing separately cannot claim the EITC unless they lived separately for the last six months of the year. Therefore, married couples in the model always file their taxes separately.
Since the credit strongly depends on the number of children in the household, I introduce children into the model. There are now households with and without children. Specifically, I let 60% of couple households have 2 children and the rest do not. Among the single workers, 25% of females and 5% of males are assumed to have 2 children. Households with children pay a flow cost of outsourcing child care when every parent is employed, while households without children do not. Among those households with children, 1/3 are assumed to have a higher cost than the other to capture the high skewness of the distribution of child care costs.

The low and high costs of child care are denoted by $c_l$ and $c_h$, respectively. These costs fully incur when every parent in the family is employed. However, when there is at least one non-employed parent, then the children do not need a full-time care. The family can hire an outside caregiver only when the non-employed parent is seeking for a job. Therefore, the cost reduces to zero if the non-employed parent is not participating in the labor market, and it reduces to $c_i/4$ for each $i$ in $\{l, h\}$, if the non-employed parent is actively seeking for a job. A two-parent household with two unemployed workers can coordinate their time to search and take care of their children by themselves. Therefore, couple households with two unemployed partners do not pay child care costs. In an example simulation, I set parameters $c_l$ as 0.2 and $c_h$ as 0.4 which is about 45% of the median income.

\[\text{jointly.}\]

\[\text{In Census 2018, 65\% of married husbands of age from 25 to 54 have at least one children under age 18. The number of single mothers is 36\% of the number of married mothers, and the number of single fathers is 8\% of the number of married fathers. Households with children have about 2 children on average.}\]

\[\text{For simplicity, I abstract away from lifecycle aspects of child baring and assume that the number of children and cost of child care are constant over time in each household. If I take it into account that children are born and age over time, then the difference in labor market behaviors between households with and without children will be mitigated.}\]

\[\text{In the survey of the Federal Reserve Bank of New York, unemployed workers spend 11 hours per week for job search. This is approximately 1/4 of the full-time working hours which is 40.}\]

\[\text{Family level data in PSID 2015 shows that households with children with non-working wives paid $3,758 on average during the year of 2013. I abstract away from the fact that families with non-working parents are also spending positive costs in child care. In households where both the head and the wife were working full-time year-round, the average child care cost went up to $6,366. Also, the distribution of the costs is highly skewed so that the average cost among the top 35\% (in the sense of child care costs) is $12,035 which is higher by $8,276 than the average child care cost of the households with non-working wives. This gap accounts for 32\% of the median personal income in 2013, which is $25,795 in 2013 dollars. If there is a selection bias in the sense that households with non-working mothers are the ones with higher costs of}\]
In the family with two children, each member of the family spends the total income of the parents divided by \((n + 2)\), where \(n\) is the number of parents in the household, which is either 1 or 2. Parents are benevolent in that they care about children’s utility. Specifically, the instant utility of a single mother who is employed at wage rate \(w\) and has two children is \((1 + 2\gamma)u(\frac{w-c}{3}, ah)\), where \(\gamma\) is the parameter of benevolence. In simulation \(\gamma\) is set to be 1.

For tractability, I assume that the credit is given to eligible households period by period, which is two-week-long. To solve the problem of the annual tax credit as in reality, problems must be solved for each period of a year because a worker’s decisions would depend not only on the household’s current state, but also on the cumulative annual income of the family.

### 6.3 The Model’s Prediction on the Effects of the EITC on Employment

The model’s prediction on the effects of the EITC on the employment is shown in Figure 10. The EITC decreases the employment rate of married parents and increases that of single parents. After the provision of the EITC, all married mothers stay home. As their husbands are employed most of the times, married women’s earnings are extra income in their households. Since an employed husband’s wage is always high enough to reach the maximum credit, extra income of the wife only decreases the benefit, which generates a strong disincentive for married mothers to work. For single parents, however, the EITC increases the employment rate. Single parents with high costs of child care participate in the market and search for jobs when not employed only after the provision of the EITC. They choose not to participate in the market without the program because the wage is not high enough to be attractive given that they have to pay child care costs. Therefore, the EITC increases the labor force participation rate and the employment rate of single parents.

Single workers without children and married males with and without children do not outsourcing child care, the cost \(c_h\) must be chosen higher than 32% of the median income.
change their participation decisions before and after the EITC. However, their employment rates also decrease slightly after the EITC. This is an equilibrium effect coming from the demand side of the labor market. Married workers with children are now more likely to quit a job. Since firms do not observe whether an applicant has children or not, they react to the increase in the separation rate of a subset of workers by reducing the submarket tightness for those wage rates that are affected by the policy intervention. Therefore, the EITC weakly reduces the job finding probability at each wage rate. Workers can respond to the changes in the tightness in two ways. First, they can stay in the same submarket after the EITC as before, accepting the lower job finding rate. Second, they can choose to increase their search target. If the wage rate were high enough, no workers would quit the job even after the EITC, and therefore, there is no decrease in submarket tightness there. In equilibrium, workers take the second strategy. Their job finding rates decrease under both strategies, so does the employment rate.

32Single workers do not want to separate from the job they searched for because the status of a single family does not change along with a spell of employment. However, the status of the household where a married worker belongs can change because of the partner’s losing or finding a job.
6.4 Comparison to the Data

Empirical research on the EITC has documented positive effects of the program on single mothers’ labor force participation. For example, [Eissa and Liebman (1996)] found that the EITC increased single mothers’ labor force participation by 2.8% relative to single women without children. [Hotz, Mullin and Scholz (2006)] also found a substantial, positive effect of the policy on the employment of eligible families using the data of California. Generally, the EITC is said to be the most effective tool which increased the single mothers’ employment rate a lot during the ’90s [Meyer and Rosenbaum (2001)]. However, [Hotz, Mullin and Scholz (2006)] found no effects of the EITC on the labor force participation rate of married workers in two-parent families. [Eissa and Hoynes (2004)] even documented a negative effect of the EITC on married women’s labor force participation. These findings are qualitatively consistent with the predictions of the model.

6.5 Welfare Consequences

To fund the EITC, the government imposes a 9.8% of income tax. Consumption path of workers without children get only worse after the EITC, because they pay a positive income tax while they do not receive benefit from the program.\footnote{Although a family without children can receive the benefit if their income is smaller than 2/3 of the median wage for a couple and 1/2 of the median wage for a single, workers do not search for those low wages just to receive the credit. The maximum credit a household without children can receive is 0.016 which is too small to attract workers.} Therefore, I focus on the effects of the EITC on the welfare of parents only. I again use the comparison in the present value of consumption paths to determine whether a household become better or worse off because of the policy.

The program enhances the welfare of every single parent unless they pay more taxes than the credits. The EITC does not affect period consumption of non-employed single parents because they do not pay taxes nor receive credits. However, the program benefits employed single parents by offering more credits than taxes. In the example simulation,
couple households also receive more than they pay. Each household of a married couple with children receives 0.16 on average when the husband is employed. However, the EITC makes only 48% of married parents better-off in the sense of welfare. After the EITC, no wives participate in the market because, if both partners are employed, household income will be too high to be eligible for the credit. They will only pay the tax in that case. Therefore, the program distorts couple households’ behaviors in the labor market by making some of the options better but the other options worse. Overall, the program can make some married parents worse off despite the benefits which is observationally larger than taxes.

7 Conclusion

I construct an equilibrium model of couple households with endogenous labor force participation and search frictions. The model possesses an equilibrium where a married worker responds to an increase in the partner’s wage by reducing the market participation, increasing the search target, and increasing the job separation rate. I show that the framework is able to, qualitatively and quantitatively, account for the correlations in spouses’ labor market outcomes in terms of participation, unemployment duration, and wage rates.

The model is suitable to reassess government policies that affect households’ decisions in the labor market. I analyze the effects of UI and the EITC on the employment and welfare. The model shows that generous unemployment insurance can increase the employment rate by mitigating married females’ disincentive to participate in the labor market. Moreover, UI increases the welfare of single workers more than married workers. In the analysis of the EITC, I show that it increases the employment rate of single parents but decreases the employment rate of other workers. Also, the EITC raises the welfare of a half of married parents and all single parents.
References


