On Households and Unemployment Insurance

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Abstract

In this paper we study unemployment insurance in a framework where the main source of heterogeneity among agents is the type of household they live in: some agents live alone while others live with their spouses as a family. Our exercise is motivated by the fact that married individuals can rely on spousal income to smooth labor market shocks, while singles cannot. We extend a version of the standard incomplete markets model to include two-agent households and calibrate it to the US economy, with special emphasis on matching differences in labor market transitions among different types of households. Our central finding is that the unemployment insurance program improves the welfare of single households but not of married ones. We show that this result is driven by the amount of self insurance existing in married households and thus, we highlight the interplay between self and government provided insurance and its implication for policy.

Keywords: Households, Marriage, Family, Unemployment, Unemployment Insurance, Worker Flows, Heterogeneous Agents.

JEL Codes: **D91, E24, J64, J65**

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1 Introduction

This paper studies the welfare effects of publicly provided Unemployment Insurance (UI) in an environment where the main source of heterogeneity among individuals is the type of household they live in: some agents live alone while others live with their spouses as a family. While the standard framework used to study the effects of UI focuses on single-agent models, this paper provides a more complete picture because of two reasons. First, as pointed out in Choi and Valladares-Esteban (2015), married and single individuals display striking differences in labor market dynamics and performance.[1] In particular, married individuals have lower unemployment rates than their single counterparts, suggesting that the two groups might have different needs with respect to UI. Second, the family can be an important source of insurance, since when one family member is laid off, the other may start working to smooth consumption.

The framework we use here, which extends the Aiyagari-Bewley-Huggett economy in Krusell, Mukoyama, Rogerson, and Sahin (2011), has five salient features.[2] First, households decide labor supply along the extensive margin. Second, agents are subject to non-insurable income and working opportunity shocks, cannot borrow, and the only saving technology available is a risk free asset which pays an exogenous interest rate. Third, agents are heterogeneous in gender and household type, that is, there are four types of agents: single females, single males, married females, and married males. Fourth, married agents take decisions within a unitary framework and pool income, consumption, and savings with their spouses. Finally, there is a government that, without having perfect information on the working opportunities of the agents, runs an unemployment insurance program which resembles the one in place in the US.

The model is able to account for different moments of the data, including monthly transitions across labor market states, the labor market stocks associated to these transitions, the duration of unemployment insurance spells, and the fraction of unemployed workers who receive unemployment benefits in the US economy. We use the parameters that best replicate the data to perform quantitative exercises, mainly we modify the level of unemployment benefits (funded through income taxes) and compute overall and agent specific welfare numbers.

Our main finding is that for married households, UI is not welfare improving. That is, the

[1] Throughout this paper the terms single and non-married are used interchangeably, referring to any person who is labeled as "never married", "separated", "divorced" or "widowed" in the Current Population Survey (CPS). We ignore cohabiting individuals, given the inability to distinguish them in a non-arbitrary way.

[2] See Aiyagari (1994), Bewley (1980), and Huggett (1993).

family is a better insurance device than the publicly provided unemployment insurance program. This result does not depend on the different likelihood of being unemployed between married and single individuals nor on the distinct characteristics of their income shocks. On the contrary, our finding is a consequence of the joint decisions and the pooling of income, consumption, and savings that takes place inside the family. For two single agents living together as a family, UI would not be welfare-improving, while for a married agent living alone (as a single), UI would improve welfare.

There are several papers which study the welfare implications and the effects of unemployment insurance programs. Abdulkadiroglu, Kuruscu, and Sahin (2002) point out how important hidden assets are in determining the optimal unemployment insurance scheme. Gomes, Greenwood, and Rebelo (2001) study the effects of unemployment insurance and business cycles in an incomplete markets framework in which the decision to accept or reject jobs is modeled explicitly. Hansen and Imrohoroglu (1992) find that the inability of the government to distinguish between voluntary and involuntary non-employment may reduce the welfare gains of unemployment insurance. Hopenhayn and Nicolini (1997) show how to design an unemployment insurance program in an environment where search effort is not observable by the insurance provider. Rendon (2006) analyzes the interactions between wealth accumulation and job search dynamics. Shimer and Werning (2008) highlight the role of unemployment insurance as a liquidity provision device.

Similarly to Abdulkadiroglu, Kuruscu, and Sahin (2002), Gomes, Greenwood, and Rebelo (2001), Hansen and Imrohoroglu (1992), Rendon (2006), and Shimer and Werning (2008), in our framework agents accumulate assets to self-insure against employment shocks. We depart from these studies by introducing the family as another source of insurance for some of the agents in the economy (we also allow for heterogeneity in the amount of non-employment risk across types of agents). As in Hansen and Imrohoroglu (1992) and Hopenhayn and Nicolini (1997) , we assume that the government is not able to perfectly distinguish between workers who reject job offers and those who cannot find one. Hence unemployment insurance distorts labor supply decisions of households.

Much less work has been done on the effects of unemployment insurance in frameworks where the family plays an important role, although there are some exceptions. The closest study to ours is Ortigueira and Siassi (2013), who use an Aiyagari-Bewley-Huggett economy to analyze the amount of insurance provided by married households against non-employment risks. Our analysis differs from theirs in three dimensions. First, the model presented here accounts for the labor stocks and transitions across employment, unemployment and non-participation associated with the four types of individuals considered (single females, single males, married females, and married males). Second, we do not assume that the government has perfect information about agents' opportunities to work. This feature generates a distortionary effect of UI over participation decisions. Finally, the UI considered here incorporates a past-employment requirement resembling one of the eligibility conditions existing in the US system. This element plays an important role in the employment decisions of the agents.

Some other authors have also analyzed unemployment insurance in multi-agent environments. Ek and Holmlund (2010) study optimal unemployment insurance of couples in a Diamond-Mortensen-Pissarides framework. Our paper differs from their work in two dimensions. First, we do not consider unemployment benefits as the outside option of a worker in a bargaining process and, second, the model used here is able to account for multiple moments of the data associated with the different labor market dynamics between singles and married individuals in the US economy. Di Tella and MacCulloch (2002) study the provision of unemployment insurance in a context where agents form networks to share risk (these networks are what they consider families). We consider the family as the union generated by the contract of marriage and we abstract from commitment issues between spouses. Moreover, instead of a theoretical approach, we propose a quantitative exercise to test the effect of public intervention.

Although single-agent environments are predominant in quantitative macroeconomic and public policy analysis, there is a growing literature which is moving towards two-agent frameworks. Guner, Kaygusuz, and Ventura (2012) study the welfare implications of changes in the US tax code in a model where decisions are taken by two-earner households. Heathcote, Storesletten, and Violante (2010) explore the quantitative and welfare implications of the rise in college premium, the narrowing of the gender wage gap, and the increase of wage volatility using a model in which the decision unit is a two-agent household. Hong and Ríos Rull (2007) analyze social security with two-member households. Kleven, Kreiner, and Saez (2009) study optimal taxation modeling explicitly second-earner decisions. We follow this stream of the literature by analyzing the implications of an unemployment insurance program in a model with single and married households.

This paper is also related to the literature that studies household interactions and frictions in the labor market. Mankart and Oikonomou (2012) show that a household search model can account for some regularities of the US data that can not be replicated by single-agent search models. Guler, Guvenen, and Violante (2012) theoretically analyze a McCall-type search problem of a two-member household, under different types of preferences. Dey and Flinn (2008) study the implications of health insurance coverage in a search model where the decision unit is the household. Flabbi and Mabli (2012) analyze the bias in structurally estimated parameters in search models where the misspecification is related to joint-search.

2 The Model

In this section we develop a version of the standard incomplete markets model, in the spirit of Aiyagari (1994) and extended as in Chang and Kim (2007) and Krusell, Mukoyama, Rogerson, and Sahin (2011). Time is discrete and the time horizon is infinite. The economy is populated by a continuum of infinitely lived households with total mass equal to one. There are agents of two genders, females (f) and males (m). Agents may live alone, in single households ($\mathcal{S}$) or with their spouse, in married households ($\mathcal{M}$).

Single households can be composed of one female or one male, while married households consist of two members, one of each gender. Hence, there are four types of agents, single females ($\mathcal{S}$, f), single males ($\mathcal{S}$,m), married females ($\mathcal{M}$, f), and married males ($\mathcal{M}$,m). A fraction $\Phi_{\mathcal{S},f}$ of the households corresponds to single females, a fraction $\Phi_{\mathcal{S},m}$ to single males, and the rest $(1-\Phi_f-\Phi_m=\Phi_{\mathcal{M}})$ are married households. Household type, $\mathcal{H}\in\{\mathcal{S},\mathcal{M}\}$, and gender, $g\in\{f,m\}$, are exogenous.

Households discount the future at rate $0<\beta<1$, derive utility from consumption streams over time and pay a utility cost when working. Preferences for single households are given by:

$$\log(c)-\alpha_{\mathcal{S},g}e_g, \quad g\in\{f,m\}, \tag{1}$$

while for married households, they are:

$$\log\left(\frac{c}{1+\chi}\right)-\alpha_{\mathcal{M},f}e_f-\alpha_{\mathcal{M},m}e_m-\alpha_{\mathcal{M}}e_fe_m. \tag{2}$$

In both cases, $c\geq 0$ stands for consumption in the current period, $e_g\in\{0,1\}$ is a discrete variable describing the work decision (1 means work) and $\{\alpha_{\mathcal{S},g},\alpha_{\mathcal{M},g},\alpha_{\mathcal{M}}\}$ are the parameters that quantify the disutility of work for each gender $g\in\{f,m\}$. The restriction that e_g is either zero or one implies that all labor supply adjustments are done through the extensive margin.

Note that, for married households, it is assumed a unitary framework in which consumption is a public good adjusted by an adult equivalence scale (χ). Within married households, the *individual* disutility of working ($\alpha_{\mathcal{M},g}$) is suffered by the household as a whole. Moreover, if both spouses work at the same time, the household suffers a utility cost associated to joint employment ($\alpha_{\mathcal{M}}$). The idea behind this cost is that, for married couples, second earners forgo a valuable contribution to the household when employed (childbearing, home production, etc.).

Individual labor income of any agent in the economy, irrespective of gender or household type, is given by

$$(1-\tau)\, ze, \tag{3}$$

where τ is a linear labor income tax, e is the binary decision to work and z is a labor income shock.[3] The idiosyncratic shock z differs across genders and household types.

For single households, z follows an AR(1) stochastic process in logs. Given by

$$\log z'_{\mathcal{S},g} = \rho_{\mathcal{S},g} \log z_{\mathcal{S},g} + \varepsilon'_{\mathcal{S},g} \quad g \in \{f, m\}\,, \tag{4}$$

where $\rho_{\mathcal{S},g}$ represents the persistence parameter of the process, and $\varepsilon_{\mathcal{S},g} \sim N\left(0, \sigma_{\mathcal{S},g}\right)$ is the innovation shock in the current period.

For agents living in married households, labor income shocks evolve jointly following a VAR(1) stochastic process in logs, given by

$$\log \begin{bmatrix} z'_{\mathcal{M},f} \\ z'_{\mathcal{M},m} \end{bmatrix} = \rho_{\mathcal{M}} \log \begin{bmatrix} z_{\mathcal{M},f} \\ z_{\mathcal{M},m} \end{bmatrix} + \begin{bmatrix} \varepsilon'_{\mathcal{M},f} \\ \varepsilon'_{\mathcal{M},m} \end{bmatrix}, \tag{5}$$

where $\rho_{\mathcal{M}}$ is a singleton, which determines the persistence of the process. The vector $\begin{bmatrix} \varepsilon'_{\mathcal{M},f} \\ \varepsilon'_{\mathcal{M},m} \end{bmatrix}$ is distributed according to

$$\begin{bmatrix} \varepsilon'_{\mathcal{M},f} \\ \varepsilon'_{\mathcal{M},m} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_f & \sigma_{fm} \\ \sigma_{fm} & \sigma_m \end{bmatrix} \right), \tag{6}$$

where σ_f is the standard deviation of female's innovation shock, σ_m is the standard deviation of

[3] Notice that the wage is exogenous and normalized to 1. The labor income shock can also be interpreted as the amount of efficiency units of labor per wage unit.

male's income shock, and σ_{fm} is the covariance between the two innovation shocks. It is assumed that the standard deviation of the two innovation shocks is the same and it is denoted by $\sigma_{\mathcal{M}} = \sigma_f = \sigma_m$. Notice that the correlation between the two innovation shocks is given by $\phi = \sigma_{fm}/\sigma^2_{\mathcal{M}}$.

Besides the discrete labor supply choice, households decide how much to consume and how much to save for the future. The only technology available for saving is a risk-free asset which pays an exogenous real interest rate r. Households are not allowed to borrow against future income.

2.1 The Labor Market

Labor income shocks are not the only source of uncertainty in this economy. To capture frictions in the labor market, agents are subject to working opportunities shocks that determine whether an agent has the possibility to work or not in a given period.

We assume that the probability of having a work opportunity (or job offer) in the current period depends on whether the agent was employed or not in the previous period, and on the household type and gender. Those agents who were not employed in the previous period, receive a job offer with probability $\lambda_{\mathcal{H},g}$. Agents who were employed last period, lose their opportunity to work with probability $\delta_{\mathcal{H},g}$.

The assumption that the probability of having an opportunity to work in a given period depends on the employment status in the previous period is based on the structure of the labor market transitions observed in the data.[4] In the data, those individuals that are employed in the previous month present a much higher likelihood of employment in the next period than those individuals that were not employed in the previous period. In the model, this idea is captured simply by setting $1 - \delta_{\mathcal{H},g} > \lambda_{\mathcal{H},g}$.

The fact that both the arrival ($\lambda_{\mathcal{H},g}$) and the destruction probability ($\delta_{\mathcal{H},g}$) depend on gender and household type captures two potential differences among single females, single males, married females, and married males. First, the different composition of unobservable characteristics that these groups might present in the data. For example, if there is some unobservable characteristic that lead people to both be more likely to get married and less likely to be unemployed, this parametrization should be able to capture this difference. Secondly, in the model, conditional on the decision of employment versus non-employment, the probability of receiving/losing an opportunity to work is exogenous to the actions of the agents. For example, agents cannot exert more effort

[4]See Choi and Valladares-Esteban (2015).

searching for a work opportunity in order to increase the likelihood of finding one. However, there might exist systematic differences between singles and married, males and females, in this dimension. These differences are partially captured by the model through differences among the arrival and destruction probabilities.

In contrast to standard search models, here agents have to decide whether to work or not each period, independently of their employment status in the previous period. Agents might *quit* their job, if after being employed last period, they receive again an opportunity to work but decide not to work. The decision to work or not, in the case of single households, is mainly determined by the amount of assets, productivity, and the unemployment insurance status of the agent (see details below). For married individuals, the labor market situation of the spouse plays also a very important role along with the factors listed for singles.

The fact that the labor supply decision of the agents can be evaluated irrespective of whether they face a job offer or not generates two groups of non-employed agents. On the one hand, there are agents who decide not to work even-though they have the opportunity to do so. On the other hand, there are agents who would like to work but, due to the frictions in the market, do not have the opportunity to do it. We use this distinction to connect the model to the data as described in Section 2.6.

2.2 The Government and the Unemployment Insurance

In this economy there is a government that taxes labor income, balances the budget every period, and finances an Unemployment Insurance (UI) program. The objective of the UI is to pay a compensation to those workers who lost their opportunity to work and did not find a new one. In other words, all agents who are hit by the destruction probability ($\delta_{\mathcal{H},g}$) and do not find a new working opportunity $(1 - \lambda_{\mathcal{H},g})$ are compensated with a transfer $b > 0$ from the government.

Although the government can perfectly observe whether an agent is employed or not, that is not the case for working opportunities. Hence, the government cannot perfectly distinguish between workers who do not have opportunities and agents who refuse them. This implies that agents have the possibility to cheat, and receive unemployment benefits even-though they could accept a job offer.

Each period, a fraction π of the agents who have an opportunity to work are endowed with the ability to hide their situation from the government. Knowing their ability to cheat, agents choose between work or receiving unemployment benefits.[5] Notice that this is a non-trivial decision given that the probability of having an opportunity to work next period depends on the employment decision this period. If an agent decides to refuse an opportunity to work in order to enjoy benefits, she/he is not only forgoing the income associated to work, but also risking the possibility of not having an opportunity to work in the following period.

The inability of the government to perfectly identify those agents with work opportunities distorts agents' decisions. First, those who were enjoying benefits last period and receive an opportunity to work today, might be able to extend their UI spell. That is, the UI distorts the willingness to accept offers for non-employed agents. Second, for those agents employed in the previous period, their decision to work again in the current period might be affected by the possibility to receive benefits, inducing endogenous *quits*.[6]

The UI considered in this model is fairly similar to the one in place in the US. Since unemployment insurance regulations differ across US states, it is difficult to summarize their characteristics. However, the program can be outlined along three dimensions: eligibility, amount of benefits, and duration.[7] In terms of eligibility, the program demands workers to stay in their job for a certain period of time, provide an acceptable reason for job separation, and not to have other job options. In the model, workers must be employed at least one period before being able to collect benefits.[8] Also, those agents who have a working opportunity are not able to receive benefits unless they are endowed with the ability to hide opportunities. Finally, an acceptable reason for job separation is understood in the model as being hit by the destruction probability shock ($\delta_{\mathcal{H},g}$).

Regarding the amount of benefits, the model is calibrated to match the unemployment benefits received by workers in the data. Finally, while in the US the unemployment insurance specifies a maximum length of for receiving benefits, the model does not explicitly impose any limitation.[9] However, the model does a reasonable job replicating the duration of UI spells and the fraction of unemployed agents who receive benefits. In the model, agents do not receive benefits for a long period of time mainly because they start working, or because they receive an opportunity to work and cannot hide it from the government.

[5] This feature is a simplification of the moral hazard problem in Hansen and Imrohoroglu (1992).

[6] A quit is understood as the situation where the agent worked last period and, having an opportunity to work in the current period, decides not to do so.

[7] Nicholson and Needels (2006) provide a general description of the main features of the program in the US.

[8] The simplification of one period of employment is mainly done for computational reasons. Adding any employment tenure requirement higher than one period implies a new state variable.

[9] The standard limit is 26 weeks.

In what follows, we describe the value functions which define the optimization problem of each type of household in the economy. Single household can be in two situations, employed or non-employed. In the case of married agents, since there are two individuals in the household, the set of possibilities expands to four potential scenarios: both work, the female works, the male works, or none works.

2.3 Single Households

Four factors define the situation of a single household. First, whether the agent in the household is working or not. Second, the level of assets held by the agent (a). Third, her/his labor income shock ($z_{\mathcal{S},g}$), which evolves according to the process described in Equation (4). And, finally, when the agent is not working, whether the agent receives unemployment benefits or not. If the agent receives unemployment benefits, the indicator variable i_g takes value 1, while it is 0 in the opposite case. Remember that an agent can receive benefits for two reasons: because she/he is eligible for benefits (does not have an opportunity to work) or because she/he manages to cheat the government.

Let $W(a, z_{\mathcal{S},g})$ represent the value function for a single household where the agent is employed and $N(a, z_{\mathcal{S},g}, i_g)$ be the value function of a single non-employed household. For, $g \in \{f, m\}$, $N(a, z_{\mathcal{S},g}, i_g)$ is defined as:

$$\begin{aligned} N(a, z_{\mathcal{S},g}, i_g) = \max_{c,a' \geq 0} \{\log(c) + \\ +\beta E_{z'_{\mathcal{S},g}} \left[\begin{array}{r} \lambda_{\mathcal{S},g} \max E_{i'_g} \left\{ W\left(a', z'_{\mathcal{S},g}\right), N\left(a', z'_{\mathcal{S},g}, i'_g\right) \right\} + \\ + (1-\lambda_{\mathcal{S},g}) N\left(a', z'_{\mathcal{S},g}, i'_g = i\right) \end{array} \right] \end{aligned} \tag{7}$$

subject to

$$c + a' = (1+r)a + bi_g, \tag{8}$$

and where

$$i' = \begin{cases} 1, & \text{with probability } \pi, \text{ if } i_g = 1 \\ 0, & \text{otherwise.} \end{cases} \tag{9}$$

A non-employed agent might have two sources of income. If she/he is entitled to benefits ($i_g = 1$, the income of the agent consists of assets income and unemployment benefits. In the case of not being eligible for benefits the agent has to live out of savings (a). If the agent end-ups without an opportunity to work next period ($1 - \lambda_{\mathcal{S},g}$), her/his unemployment insurance status is unchanged, that is, continues to receive benefits if she/he was receiving benefits in the previous period and vice versa. If the agent receives a job offer ($\lambda_{\mathcal{S},g}$), two situations are possible. First, if she/he was not receiving unemployment benefits last period, the agent chooses between work and continuing non-employed without benefits. Second, if she/he was receiving benefits in the previous period, with probability π, the agent is able to hide the opportunity of work from the government. In this case her/his decision is between working and not working while receiving benefits. With probability $1-\pi$, the government knows that the agent got an opportunity, and the decision is between work and non-employment without benefits.

Similarly, the value function for single employed household, $W(a, z_{\mathcal{S},g})$, is defined by:

$$
\begin{aligned}
W(a, z_{\mathcal{S},g}) = \max_{c,a' \geq 0} \{\log(c) - \alpha_{\mathcal{S},g} + \\
+\beta E_{z'_{\mathcal{S},g}} \left[\begin{array}{r} (1-\delta_{\mathcal{S},g}) E_{i'_g} \max \left\{ W\left(a', z'_{\mathcal{S},g}\right), N\left(a', z'_{\mathcal{S},g}, i'_g\right) \right\} + \\ +\delta_{\mathcal{S},g} N\left(a', z'_{\mathcal{S},g}, 1\right) \end{array} \right]
\end{aligned}
\tag{10}
$$

subject to

$$
c + a' = (1+r)\, a + (1-\tau)\, z_{\mathcal{S},g}, \tag{11}
$$

and where

$$
i'_g = \begin{cases} 1, & \text{with probability } \pi \\ 0, & \text{otherwise.} \end{cases} \tag{12}
$$

If the agent works, she/he receives labor income defined by her/his productivity after taxes ($(1-\tau)\, z_{\mathcal{S},g}$). However, the household suffers also a utility cost from working given by $\alpha_{\mathcal{S},g}$. If an employed agent starts the following period without a working opportunity (after shock $\delta_{\mathcal{S},g}$), she/he then becomes non-employed with benefits. If, next period, an opportunity to work appears (probability $1-\delta_{\mathcal{S},g}$) the agent might be able to hide it from the government. With probability π, she/he decides between work and non-employment with benefits, while with probability π the agent chooses between work an non-employment without benefits.

For each optimization problem, policy functions for the optimal level of asset holdings, $a^{\star}_{W,g}(a, z_{\mathcal{S},g}, i_g)$ and $a^{\star}_{N,g}(a, z_{\mathcal{S},g}, i_g)$, can be obtained. The maximization decision that households may face at the beginning of each period, $\max\{W(a, z_{\mathcal{S},g}), N(a, z_{\mathcal{S},g}, i_g)\}$,defines the labor supply policy function $e^{\star}_{\mathcal{S},g}(a, z_{\mathcal{S},g}, i_g)$. Notice that the policy function for labor supply is well defined for all households irrespective of whether they actually face the opportunity to work or not. In other words, it is possible to know for all non-employed agents if they would accept a job or not. This fact is used to reconcile the model with the data as described in Section 2.6. The main idea is that among all non-employed workers, those who would decline a job offer are considered non-participants, while those who would take the offer, are categorized as unemployed. That is, unemployment is defined by agents who would like to work but cannot do it because of labor market frictions.[10]

2.4 Married Households

The optimization problem of a married household is defined by four factors. First, the amount of asset holdings (a). Second, the labor income shock of each member of the household ($z_{\mathcal{M},f}$ and $z_{\mathcal{M},m}$) which evolves according to the process described in Equation (5). Third, which agents in the household, if any, are employed. And, finally, if there is any member of the household who does not have a job, whether she/he is receiving unemployment benefits or not (i_f and/or i_m). Notice that, on top of the assumption of a unitary framework for married households, it is assumed that married households hold their assets jointly.

Let $\mathcal{W}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}\right)$ denote the value function for a married household where both agents are working. Let $\Omega_f\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_m\right)$ represent the value function of a married household where only its female member works, while $\Omega_m\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f\right)$ stands for the opposite case, that is, the male works and the female does not. Finally, let $\mathcal{N}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ denote the value function for a married household where none of the agents are working.

$\mathcal{N}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ is defined by:

$$\mathcal{N}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right) = \max_{c,a'\geq 0}\{\log\left(\tfrac{c}{1+\chi}\right) + \\ +\beta E_{z'_{\mathcal{M},f}, z'_{\mathcal{M},m}, i'_f, i'_m}\left[\begin{array}{r} \lambda_{\mathcal{M},f}\lambda_{\mathcal{M},m}E_{i'_f,i'_m}\max\left\{\mathcal{W}\left('\right), \Omega_f\left('\right), \Omega_m\left('\right), \mathcal{N}\left(')\right)\right\} + \\ +\lambda_{\mathcal{M},f}\left(1-\lambda_{\mathcal{M},m}\right)E_{i'_f}\max\left\{\Omega_f\left(', i'_m = i_m\right), \mathcal{N}\left(', i'_f, i'_m = i_m\right)\right\} + \\ +\left(1-\lambda_{\mathcal{M},f}\right)\lambda_{\mathcal{M},m}E_{i'_m}\max\left\{\Omega_m, \left(', i'_f = i_f\right), \mathcal{N}\left(', i'_f = i_f, i'_m\right)\right\} + \\ +\left(1-\lambda_{\mathcal{M},f}\right)\left(1-\lambda_{\mathcal{M},m}\right)\mathcal{N}\left(', i'_f = i_f, i'_m = i_m\right) \end{array}\right] \tag{13}$$

subject to

$$c + a' = (1+r)\,a + b\left(i_f + i_m\right), \tag{14}$$

[10]See Krusell, Mukoyama, Rogerson, and Sahin (2011) for a discussion.

and where

$$i'_g = \begin{cases} 1, & \text{with probability } \pi, \text{ if } i_g = 1 \\ 0, & \text{otherwise.} \end{cases} \qquad g \in \{f, m\} \tag{15}$$

Any married household can face up to four different situations each period: both members have an opportunity to work, only the female has an opportunity, only the male, or none of them have a working opportunity. As it is the case for singles, if an agent of a married household, who is not employed in the current period, does not receive an opportunity to work in the following period, her/his status with respect to unemployment benefits is not changed. In the case that she/he was not receiving benefits last period, she/he does not receive benefits in the current period and vice versa (in general, $i'_g = i_g$ for $g \in \{f, m\}$).

Also, as for singles, married agents might be able to hide their working opportunities from the government. Notice that, in the case that both members of the household have a working opportunity, four different scenarios can occur: both members of the household can hide their opportunity, only the female can do it, only the male, or none of them are able to cheat the government. Of course, the possibility to hide an offer and continue to receive benefits is conditional on being already receiving benefits.

The value function for a married household where only the female is employed, is defined by:[11]

$$\Omega_f \left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_m\right) = \max_{c,a' \geq 0} \{\log\left(\frac{c}{1+\chi}\right) - \alpha_{\mathcal{M},f} + \\ +\beta E_{z'_{\mathcal{M},f}, z'_{\mathcal{M},m}} \begin{bmatrix} (1-\delta_{\mathcal{M},f})\,\lambda_{\mathcal{M},m} E_{i'_f, i'_m} \max\left\{\mathcal{W}\left(\prime\right), \Omega_f\left(\prime\right), \Omega_m\left(\prime\right), \mathcal{N}\left(\prime\right)\right\} + \\ +(1-\delta_{\mathcal{M},f})\,(1-\lambda_{\mathcal{M},m})\, E_{i'_f} \max\left\{\Omega_f\left(\prime, i'_m = i_m\right), \mathcal{N}\left(\prime, i'_f, i'_m = i_m\right)\right\} + \\ +\delta_{\mathcal{M},f}\lambda_{\mathcal{M},m} E_{i'_m} \max\left\{\Omega_m\left(\prime, i'_f = 1\right), \mathcal{N}\left(\prime, i'_f = 1, i'_m\right)\right\} + \\ +\delta_{\mathcal{M},f}\,(1-\lambda_{\mathcal{M},m})\,\mathcal{N}\left(\prime, i'_f = 1, i'_m = i_m\right) \end{bmatrix} \tag{16}$$

subject to

$$c + a' = (1+r)\,a + (1-\tau)\,z_{\mathcal{M},f} + b i_m, \tag{17}$$

where

$$i'_f = \begin{cases} 1, & \text{with probability } \pi \\ 0, & \text{otherwise,} \end{cases} \tag{18}$$

[11]The value function for a married household where the opposite scenario occurs (male is employed while the female is non-employed) is symmetrical, thus we ommit its presentation.

and

$$
i'_m = \begin{cases} 1, & \text{with probability } \pi, \text{ if } i_m = 1 \\ 0, & \text{otherwise.} \end{cases} \tag{19}
$$

A couple of remarks are important regarding the value functions describing the cases were only the female or the male are working in a married household. First, although only one member of the household works, the utility cost of working ($\alpha_{\mathcal{M},f}$ or $\alpha_{\mathcal{M},m}$) is suffered by the household as a whole. Second, as it is the case for single agents, if the employed member of the household does not have an opportunity to work next period, she/he will receive unemployment benefits.

The value function for a household in which both members are employed, is defined by:

$$
\begin{aligned}
\mathcal{W}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}\right) = \max_{c,a' \geq 0} \{ \log\left(\tfrac{c}{1+\chi}\right) - \alpha_{\mathcal{M},f} - \alpha_{\mathcal{M},m} - \alpha_{\mathcal{M}} + \\
+\beta E_{z'_{\mathcal{M},f}, z'_{\mathcal{M},m}} \left[\begin{array}{r} \left(1-\delta_{\mathcal{M},f}\right)\left(1-\delta_{\mathcal{M},m}\right) E_{i'_f, i'_m} \max\left\{\mathcal{W}\left(\prime\right), \Omega_f\left(\prime\right), \Omega_m\left(\prime\right), \mathcal{N}\left(\prime\right)\right\} + \\
+\left(1-\delta_{\mathcal{M},f}\right)\delta_{\mathcal{M},m} E_{i'_f} \max\left\{\Omega_f\left(\prime, i'_m = 1\right), \mathcal{N}\left(\prime, i'_f, i'_m = 1\right)\right\} + \\
+\delta_{\mathcal{M},f}\left(1-\delta_{\mathcal{M},m}\right) E_{i'_m} \max\left\{\Omega_m\left(\prime, i'_f = 1\right), \mathcal{N}\left(\prime, i'_f = 1, i'_m\right)\right\} + \\
+\delta_{\mathcal{M},f}\delta_{\mathcal{M},m}\mathcal{N}\left(\prime, i'_f = 1, i'_m = 1\right)
\end{array} \right]
\end{aligned} \tag{20}
$$

subject to

$$
c + a' = (1+r)\, a + (1-\tau)\left(z_{\mathcal{M},f} + z_{\mathcal{M},m}\right), \tag{21}
$$

and where

$$
i'_g = \begin{cases} 1, & \text{with probability } \pi \\ 0, & \text{otherwise.} \end{cases} \qquad g \in \{f, m\} \tag{22}
$$

When both agents are employed, the household not only suffers the individual utility cost of each working member ($\alpha_{\mathcal{M},f}$ and $\alpha_{\mathcal{M},m}$) but also an extra utility cost associated with joint employment ($\alpha_{\mathcal{M}}$). In this case, if any of the two agents (or both of them) starts the following period without an opportunity to work, she/he will automatically receive benefits.

Like in the case of non-married households, each maximization problem characterizes a policy function for optimal asset accumulation: $a^\star_{\mathcal{W}}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$, $a^\star_{\Omega_f}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$, $a^\star_{\Omega_m}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ and $a^\star_{\mathcal{N}}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$. At the same time, given any state for a married household a policy function for labor supply can be defined $\left(e_{\mathcal{M},f}, e_{\mathcal{M},f}\right) = e^\star_{\mathcal{M}}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$. This policy function is used to link the model with the data as described in Section 2.6.

2.5 Equilibrium

We assume a small open economy economy: both the interest rate (r) and the price of labor are exogenous, with the latter normalized to one. One equilibrium object is the proportional tax (τ) that, given the labor income in the economy, is needed to finance the UI. The others are the stationary distribution of agents across states.

Let $X_{\mathcal{S}}^{g}\left(a, z_{\mathcal{S},g}, i_g\right)$ be the measure across states of single households of gender $g \in \{f, m\}$ who have an opportunity to work in a given period. Analogously, let $X_{\mathcal{M}}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ be the distribution of married households where both agents have an opportunity to work, $X_{\mathcal{M}}^{f}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ corresponds to households where only the female has an opportunity, and $X_{\mathcal{M}}^{m}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ represents those households where only the male has a working opportunity. Also, define $B_{\mathcal{S}}^{g}\left(a, z_{\mathcal{S},g}, i_g\right)$ as the measure of single households that receive unemployment benefits in a given period. For married households, $B_{\mathcal{M}}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ is the distribution of households where both members receive benefits, $B_{\mathcal{M}}^{f}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ represents those households where only the female receives benefits, and $B_{\mathcal{M}}^{m}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)$ stands for the measure of households where only the male receives benefits.

The budget of the government each period is given by:

$$\begin{aligned}
&\frac{\tau}{b}[\sum_{g=f,m}\int z_{\mathcal{S},g}e^{\star}_{\mathcal{S},g}dX_{\mathcal{S}}^{g}\left(a, z_{\mathcal{S},g}, i_g\right) + \int\left(z_{\mathcal{M},f}e^{\star}_{\mathcal{M},f} + z_{\mathcal{M},m}e^{\star}_{\mathcal{M},m}\right)dX_{\mathcal{M}}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right) + \\
&\quad + \sum_{g=f,m}\int\left(z_{\mathcal{M},g}e^{\star}_{\mathcal{M},g}\right)dX_{\mathcal{M}}^{g}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right)] = \sum_{g=f,m}\int dB_{\mathcal{S}}^{g}\left(a, z_{\mathcal{S},g}, i_g\right) + \\
&\quad + \int dB_{\mathcal{M}}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right) + \sum_{g=f,m}\int dB_{\mathcal{M}}^{g}\left(a, z_{\mathcal{M},f}, z_{\mathcal{M},m}, i_f, i_m\right).
\end{aligned} \tag{23}$$

The revenue of the government, the left hand side of equation 23, is determined by how many single agents work and which is their productivity plus how many married agents are employed and their productivity. The expenditure of the government, in the right hand side, it basically the sum of agents who receive unemployment benefits. How many agents are entitled to benefits is mainly determined by the employment opportunity shocks. Hence, labor market frictions pin down the size of government spending. Then, taxes are crucially affected by labor market frictions and by how many agents are working, that is by the labor supply of the economy.

2.6 Employment, Unemployment and Non-participation

To connect the model with the moments of the data one needs a strategy to group agents in three categories: Employment (E), Unemployment (U) and Non-participation (N). To do this, we follow the strategy of Krusell, Mukoyama, Rogerson, and Sahin (2011) .

According to the value functions described in the previous sections, the division between employed and non-employed agents is straightforward: those agents who work, are categorized as Employed. Among those who do not work, the ones who would like to work but cannot do it because they do not have an opportunity are categorized as Unemployed. The rest of the non-employed agents would not accept a job offer even if they had one, then, they are categorized as Non-participants.[12]

In the case of single households, if an agent is not employed but her/his policy function for labor supply, $e^{\star}_{\mathcal{S},g}$, equals 1 she/he will be categorized as unemployed. On the contrary, if the policy function equals 0, she/he will be categorized as non-participant. Basically, the strategy to establish the difference between Unemployment and Non-participation is based on the willingness to accept a job opportunity. If the utility cost of performing a job search is low, this definition is close to the actual categorization of the labor force performed by, for example, the Bureau of Labor Statistics in the US.

An analogous strategy is followed for married households. For each household, irrespectively of who actually has an opportunity to work, it is possible to know which agents in the household would like work. This information is contained in the policy function $e^{\star}_{\mathcal{M}}$. So, as an example, if in a married household both agents have the opportunity to work but only the female actually works, then the male agent in this household is considered non-participant. Similarly, if it is only the female the one who has an opportunity to work, but both would like to work, the male agent in this household is labeled as unemployed.

3 Parameterization

A period model is one month. The model considers four types of individuals: single females, single males, married females, and married males. The objective of our calibration is to match labor market stocks and dynamics across these stocks for each of these four groups.

[12] For a deeper discussion about this strategy see Section 3.1 in Krusell, Mukoyama, Rogerson, and Sahin (2011).

Symbol	Description	Value
β	Discount factor	0.9967
r	Monthly interest rate	0.00374
b	Unemployment benefits	0.45
$\Phi_{\mathcal{S},f}$	Fraction single females	0.25
$\Phi_{\mathcal{S},m}$	Fraction single males	0.25
χ	Adult equivalence scale	0.7
π	Cheating probability	0.05
Single Female Households		
$\alpha_{\mathcal{S},f}$	Disutility of work	0.6889
$\delta_{\mathcal{S},f}$	Destruction probability	0.0173
$\lambda_{\mathcal{S},f}$	Arrival probability	0.4008
$\rho_{\mathcal{S},f}$	Persistence income process	0.9905
$\sigma_{\varepsilon_{\mathcal{S},f}}$	Standard deviation income process	0.6473
Single Male Households		
$\alpha_{\mathcal{S},m}$	Disutility of work	0.5699
$\delta_{\mathcal{S},m}$	Destruction probability	0.0197
$\lambda_{\mathcal{S},m}$	Arrival probability	0.3451
$\rho_{\mathcal{S},m}$	Persistence income process	0.9906
$\sigma_{\varepsilon_{\mathcal{S},m}}$	Standard deviation income process	0.5299
Married Households		
$\alpha_{\mathcal{M},f}$	Disutility of work female	0.2123
$\alpha_{\mathcal{M},m}$	Disutility of work male	0.0177
$\alpha_{\mathcal{M}}$	Disutility of joint work	0.2174
$\delta_{\mathcal{M},f}$	Destruction probability female	0.0032
$\delta_{\mathcal{M},m}$	Destruction probability male	0.0099
$\lambda_{\mathcal{M},f}$	Arrival probability female	0.5682
$\lambda_{\mathcal{M},m}$	Arrival probability male	0.4744
$\rho_{\mathcal{M}}$	Persistence income process	0.9923
$\sigma_{\varepsilon_{\mathcal{M}}}$	Standard deviation income process	0.0909
ϕ	Correlation innovation shocks	0.1637

Table 1: Benchmark parameter values.

For each household type, there are nine transition probabilities between employment, unemployment and non-participation, but only six are independent since transitions from the same starting labor market state must add up to one. In the model, these six moments determine the fraction of agents in each state, that is, the labor market stocks, by a simple steady state argument. In the data, this is a very good approximation, as noted for example by Shimer (2012). In total, our calibration exercise targets twenty-four data moments: six transitions by four types of households. We follow Choi and Valladares-Esteban (2015) to compute these transitions, by using monthly data from the Current Population Survey (CPS) and controlling for observables and other known empirical issues. We use a subsample from January 2000 to December 2005, because both the unemployment rate and the female labor supply were stable during that period. Since we consider a Steady State framework for our model, this sample period suits us best: there were significant increases in the supply of labor by females (especially married) from the late 1970s, which stabilized during the early 2000s.

Table 1 presents all parameters values along with a brief description. The first seven parameters in Table 1 are common across households while the remaining twenty parameters are household and/or gender specific: five correspond to single female households, five for single male households, and ten for married households. The first six parameters in Table 1 are chosen using a priori information. The discount factor (β) is selected to be the monthly equivalent of the usual discount factor used in the neoclassical growth model, that is, 0.9967. The monthly interest rate (r) is selected to reflect a 4% annual interest rate. The unemployment insurance payment (b) is set to 0.45 which is a standard value in the search literature (see Gomes, Greenwood, and Rebelo (2001) or Hansen and Imrohoroglu (1992). Both the proportion of single females ($\Phi_{\mathcal{S},f}$) and the proportion of single males ($\Phi_{\mathcal{S},m}$) in the economy are computed using the CPS for the years 2000 to 2005. Finally, the adult equivalence scale (χ) is set to 0.7, the OECD scale. The rest of parameters are calibrated to minimize the distance between the twenty-four transition probabilities described above, as computed from the data vs those generated by the simulated model.

3.1 Single Households

The parameters related with single households (disutility of work $\alpha_{\mathcal{S},g}$, destruction probability $\delta_{\mathcal{S},g}$, arrival probability $\lambda_{\mathcal{S},g}$, persistence of income process $\rho_{\mathcal{S},g}$ and standard deviation of the income process $\sigma_{\mathcal{S},g}$), both for females (f) and males (m), are calibrated to match the transitions across labor market states associated to each group. Table 2 compares the performance of the simulated model with the data for single females while Table 3 does it for single males.

Data				Model			
From / To	E	U	N	From / To	E	U	N
E	96.81	1.10	2.09	E	95.43	1.10	3.47
U	24.72	53.61	21.67	U	39.42	58.44	2.14
N	3.10	1.74	95.16	N	4.44	1.74	93.82
Employment Rate			60.76	Employment Rate			61.04
U-to-Pop Ratio			3.11	U-to-Pop Ratio			3.11
Unemployment Rate			4.87	Unemployment Rate			4.85

Table 2: Data versus Model (%). Single Females. CPS 2000-2005.

Data				Model			
From / To	E	U	N	From / To	E	U	N
E	96.29	1.55	2.16	E	95.21	1.24	3.55
U	25.86	57.33	16.81	U	33.92	63.85	2.23
N	3.58	1.93	94.50	N	5.09	1.93	92.98
Employment Rate			63.97	Employment Rate			62.67
U-to-Pop Ratio			3.99	U-to-Pop Ratio			3.92
Unemployment Rate			5.88	Unemployment Rate			5.88

Table 3: Data versus Model (%). Single Males. CPS 2000-2005.

Both for females and males, the employment rate is mainly determined by the disutility of work ($\alpha_{\mathcal{S},g}$) and the standard deviation of the income process ($\sigma_{\mathcal{S},g}$). The destruction probability ($\delta_{\mathcal{S},g}$) and the arrival probability ($\lambda_{\mathcal{S},g}$) are the main parameters responsible for the transitions from employment (E) to unemployment (U), from unemployment (U) to employment (E), from inactivity (N) to employment (E) and for the overall unemployment rate. On the other hand, transitions from E to E, U to U and from N to N are affected mostly by the persistence parameter of the income process, $\rho_{\mathcal{S},g}$.

The model does a good job replicating all the moments of the data except for the three transitions out of unemployment. Basically, the model is not able to account for the transition from U to N which implies that the other two transitions from unemployment are not properly matched (transitions out of each state must sum up to one). Given the structure of the model this is not a surprising outcome. The only reason why an agent might transit from unemployment to non-participation is because, given a sufficient amount of assets, changes in the income process induce her/him to prefer not to work. In practice, other factors which are not included in the model might be playing an important role (welfare subsidies, human capital depreciation, individuals going back to school, etc.).

3.2 Married Households

In the case of married households, ten parameters are calibrated to simulate twelve targets. Table 4 compares the performance of the model with the data for married females and Table 5 does it for married males.

Data				**Model**			
From / To	E	U	N	From / To	E	U	N
E	96.18	0.77	3.05	E	96.39	0.23	3.38
U	26.78	47.02	26.20	U	32.84	33.29	33.87
N	3.30	1.13	95.57	N	3.55	2.03	94.43
Employment Rate			55.32	Employment Rate			55.21
U-to-Pop Ratio			1.85	U-to-Pop Ratio			1.50
Unemployment Rate			3.24	Unemployment Rate			2.65

Table 4: Data versus Model (%). Married Females. CPS 2000-2005.

Data				**Model**			
From / To	E	U	N	From / To	E	U	N
E	97.60	0.92	1.48	E	97.56	0.78	1.65
U	29.88	56.58	13.53	U	33.68	44.59	21.73
N	3.37	1.16	95.47	N	6.22	3.88	89.91
Employment Rate			72.86	Employment Rate			79.04
U-to-Pop Ratio			2.22	U-to-Pop Ratio			2.41
Unemployment Rate			2.96	Unemployment Rate			2.96

Table 5: Data versus Model (%). Married Males. CPS 2000-2005.

Analogously to single households, employment rates are mainly affected by the three parameters related to the disutility of work ($\alpha_{\mathcal{M},f}$, $\alpha_{\mathcal{M},m}$ and $\alpha_{\mathcal{M}}$). Our calibration assigns a disutility of work for a married man which is lower than the one for a married women. This is the main wedge that the model needs to replicate: in the data, married males are more likely to be employed than married females. The destruction probabilities ($\delta_{\mathcal{M},g}$) and the arrival probabilities ($\lambda_{\mathcal{M},g}$) are mainly responsible for transitions from E to U, from U to E, from N to E and for the unemployment rate. The main parameter determining the transitions within the same state (from E to E, from U to U and from N to N), both for females and males, is the persistence parameter of the income process ($\rho_{\mathcal{M}}$). Finally, the correlation between spouses' income shocks (ϕ) mainly affects the transition U to E.

As in the case of single households, the model is not completely accurate replicating the transitions out of unemployment. However, now the transition from U to N is much better captured than in the case of single households. This is due to the responses to spouses employment status, or the *added worker effect*. As an example, take the case of a household in which both agents are unemployed. If, let's say, the male finds a job opportunity and his productivity is high enough, the female might decide that she does not want a job anymore, hence, she becomes a non-participant. That is, consumption sharing inside of a married household provides an additional motive for agents to transit from unemployment to non-participation. Finally, the model slightly underestimates the employment rate of both females and males.

3.3 The Calibrated Labor Income Processes

There is a large literature that estimates income processes directly from the data (for example Hyslop (2001) or Blundell, Pistaferri, and Preston (2008)). Here, instead of using the values from the literature, We estimate the labor income processes that provide a better match to observed labor market dynamics from the data. The main reason for choosing this route is that, conceptually, the income processes present in the model are not only related with labor income per se but also capture other shocks that affect the payoffs of working: shocks to home production, family shocks, preference shocks, etc.[13]

Nonetheless, the estimated parameters for the labor income shocks do not differ much from other computations in the literature. Regarding the magnitude of the estimates, the values obtained are in a similar range of the estimates of idiosyncratic wage shocks in French (2005) or Floden and Lindé (2001). Concerning the differences between married and singles, Santos and Weiss (2012)

[13]See discussion in Krusell, Mukoyama, Rogerson, and Sahin (2011).

use PSID data to compute income processes for males of the two groups. As it is the case for our estimates, they find that the process for married is more persistent than for singles, and that the standard deviation of the process for married is lower than for singles. Finally, our estimate of the correlation between income shocks of married agents is not very different from the estimation in Hyslop (2001).

In terms of non-targeted moments, table 6 shows a comparison between predictions from our model and the data with respect to two key statistics which are related to coverage of unemployment insurance: average observed duration of unemployment benefits (measured in weeks) and the share of unemployed workers who receive unemployment insurance.

	Data	Model
Duration of unemployment benefits (weeks)	16.61	9.60
Share of unemployed workers covered by UI (%)	39.18	33.80

Table 6: Duration comes from FRED (Saint Louis FED). Efficiency comes from US Department of Labor, Employment and Training Administration.

4 Results

4.1 Accounting For The Marriage Unemployment Gap

In the benchmark economy, different labor market outcomes between married and single agents are generated by two factors: On the one hand, single and married households face different labor market environments because they are endowed with different employment and productivity shocks. On the other hand, the decision environments of married and single agents are different. Married agents take decisions with their spouses, single agents make decisions *alone*, and each type of household is characterized by different utility costs of working. The different utility costs of working along with the fact that married agents decide under a unitary framework pooling resources is what we define as *the family*.

In our framework, the differences between the parameters that characterize the labor market environment of single agents and the parameters that characterize the labor environment of married agents capture all the differences in the targeted moments that cannot by accounted for by the family. Since the targeted moments are net of the effects of observable demographics,[14] the parameters capture the differences generated by unobservable characteristics.

	Employment Rate		Unemployed to Population Ratio		Unemployment Rate	
	Singles	Married	Singles	Married	Singles	Married
Benchmark	62.67	79.04	3.92	2.41	5.88	2.96
Destruction probability	62.67	75.41	3.92	4.12	5.88	5.19
Arrival probability	62.67	79.30	3.92	6.12	5.88	7.17
Correlation shocks	62.67	68.92	3.92	7.29	5.88	9.56
Peristence income process	62.67	70.18	3.92	6.86	5.88	8.90
S.d. income process	62.67	60.84	3.92	16.01	5.88	20.83

Table 7: Counterfactual experiment for Males. The experiment consists of changing the parameters that characterize the situation of married household for those of single agents. Each row adds the to the effect of all previous rows.

In order to isolate the effect of the family on unemployment outcomes we build a set of counterfactual economies. The results of this experiment for males are presented in Table 7. Each row presents the employment rate, the unemployed to population ratio and unemployment rate for a different counterfactual economy. While the first row presents the outcomes of the benchmark calibration, the second row is an economy in which married agents face the same job destruction probability of single males. In the economy described in the third row, married agents face the same job destruction and job arrival probabilities of single men. The fourth row, is the same as the third one, and sets the correlation between income shocks of married agents to 0. The fifth row adds all the changes from rows one to four and sets the persistence of the income process of married households to the level of single males. Finally, the last row represents an economy in which married households are endowed with the same labor market environment of single males.

In the latter economy, differences in labor market outcomes are only generated by the family. In this counterfactual, married agents present a lower employment rate (60.84% versus 62.67%) and are more likely to be unemployed than singles. In particular, the unemployment rate of married agents is 20.83% while it is 5.88% for singles. These results illustrate the main effect of the family on employment and unemployment. Because the family provides insurance, it reduces agents'

[14]See our discussion above and Choi and Valladares-Esteban (2015).

willingness to work. In our model, the share of agents that is willing to work is given by the participation rate (employment rate plus unemployed to population ratio). Both employed and unemployed agents find working optimal but unemployed agents do not receive a job offer. In the benchmark economy 81.45% of married males find working optimal. However, when married males face the labor market environment of single males (last row in Table 7), 76.85% of married males find working optimal. Thus, the family effect pushes the unemployment rate up.

4.2 Welfare Implications of The Unemployment Insurance Program

The main purpose of this section is to understand whether the unemployment insurance program described in Section 2.2 has different welfare implications for single and married households. In order to achieve this goal, the first counterfactual experiment we conduct is to change the amount of unemployment benefits in the economy, find the correspondent tax that is able to finance it, and compute welfare levels for each type of household.

As explained in Section 2.5, the properties of the income shocks and the parameters related to labor market frictions determine the steady state distribution of agents across states. Using these distributions, welfare is computed as the weighted sum of the value of being in a particular state for each type of household in the steady state.

Figure 1 displays the welfare levels, with respect to the benchmark calibration, that different amounts of unemployment benefits generate for both single males and married households. Each point represents the percentage change with respect to the amount of welfare that each household obtains in the benchmark economy. Remember that each amount of unemployment benefits is associated to a tax rate that balances the budget of the government.

While for single households higher amounts of unemployment benefits are associated with higher welfare, for married households the relationship is of the opposite sign. Single households are willing to accept higher income tax rates in exchange of receiving higher benefits when not having opportunities to work. However, married households dislike the increase in taxes that higher benefits imply. In fact, for married households the best situation possible is no benefits (and no taxes) at all.

The fact that the UI is not able to improve the welfare of married households can be explained as follows. In this economy, taxes can be understood as the *premium* that a household pays in order to receive a compensation whenever an agent looses the opportunity to work. Given an amount of

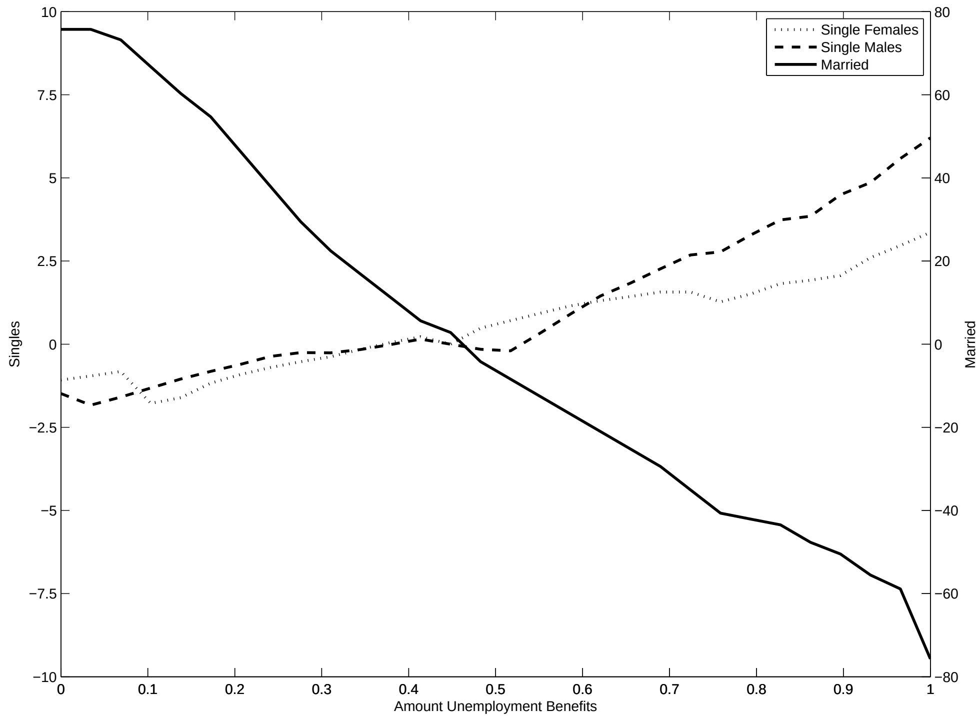

Figure 1: Changes in welfare levels for different amounts of unemployment benefits. Benchmark calibration.

unemployment benefits, the premium of the insurance is mainly pinned down by the labor market frictions in the economy, due to the fact that the government runs a balanced budget. In other words, the price of the insurance is determined by how many agents loose their opportunity to work. Most importantly, the premium (the tax) and the compensation (the unemployment benefits) of the unemployment insurance are the same for all the agents in the economy. However, married agents are less likely to be unemployed than their single counterparts. Moreover, the family is already providing insurance against employment loss. Hence, the insurance policy offered by the UI program is not adjusted to their needs. Loosely speaking, the unemployment insurance scheme is biased towards the singles, who need *more* insurance.

Figure 2 performs the same exercise but in a counterfactual economy in which married households are endowed with the same labor market environment parameters as single males. In this case, the qualitative results are the same. Married households do not benefit from the UI program while singles do. From this exercise we conclude that the main reason married households do not benefit from the unemployment insurance program is not because their lower likelihood of being

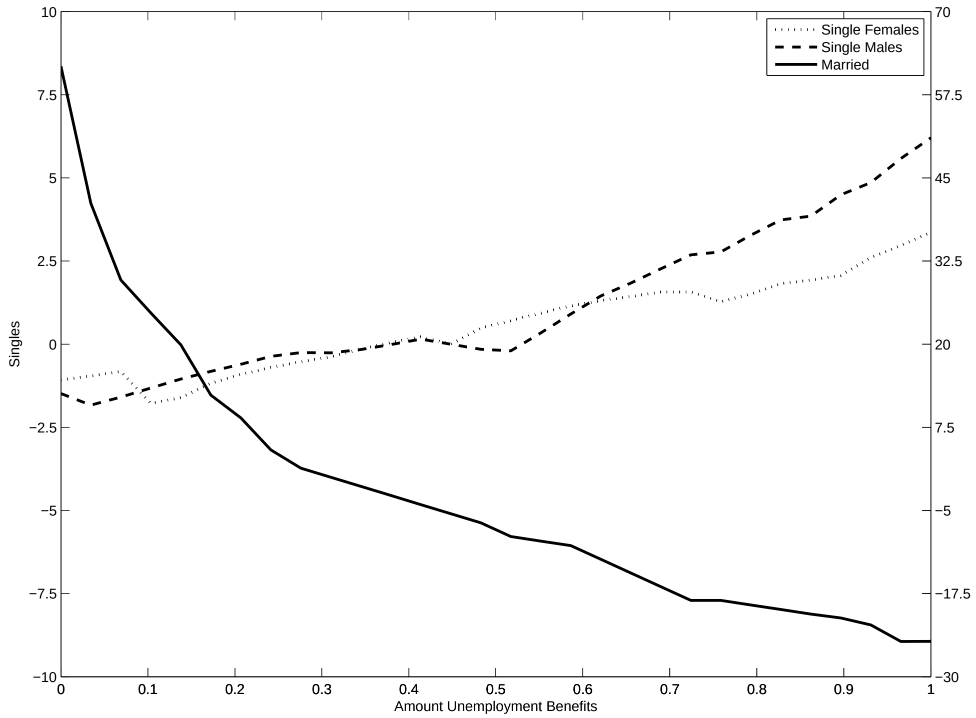

Figure 2: Changes in welfare levels for different amounts of unemployment benefits. Counterfactual Experiment. A counterfactual married couple is a single male married to a single female.

unemployed but the fact that the family is able to provide insurance in a cheaper way.

5 Conclusions

In this paper we propose a framework where we make explicit the coexistence of single and married workers in the labor market. Our quantitative model is an extension of the standard incomplete markets model and is able to replicate the differences in labor market stocks and unemployment rates observed in the US economy. We use the model to study the welfare properties of the US unemployment benefit scheme and find that unemployment insurance is welfare enhancing for single agents, but it is not for married ones. Using the model, we assess that this result is due to the fact that households with more than one member have a strong insurance mechanism, which is the pooling of household resources, through joint savings and the added worker effect. Our results show the importance of studying the interplay between government provided and private (self) insurance in environments with heterogeneous agents.

References

Abdulkadiroglu, A., B. Kuruscu, and A. Sahin (2002): "Unemployment Insurance and the Role of Self-Insurance," *Review of Economic Dynamics*, 5(3), 681–703.

Aiyagari, S. (1994): "Uninsured idiosyncratic risk and aggregate saving," *The Quarterly Journal of Economics*, 109(3), 659–684.

Bewley, T. (1980): "Interest Bearing Money and The Equilibrium Stock of Capital," Mimeo.

Blundell, R., L. Pistaferri, and I. Preston (2008): "Consumption Inequality and Partial Insurance," *American Economic Review*, 98(5), 1887–1921.

Chang, Y., and S.-B. Kim (2007): "Heterogeneity and Aggregation: Implications for Labor-Market Fluctuations," *American Economic Review*, 97(5), 1939–1956.

Choi, S., and A. Valladares-Esteban (2015): "The Marriage Unemployment Gap," Mimeo.

Dey, M., and C. Flinn (2008): "Household Search and Health Insurance Coverage," *Journal of Econometrics*, 145(1), 43–63.

Di Tella, R., and R. MacCulloch (2002): "Informal family insurance and the design of the welfare state," *The Economic Journal*, 112, 481–503.

Ek, S., and B. Holmlund (2010): "Family Job Search, Wage Bargaining, and Optimal Unemployment Insurance," *The B.E. Journal of Economic Analysis and Policy*, 10(1), 47.

Flabbi, L., and J. Mabli (2012): "Household Search or Individual Search: Does it Matter? Evidence from Lifetime Inequality Estimates," IZA Discussion Paper No. 6908.

Floden, M., and J. Lindé (2001): "Idiosyncratic Risk in the United States and Sweden: Idiosyncratic Risk in the United States and Sweden: Is There a Role for Government Insurance?," *Review of Economic Dynamics*, 4, 406–437.

French, E. (2005): "The Effects of Health, Wealth, and Wages on Labour Supply and Retirement Behaviour," *The Review of Economic Studies*, 72(2), 395–427.

Gomes, J., J. Greenwood, and S. Rebelo (2001): "Equilibrium Unemployment," *Journal of Monetary Economics*, 48(1), 109–152.

Guler, B., F. Guvenen, and G. Violante (2012): "Joint-Search Theory: New Opportunities and New Frictions," *Journal of Monetary Economics*, 54(4), 352–369.

Guner, N., R. Kaygusuz, and G. Ventura (2012): "Taxation and Household Labour Supply," *The Review of Economic Studies*, 79(3), 1113–1149.

Hansen, G., and A. Imrohoroglu (1992): "The Role of Unemployment Insurance in an Economy with Liquidity Constraints and Moral Hazard," *Journal of Political Economy*, 100(1), 118–142.

Heathcote, J., K. Storesletten, and G. L. Violante (2010): "The Macroeconomic Implications of Rising Wage Inequality in the United States," *Journal of Political Economy*, 118(4), 681–722.

Hong, J. H., and J. V. Ríos Rull (2007): "Social Security, Life Insurance and Annuities for Families," *Journal of Monetary Economics*, 54, 118–140.

Hopenhayn, H., and J. P. Nicolini (1997): "Optimal Unemployment Insurance," *Journal of Political Economy*, 105(2), 412–438.

Huggett, M. (1993): "The Risk-Free Rate in Heterogeneous-Agent Incomplete-Insurance Economies," *Journal of Economic Dynamics and Control*, 17(5-6), 953–969.

Hyslop, D. R. (2001): "Rising U.S. Earnings Inequality and Family Labor Supply: The Covariance Structure of Intrafamily Earnings," *American Economic Review*, 91(4), 755–777.

Kleven, H. J., C. T. Kreiner, and E. Saez (2009): "The Optimal Income Taxation of Couples," *Econometrica*, 77(2), 537–560.

Krusell, P., T. Mukoyama, R. Rogerson, and A. Sahin (2011): "A Three State Model of Worker Flows in General Equilibrium," *Journal of Economic Theory*, 146(3), 1107–1133.

Mankart, J., and R. Oikonomou (2012): "Household Search and the Aggregate Labor Market," Mimeo, University of St. Gallen.

Nicholson, W., and K. Needels (2006): "Unemployment Insurance: Theory and Policy," *Journal of Economic Perspectives*, 20(3), 47–70.

Ortigueira, S., and N. Siassi (2013): "How Important Is Intra-Household Risk Sharing for Savings and Labor Supply?," *Journal of Monetary Economics*, 60(6), 650–666.

Rendon, S. (2006): "Job Search and Asset Accumulation Under Borrowing Constraints," *International Economic Review*, 47(1), 233–263.

Santos, C., and D. Weiss (2012): "Risky Income, Risky Families: Marriage and Divorce in a Volatile Labor Market," Mimeo.

Shimer, R. (2012): "Reassessing the Ins and Outs of Unemployment," *Review of Economic Dynamics*, 15(2), 127–148.

Shimer, R., and I. Werning (2008): "Liquidity and Insurance for the Unemployed," *American Economic Review*, 98(5), 1922–1942.