# Spousal Labor Supply Response to Job Displacement and Implications for Optimal Transfers

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Spousal Labor Supply Response to Job Displacement and Implications for Optimal Transfers*

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Abstract
I document a small spousal earnings response to the job displacement of the family head. The response is even smaller in recessions, when earnings losses are larger and additional insurance is most valuable. I investigate whether the small response is an outcome of the crowding-out effects of government transfers. To accomplish this, I use an incomplete markets model with family labor supply and aggregate fluctuations where predicted spousal labor supply elasticities with respect to transfers are in line with microeconomic estimates both in aggregate and across subpopulations. Counterfactual experiments indeed reveal that generous transfers in recessions discourage the spousal labor supply significantly. I then show that the optimal policy features procyclical means-tested and countercyclical employment-tested transfers, unlike the existing policy that maintains generous transfers of both types in recessions. Abstracting from the incentive costs of transfers on the spousal labor supply changes both the level and cyclicality of optimal transfers.

JEL-Codes: E24, E32, H31, J64

Keywords: Unemployment, Business Cycles, Fiscal Policy and Household Behavior, Job Search

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†An Online Appendix for this paper is available on the author’s website: https://serdarbirinci.weebly.com/research.html. Contact: serdar.birinci@stls.frb.org

‡The views expressed in this paper do not necessarily reflect the positions of the Federal Reserve Bank of St. Louis or the Federal Reserve System.
1 Introduction

Job displacement has large negative and long-lasting effects on individual labor earnings. These effects are more pronounced when the displacement happens in recessions. The impact of earnings losses on family consumption is mitigated through both public insurance and private insurance, a crucial component of which is spousal labor supply adjustments. Importantly, the magnitude of the spousal labor supply response to unexpected earnings fluctuations depends on the generosity of government transfers made available to these households. Thus, while generous transfers in recessions are thought to alleviate earnings losses in the event of the family head’s job displacement, they may crowd out private insurance in the form of the spousal labor supply and, in effect, leave households worse off because of a higher tax burden. Given the interaction of public and private insurance, I ask the following questions: how much do government transfers affect the magnitude of the spousal labor supply response to the family head’s job displacement over the business cycle? What is the optimal design of transfers over the business cycle when the spousal labor supply is endogenous to government policy?

To answer these questions, I first measure the impact of a family head’s job displacement both in recessions and in expansions on family labor earnings (i.e., sum of the family head’s and spouse’s labor earnings) and spousal labor earnings, using data from the Panel Study of Income Dynamics (PSID). Little is known about the change in family and spousal earnings upon the head’s job displacement across recessions and expansions, but it has an important role in quantifying the magnitude of private insurance available to families over the business cycle. I address this gap by documenting two novel results. First, families enjoy some insurance from the presence of a second earner at the time of the head’s displacement. In particular, the average decline in family labor earnings is around two-thirds of the average decline in the head’s labor earnings one year after the job displacement in recessions and expansions. Second, the change in spousal earnings in response to the head’s displacement is small, especially after displacements that occur in recessions. Over 10 years after the head’s displacement, the average change in spousal earnings of that family relative to the spousal earnings of a family with a non-displaced head is only $-0.8$ percent in

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1 For example, Blundell, Pistaferri, and Saporta-Eksten (2016) show that family labor supply provides sizeable consumption insurance against wage shocks within the family.

2 In my sample, the family head is almost always male.
recessions and 8 percent in expansions. This result is particularly interesting because one might expect a stronger spousal earnings response during times when the head experiences larger earnings losses.

I argue that the small spousal earnings response in recessions is an outcome of crowding-out effects of existing government transfers, which are more generous in recessions relative to expansions (i.e., countercyclical). To investigate this, I use an incomplete markets model with family labor supply and labor productivity-driven business cycles, where the labor supply decisions of both members of the household are endogenous to changes in government transfers. In the model, employed individuals are subject to idiosyncratic job displacement risk, while unemployed individuals face the risk of a long duration without a job because of frictions in the labor market that prevent the formation of matches. The strength of the labor market frictions varies over the business cycle: job displacement rates increase, while job finding rates endogenously decrease in recessions since firms reduce vacancy postings when labor productivity is lower. This recognizes that besides crowding-out effects of generous transfers, spousal labor supply responses can be muted also because of lower job finding rates in recessions. I show that when the model is calibrated to match the level and cyclicality of i) the head’s earnings losses upon job displacement, ii) job finding rates, and iii) government transfers, it generates a small change in spousal earnings upon the head’s displacement in recessions, as in the data.

To ensure that the role of government transfers in explaining the small change in spousal earnings upon the head’s displacement is not overstated in the model, I compare the magnitude of model-implied female labor supply elasticities to those found in empirical studies. First, several microeconomic studies estimate the magnitude of the female labor force participation elasticity with respect to net wages identified from unexpected changes in taxes or tax credits. Overall, these estimates are between 0.15 – 0.43, and the magnitude of this elasticity is decreasing based on the level of household income targeted in the tax reform. In the model, by implementing an unexpected change in income taxes, I find that the female participation elasticity with respect to net wages is 0.31, and, importantly, it is also decreasing in household income. For this reason, in the model, the spousal labor supply is more responsive to changes in policy in recessions, when the head’s earnings losses are larger and household income is lower. Second, using the PSID, I calculate the magnitude of the elasticity of spousal earnings with respect to the amount of transfer
receipt across households living in U.S. states with different transfer generosity. I find that the magnitude of this elasticity is 0.44 in the data, while the model’s estimate is 0.37. Furthermore, the model reveals that spousal earnings change the most when the amount of means-tested transfers is varied, while spousal earnings are almost inelastic to the generosity of employment-tested transfers.\(^3\) This is because the eligibility for means-tested transfers requires low family labor income, which puts an implicit income tax on spousal labor supply and thus discourages it when the transfer amount is large. On the other hand, eligibility for employment-tested transfers requires job search, and such transfers pay only low amounts for a short duration.

Using this model, I implement a counterfactual experiment that allows me to isolate the effects of government policy changes on the spousal labor supply. In this experiment, where total government transfers are designed to be less generous in recessions and more generous in expansions (i.e., procyclical), I find that spousal earnings increase significantly following the head’s displacement in recessions but remain small in expansions. This result is an outcome of the larger magnitude of female labor supply elasticities when household income is lower, which happens in recessions due to larger earnings losses upon job displacement. The procyclical policy leaves the marginal utility of consumption high after job loss in recessions and induces spouses to supplement family earnings by working. In expansions, earnings losses are relatively smaller and the marginal value of increasing spousal earnings is lower. Hence, during these times, the spousal earnings response to the head’s displacement is small and almost inelastic to transfer generosity. This result sheds light on why the change in female earnings upon the job loss of the primary earner of the household, otherwise known as the “added worker effect,” is small.\(^4\) I argue that female earnings is in fact responsive to both the earnings loss of the primary earner and changes in transfer generosity, but in an opposite way. As a result, the measured female earnings response from the data is masked by the crowding-out effects of transfers.

Next, I study the optimal design of means-tested and employment-tested transfers over the business cycle. I find that the optimal policy features procyclical means-

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\(^3\) The Supplemental Nutrition Assistance Program (SNAP), Earned Income Tax Credit (EITC), and Temporary Assistance for Needy Families (TANF) are examples of means-tested transfers, while unemployment insurance (UI) is an example of employment-tested transfers. These types of government transfers are typically available to families with displaced members.

tested and countercyclical employment-tested transfers. Overall, however, total government transfers under the optimal policy are procyclical, which is in contrast to the current policy that maintains generous transfers in recessions. Means-tested transfers are procyclical because lower transfers in recessions induce a large increase in spousal entry into the labor force upon a head’s displacement. This is a direct implication of the high incentive costs of generous means-tested transfers, especially when household income is lower. The provision of insurance is better accomplished through more generous employment-tested transfers in recessions, when unemployment is higher.

In an economy in which the optimal policy is implemented, labor force participation of married women is 5 percentage points higher compared to an economy in which the current policy is implemented. Higher employment reduces the income tax required to finance a similar average level of government transfers. Moreover, the economy under the optimal policy is wealthier and has a lower fraction of families with non-positive net liquid wealth. These differences in the macroeconomy result in a higher average consumption level and slightly lower average consumption volatility. Overall, the optimal policy yields an ex-ante welfare gain of around 0.6 percent additional lifetime consumption compared with the current policy. Most of the welfare gains are enjoyed by wealth-poor families with an unskilled male who is married to a skilled female. It is precisely for this family that a spouse’s participation in the labor force can bring higher levels of income to the family, which is especially valuable when the displacement risk of the head is larger.

To explore whether accounting for the endogeneity of the spousal labor supply to transfers is critical in determining the optimal policy, I modify the baseline model such that the spousal labor supply is exogenous to government policy. In particular, I keep female labor supply decisions unchanged even when government policy is varied. Abstracting from the incentive costs of transfers on the spousal labor supply results in an optimal policy that is more generous on average than the optimal policy in the model with an endogenous spousal labor supply. Furthermore, the optimal policy now features slightly countercyclical means-tested and employment-tested transfers because the optimal cyclicality of government transfers is now driven largely by the cyclicality of insurance benefits, which is larger in recessions. This exercise shows that endogenizing the spousal labor supply to changes in government policy is critical in

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I will show in Section 5 that the optimal policy has levels of average transfers similar to those in the current policy.
determining both the optimal level and cyclicality of government transfers. As a result, policy makers should recognize that married households have an important source of self-insurance through adjustments in the spousal labor supply, and generous payments to these households make them worse-off due to large crowding-out.

**Related literature** This paper contributes to the growing literature on the effects of job displacement on earnings. Empirically, it is documented that job displacement has large negative and persistent effects on individual labor earnings (Jacobson, LaLonde, and Sullivan 1993, Ruhm 1991, Stevens 1997). More recently, Davis and Von Wachter (2011) show that earnings losses are larger when displacement happens in recessions. Jarosch (2015), Huckfeldt (2016), Krolikowski (2017), and Jung and Kuhn (2019) develop models that can endogenously generate persistent and negative effects of job displacement on earnings. In this paper, I rather focus on the effects of job displacement over the business cycle on the labor supply behavior of the secondary earner. I first estimate the impact of a head’s job displacement in recessions and expansions on spousal earnings and hours. This helps me to quantify the magnitude of available spousal insurance to displaced individuals in recessions and expansions. I then use these empirical findings in a model to understand the effects of government transfers on the spousal earnings response to the head’s displacement and study the optimal design of transfers over the business cycle.

Two separate strands of literature analyze the role of female labor supply as an insurance mechanism against idiosyncratic earnings risk within the family (Blundell, Pistaferri, and Saporta-Eksten 2016, Wu and Krueger 2019) and how income taxation effects married women’s labor supply (Kaygusuz 2010, Guner, Kaygusuz, and Ventura 2012, Bick and Fuchs-Schundeln 2017, Borella, De Nardi, and Yang 2019). This paper aims to combine these two strands of work as it analyzes the magnitude of private insurance provided by the labor supply response of the secondary earner against the earnings loss of the primary earner over the business cycle and how this private insurance mechanism is affected by the generosity of government transfers. Specifically, I investigate the role of generous government transfers in explaining the small changes in spousal earnings upon the head’s displacement and study the optimal design of transfers over the business cycle, taking into account the endogeneity of private insurance to transfer generosity.

Finally, a separate literature studies the optimal design of transfer programs. It is
possible to divide this large literature into two groups based on modeling choices and welfare analysis. The first group of papers studies the optimal design of transfers using models with an endogenous family labor supply but without aggregate fluctuations (Ortigueira and Siassi 2013, Fernandez-Blanco 2017, Mankart and Oikonomou 2017, Choi and Valladares-Esteban 2019, Haan and Prowse 2019). The second group studies the optimal design of taxes or transfers in a model with aggregate fluctuations but without an endogenous family labor supply as a private insurance mechanism (Mitman and Rabinovich 2015, Bhandari et al. 2018, Landais, Michaillat, and Saez 2018, McKay and Reis 2019, Birinci and See 2020). This paper combines these two groups of studies as it analyzes the optimal level and cyclicality of means-tested and employment-tested transfers using a model with an endogeneous family labor supply and aggregate fluctuations. Relative to the first group of papers, I find that more than half of the welfare gains from the optimal policy are attributable to its cyclicality. Relative to the second group of papers, I show that endogenizing the spousal labor supply to policy changes the optimal level and cyclicality of transfers.

This paper is organized as follows. Section 2 presents the model. Section 3 documents the empirical findings about the impact of the head’s displacement on family and spousal earnings, explains the calibration strategy, and discusses the model’s validation against untargeted data moments. Section 4 analyzes the effects of transfer policies on the spousal labor supply response to the head’s displacement and studies the optimal design of government transfers. Section 5 provides a list of extensions and robustness checks. Finally, Section 6 concludes. The Appendix provides more details on the data, model, and results.

2 Model

2.1 Environment

Setting Time $t$ is discrete and runs forever. The economy is populated by a large number of ex-ante identical households $j$ that consist of a male $m$ and a female $f$ individual $i$; i.e., $i \in \{m, f\} \forall j$. In each period, a household can be in the labor force or retired. Both members of a household in the labor force retire with probability $\zeta_R$.\footnote{Throughout the paper, I suppress the index $j$ when it is clear that a variable is a household variable. Instead, I use the index $i$ for individual variables to differentiate them from household variables.}
Retired households die with probability $\zeta_D$, and they are replaced by new households entering into the labor force. Households discount the future at rate $\beta$.

Households are heterogeneous in terms of their assets $a \in A \equiv [a_L, a_H] \subseteq \mathbb{R}$, human capital $h_i \in H \equiv \{h_L, ..., h_H\}$ of each member, and employment status $l_i$ of each member who can be employed $E$, unemployed and eligible for employment-tested UI benefits $U_b$, unemployed and ineligible for such benefits $U_n$, or retired $R$.

Households have access to incomplete asset markets where they can save or borrow up to a limit at an exogenous interest rate $r$. They make joint choices of savings and labor supply of the non-employed members. Preferences are given by

$$U(c, s_m, s_f) = u(c) + \sum_i \eta_i (1 - s_i)$$

where $u(\cdot)$ is a strictly increasing and strictly concave utility function over household consumption level $c$ that satisfies Inada conditions; $s_i \in \{0, 1\}$ is labor supply decision of individual $i$ at the extensive margin; and $\eta_i$ is the value of leisure. The only parameter that defines gender in this model is $\eta_i$. This implies that the utility cost of work or search is different between males and females to capture the employment differences between them. Furthermore, employed individuals work full-time and there is no on-the-job-search. Thus, the above functional form assumes that individuals only enjoy the value of leisure if they do not look for jobs when unemployed.\footnote{In Section 5, I also analyze the effect of a utility function with non-separable consumption and leisure on my main results, following Blundell, Browning, and Meghir (1994) and Attanasio and Weber (1995).}

The aggregate state variables of the economy are summarized by $\mu = (z, \Gamma)$, where $z$ is aggregate labor productivity and $\Gamma$ is the distribution of households across states. The law of motion for the aggregate states is given by $z' \sim \Phi(z' | z)$ and $\Gamma' = \Lambda(\mu, z')$.

**Labor market** The labor market is segmented in human capital $h$; i.e., jobs are characterized by their human capital requirement level $h$. Vacant firms post job openings in specific human capital submarkets after paying a fixed cost $\kappa$ of posting a vacancy. On the other side of the labor market, unemployed individuals look for jobs that are compatible with their own human capital level.

The labor market tightness of submarket $h$ is defined as the ratio of vacancies $v$ posted in the submarket to the number of unemployed searching for a job within that submarket; i.e., $\theta(h; \mu) = \frac{v(h; \mu)}{u(h; \mu)}$. Let $M(v, u)$ be a constant-returns-to-scale matching
function that determines the number of matches in a submarket with the number of unemployed \( u \) and number of vacancies \( v \). Then, 
\[
p(h; \mu) = \frac{M(v(h;\mu),u(h;\mu))}{u(h;\mu)}
\]
is the job finding rate and 
\[
q(h; \mu) = \frac{M(v(h;\mu),u(h;\mu))}{v(h;\mu)}
\]
is the vacancy filling rate in submarket \( h \) when the aggregate state is \( \mu \). The constant-returns-to-scale assumption guarantees that the equilibrium object \( \theta \) suffices to determine the job finding and vacancy filling rates since 
\[
p(\theta) = M(v, u) = M(1, 1)
\]
while 
\[
q(\theta) = M(v, u) v = M(1, \theta)
\].

Once matched, the firm-worker pair converts one unit of labor into 
\( g(h, z) \) units of consumption goods, where \( g(\cdot) \) is a strictly increasing function of a worker’s human capital level \( h \) and aggregate productivity \( z \). The firm pays a wage \( w(h, z) \) to the worker. I assume that the period output is shared between the firm and the worker. In particular, the worker receives an \( \alpha \) share of the period output as a wage, which implies that 
\[
w(h, z) = \alpha g(h, z).
\]
The firm-worker pair continues to operate until the match exogenously dissolves with probability \( \delta(h, z) \in [0, 1] \) or the worker retires with probability \( \zeta_R \). The \( \delta(\cdot) \) is a decreasing function of both \( h \) and \( z \).

**Human capital dynamics**  
Human capital level \( h \) lies in an equispaced grid \( H \). All newborn individuals begin with the lowest skill level. For an unemployed individual with human capital level \( h \), human capital evolves as follows:
\[
h' = \begin{cases} 
    h & \text{with probability } 1 - \pi^U \\
    h - \Delta^U(z) & \text{with probability } \pi^U.
\end{cases}
\]
Similarly, human capital level \( h \) of an employed individual evolves as follows:
\[
h' = \begin{cases} 
    h + \Delta^E & \text{with probability } \pi^E \\
    h & \text{with probability } 1 - \pi^E.
\end{cases}
\]

Relative to Ljungqvist and Sargent (1998), I make an additional assumption and allow \( \Delta^U \) to vary over the business cycle \( z \) to generate larger earnings losses upon job displacements in recessions, as documented by Davis and von Wachter (2011).

\( ^8 \)This assumption is similar to that in Herkenhoff, Phillips, and Cohen-Cole (2019), and it implies that varying the government policy does not affect equilibrium wages and thus firm vacancy posting decisions, leaving the labor demand the same across policies. This allows me to better isolate the effect of transfers on labor supply. In Section 5, I extend the baseline model to endogenize wage choices of the unemployed into a directed search model and analyze the effects of this assumption on my main results.
**Government transfers**  Government runs three transfer programs: means-tested, employment-tested, and retirement transfers. Employment-tested and means-tested transfers are paid to only eligible households in the labor force, while retirement transfers are paid to only retired households. The time-invariant amount of retirement transfers is given by $b_R$.

Eligibility for means-tested transfers is determined at the household level, similar to the implementation of means-tested transfers in the U.S. A household is eligible for means-tested transfers if the amount of household assets $a$ is lower than an asset threshold $a_0$, and if the amount of household labor income $y$ (which is the summation of the labor income of both the head and the spouse) is lower than an income threshold $y$. Both $a$ and $y$ are policy instruments of the government. Eligibility for these transfers never expires as long as the income and assets tests are satisfied. The amount of means-tested transfers may vary over the business cycle, and it is given as follows$^9$:

$$
\phi(z; a, y) = \begin{cases} 
\phi(z) & \text{if } y < y_0, a < a_0 \\
0 & \text{otherwise}
\end{cases}
$$

On the other hand, eligibility for employment-tested transfers is determined at the individual level as in the UI program in the U.S. An individual may be eligible $U_b$ or ineligible $U_n$ for employment-tested transfers upon job displacement, and the eligible individual only starts receiving these transfers if he/she is actively searching for a job; i.e., $s_i > 0$. Employment-tested transfers stochastically expire at rate $e(z) \in [0, 1]$, as in Mitman and Rabinovich (2015). The amount of employment-tested transfers also varies over the business cycle, and it is given as follows:

$$
b(z; l_i, s_i) = \begin{cases} 
b(z) & \text{if } l_i = U_b, s_i > 0 \\
0 & \text{otherwise}
\end{cases}
$$

To finance these programs, the government levies a flat income tax $\tau$ applied to

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$^9$I restrict the policy instruments to depend on the aggregate state of the economy $\mu$ only through the current aggregate productivity $z$ and not through the distribution of individuals across states $\Gamma$. This restriction allows my model to retain block recursitivity, which I explain in Section 2.4.

$^{10}$Here, I assume that the government can observe the search behavior of the unemployed. In the U.S., UI offices may verify job search activities of UI recipients by asking them to fill out a form requiring the name, location, and contact information of any employer recently contacted. In Section 5, I remove the assumption that search effort is observable to the government and check the implications on my main results.
labor income, employment-tested transfers, and retirement transfers.\textsuperscript{11} The government balances the following budget constraint in expectation:

\[
\sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t \times \left[ \sum_i 1\{l_{it}=E\} w_{it} \tau - \sum_i 1\{l_{it}=U_b, s_{it}>0\} b_t (1-\tau) \right. \\
- \sum_j 1\{y_{jt}<y, a_{jt}<a\} \phi_t - \sum_j 1\{l_{jt}=R\} b_R (1-\tau) \right] = 0 ,
\]

where the terms in the brackets are total tax revenues generated from employed individuals and the sum of net transfers paid to eligible individuals or households.

**Timing** Every single period \(t\) is divided into three stages. In the first stage, a \(\zeta_R\) fraction of households in the labor force retire and a \(\zeta_D\) fraction of retired households die and are replaced with new households entering into the labor force. Then, aggregate productivity \(z\) is realized and level of \(z\) determines i) the generosity of employment-tested transfers \(b\left( z \right)\), its expiration rate \(e\left( z \right)\), the generosity of means-tested transfers \(\phi\left( z \right)\) and ii) the exogenous job separation rate \(\delta\left( h, z \right)\) in each submarket \(h\). This implies that a \(\delta\left( h, z \right)\) fraction of those employed in \(t-1\) in each submarket \(h\) lose their job and must spend at least one period unemployed. Among these job losers, \(e\left( z \right)\) fraction become ineligible for employment-tested transfers.

Search and matching in the labor market occurs in the second stage. Vacant firms decide the human capital submarket in which to post a vacancy, while unemployed individuals look for a job in a submarket that is compatible with their own human capital level. Then, \(p\left( h, z \right)\) fraction of unemployed individuals searching for a job in submarket \(h\) find a job. Human capital stochastically evolves based on labor market outcomes. The third stage is the production and consumption stage. Each firm-worker pair produces \(g\left( h, z \right)\) units of goods. Wages are paid to workers and transfers are paid to eligible households, and they make their joint saving/borrowing decision. Finally, households jointly decide whether their unemployed members will look for a job in the labor market stage at time \(t+1\), where the forgone utility of leisure for the member with positive labor supply is incurred at time \(t\).

\textsuperscript{11}According to the U.S. tax policy, Social Security and UI benefits are subject to income tax, while means-tested transfers are mostly non-taxable. Moreover, in Section 5, I also analyze the effects of progressive taxation on the main results.
2.2 Household Problem

Among the households in the labor force, there are nine distinct types of households in terms of the employment statuses of their members. In the main text, I will lay out the recursive problem of three types of households: i) one member is employed, the other is unemployed and eligible for UI; ii) both members are unemployed and eligible for UI; and iii) both members are employed. The rest are discussed in Appendix A.

Let \( V_{l_m l_f} \) denote the value function of a household when the male’s employment status is \( l_m \) and the female’s employment status is \( l_f \) after search and matching has occurred. Let \( h \equiv (h_m, h_f) \) and \( l \equiv (l_m, l_f) \) be the human capital and employment state vectors of the household, respectively. To simplify the notation further in the recursive formulations below, let \( \delta_i \equiv \delta(h_i, z) \) and \( p_i \equiv p(h_i, z) \) be the job displacement rate and job finding rate, respectively, of individual \( i \in \{m, f\} \), and \( \delta'_i \) and \( p'_i \) denote the respective probabilities in the next period. Finally, let \( \lambda_b = 1 - e(z) \) be the probability that eligibility for employment-tested benefits does not expire, and \( \lambda_n = e(z) \) be the expiration probability. Similarly, \( \lambda'_b \) and \( \lambda'_n \) denote the respective probabilities in the next period.

**Employed-unemployed household** First, consider a household in which the head is employed and the spouse is unemployed and UI eligible. The recursive problem of this household is given as follows\(^\text{12}\):

\[
V^{EU_b}(a, h; \mu) = \max_{a' \geq a_L, s_f \in \{0, 1\}} u(c) + \eta f (1 - s_f) + \beta \left[ (1 - \zeta_R) \mathbb{E}_{h', \mu'} [V^{EU_b}(a', h'; \mu') | s_f, l, h, \mu] + \zeta_R V^R(a') \right]
\]

subject to

\[
\begin{align*}
c + a' &\leq (1 + r) a + y + \phi(z; a, y) + b(z; U_b, s_f) (1 - \tau) \\
y & = w(h_m, z) (1 - \tau) \\
\Gamma' & = \Lambda(\mu, z') \quad \text{and} \quad z' \sim \Phi(z' | z).
\end{align*}
\]

The household decides their savings and the female’s labor force participation since she is the non-employed member of the household. If the household stays in the labor

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\(^{12}\)The problem of the symmetric household is identical to this household’s problem with the change of indices for \( m \) and \( f \).
force with probability $1 - \zeta_R$, the household takes expectation over the transition of employment statuses, human capital levels of both members, and the aggregate states, conditional on the current employment statuses, the human capital levels of both members, the job search decision for the female, and the aggregate state. If the household retires with probability $\zeta_R$, then the only relevant state variable is assets.

It is also insightful to discuss the expectation over the transition of employment statuses of this household, which I lay out below:\(^{13}\):

$$
\mathbb{E}_{h', \mu'} [V''(a', h'; \mu')] = \mathbb{E}_{h', \mu'} \left[ s_f (1 - \delta'_m) \left( p'_f V^{EE}(a', h'; \mu') + \left( 1 - p'_f \right) \sum_{k \in \{b,n\}} \lambda'_k V^{EU_k}(a', h'; \mu') \right) + s_f \delta'_m \left( p'_f \sum_{k} \lambda'_k V^{U_k E}(a', h'; \mu') + \left( 1 - p'_f \right) \sum_{k,d \in \{b,n\}} \lambda'_k \lambda'_d V^{U_k U_d}(a', h'; \mu') \right) + (1 - s_f) (1 - \delta'_m) \sum_{k} \lambda'_k V^{EU_k}(a', h'; \mu') + (1 - s_f) \delta'_m \sum_{k,d \in \{b,n\}} \lambda'_k \lambda'_d V^{U_k U_d}(a', h'; \mu') \right] \bigg| h, \mu
$$

where I drop the conditions of the expectation on the left-hand side to save space.

The first line on the right-hand side is the case when the female is unemployed and searching for a job in the current period and the male keeps his current job. In this case, if she finds a job, the household will be an employed-employed household, otherwise the household will continue to be an employed-unemployed household, but she may retain or lose eligibility for employment-tested transfers. The second line describes the case when the female is searching for a job and the male loses his current employment. Then, if she finds a job, the household will be an unemployed-employed household where the male may or may not be eligible for employment-tested transfers. The third line describes the case when she does not search for a job and continues to be unemployed with or without eligibility, and he keeps his current job. Finally, the last line shows the case when she does not search for a job and he loses his job.

\(^{13}\)Expectations over human capital levels and aggregate states are discussed previously.

\(^{14}\)According to the current UI policy in the United States, not all workers transitioning into unemployment qualify for UI benefits. In particular, individuals do not qualify for benefits if they voluntarily quit their job or if they do not meet requirements for wages earned or time worked during an established period of time, referred to as the base period.
For the household in which the male is employed but the female is unemployed and ineligible, the above equations are the same except that she does not receive employment-tested transfers and stays ineligible if she does not find a job.\textsuperscript{15}

\textbf{Unemployed-unemployed household}  
Next, the recursive problem of a household in which both members are UI eligible unemployed is given as follows:

\[
V^{UbUb}(a, h; \mu) = \max_{a' \geq a_L, s_m, s_f \in \{0, 1\}} u(c) + \sum_{i \in \{m, f\}} \eta_i (1 - s_i) + \beta \left[ (1 - \zeta_R) \mathbb{E}_{r', \mu'} \left[ V^{l'}(a', h'; \mu') \mid s_m, s_f, l, h, \mu \right] + \zeta_R V^R(a') \right] 
\]

subject to

\[
c + a' \leq (1 + r) a + \phi(z; a, 0) + \left[ b(z; U_b, s_m) + b(z; U_b, s_f) \right] (1 - \tau) \Gamma' = \Lambda(\mu, z') \quad \text{and} \quad z' \sim \Phi(z' \mid z).
\]

Given that both members of the household are now unemployed, the household chooses the labor supply of both members. They enjoy leisure if they do not look for a job, in which case they do not receive employment-tested transfers even if they could both be eligible. In the current period, the household does not have any labor income. In Appendix A, I lay out and discuss the expectation over the transition of employment statuses of this household.

\textbf{Employed-employed household}  
Finally, the recursive problem of an employed-employed household is given as follows:

\[
V^{EE}(a, h; \mu) = \max_{a' \geq a_L} u(c) + \beta \left[ (1 - \zeta_R) \mathbb{E}_{r', \mu'} \left[ V^{l'}(a', h'; \mu') \mid l, h, \mu \right] + \zeta_R V^R(a') \right] 
\]

subject to

\[
c + a' \leq (1 + r) a + y + \phi(z; a, y) \\
y = \left[ w(h_m, z) + w(h_f, z) \right] (1 - \tau) \\
\Gamma' = \Lambda(\mu, z') \quad \text{and} \quad z' \sim \Phi(z' \mid z).
\]

\textsuperscript{15}This captures the fact that according to current UI policy in the United States, unemployed individuals receive UI benefits only for a certain number of weeks - which varies over the business cycle - and once that threshold is reached, the unemployed cannot continue to collect UI benefits.
This household chooses only consumption vs savings. Individuals of this household are not eligible for employment-tested transfers. Total labor earnings of the household is equal to the sum of the net wages of the male and female. Appendix A provides details on the expectation term.

2.3 Firm Problem

First, consider a firm that is matched with a worker in submarket $h$ when the aggregate state is $\mu$. The pair operates under a constant-returns-to-scale technology and produces $g(h, z)$ units of output, and the worker is paid a wage of $w(h, z)$. The match dissolves either through job displacement with probability $\delta(h, z)$ or the worker’s retirement with probability $\zeta_R$. Let $J(h; \mu)$ be the value of this firm. Then, the recursive problem of this firm is given as follows:

$$\begin{align*}
J(h; \mu) &= g(h, z) - w(h, z) + \frac{1}{1+r} (1 - \zeta_R) \mathbb{E}_{h', \mu'} \left[ (1 - \delta(h', z')) J(h'; \mu') \bigg| h, \mu \right] \\
\text{subject to} \\
\Gamma' &= \Lambda(\mu, z') \quad \text{and} \quad z' \sim \Phi(z' | z).
\end{align*}$$

(5)

Meanwhile, the value of a vacant firm that posts a vacancy in submarket $h$ under aggregate state $\mu$ is given by

$$V(h; \mu) = -\kappa + q(\theta(h; \mu)) J(h; \mu)$$

(6)

where $\kappa$ is a fixed cost of posting a vacancy that is financed by risk-neutral foreign entrepreneurs who own the firms.

When vacant firms decide on the submarket in which to post a vacancy to maximize profits, they face the trade-off between the probability of filling a vacancy and the level of surplus from a match. This trade-off exits because if a firm posts a vacancy in a high human capital submarket, then the firm’s surplus from the match in that submarket will be higher given that the period output net of wages is increasing in $h$ and job displacement rate $\delta(\cdot)$ is decreasing in $h$. However, the probability of filling the vacancy is lower in high human capital submarkets given that few unemployed individuals are able to visit such submarket to search for a job.

The free-entry condition implies that profits are just enough to cover the cost of
filling a vacancy in expectation. As a result, the owner of the firm makes zero profits
in expectation. Thus, \( V (h; \mu) = 0 \) for any submarket \( h \) such that \( \theta (h; \mu) > 0 \). Then, imposing the free-entry condition to Equation (6) yields the market tightness:

\[
\theta (h; \mu) = \begin{cases} 
q^{-1} \left( \frac{n}{J(h; \mu)} \right) & \text{if } h \in \mathcal{H} (\mu) \\
0 & \text{otherwise.}
\end{cases}
\] (7)

The equilibrium market tightness contains all the relevant information needed by
households to evaluate the job finding probabilities at each submarket.

2.4 Equilibrium

**Definition of the Recursive Equilibrium:** Given government policies \( b(\cdot), e(\cdot), \phi(\cdot), q, y, b_R, \) and \( \tau \), a recursive equilibrium is a list of household policy functions for
assets \( \{a_{l,m,f} (a, h, \mu)\}_{l_m,l_f \in \{E, U_b, U_n, R\}} \) and the labor supply of unemployed members
of the household \( \{s_i (a, h, \mu)\}_{i \in \{m, f\}} \), a market tightness function \( \theta (h; \mu) \), and an
aggregate law of motion \( \mu' = (z', \Gamma') \) such that

1. Given government policy, shock processes, and the aggregate law of motion,
the household’s policy functions solve their respective dynamic programming
problems (2), (3), (4), and similar problems for other types of households.

2. The labor market tightness is consistent with the free-entry condition (7).

3. The government budget constraint (1) is satisfied.

4. The law of motion of the aggregate state is consistent with household policy
functions.

Notice that to solve the recursive equilibrium defined above, one must keep track
of an infinite dimensional object \( \Gamma \), making the solution of the model infeasible. To
address this issue, I utilize the structure of the model and use the notion of a block
recursive equilibrium (BRE) developed by Menzio and Shi (2010, 2011).\(^{\text{16}}\)

**Definition of the BRE:** A BRE for this economy is an equilibrium in which the
value functions, policy functions, and labor market tightness depend on the aggregate

\(^{\text{16}}\)To the best of my knowledge, this paper is the first to extend the concept of a block recursive
equilibrium in an endogeneous family labor supply model with aggregate fluctuations.
state of the economy $\mu$, only through the aggregate productivity $z$ and not through the aggregate distribution of agents across states $\Gamma$.

In the Online Appendix, I provide a proof for the existence of a BRE and discuss the computational algorithm for solving a BRE.\textsuperscript{17} The block recursivity of the model is useful because it allows me to solve the model without keeping track of the distribution of agents across states $\Gamma$. This becomes especially important when I solve for the optimal transfers, which requires solving the equilibrium and finding the tax rate that balances the government budget over a long simulation for any policy reform.

## 3 Calibration and Validation

I calibrate the model to match the level and cyclicality of i) heads’ earnings losses upon job displacement, ii) government transfers, and iii) job finding rates, among others. It is important to match the depth and cyclicality of heads’ earnings losses because it determines how critical the role of both public and private insurance is when a job displacement occurs. Likewise, matching the average generosity of government transfers and how it varies over the business cycle allows me to correctly quantify the insurance benefits of transfers as well as their incentive costs on the family labor supply. Finally, the model must also match well how job finding rates vary over the cycle since this directly affects the strength of private insurance mechanisms through spousal earnings. Spouses may find it difficult to find a job in recessions and may thus not be able to provide adequate insurance.

Next, I show that the calibrated model generates the observed small spousal earnings response to the head’s displacements especially in recessions. Furthermore, the model-implied female labor supply elasticities with respect to changes in taxes and transfers are in line with estimates from the microeconomic studies.

### 3.1 Earnings upon job displacement over the cycle

**Data and methodology** In this section, I use data from the PSID for 1968-2015 to study the changes in head earnings and hours, spousal earnings and hours, and family earnings upon a family head’s job displacement over the business cycle. For

\textsuperscript{17} An Online Appendix for this paper is available at the author’s website: https://serdarbirinci.weebly.com/research.html.
In this analysis, I restrict the sample to families in which both the husband and the wife are between the ages of 20 and 60 and not in the Latino sample. I drop families with only one year of observations and those above the 99th percentile of the family labor income distribution. I create variables for involuntary job displacement using a question that asks the reason for losing the previous job to individuals who are either without a job or have been employed in their current job for less than a year. Following the literature, I define an involuntary job loss as a separation due to a firm closure, layoff or firing. The resulting unbalanced sample of families contains 86,541 observations on 9,383 families: 1,204 with at least one displacement in a recession and 2,269 with at least one displacement in an expansion. The family heads of 674 families had at least one displacement in a recession and one in an expansion. In this sample, there are 1,573 displacements in recessions and 3,517 displacements in expansions. Appendix B provides more details about the data and sample selection.

I study the effects of the head’s job displacement on his individual earnings and hours, spousal earnings and hours, and family earnings, using the regression specification in Jacobson, Lalonde, and Sullivan (1993) and Stevens (1997) given as follows:

$$y_{it} = \beta X_{it} + \sum_{k=-2}^{10} \psi_k D_{it}^k + \alpha_i + \gamma_t + \epsilon_{it}$$  \hspace{1cm} (8)$$

For different regressions, the outcome variable $y_{it}$ will separately be the real annual labor earnings of the head, the spouse, and the family (defined as the sum of the head’s and the spouse’s labor earnings), as well as the head’s and spouse’s annual working hours. The variable $X_{it}$ is a vector of time-varying family characteristics, including a quadratic term of the head’s experience, a quadratic term of the spouse’s experience, the number of children, and the number of children younger than 6 years of age. The variable $\alpha_i$ captures a time-invariant unobserved error component associated with family $i$, and $\gamma_t$ is an error component common to all families in the sample at year $t$. The vector of dummy variables $D_{it}^k$ indicates a job displacement of the head in a

\footnote{Based on the definition of the head in the PSID, the family head is almost always male. In my sample, only 49 observations have a female head among the 86,541 observations.}

\footnote{The Online Appendix shows that the results are robust to alternative sample selections.}

\footnote{The latter category includes workers who report that they have been fired, which is typically not considered an exogenous job displacement event. However, Boisjoly, Duncan, and Smeeding (1994) report that only 16 percent of the workers in the layoff or fired categories have indeed been fired.}

\footnote{Labor earnings include wages and salaries, bonuses, overtime, tips, commissions, professional practice or trade, market gardening, miscellaneous labor income, and extra job income.}
future, current, or previous year. For example, \( D_{it}^3 = 1 \) if the individual \( i \) is displaced at time \( t - 3 \) and zero otherwise. I estimate the impact of a head’s job displacement on individual and spousal earnings and hours as well as family earnings in the two years preceding the job loss \( (k = -2, -1) \), in the year of the job loss \( (k = 0) \), and in every year until 10 years after the job loss \( (k = 1, 2, ..., 10) \). Thus, \( \psi_k \) captures the effect of job displacement on outcome variables in families whose head was displaced \( k \) years prior/after (treatment group) relative to families whose head had never been displaced (control group). Individuals in the control group would have \( D_{it}^k = 0 \) for all years \( t \). In all of the results below, the relative change of an outcome variable means the change in the outcome variable of the treatment group relative to the change in the outcome variable of the control group.\(^{22}\)

To measure the differential effects of job displacements in recessions and in expansions on outcome variables, I group displacements into those that occurred in recessions and those that occurred in expansions using NBER business cycle definitions. This means that when a displacement occurs in a recession year \( t \), the individual is considered to be part of the treatment group displaced in recessions. I then estimate the regression Equation (8) for i) a treatment group where the head is displaced only in recessions and a control group where the head is never displaced and ii) a treatment group where the head is displaced only in expansions and a control group where the head is never displaced. The regressions are estimated with fixed effects and robust standard errors clustered at the family level. In the following figures, I report estimated \( \psi_k \) as a percent of the pre-displacement mean of the outcome variable.

**Head earnings** Figure 1 shows the change in relative labor earnings of the family head upon job displacement in recessions and expansions. The solid-blue lines show the estimated coefficients \( \{\psi_k\}_{k=-2}^{10} \) as a percent of the pre-displacement mean labor earnings of displaced heads, and the dashed light-blue lines shows the 90 percent confidence interval. I compare these results obtained from the PSID with the estimates of Davis and von Wachter (2011), who use Social Security Administration (SSA) data between 1974-2008.\(^{23}\) I find that the magnitude of the average drop in the head’s

\(^{22}\)Individuals who experience an unemployment spell because of reasons other than displacement (such as quitting) are part of the control group.

\(^{23}\)My econometric model is slightly different from the model that Davis and von Wachter (2011) use. In their analysis, they regress Equation (8) for every year, obtain \( \psi_k \) for each of these years, and then report the average values of \( \psi_k \) across these years. Given that my sample size from the PSID is smaller, I follow the baseline specification applied by Jacobson, LaLonde, and Sullivan (1993)
Note: This figure plots the changes in relative labor earnings of the family head upon job displacement in recessions (left panel) and expansions (right panel). I estimate the changes in relative earnings from a distributed lag-recession model using the PSID. The solid-blue lines show the point estimates, and the dashed light blue-lines show the 90 percent confidence intervals. For comparison, the orange lines show the estimates of Davis and von Wachter (2011).

Relative labor earnings is larger when the head is displaced in recessions. In the year following the job displacement, the relative earnings drop by 39 percent in recessions and 22 percent in expansions. These results are consistent with the findings of Davis and von Wachter (2011), as they also document larger earnings losses upon displacements in recessions (39 percent) than in expansions (25 percent). A notable difference between my results and their result is that the persistence of earnings losses is not as prolonged in my results. This difference is because of two reasons. First, my sample is restricted to married or cohabiting households. Second, the attrition rate from the survey data is larger for the long-term unemployed.24

Figure A.1 in Appendix B measures the effect of a head’s job displacement over the business cycle on his annual hours. I find that hours recover relatively quickly. When considered together, these results suggest that both the cyclical gap in earnings losses upon displacement over the business cycle and the persistence of earnings losses are largely explained by a drop in wages rather than a drop in hours.

and Stevens (1997) who also use the PSID. However, I still compare my results to Davis and von Wachter’s (2011) results because they provide the only empirical benchmark for the cyclicality of the magnitude of earnings losses upon job displacement.

24When I actually drop the displacement events of households when they are not present in the survey at least 6 years following their displacements, the persistence of earnings losses becomes closer to the one in Davis and von Wachter (2011).
**Family and spousal earnings** The main focus of this section is to measure the effects of a head’s job displacement in recessions and in expansions on family earnings (defined as the sum of head and spouse labor earnings), and spousal earnings and hours.\textsuperscript{25} Figure 2 shows the change in relative labor earnings of the family upon job displacement of the family head in recessions and expansions and compares it to the changes in relative head earnings as obtained above. I highlight three results. First, I find that family earnings drop by 28 percent when the head’s displacement occurs in recessions and by 15 percent when it occurs in expansions in the year following displacement. This implies that families enjoy some insurance from a second earner simultaneously employed with the head prior to his displacement. Having the spouse retain employment results in family earnings dropping by one-third less than the head’s individual earnings.\textsuperscript{26} Second, the initial cyclical gap of family earnings losses upon the head’s job displacement in a recession versus in an expansion ($28 - 15 = 13$ pp) is not very different from the initial cyclical gap of the head’s earnings losses ($39 - 22 = 17$ pp). Finally, the statistical significance of the coefficients based on the 90th percent confidence intervals, plotted as red-dashed lines in Figure 2, suggests that family earnings recover 4 years after displacements in recessions (1 year earlier than the head’s earnings recovery), and 3 years after displacements in expansions (2 years earlier than the head’s earnings recovery). However, notice that the slopes of the recoveries of the head’s earnings and the family earnings look similar to each other. This hints that earlier recoveries of family earnings are due to a smaller initial drop coming from already working spouses rather than the behavioral response of, say, non-employed spouses who may enter the labor force to increase earnings.

The small behavioral response of spouses is confirmed by Figure 3, which shows the change in relative spousal earnings upon the head’s displacement in recessions and in expansions. I find that the relative spousal earnings upon the head’s displacement in recessions fluctuates around 0 and that this behavioral response is always insignificant across years after the head’s displacement in recessions. The mean of

\textsuperscript{25}Pruitt and Turner (2019) measure the spousal earnings response to earnings fluctuations of the household head both in recessions and in expansions using SSA data but do not focus on measuring the response to job displacement shocks specifically. Job displacement events are particularly relevant because their effects are large and long-lasting compared with temporary earnings fluctuations. My paper focuses on measuring the dynamic response of spousal earnings and hours specifically in response to a head’s job displacement and how this response varies over the business cycle.

\textsuperscript{26}The presence of a second earner reduces the initial earnings losses by $(39 - 28)/39 = 28$ percent in recessions and $(22 - 15)/22 = 32$ percent in expansions.
Figure 2: Labor Earnings of the Head and Family upon Job Displacement

![Diagram showing labor earnings changes for head and family in recessions and expansions.]

Note: This figure plots the changes in relative labor earnings of the head (blue line) and relative labor earnings of the family (red line) - defined as the sum of head and spouse labor earnings - upon the head’s job displacement in recessions (left panel) and expansions (right panel). The dashed light-red lines show the 90 percent confidence intervals for family earnings. I estimate the changes in relative labor earnings of the head and the family from a distributed lag-recession model using the PSID.

...the post-displacement coefficients is only $-0.8$ percent for displacement in recessions. Hence, the insignificance of the post-displacement coefficients is not only explained by larger error bands around the point estimates in the recession regression due to a comparably smaller sample size, but also because of the small average behavioral spousal response to the head’s displacement in recessions. On the other hand, in expansions, there is a slight positive trend in spousal earnings response, but the coefficients are also insignificant until year 6. Similarly, the mean of the post-displacement coefficients is 8 percent in expansions. Furthermore, the p-values of a joint significance test of the post-displacement coefficients allow us to reject the hypothesis that they are jointly significant ($p = 0.35$ in recessions and $p = 0.11$ in expansions).

Figure A.2 in Appendix B measures the effect of the head’s job displacement over the business cycle on annual spousal hours. I also find that the change in spousal hours upon the head’s displacement in recessions is very small, with a mean post-displacement coefficient of only $-0.1$ percent ($p = 0.36$). On the other hand, spousal hours in expansions become significantly positive 3 years after the head’s displacement and later increase by up to 15 percent. The mean of the post-displacement coefficients

---

27The small initial response of relative hours both in recessions and expansions is consistent with previous “added worker effect” literature that studies the contemporaneous change in spousal hours upon the head’s unemployment without conditioning on the timing of the unemployment over the cycle (Heckman and MaCurdy 1980, 1982, Cullen and Gruber 2000).
Note: This figure plots the changes in relative labor earnings of the spouse upon the family head’s job displacement in recessions (left panel) and expansions (right panel). I estimate the changes in relative spousal labor earnings from a distributed lag-recession model using the PSID. The solid-blue lines show the point estimates, and the dashed light-blue lines show the 90 percent confidence intervals.

in expansions is 10.1 percent ($p = 0.02$).

**Summary of empirical results** It is useful to summarize empirical findings of this section, all of which except the first one are novel contributions to the literature.

First, I find that there are large negative and persistent effects of the head’s job displacement on his own labor earnings and that the magnitude of the earnings losses is larger when the displacement occurs in recessions, as in Davis and von Wachter (2011). Second, the mere presence of a second earner already mitigates close to one-third of the head’s earnings losses upon job displacements both in recessions and in expansions. Third, there is no evidence for significantly positive spousal earnings and hours responses to the head’s displacement in recessions, when the drop in the head’s earnings is much larger. On the other hand, the spousal earnings and hours responses to the head’s displacement in expansions become significantly positive at least 3 years after the displacement, with the hours increasing by as much as 15 percent.

The last empirical result is particularly interesting because one could expect stronger spousal earnings and hours responses during times when the head experiences larger earnings losses. Later, using the model, I investigate whether this small spousal earnings response is an outcome of crowding-out effects of transfers.
3.2 Calibration

**Functional forms** The model period is set to be a quarter. The utility function over consumption is \( u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma} \) with risk aversion parameter \( \sigma \). The labor market matching function is \( M(v, u) = \frac{uv}{[u^\gamma + v^\gamma]^{1/\gamma}} \) as in den Haan, Ramey, and Watson (2000), which implies that the job finding rate \( p(\theta) = \theta (1 + \theta^\gamma)^{-1/\gamma} \) and vacancy filling rate \( q(\theta) = (1 + \theta^\gamma)^{-1/\gamma} \) are between 0 and 1.

As in Shimer (2005), I use a process for the job displacement rate that depends on labor productivity, which is extended to incorporate that displacement rates across jobs with various skill levels may differ:

\[
\delta(h, z) = \bar{\delta} \times \exp\left(\omega^\delta_x \times (z - \bar{z})\right) \times \exp\left(\omega^\delta_h \times (h - \bar{h})\right),
\]

where \( \bar{\delta} \) is the mean of the displacement rate over time; \( \omega^\delta_x \) captures the volatility of the job displacement rate over time; \( \omega^\delta_h \) captures the variation of the job displacement rate across skills; and \( \bar{z} \) and \( \bar{h} \) are average labor productivity and human capital levels, respectively. These separation shocks can be interpreted as idiosyncratic match quality shocks that drive down the productivity of a match to a low enough level so that the match endogenously finds it optimal to dissolve, as in Lise and Robin (2017). Finally, the production function is \( g(h, z) = hz \).

I restrict the policy instruments to take the form of the means-tested transfer amount and the employment-tested transfer amount as linear functions of current aggregate labor productivity. I set \( \phi(z) = \bar{\phi} - \omega^\phi (z - \bar{z}) \) and \( b(z) = \bar{b} - \omega^b (z - \bar{z}) \). This implies that if, for example, \( \omega^\phi > 0 \), then means-tested policy is countercyclical.

The logarithm of the aggregate labor productivity \( z_t \) follows an AR(1) process:

\[
\ln z_{t+1} = \rho \ln z_t + \sigma_\epsilon \epsilon_{t+1},
\]

where \( 0 \leq \rho < 1 \), \( \sigma_\epsilon > 0 \) and \( \epsilon \) are independent and identically distributed standard normal random variables. I take \( z_t \) as the average seasonally adjusted quarterly real output per person in the non-farm business sector, which is constructed by the Bureau of Labor Statistics (BLS). The data for the time period 1948:I-2007:IV is logged and Hodrick-Prescott (HP) filtered to obtain deviations from trend. Estimation of this process yields \( \rho = 0.7612 \) and \( \sigma_\epsilon = 0.0086 \).

\[\text{28} \] I exclude the Great Recession period from this data due to the increase in the value of this measure of productivity, since the reconciliation of this is beyond the scope of my paper. Standard deviations of quarterly time series are computed as log deviations from an HP trend with parameter 1600. For standard deviations of annual times series, I use the same object with parameter 100.
**External calibration** Having specified functional forms and the law of motion of the productivity process, I now calibrate several parameters outside of the model. Table A.2 in Appendix C summarizes these parameters and their values.

I choose a risk aversion parameter of $\sigma = 2$. I set the value of leisure for males to be $\eta_m = 0$, implying that they are always searching for a job and that changes in government transfers do not affect the search behavior of the household’s primary earner in the model.\(^{29}\) Next, I set $r = 0.5$ percent, which generates an annual return on assets of around 2 percent. I set $\zeta_R = 0.625$ percent and $\zeta_D = 1.7$ percent, implying a 40-year average working lifetime and around 15 years of retirement, respectively. I set the worker’s share of output $\alpha$ to match the ratio of wages and salaries to GDP.

I use 20 equally spaced grid points for human capital, $h \in \{h_L, ..., h_H\}$. I set $h_L = 0.2$ and $h_H = 1.8$. I assume that human capital increases by one step with probability $\pi^E$ when employed. This implies $\Delta^E = 0.084$. Moreover, I set the probability of human capital depreciation when unemployed $\pi^U$ to be 0.75.\(^{30}\)

I also calibrate the asset and income thresholds $a$ and $y$ for means-tested transfers, as well as the benefit expiration rate $e(\cdot)$ for employment-tested transfers outside of the model. I incorporate three means-tested transfers: SNAP, EITC, and TANF. The asset threshold of eligibility for SNAP was $2000$ between 1997 and 2007, according to the program reports published by the U.S. Department of Agriculture.\(^{31}\) The asset threshold of eligibility for EITC was $2350$ in 1995 and $2900$ in 2007, according to the program reports published by the U.S. Internal Revenue Service (IRS).\(^{32}\) Finally, in 2007, while the asset limit for TANF eligibility varied across different states, most states applied $2000$ as the asset limit, according to the program report published by the U.S. Department of Health and Human Services.\(^{33}\) In order to convert these values into model units, I calculate the ratio of the weighted-average of these asset limit values in the data to quarterly minimum labor earnings and find a ratio of

\(^{29}\)The average labor force participation rate of married men is 92 percent, implying that $\eta_m$ would be small if anything. Moreover, this assumption allows me to focus on the effects of government transfers on the spousal labor supply.

\(^{30}\)Ljungqvist and Sargent (1998) set $\pi^U = 0.2$ in the calibration of their model, where the model period is 2 weeks. For a quarterly calibration (i.e., around a 6-period unemployment spell), this implies that the probability of experiencing human capital loss is around 0.75.

\(^{31}\)These reports are titled “Characteristics of Supplemental Nutrition Assistance Program Households” and have been published every fiscal year since 1997. Reports are available at https://www.fns.usda.gov/ops/supplemental-nutrition-assistance-program-snap-research.

\(^{32}\)These reports are available at https://www.irs.gov/pub/irs-prior.

\(^{33}\)This report is available at https://www.acf.hhs.gov/sites/default/files/opre/wel_rules07.pdf
Then, I set \( a \) in the model so that the ratio of the asset limit \( a \) to quarterly minimum labor earnings, \( \alpha h_L z_L \), in the model is the same as its counterpart in the data.\(^{35}\)

Using the same program reports, I first calculate the weighted-average of income limits for these three programs in 2007. I find that the average gross quarterly income limit is around $7000. Similarly, I calculate the ratio of this value to the same quarterly minimum labor earnings in the data and find a ratio of 2.58. Then, I set \( y \) in the model so that the ratio of the income limit \( y \) to quarterly minimum labor earnings in the model is the same as its data counterpart.

Finally, the average duration of UI payments is around 26 weeks, which is typically extended during recessions. For example, during the Great Recession, it was extended to 99 weeks. Hence, I set the expiration rate of employment-tested transfers to 0.5 (i.e., \( 1/2 \)) when the labor productivity is greater than or equal to its mean, and set it to 0.13 (i.e., \( 1/(99/13) \)) when labor productivity is at its lowest level.\(^{36}\)

**Internal calibration** I jointly estimate the remaining 15 parameters using the model. Table A.3 in Appendix C summarizes the results.

I choose two parameters, the discount factor \( \beta \) and borrowing limit \( a_L \), to match two data moments of the asset-to-income distribution from the 2007 SCF: the fraction of households with non-positive liquid wealth and the median ratio of the credit limit to quarterly labor income. Appendix B provides the details of calculating these moments from the data.

The utility value of leisure for females \( \eta_f \) controls the level of opportunity cost of a female searching for a job. I choose \( \eta_f \) to match the female labor force participation rate (LFPR) relative to the male LFPR in the data. I use monthly data from the 2000-2007 CPS to compute the average LFPR of males and females separately for a sample of married or cohabiting couples between ages 20 and 60, i.e., a sample similar to the PSID sample used in Section 3.1. I find that the average LFPR is 71 percent

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\(^{34}\)Between 2000 and 2006, the federal minimum hourly wage was $5.15, and in 2007 it was $5.85. For these years, I calculate the total quarterly minimum labor earnings as \( \text{min hourly wage} \times 40 \text{ hours/week} \times 13 \text{ weeks/quarter} \). Next, I divide the average of the asset limit by average quarterly minimum labor earnings in the data.

\(^{35}\)Notice that quarterly minimum labor earnings in the model are invariant to policy changes. This allows me to calibrate both \( a \) and \( y \) outside of the model.

\(^{36}\)Specifically, the grid for \( e \) is set to be \( [1/(99/13), 1/(75/13), 1/(26/13), 1/(26/13), 1/(26/13)] \), where 75 weeks reflects the Extended Benefit (EB) program of UI transfers.
for female and 92 for male, which implies a relative female LFPR of 77 percent.

The next five parameters are calibrated to discipline five labor market moments of the model. I choose the cost of posting a vacancy $\kappa$ to match the average unemployment rate. I target the volatility of the job finding rate in the data by choosing the elasticity of matching function $\gamma$.\textsuperscript{37} I use the three parameters $\delta$, $\omega_{h}^{\delta}$, and $\omega_{h}^{\delta}$ of the job displacement process in the model to match three moments in the data: the average job displacement rate, its volatility over time, and its variation across the earnings distribution. I calculate the ratio of the median predisplacement labor earnings of displaced household heads (i.e., labor earnings one year prior to displacement) to the median labor earnings of never-displaced heads using the PSID data. I find that this ratio is 76 percent in the data, which implies that the median earnings of the displaced is 76 percent of the median earnings of the never displaced heads, i.e, the displacement risk is relatively higher for lower-paying jobs. In the model, $\omega_{h}^{\delta}$ controls the heterogeneity in job displacement risk across workers with different human capital, and thus wages, given that skill level directly affects wages in the model. Hence, I choose $\omega_{h}^{\delta}$ to match the same earnings ratio in the model.

I choose two parameters of the human capital process to discipline the cyclicality of the initial drop in head earnings upon job loss and the labor earnings distribution across employed individuals. Recall that the magnitudes of the declines in human capital $\Delta U$ vary over the cycle, so the model exogenously generates the cyclicality of the initial drop in head earnings upon job loss. I set $\Delta U = 0.59$ for realizations of $z$ that are lower than its mean value $\bar{z}$ and $\Delta U = 0.34$ for realizations of $z$ that are greater than or equal to $\bar{z}$.\textsuperscript{38} Figure 4 compares head earnings losses upon job displacement in recessions and in expansions between the model and the data.

Next, the probability of human capital accumulation $\pi^{E}$ controls skill distribution and thus the earnings distribution. For example, if $\pi^{E}$ is very large, then workers would quickly accumulate their human capital, and the resulting dispersion of earn-

\textsuperscript{37}The job finding rate data were constructed by Robert Shimer. For additional details, please see Shimer (2012). The data from June 1967 - December 1975 were tabulated by Joe Ritter and made available by Hoyt Bleakley.

\textsuperscript{38}In principle, the model generates larger earnings losses upon displacements in recessions relative to displacements in expansions due to endogenously lower job finding rates in recessions. However, this alone is insufficient to generate the observed difference in magnitude. Hence, an extra assumption on larger human capital loss when unemployed in recessions is needed. Moreover, this assumption is in fact reasonable, given that most human capital is indeed occupation specific (Kambourov and Manovskii 2009), and finding a job within the same occupation is much more difficult in recessions (Huckfeldt 2016).
Figure 4: Labor Earnings of the Head upon Displacement: Model vs Data

Note: This figure plots the changes in relative labor earnings of the family head upon job displacement in recessions (left panel) and expansions (right panel) both in the model and in the data. I estimate the changes in relative labor earnings from a distributed lag-recession model using the PSID. The solid-blue lines show the point estimates, and the dashed light-blue lines show the 90 percent confidence intervals. I compare these results to the estimates obtained from the same regression using the model-simulated data, which are aggregated to yearly periods. Earnings losses one year after displacements both in recessions and expansions are targeted in the model calibration.

Earnings would be small. I choose \( \pi^E \) to match the ratio of the 90th to the 10th percentile of labor earnings distribution of employed individuals from the PSID 2007.

Finally, the remaining five parameters of the model are related to government transfers. I measure the average generosity of means-tested transfers by the ratio of total quarterly means-tested transfers per recipient to quarterly minimum labor earnings using NIPA data for 1976 - 2007 and NIPA reports.\(^{39}\) The average ratio across these years in the data is 0.74, implying that, on average, the means-tested transfer amount is 74 percent of minimum earnings. I choose the average level of means-tested transfers \( \bar{\phi} \) so that this statistic in the model is the same as in the data. Similarly, I calculate the average ratio of total quarterly UI transfers per unemployed individual to quarterly minimum labor earnings, using data on UI transfer amounts from NIPA and data on the total number of unemployed from the BLS for 1948 - 2007, and find a ratio of 0.36. Again, I choose the average level of employment-tested

\(^{39}\)For each program, the program reports published by the government agencies provide information on the number of recipients each year. Using these data together with data from NIPA, I calculate the total transfer amount per recipient for each program in a given year and then sum these amounts to obtain the total means-tested transfer amount per recipient for that year. The year that we observe positive transfer amounts paid under each of the three programs in NIPA is 1976. I divide annual amounts of total means-tested transfers per recipient by 4 to obtain the quarterly amounts. Then, I divide this amount by the quarterly minimum labor income to obtain the ratio of total quarterly means-tested transfers per recipient to minimum labor earnings in the data.
transfers $\bar{b}$ so that this statistic in the model is the same as in the data.\footnote{Using micro data from Survey of Income and Program Participation (SIPP) for 1996 - 2014, I find that, on average, around 35 percent of total means-tested transfers and 60 percent of total UI transfers are paid to married households. Also, married households constitute around 33 percent of all means-tested transfer recipients and 58 percent of all UI recipients. Finally, around 60 percent of all transfers received by married households are means-tested transfers. Figure A.3 in Appendix B presents these results.} Then, I choose $\omega_f$ and $\omega_b$ to match the standard deviation of total means-tested transfers per recipient and total UI transfers per unemployed individual in the data. Last, I set retirement transfers $b_R$ to match the average ratio of Social Security payments to GDP.

3.3 Validation

In this section, I show that the model endogenously generates a small spousal earnings response to the job displacement of the family head. I then benchmark model-implied female labor supply elasticities with respect to tax reforms against microeconomic estimates. Appendix C also compares model outcomes with a list of other important untargeted data moments, including consumption drop upon job loss, asset-to-income distribution, marginal propensities to consume, and the extend to which displacement events are correlated across the head and the spouse. These supplement the discussion in the main text on how the model is able to generate the observed spousal earnings response as well as a reasonable magnitude of elasticity to tax reforms. For example, generating the left tail of the asset-to-income distribution is critical to obtain a large magnitude of the female participation elasticity with respect to net wages, as in the data, because, according to the micro estimates, the labor supply of women in low income households is much more elastic to changes in taxes than that of women in high income households.

Spousal earnings upon the head’s job displacement Figure 5 compares the change in spousal earnings upon the head’s job displacement in recessions and expansions between the model and the data. In the model, changes in spousal earnings upon the head’s displacement both in recessions and expansions are limited, as in the data. However, the model fails to capture the slight positive trend in the change in spousal earnings in expansions that we observe in the data. In recessions (expansions), the mean of the post-displacement coefficients is 3.2 (5.2) percent in the model.
Figure 5: Spousal Earnings Response to the Head’s Job Displacement: Model vs Data

Note: This figure plots the changes in relative labor earnings of the spouse upon the head’s job displacement in recessions (left panel) and in expansions (right panel) both in the model and in the data. I estimate the changes in relative spousal earnings from a distributed lag-recession model using the PSID. The solid-blue lines show the point estimates, and the dashed light-blue lines show the 90 percent confidence intervals. I compare these results to the estimates obtained from the same regression using the model-simulated data, which are aggregated to yearly periods.

compared with $-0.8\ (8)$ percent in the data. This comparison shows that when the model is calibrated to match the levels and cyclicalities of i) the head’s earnings losses upon job displacement, ii) government transfers, and iii) job finding rates, it is able to generate a small change in spousal earnings upon the head’s displacement, especially in recessions, as I have documented in the data.

**Female labor supply elasticities** To ensure that the role of crowding-out effects of transfers in explaining the small spousal earnings response is not overstated in the model, I compare the magnitude of model-implied spousal labor supply elasticities with respect to changes in net wages or transfers to those found in microeconomic studies.

The first panel of Table 1 compares female participation elasticity with respect to net wages in the data and the model. Chetty et al. (2012) summarize the magnitude of this elasticity estimates identified from permanent wage changes resulting from unexpected tax reforms across seven different studies.\(^{41}\) They report female participation elasticity as the change in log employment rates divided by the change in log net-of-tax wages. For example, to obtain this elasticity, Eissa and Hoynes (2004) com-

\(^{41}\)Chetty et al. (2012) summarize results from nine different papers in total. However, two of these papers focus on men in their sample. Hence, I consider the remaining seven papers as my comparable benchmarks.
Table 1: Magnitudes of Female Labor Supply Elasticities: Data vs Model

<table>
<thead>
<tr>
<th></th>
<th>All households</th>
<th>Low-income households</th>
<th>High-income households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female participation elasticity with respect to net wages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>0.15 – 0.43</td>
<td>0.27 – 0.43</td>
<td>0.15</td>
</tr>
<tr>
<td>Model</td>
<td>0.31</td>
<td>0.38</td>
<td>0.21</td>
</tr>
<tr>
<td>Female labor earnings elasticity with respect to transfers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>0.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model $\bar{\phi}$</td>
<td>0.36</td>
<td>0.47</td>
<td>0.23</td>
</tr>
<tr>
<td>Model $\bar{b}$</td>
<td>0.01</td>
<td>0.03</td>
<td>0.002</td>
</tr>
</tbody>
</table>

*Note:* This table compares female participation elasticity with respect to net wages and female labor earnings elasticity with respect to transfers both in the data and the model. Comparisons are made for all females, females in low-income households, and females in high-income households. Empirical estimates of the participation elasticities are summarized by Chetty et al. (2012), and the empirical estimates of the earnings elasticity are calculated by the author from the PSID. Participation elasticity is calculated as the change in log female employment rates divided by the change in log net-of-tax wage rates, while earnings elasticity is calculated as the change in log female labor earnings divided by the change in log transfer amounts.

To calculate the same elasticity in the model, I implement an unexpected and permanent decline in $\tau$ so that the average net wages of the employed in the model, i.e., $(1 - \tau) \bar{w}$, where $\bar{w}$ is the average wage in the model prior to a change in the tax rate, increases by 10 percent. This way, the model generates permanent changes in wages resulting from income tax reform, which is similar to the identification used in the microeconomic studies. I then calculate the model-implied female participation elasticity with respect to net wages as the ratio of the change in log female employment rates to the change in log average wages of the employed. I find that the magnitude of female participation elasticity with respect to net wages is 0.31 in the model, which lies in between the range of the values found in the literature.

Importantly, it is possible to divide a subset of these empirical estimates summarized by Chetty et al. (2012) into two groups based on the demographics and charac-
teristics of their sample. On one hand, we can group estimates by Eissa and Liebman (1996), Meyer and Rosenbaum (2001), and Eissa and Hoynes (2004) as participation elasticities of females in low-income households. This is because these three studies focus on either married women in low-income households or single women receiving government transfers, both of which can be interpreted as spouses in low-income households from the lens of my model. On the other hand, Liebman and Saez (2006) estimate the participation elasticity of females who are married to high-income males whose income is above 75th percentile of the income distribution. A comparison of the magnitudes of elasticities reveals that the participation elasticity is much larger for females in low-income households than in high-income households.

In the model, I compute the elasticity separately for women in low-income and high-income households using the same experiment as above. The model also generates the declining profile of the magnitude of this elasticity in household income. However, the model overestimates the magnitude for high-income households. This is because, as shown in Appendix C, the model does not generate the high amount of wealth held by the households in the right tail of the asset-to-income distribution for whom the magnitude of this elasticity is expected to be very low.

The second panel of Table 1 compares female labor earnings elasticity with respect to transfers in the data and the model. I calculate this elasticity in the data using my PSID sample. Specifically, I compare the change in spousal earnings upon the head’s job displacement for households living in either the U.S. states providing the most-generous transfer payments or the U.S. states providing the least-generous transfer payments. In particular, I group the sample of households into these two groups and run the regression Equation (8) separately with spousal earnings and transfer receipts as dependent variables, also controlling for state fixed effects and state-level employment rates to account for labor market differences. As a result, I obtain post-

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42Eissa and Hoynes (2004) report the average gross hourly wages of husbands and wives as $12.09 and $7.56 in 1995 dollars, respectively, for their entire sample. This implies that the ratio of the total gross hourly wage of the household ($19.65) to the hourly minimum wage in 1995 ($4.25) is equal to 4.62 in their sample. To discipline the model sample of low-income households, I consider low-income households as those with total gross labor earnings less than or equal to 4.62 times the model’s minimum wage. On the other hand, the data sample in Liebman and Saez (2006) includes family heads whose earnings are above the 75th percentile. Hence, in the model, I classify households as high-income if the head’s gross wage is greater than or equal to the 75th percentile of the wage distribution of the employed.

43U.S. states with the most-generous safety net programs are Vermont, District of Columbia, North Dakota, Massachusetts, and Minnesota. U.S. states with the least-generous safety net programs
displacement changes in the dollar amounts of spousal earnings and transfer receipts for households with a displaced head relative to households without a displaced head separately for these two groups of displaced households living in different states. Then, I calculate the ratio of the difference in log spousal earnings to the difference in log transfer receipts of displaced households between the most-generous states and the least-generous states, and find the absolute value of this ratio is 0.44.

I perform a similar exercise in the model by separately implementing an unexpected and permanent 10 percent decline in the average generosity of means-tested transfers $\bar{\phi}$ and employment-tested transfers $\bar{b}$. While the model-implied magnitude of this elasticity is close to its data counterpart, the model reveals that most of the response is driven by changes in means-tested transfers and that female earnings are almost inelastic to the generosity of employment-tested transfers. This is because eligibility for employment-tested transfers requires job search and such transfers pay only low amounts for a short duration. On the other hand, the eligibility for means-tested transfers requires low family labor income, which puts an implicit income tax on spousal labor supply and thus discourages it when the transfer amount is large.

4 Results

In this section, I present two main results. First, I implement a counterfactual experiment to explore the role of more generous-government transfers during recessions in explaining the small change of spousal earnings upon the head’s displacement in recessions. Second, I study the optimal design of means-tested and employment-tested transfers over the business cycle.

4.1 Effects of transfers on spousal earnings response

The calibrated model is designed to isolate the effect of varying transfers on spousal labor supply. I achieve this in two steps. First, I normalize the value of leisure for

are Alabama, South Carolina, Florida, Nevada, and Georgia. I have 421 displacements in the former sample and 647 displacements in the latter sample. Given this small sample size, it is unfortunately not possible to further divide these samples into displacements in recessions and in expansions, or displacements that occur in low-income or high-income families. One valid concern in this estimation is the selection of households with frequently displaced heads into states with more-generous transfers. I acknowledge this concern and view the estimates in this exercise as suggestive correlational evidence.
Note: This figure plots the changes in relative spousal labor earnings upon the head’s job displacement in recessions (left panel) and in expansions (right panel) in the model under the countercyclical baseline policy and a procyclical policy. The procyclical policy here is the optimal policy obtained in the next section. I estimate the changes in spousal earnings from a distributed lag-recession model using model-simulated data, which are aggregated to a yearly period.

males $\eta_m$ to be 0 to make male workers inelastic to changes in government policy. Second, I assume that the wages paid in each human capital submarket are a fraction of the period’s aggregate labor productivity. This implies that wages and firm vacancy-posting decisions are invariant to government policy in the baseline model.44 These two assumptions allow me to focus on changes in the spousal labor supply response to the head’s job displacement under different government policies.

Figure 6 compares the changes in spousal earnings upon the head’s job displacement in recessions and expansions in the model under the countercyclical baseline/existing policy and a procyclical policy.45 I find that the mean of the post-displacement coefficients in recessions is 14 percent under the procyclical policy as opposed to 3.2 percent under the countercyclical policy. For expansions, it is 2.9 percent under the procyclical policy and 5.2 percent under the countercyclical policy. Hence, under the procyclical policy, the spousal insurance is now much larger in recessions when the household needs it the most.46

44 In Section 5, I explore the implications of allowing for endogenous wage choices by households, to capture the effects of transfers on labor demand.

45 The procyclical policy here is the optimal policy obtained in the next section.

46 This result implies a higher spousal labor supply response when transfers are less generous. Similarly, Bredtmann, Otten, and Rulff (2017) use data from 28 European countries between 2004 and 2013, and show that wives’ labor supply in response to their husband’s unemployment is strongest in less generous welfare states (i.e., the Mediterranean, Central, and Eastern European countries), while it is weakest in more generous welfare states (i.e., the Continental European and Nordic countries).
This result is driven by the fact that, in recessions, the head’s job displacement causes a larger drop in household income and this makes the spousal labor supply more elastic to changes in government transfers, as shown in Table 1. Hence, reducing the generosity of transfers in recessions significantly increases the spousal earnings response to the head’s displacement. In contrast, expansions are periods when earnings losses are not as pronounced. As such, the spousal earnings response is small and almost inelastic to the generosity of government transfers.

This experiment contributes to our understanding of why the change in female labor supply upon earnings loss within the family, otherwise known as the “added worker effect,” is small (Heckman and MaCurdy 1980, 1982, Lundberg 1985, Cullen and Gruber 2000, Stephens 2002, Hendren 2017). First, Table 1 reveals that, in both the model and the data, female labor supply responds to changes in transfer generosity. Second, the model shows that, absent the generous transfers in recessions, spousal earnings increase significantly upon the head’s displacement in recessions. These imply that female labor supply is in fact responsive to both the earnings loss of the primary earner and changes in government transfer generosity, but in an opposite way. As a result, the measured female labor supply response from the data is masked by the crowding-out effects of transfers.

4.2 Optimal policy in the baseline model

The results in the previous section show that the incentive costs of transfers on the spousal labor supply are larger in recessions and smaller in expansions. Since existing transfers are more generous in recessions, it implies that there may be potential welfare gains from changing the generosity of government transfers over the business cycle. Motivated by this observation, I now study the optimal design of means-tested and employment-tested transfers over the business cycle.

The government chooses the policy instruments to maximize the ex-ante lifetime utility of a household who is born (under the veil of ignorance) into the stationary equilibrium under the existing/current policy, subject to the government budget constraint. Specifically, the government’s objective is to maximize a utilitarian social welfare function subject to Equation (1) by choosing a set of policy instruments. The policy reform implemented at this time is unanticipated and permanent. Moreover, the welfare analysis incorporates the effects of the transition path from the station-
Table 2: Current Policy vs Optimal Policy in the Baseline Model

<table>
<thead>
<tr>
<th>Labor Productivity</th>
<th>Means-tested</th>
<th>Employment-tested</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current Policy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>1.61</td>
<td>0.86</td>
<td>2.48</td>
</tr>
<tr>
<td>Recession</td>
<td>1.90</td>
<td>1.04</td>
<td>2.94</td>
</tr>
<tr>
<td></td>
<td>Optimal Policy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>1.40</td>
<td>1.18</td>
<td>2.58</td>
</tr>
<tr>
<td>Recession</td>
<td>0.40</td>
<td>1.34</td>
<td>1.74</td>
</tr>
</tbody>
</table>

Note: This table compares per-recipient transfer amounts as a multiple of the minimum wage in the model paid under the means-tested and under the employment-tested transfers in the current policy and the optimal policy. Separate comparisons are presented for when aggregate labor productivity $z$ is at its average level $\bar{z}$ and its minimum level; i.e., deep recession. The minimum wage in the model is exogenous to changes in policy, and thus reporting transfer amounts as a multiple of the minimum wage presents a useful interpretation.

In my main optimal policy analysis, the focus is to obtain the optimal level and cyclicality of means-tested and employment-tested transfer amounts. Thus, I jointly search over four policy parameters $\left(\tilde{\phi}, \omega_\phi, \tilde{b}, \omega_b\right)$ together with the implied tax rate $\tau$ to solve for the optimal transfer policy. Later in Section 5, I extend this analysis by also optimizing over the income and asset thresholds $y$ and $a$ of the means-tested transfers, as well as the expiration rate $e(\cdot)$ of the employment-tested transfers.

Table 2 compares the per-recipient transfer amount as a multiple of the minimum wage in the model paid under means-tested and employment-tested transfers in the current policy with that in the optimal policy. Separate comparisons are presented for when the aggregate labor productivity $z$ is at its average level and its lowest level, i.e., in a deep recession. The minimum wage in the model is exogenous to changes in policy and thus reporting each transfer amount as a multiple of the minimum wage presents a useful interpretation.

I find that the optimal policy and current policy feature similar levels of total transfers when labor productivity is at its average level. What is different between the optimal policy and current policy is the cyclicality of transfers. In particular, in a recession, the optimal policy provides less-generous means-tested transfers (procyclical), while the current policy provides more-generous means-tested transfers (countercyclical). Less-generous transfers in recessions alleviate the large incentive costs on
the labor supply of spouses. This induces a higher female labor force participation in response to the larger increase in the marginal utility of consumption from the head’s larger earnings losses upon displacement in recessions. On the other hand, the optimal policy provides more-generous employment-tested transfers in recessions (counter-cyclical) and of comparable cyclicality with those from the current policy. The provision of insurance benefits in recessions is better accomplished through employment-tested transfers because the eligibility for employment-tested transfers is based on individual’s employment status, and it does not check spousal earnings. Moreover, these transfers are small payments and, more importantly, limited in duration. These dampen the crowding-out effects on the spousal labor supply. This finding is corroborated by the results of Table 1, where I show that the magnitude of female labor supply elasticity with respect to changes in $\bar{b}$ is small.

These results show that the optimal policy incorporates both types of transfers. One might think that, given its large implicit income tax on spousal earnings, it may be welfare improving to completely eliminate means-tested transfer programs and provide public insurance only through employment-tested transfers. However, this proposal turns out to be suboptimal for two reasons. First, incentive costs of transfers on spousal earnings are highly cyclical, as discussed in the previous section, such that they are much larger in recessions. Thus, reducing the amount of means-tested transfers during recessions is sufficient to induce a higher job search effort of women upon the head’s job displacement. Second, females with low human capital — who have been nonemployed for a long time — are not able to find a job especially during recessions, even if they are induced to look for a job under the optimal policy. Hence, the optimal policy better targets insurance toward such long-term unemployed with high marginal utility of consumption through permanent means-tested transfers.

**Effects of optimal policy on the macroeconomic outcomes** Table 3 compares the average values of macroeconomic outcomes under the current policy with those under the optimal policy across two steady states. Compared with the economy under the current policy, the economy under the optimal policy has a similar unemployment rate but much higher relative LFPR of married women, 76 percent versus 71 percent. As a result, the median skill of females is larger under the optimal policy, as they spend more time employed. The increase in employment reduces the income tax required to finance a similar level of total government transfers (as shown in Table 2) from 16.2
Table 3: Macroeconomic Effects of the Optimal Policy

<table>
<thead>
<tr>
<th></th>
<th>Current Policy</th>
<th>Optimal Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor market and taxation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment rate (%)</td>
<td>5.05</td>
<td>5.08</td>
</tr>
<tr>
<td>Relative female LFPR (%)</td>
<td>71</td>
<td>76</td>
</tr>
<tr>
<td>Median skill of female</td>
<td>0.98</td>
<td>1.1</td>
</tr>
<tr>
<td>Income tax (%)</td>
<td>16.2</td>
<td>15.6</td>
</tr>
<tr>
<td>Asset-to-income distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median asset-to-income ratio</td>
<td>1.1</td>
<td>1.45</td>
</tr>
<tr>
<td>Fraction with non. pos. wealth (%)</td>
<td>13</td>
<td>9.1</td>
</tr>
<tr>
<td>Consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.85</td>
<td>0.86</td>
</tr>
<tr>
<td>Median</td>
<td>0.77</td>
<td>0.79</td>
</tr>
<tr>
<td>Std. dev. of mean</td>
<td>0.0181</td>
<td>0.0178</td>
</tr>
<tr>
<td>Gini</td>
<td>0.41</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Note: This table compares the average values of macroeconomic outcomes under the current policy and the optimal policy. These values are obtained by using model-simulated data under these two policies. Moments related to the asset-to-income distribution and consumption are calculated for families in the labor force. The volatility of average consumption is measured by the standard deviation of log deviations from an HP trend with parameter 1600.

The wealth distribution of families in the labor force also shifts right under the optimal policy, as we observe a sizeable decline in the fraction of families with non-positive net liquid wealth and an increase in the median value of the asset-to-income distribution. These changes in the macroeconomy increase the average consumption level under the optimal policy. I find that the mean and the median of consumption across these families are respectively 1 and 2 percentage points larger under the optimal policy than under the current policy. While the Gini of the consumption distribution is the same under these two policies, the volatility of average consumption is only slightly lower under the optimal policy because of the offsetting effects of the increase in spousal earnings and the decline in transfer receipts under the optimal policy in recessions.

In Appendix E, I analyze the effects of the optimal policy on household behavior by comparing household consumption, labor earnings, and assets under the optimal policy and current policy.

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Table 4: Heterogeneous Welfare Gains from the Optimal Policy

<table>
<thead>
<tr>
<th>Family employment: Only head employed</th>
<th>Female skill</th>
<th>Male skill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ p50  &gt; p50</td>
<td>≤ p50  &gt; p50</td>
</tr>
<tr>
<td>Asset</td>
<td>≤ p50  0.50  1.09</td>
<td>0.73  0.42</td>
</tr>
<tr>
<td></td>
<td>&gt; p50  0.29  0.38</td>
<td>0.35  0.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family employment: Both unemployed</th>
<th>Female skill</th>
<th>Male skill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ p50  &gt; p50</td>
<td>≤ p50  &gt; p50</td>
</tr>
<tr>
<td>Asset</td>
<td>≤ p50  1.21  1.66</td>
<td>1.31  0.91</td>
</tr>
<tr>
<td></td>
<td>&gt; p50  0.28  0.78</td>
<td>0.76  0.41</td>
</tr>
</tbody>
</table>

Note: This table shows the heterogeneous welfare gains from the optimal policy for various groups. Cutoffs for the asset and skill groups are obtained from the stationary distribution of the economy before the government changes the policy to the optimal policy. Welfare gains are in percent lifetime-equivalent consumption terms and computed relative to the current policy.

Heterogeneous welfare gains from the optimal policy The optimal policy yields welfare gains equivalent to around 0.6 percent of additional lifetime consumption compared with the current policy. But, ex-post welfare gains are heterogeneous. To demonstrate this, I group families by their employment status, asset level, and male and female skill level based on their states on the stationary distribution prior to policy reform and obtain an aggregate welfare for each group by only integrating over families that belong to that group. Table 4 summarizes the results.

I find that most of the welfare gains are enjoyed by wealth-poor families with an unskilled male who is married to a skilled female. It is precisely for this family for whom a female’s participation in the labor market can bring the largest gains in consumption, especially when the displacement probability of the unskilled male is larger. On the contrary, the lowest welfare gains are enjoyed by wealth-rich families with a skilled male and an unskilled female for whom spouses are less likely to enter the labor market as their need for any insurance is the least.

\(^{47}\) Roughly half of these welfare gains are attributable to optimizing over the average level of transfers and the rest are attributable to optimizing over the cyclicality of transfers.
Table 5: Optimal Policy in the Baseline vs Exogeneous Spousal Labor Supply Model

<table>
<thead>
<tr>
<th>Labor Productivity</th>
<th>Means-tested</th>
<th>Employment-tested</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optimal Policy in the Baseline Model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>1.40</td>
<td>1.18</td>
<td>2.58</td>
</tr>
<tr>
<td>Recession</td>
<td>0.40</td>
<td>1.34</td>
<td>1.74</td>
</tr>
<tr>
<td><strong>Optimal Policy in the Exogeneous Spousal Labor Supply Model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>2.58</td>
<td>0.32</td>
<td>2.90</td>
</tr>
<tr>
<td>Recession</td>
<td>2.69</td>
<td>0.40</td>
<td>3.09</td>
</tr>
</tbody>
</table>

*Note:* This table compares per-recipient transfer amounts as a multiple of the minimum wage under the optimal policy of the baseline model and under the optimal policy in the exogeneous spousal labor supply model. Separate comparisons are presented for when aggregate labor productivity $z$ is at its average level $ar{z}$ and its minimum level, i.e., deep recession. The minimum wage in the model is exogen eous to changes in policy, and thus reporting transfer amounts as a multiple of the minimum wage presents a useful interpretation.

4.3 Optimal policy in the exogenous labor supply model

I now explore the implications of abstracting from the endogeneity of private insurance (i.e., spousal labor supply) to public insurance in determining the optimal policy. In particular, I consider an alternative environment in which female labor force participation decisions are invariant to changes in government policy. In order to do so, I fix spousal labor supply decisions to be those under the current (old) policy $o$ for any new (proposed) policy $n$; i.e., $s^n_f = s^o_f \forall n$. Then, I solve for the optimal policy of this model using the same methodology as before. Table 5 compares per-recipient transfer amounts as a multiple of the minimum wage under the optimal policy of the baseline model with endogenous female labor supply and under the optimal policy of this alternative model with exogenous labor supply.

I find that the optimal policy in the exogenous spousal labor supply model is different than the optimal policy of the baseline model in two ways. First, total transfers paid is more generous. Second, the optimal policy in this case features countercyclical means-tested and employment-tested transfers. This is because the incentive costs of transfers are now unaccounted for and thus the optimal cyclicality of government transfers is mostly determined by the cyclicality of insurance benefits, which is larger in recessions when unemployment risk is larger. Moreover, according to this optimal policy, around 90 percent of total transfers are means-tested since means-tested transfers better target insurance toward families who need it the most and for whom incentive costs are now disregarded.
Table 6: Welfare Gains under Optimality of Other Policy Instruments

<table>
<thead>
<tr>
<th>Welfare gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline optimal</td>
</tr>
<tr>
<td>+ Optimal both $a$ and $y$</td>
</tr>
<tr>
<td>+ Optimal $a$</td>
</tr>
<tr>
<td>+ Optimal $y$</td>
</tr>
<tr>
<td>+ Optimal $e$</td>
</tr>
</tbody>
</table>

Note: This table first shows the welfare gains from the baseline optimal policy calculated in Section 4.2, from optimizing over the transfer level and cyclicality of both means-tested and employment-tested transfers (first row). Then, on top of this optimal policy, it shows welfare gains from optimizing over i) both levels of asset and income thresholds $a$ and $y$ of eligibility for means-tested transfers (second row), ii) only the level of asset threshold $a$ (third row), iii) only the level of income threshold $y$ (fourth row), and finally iv) only the level and cyclicality of the employment-tested transfer expiration rate $e(\cdot)$ (fifth row). Welfare gains are in percent lifetime-equivalent consumption terms and computed relative to the current policy.

Overall, this exercise shows that endogenizing the spousal labor supply response to changes in government policy is a critical determinant of both the optimal level and cyclicality of transfers. From the lens of my model, when we disregard this mechanism, the resulting optimal policy looks similar to the current policy in the United States, given that both provide more-generous employment-tested and means-tested transfers in recessions. However, when we take into account the endogenous spousal labor supply response to policy, the optimal policy turns out to be largely different. As a result, policy makers should recognize that married households have an important source of self-insurance through adjustments in the spousal labor supply, and generous payments to these households make them worse-off due to large crowding-out.

5 Extensions and Robustness

In this section, I first extend the set of policy instruments on the optimal policy analysis. In particular, on top of the optimal policy (i.e., under the optimal levels and cyclicalities of the means-tested and employment-tested transfers obtained in Section 4.2), I optimize over levels of asset and income thresholds $a$ and $y$ of eligibility for means-tested transfers as well as the the level and the cyclicality of the employment-tested transfer expiration rate $e(\cdot)$ one at a time. Table 6 shows that optimizing
Table 7: Welfare Gains from the Optimal Policy under Alternative Assumptions

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Welfare gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline optimal</td>
<td>0.61</td>
</tr>
<tr>
<td>Incorporating Medicaid into means-tested transfers</td>
<td>0.51</td>
</tr>
<tr>
<td>Removing job search requirements for employment-tested transfers</td>
<td>0.48</td>
</tr>
<tr>
<td>Progressive taxation</td>
<td>0.95</td>
</tr>
<tr>
<td>Non-separable preferences</td>
<td>0.68</td>
</tr>
<tr>
<td>Endogenous wages</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Note: This table provides a list of robustness checks for the optimal policy analysis. It first shows the welfare gains from the optimal policy for the baseline model (first row). Then, it shows welfare gains from the same optimal policy when an assumption of the baseline model is changed. Welfare gains are in percent lifetime-equivalent consumption terms and computed relative to the current policy.

jointly over asset and income thresholds yields sizeable additional welfare gains. I find that the optimal income threshold is less restrictive (i.e., it allows families with slightly higher total labor income to be eligible for means-tested transfers), while the asset threshold is more restrictive than the current policy. Separately optimizing over asset and income thresholds reveals that the optimal income threshold increases the welfare gains the most. On the other hand, optimizing over the UI expiration rate barely affects welfare gains, given the presence of permanent means-tested transfers for the long-term unemployed.

Next, I relax a list of assumptions in the baseline model and compute the welfare gains from the optimal policy. Results are summarized in Table 7. Details on the implementation of these exercises are provided in Appendix F.

Overall, welfare gains from the optimal policy remain similar in magnitude when each of these assumptions are changed. Moreover, under a progressive taxation system, welfare gains are significantly larger. This is intuitive given that most of the welfare gains are enjoyed by wealth-poor families, as shown in Section 4.2. When the

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48 I also check the implications of these exercises on the results of Section 4.1. Sizeable welfare gains from the baseline optimal policy in these cases imply that less-generous transfers in recessions still induce spouses to supplement family earnings by working.

49 I acknowledge that the optimal policy of the baseline model may not be the optimal policy of a model with assumptions that differ from the baseline model. However, this exercise at least shows us if there is a large quantitative effect of an assumption on welfare results.
tax system is progressive, it is this group of families whose spouses are induced to work more under the optimal policy, and they now receive higher net earnings due to their lower marginal tax rates.

6 Conclusion

This paper documents that the spousal earnings response to the family head’s job displacement is small, especially in recessions when the head’s earnings loss is larger. Using an incomplete markets model with family labor supply and aggregate fluctuations, where the model-implied female labor supply elasticities with respect to transfers are in line with microeconomic estimates both in aggregate and across subpopulations, I find that existing generous transfers in recessions discourage the spousal labor supply significantly after the head’s job displacement. In this framework, the optimal transfer policy features procyclical means-tested and countercyclical employment-tested transfers, unlike the existing policy. Overall, the optimal policy is procyclical because there are welfare gains of reducing transfers in recessions to induce spouses to work more when the head experiences larger earnings losses. This is a direct implication of the model’s result that spousal labor supply is more elastic to transfers in recessions when household income is lower, which is in line with the data.

In an alternative model where the spousal labor supply is invariant to transfer generosity, I show that the average transfer generosity of the optimal policy increases. Moreover, the optimal policy in this case would instead feature countercyclical transfers of both types since insurance benefits are larger in recessions and the incentive costs on the spousal labor supply are now unaccounted for. As a result, I argue that endogenizing the spousal labor supply response to changes in government policy is critical in determining both the optimal level and cyclicity of government transfers.

In this paper, I made several simplifying assumptions in order to keep the analysis computationally feasible. For example, all households in the model are assumed to be married, and thus the model abstracts from endogenous marriage and divorce decisions. It may be particularly interesting to incorporate these decisions because generous transfers may reduce the incentives to get married or stay married. I leave this to future research.
References


Appendix

A. Model

In this section, I lay out and discuss the expectation over the transition of employment statuses of unemployed-unemployed and employed-employed households, as well as the problem of a retired household, respectively. These supplement the discussion in Section 2.2 of the main text.

Unemployed-unemployed household

The expected value of an unemployed-unemployed household is given by:

\[
\mathbb{E}_{l',h',\mu'} \left[ V^{ll'} (a', h'; \mu') \right] = \mathbb{E}_{h',\mu'} \left[ s_m s_f p_m' \left( p_f' V^{EE} (a', h'; \mu') + \left( 1 - p_f' \right) \sum_{k \in \{b, n\}} \lambda_k' V^{EU_k} (a', h'; \mu') \right) \right]
\]

\[
+ s_m s_f (1 - p_m') \left( p_f' \sum_k \lambda_k' V^{U_k E} (a', h'; \mu') + \left( 1 - p_f' \right) \sum_{k,d \in \{b, n\}} \lambda_k' \lambda_d' V^{U_k U_d} (a', h'; \mu') \right)
\]

\[
+ s_m (1 - s_f) \left( p_m' \sum_k \lambda_k' V^{EU_k} (a', h'; \mu') + \left( 1 - p_m' \right) \sum_{k,d \in \{b, n\}} \lambda_k' \lambda_d' V^{U_k U_d} (a', h'; \mu') \right)
\]

\[
+ (1 - s_m) s_f \left( p_f' \sum_k \lambda_k' V^{EU_k} (a', h'; \mu') + \left( 1 - p_f' \right) \sum_{k,d \in \{b, n\}} \lambda_k' \lambda_d' V^{U_k U_d} (a', h'; \mu') \right)
\]

\[
+ (1 - s_m) (1 - s_f) \sum_{k,d \in \{b, n\}} \lambda_k' \lambda_d' V^{U_k U_d} (a', h'; \mu') \left| h, \mu \right.
\]

where I drop the conditions of the expectation in the left-hand side to save space.

The first line on the right-hand side shows the case when both male and female search for a job in the current period and he finds a job. In this case, if she also finds a job, the household will be an employed-employed household, otherwise the household will be an employed-unemployed household, but she may retain or lose eligibility for employment-tested transfers. The second line is the case when both of them search for a job and he does not find one. Then, if she finds a job, the household will be an unemployed-employed household where he may retain or lose eligibility for employment-tested transfers. If she cannot find a job, then both members of the household will continue to be unemployed, and they will both face eligibility risk.
for the employment-tested transfers. The third and fourth lines are cases when one of them searches for a job and the other does not. In these cases, if the searcher finds a job, then the household will have one employed member and the other faces eligibility risk; otherwise, both members will continue to be unemployed and face eligibility risk. Finally, the last line shows the case when both members do not search for a job, continue to be unemployed, and face eligibility risk.

Similarly, for the household in which any unemployed member is ineligible unemployed, the above expectation is the same except that this member stays ineligible for employment-tested transfers if he/she does not find a job.

**Employed-employed household**

The expected value of an employed-employed household is given by:

$$
E_{V', h', \mu'} \left[ V_{UE} \left( a', h'; \mu' \right) \right] = E_{h', \mu'} \left[ (1 - \delta_m') \left( (1 - \delta_f') V^{EE} \left( a', h'; \mu' \right) + \delta_f' \sum_{k \in \{b, n\}} \lambda' V^{EU_k} \left( a', h'; \mu' \right) \right) + \delta_m' \left( (1 - \delta_f') \sum_k \lambda' V^{UE_k} \left( a', h'; \mu' \right) + \delta_f' \sum_{k,d \in \{b, n\}} \lambda'_d V^{EU_{kd}} \left( a', h'; \mu' \right) \right) \right] \left| \mathbf{h}, \mu \right],
$$

where I drop the conditions of the expectation on the left-hand side to save space.

The first line on the right-hand side shows cases when the male keeps his job, and the female may or may not lose her job and face eligibility risk if she loses it. The second line gives cases in which he loses his job and faces eligibility risk, and again the female may or may not lose her job and face eligibility risk if she loses it.

**Retired household**  Finally, I discuss the problem of retired households. Here, I assume that both members of the household retire at the same time and the household receives a time-invariant retirement transfer $b_R$ upon retirement. In each period, retired households die with probability $\zeta_D$ and are replaced with new households entering into the labor force. I also assume that retired members of the household do not enjoy leisure. Given that retired households are not allowed to re-enter into the labor market and that they receive time-invariant transfers, their only payoff relevant state variable is asset holdings $a$.$^{50}$

$^{50}$Relaxing the assumptions about leisure or transfer payments to retired households has only small quantitative effects on the baseline calibration of the model.
Let $V^R$ be the value of a retired household. The recursive problem of this household is given as follows:

$$
V^R(a) = \max_{a' \geq a_L} u(c) + \beta (1 - \zeta_D) V^R(a')
$$

subject to

$$c + a' \leq (1 + r) a + b_R.$$

B. Data

In this section, I first discuss sample selection and construction of some of the important variables for the PSID data. Second, I document the relative change in annual working hours of the family head and the spouse upon the head’s job displacement in recessions and expansions. Finally, I explain the details of calculating asset-to-income distribution from the PSID and SCF data, as well as the amount and incidence of means-tested and employment-tested transfer receipts by married households over time from the SIPP data. These supplement the discussions in Section 3.

B.1. PSID Data

The PSID is a nationally representative survey that was conducted in the United States annually from 1968 to 1997 and biannually from 1997 to 2015. I use all of these waves of data. The PSID provides information on labor market outcomes such as annual labor earnings and working hours, as well as characteristics of the family such as age, education, and number of children. Labor earnings include wages and salaries, bonuses, overtime, tips, commissions, professional practice or trade, market gardening, miscellaneous labor income, and extra job income.\footnote{PSID defines the head of a family unit as the individual with the most financial responsibility who is at least 18 years old. In the case that this person is a female and she has a spouse or partner or a boyfriend with whom she has been living for at least one year, then she is assigned to be the head of the family unit.}

While I take many of the variables I use in the main analysis directly from the PSID, there are several variables I must create using the other available information in the data. First, to address inconsistencies for the variable defining the age of the individuals, I create a new age variable separately for the head and the spouse by an increase based on the age reported in the first observation of the family. Next, I use completed years of education to create potential years of labor market experience for.
both head and spouse in any of their available observation as \( Age - Education - 6 \) if the individual’s number of years of completed education is larger than or equal to 12, and as \( Age - 18 \) if otherwise. This way, individuals with fewer years of completed education are not assigned large values for their labor market experience. I also create the total number of children and young children (defined as children less than 6 years of age) in the family in any of their available observations using the relation of each individual in the family unit to the head of the family.

I create variables for involuntary job displacement using a question that asks the reason for the loss of the previous job of the individuals who are either without a job or have been employed in their current job for less than a year. Following the literature, I define an involuntary job loss as a separation due to firm closure, layoff or firing. As Stevens (1997) and Stephens (2002) point out, the timing of the displacement is not precisely identified in all years of the survey. This is because while the earnings and hours questions are designed to obtain information for the previous year, the question that I use to determine job displacement is not year specific. To better understand this, consider a head of the family who reports being displaced according to the definition above in the 1992 survey of the PSID. This implies that the head may be displaced any time between January 1991 and the survey date in 1992. Thus, the econometrician may assign such displacement either in 1991 (previous calendar year) or in 1992 (survey year). In my analysis, following Stephens (2002), I assume that displacements occur in the previous calendar year to align the displacement year with the earnings and hours information.

Given that I also use the data from biannual survey years of the PSID (1997-2015), displacements that occur in between these years have information only for every other year. However, I still prefer to keep this time period in my main sample especially to incorporate the Great Recession period into my analysis to better analyze the differential effects of displacements over the business cycle on the labor market outcomes of couples. Thus, when a displacement occurs in this time frame, I observe relevant variables used in my regressions biannually. Furthermore, given that the 1968 survey only identifies workers who have been displaced within the past ten years, it is not possible to determine the exact year of such displacement within these ten years. Therefore, I do not incorporate displacements that occur in 1968 into my analysis.

Table A.1 compares the characteristics of families in which the head had never been displaced with characteristics of families in which the head had been displaced at
Table A.1: Summary Statistics for Families with and without Job Displacement

<table>
<thead>
<tr>
<th></th>
<th>Never Displaced*</th>
<th>Displaced°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head’s age</td>
<td>36.49</td>
<td>32.90</td>
</tr>
<tr>
<td>Spouse’s age</td>
<td>34.38</td>
<td>30.99</td>
</tr>
<tr>
<td>Head’s education</td>
<td>15.49</td>
<td>13.19</td>
</tr>
<tr>
<td>Spouse’s education</td>
<td>15.02</td>
<td>13.07</td>
</tr>
<tr>
<td>White (%)</td>
<td>67.96</td>
<td>57.03</td>
</tr>
<tr>
<td>Number of children</td>
<td>1.30</td>
<td>1.52</td>
</tr>
<tr>
<td>Number of young children</td>
<td>0.51</td>
<td>0.65</td>
</tr>
<tr>
<td>Head’s annual hours</td>
<td>2,154</td>
<td>1,851</td>
</tr>
<tr>
<td>Spouse’s annual hours</td>
<td>1,288</td>
<td>1,142</td>
</tr>
<tr>
<td>Head’s industry - Manufacturing (%)</td>
<td>18.38</td>
<td>19.76</td>
</tr>
<tr>
<td>Number of families</td>
<td>6,584</td>
<td>2,799</td>
</tr>
</tbody>
</table>

Note: This table shows unweighted averages of selected characteristics for never-displaced families (i.e., families in which the head of the family is never displaced during any time the family is observed in the survey) and displaced families (i.e., families in which the head of the family is displaced at least once). The data are obtained from the PSID 1968-2015 surveys for families in which both the husband and the wife are between the ages of 20 and 60 and not in the Latino sample.

* Averages are obtained using all observations for families with a never-displaced head.
° Averages are obtained from the survey year prior to the displacement year of the head.

least once. Couples of the families in which the head had been displaced are slightly younger, less educated, and worked relatively fewer hours than couples who had never been displaced, even in the year prior to displacement.

The Online Appendix on the author’s website provides the details for the sample and shows that the empirical results are robust to alternative sample selections.

Head and spousal hours upon head’s job displacement  Figure A.1 shows that the magnitude of the drop in the head’s relative hours when the head is displaced in recessions (18 percent) is similar to that in expansions (14 percent) in the year following displacement. Moreover, it shows that the relative hours recover just after 2 years upon displacement both in recessions and expansions. Hence, both the cyclical gap in earnings losses upon displacements over the business cycle and the persistence of the earnings losses are largely explained by a drop in wages rather than a drop in hours. Previously, Ruhm (1991), Stevens (1997), and Huckfeldt (2016) documented this quick recovery of relative hours of the displaced workers using the PSID. My
Figure A.1: Working Hours of Family Head upon Job Displacement

![Graph showing changes in working hours of family head upon job displacement in recessions and expansions.]

Note: This figure plots the changes in relative working hours of the family head upon his job displacement in recessions (left panel) and expansions (right panel). I estimate the changes in relative labor earnings from a distributed lag-recession model using PSID. The solid blue lines show the point estimates, and the dashed light-blue lines show the 90 percent confidence interval.

findings complement their results, as I provide additional evidence that hours recover relatively quickly upon displacements both in recessions and expansions and that wage losses explain most of the cyclical gap in earnings losses.

Figure A.2 shows the change in spousal hours upon the head’s job displacement in recessions and expansions. I find that the average change in spousal hours upon heads’ displacements in recessions is small, while the average change in spousal hours upon heads’ displacements in expansions is up to 15 percent, and coefficients remain significant after 3 years following the displacement. The average post-displacement change is $-0.1$ percent in recessions and 10.1 percent in expansions.$^{52}$

Asset-to-income distribution Starting from a 1999 survey, PSID provides information on asset holdings of households for every two years. However, the amount of credit card debt is only available after 2011. For this reason, I choose to present the asset-to-income distribution for the latest survey of PSID in 2015.

I calculate the net liquid wealth of each household by adding the amount in checkings and savings accounts, the amount of bonds and other assets, the amount of stocks, and the amount of vehicle equity, and then by deducting the amount of credit card

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$^{52}$Previously, Stephens (2002) used PSID to study the impact of the head’s job displacement on relative working hours of spouses and found that the average increase in relative spousal hours is 11 percent across all years after the head’s displacement.
This figure plots the changes in relative working hours of the spouse upon the family head’s job displacement in recessions (left panel) and expansions (right panel). I estimate the changes in relative spousal hours from a distributed lag-recession model using PSID. The solid blue lines show the point estimates, and the dashed light-blue lines show the 90 percent confidence interval.

debt. Then, the fraction of families of non-positive net liquid wealth is simply given by the ratio of the total number of families with non-positive values of this net-liquid-wealth measure to the total number of families. Next, I calculate the net liquid wealth to quarterly labor income ratio by dividing this measure of net liquid wealth by total quarterly family labor income (i.e., the sum of head and spouse labor income) for each family with positive total family labor income.\textsuperscript{53} Finally, I calculate the ratio of the weighted distribution of this net liquid wealth to quarterly labor income across these families. The percentiles of the PSID 2015 distribution given in Table A.6 below are obtained from this calculation.

B.2. SCF Data

I also calculate the net liquid asset-to-income distribution from the SCF 2007. To do so, I first construct a sample of family heads with the following restrictions: i) marital status is married or cohabiting, and ii) ages of the head and spouse are between 20 and 60. This way, the SCF sample will be similar to the PSID sample.

The SCF provides information on the i) amount in up to seven different checking accounts, ii) amount in up to seven different savings/money market accounts, iii)
value of all certificates of deposits, iv) total value of all types of mutual funds, v) total value of all savings bonds, vi) total value of all bonds other than saving bonds, vii) total value of publicly traded stocks, viii) total value of all cash or call money (brokerage) accounts, ix) amount in annuity and trust accounts, x) other assets such as money owed to family or gold, silver, and other jewelry, and xi) value in vehicle equity. Summation of these values gives the total liquid wealth of the family. I then subtract the total credit card debt to obtain the net liquid wealth of each family. Next, I calculate the fraction of families of non-positive net liquid wealth and the distribution of this net liquid wealth to quarterly labor income, as in the PSID. The percentiles of the SCF 2007 distribution given in Table A.6 below are obtained from this calculation. Moreover, the median ratio of credit limit to quarterly labor income in Table A.3 is also obtained from this dataset, using the information on the total credit limit and total quarterly family labor income of each family.

B.3. SIPP Data

In this section, I document the amount and incidence of transfer receipts by married households. To do so, I use monthly data from the SIPP 1996 to 2008 Panels (covering December 1995 to August 2013) that provide information on monthly amounts of means-tested and UI transfers received by the family. Figure A.3 shows the results.

Panel A separately plots the total means-tested and employment-tested (UI) transfers paid to married households as a fraction of total transfers. On average, around 35 percent of all means-tested transfers and 60 percent of total UI transfers are paid to married households. According to Panel B, married households constitute around 33 percent of all means-tested transfer recipients and 58 percent of all UI recipients. Finally, Panel C shows that around 60 percent of all transfers received by married households are means-tested transfers. However, this value drops to as low as 30 percent after 2008. This is because, starting from this year, the survey data drastically underestimates total annual means-tested transfers when compared to total government means-tested transfers in NIPA tables, as shown in Panel D. Overall, Figure A.3 documents that means-tested transfers constitute a large fraction of total transfer receipts of married households.
Figure A.3: Transfer Receipts by Married Households

Note: Panel A separately plots the total means-tested and employment-tested (UI) transfers paid to married households as a fraction of total transfers. Panel B shows the total number of married household heads receiving means-tested and employment-tested transfers as a fraction of all recipients. Panel C shows the ratio of total means-tested transfers to total transfers (sum of means-tested and UI) received by married households. Finally, Panel D separately plots the total annual transfer amounts in SIPP data as a fraction of aggregate transfer amounts in NIPA tables for means-tested and employment-tested transfers. Values in Panels A-C are obtained from SIPP 1996-2008 panels. NIPA amounts in Panel D are obtained from Table 3.12, where I classify EITC, SNAP, and TANF payments as means-tested transfers and UI as employment-tested transfers. Dashed lines indicate time periods when the data are not available.
Table A.2: Externally calibrated parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho$</td>
<td>Autocorrelation of productivity process</td>
<td>0.7612</td>
</tr>
<tr>
<td>$\sigma_\epsilon$</td>
<td>Standard deviation of productivity process</td>
<td>0.0086</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Risk aversion</td>
<td>2</td>
</tr>
<tr>
<td>$\eta_m$</td>
<td>Value of leisure for male</td>
<td>0</td>
</tr>
<tr>
<td>$r$</td>
<td>Interest rate</td>
<td>0.5 percent</td>
</tr>
<tr>
<td>$\zeta_R$</td>
<td>Retirement probability</td>
<td>0.625 percent</td>
</tr>
<tr>
<td>$\zeta_D$</td>
<td>Death probability</td>
<td>1.7 percent</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Worker’s share of output</td>
<td>0.477</td>
</tr>
<tr>
<td>$h_L$</td>
<td>Lowest human capital</td>
<td>0.2</td>
</tr>
<tr>
<td>$h_H$</td>
<td>Highest human capital</td>
<td>1.8</td>
</tr>
<tr>
<td>$\Delta^E$</td>
<td>Human capital increase when employed</td>
<td>0.084</td>
</tr>
<tr>
<td>$\pi^U$</td>
<td>Prob. of human capital depreciation when unemployed</td>
<td>0.75</td>
</tr>
<tr>
<td>$a$</td>
<td>Asset threshold of means-tested transfers</td>
<td>0.068</td>
</tr>
<tr>
<td>$y$</td>
<td>Income threshold of means-tested transfers</td>
<td>0.240</td>
</tr>
<tr>
<td>$e$</td>
<td>Mean expiration rate of employment-tested transfers</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Note: This table summarizes the parameters calibrated outside of the model. Please refer to the main text for the interpretation of the values.

C. Calibration and Validation

Calibration

Table A.2 and A.3 summarize the externally calibrated and internally calibrated model parameters respectively.

Validation

In this section, I provide additional model validation exercises to supplement the discussion in Section 3.3 of the main text. Specifically, I compare model outcomes with a list of other important untargeted data moments including consumption drop upon job loss, asset-to-income distribution, marginal propensities to consume, and the
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation</th>
<th>Value</th>
<th>Target</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>0.983</td>
<td>Frac. of households with non-positive liquid wealth</td>
<td>0.097</td>
<td>0.13</td>
</tr>
<tr>
<td>$a_L$</td>
<td>Borrowing limit</td>
<td>$-0.67$</td>
<td>Median ratio of credit limit to labor income</td>
<td>0.64</td>
<td>0.65</td>
</tr>
<tr>
<td>$\eta_f$</td>
<td>Leisure value</td>
<td>0.51</td>
<td>Rel. female LFPR</td>
<td>0.77</td>
<td>0.77</td>
</tr>
</tbody>
</table>

**Labor Market**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation</th>
<th>Value</th>
<th>Target</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\kappa$</td>
<td>Vacancy cost</td>
<td>2.9</td>
<td>Unemployment rate</td>
<td>0.056</td>
<td>0.051</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Matching function</td>
<td>1.43</td>
<td>Std. dev of job finding rate</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>$\bar{\delta}$</td>
<td>Ave. job disp. rate</td>
<td>0.053</td>
<td>Job displ. rate</td>
<td>0.034</td>
<td>0.034</td>
</tr>
<tr>
<td>$\omega^\delta_z$</td>
<td>Displ. rate vol.</td>
<td>$-5.8$</td>
<td>Std. dev. of job displ. rate</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>$\omega^\delta_h$</td>
<td>Disp. rate across $h$</td>
<td>$-0.52$</td>
<td>Ratio of median earnings</td>
<td>0.76</td>
<td>0.77</td>
</tr>
</tbody>
</table>

**Human Capital Process**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation</th>
<th>Value</th>
<th>Target</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta^U$</td>
<td>Human capital decrease (unemp.)</td>
<td>[0.59, 0.34]</td>
<td>Cyclicality of head’s initial earnings loss</td>
<td>[0.39, 0.22]</td>
<td>[0.39, 0.22]</td>
</tr>
<tr>
<td>$\pi^E$</td>
<td>Prob. of human capital increase</td>
<td>0.04</td>
<td>Labor earnings p90/p10</td>
<td>7.60</td>
<td>6.20</td>
</tr>
</tbody>
</table>

**Government Transfers**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation</th>
<th>Value</th>
<th>Target</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{\phi}$</td>
<td>Ave. means-tested transfers</td>
<td>0.15</td>
<td>Ratio of total means-tested per recipient to min wage</td>
<td>0.74</td>
<td>0.76</td>
</tr>
<tr>
<td>$\bar{b}$</td>
<td>Ave. emp.-tested transfers</td>
<td>0.08</td>
<td>Ratio of UI per unemp. to min wage</td>
<td>0.36</td>
<td>0.37</td>
</tr>
<tr>
<td>$\omega^\phi$</td>
<td>Cyclicity of means-tested transfers</td>
<td>0.96</td>
<td>Std. dev of means-tested transfers per recipient</td>
<td>0.06</td>
<td>0.08</td>
</tr>
<tr>
<td>$\omega_b$</td>
<td>Cyclicity of emp.-tested transfers</td>
<td>0.64</td>
<td>Std. dev. of UI per unemployed</td>
<td>0.15</td>
<td>0.14</td>
</tr>
<tr>
<td>$b_R$</td>
<td>Retirement transfers</td>
<td>0.36</td>
<td>Social Security transfers/GDP ratio</td>
<td>0.041</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*Note: This table summarizes internally calibrated parameters. Please refer to the main text for a detailed discussion.*
extent to which displacement events are correlated across the head and the spouse.

**Consumption drop upon job loss** Several papers in the literature estimate the average consumption drop upon job loss. Gruber (1997) estimates a decline in food expenditure of 6.8 percent using the PSID for the period up to 1987. Saporta-Eksten (2014) uses cross-sectional variation in the PSID and measures an 8 percent decline in consumption expenditure in the year during which a job loss happens. Stephens (2004) estimates the average decline in food expenditure upon job loss in the Health and Retirement Survey (HRS) and the PSID and finds that the decline is between 12 percent (PSID) and 15 percent (HRS). Browning and Crossley (2001) report a 14 percent decline using Canadian Out of Employment Panel (COEP) survey data. Chodorow-Reich and Karabarbounis (2016) conduct an analysis of the effects of job loss on consumption both in the PSID and the Consumer Expenditure Survey (CE) and find that the decline in total food expenditure is between 14 percent (PSID) and 21 percent (CE). Finally, Aguiar and Hurst (2005) measure a 19 percent decline in food expenditure among the unemployed using scanner data.

I estimate the consumption drop upon job displacement in the model using Equation (8). I find that family consumption drops on average by 14 percent in the year following the head’s displacement, which is in line with the available empirical estimates discussed above.

**MPC: the average, cyclicality, and heterogeneity** Insurance benefits of transfers can be directly measured by the fraction of an unexpected transfer that families spend on consumption.

The empirical literature documents two aggregate MPC data moments that I use to validate the model. First, Parker et al. (2013) measure that households, under different specifications, spend between 12 and 30 percent of unexpected tax rebates in the quarter that they are received. Second, Gross, Notowidigdo, and Wang (2019) measure the cyclicality of the MPC by exploiting the unexpected changes in credit card borrowing limits of previously bankrupt individuals and find that the MPC is countercyclical over the Great Recession. They show that the average semiannual

\[ \text{Decline in consumption} = 0.14 \]
Table A.4: Average MPCs: Model vs Data

<table>
<thead>
<tr>
<th></th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average economy-wide quarterly MPC</td>
<td>0.22</td>
<td>0.12 – 0.30</td>
</tr>
<tr>
<td>Semiannual MPC increase for</td>
<td>0.10</td>
<td>0.08</td>
</tr>
<tr>
<td>borrowing-constrained in recessions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note:* This table shows the average quarterly economy-wide MPC and the average increase in semiannual MPC of borrowing-constrained individuals in a recession implied by the model’s simulation. I group families with non-positive net liquid wealth as borrowing-constrained families. The MPC of each family type is calculated by computing the fraction consumed out of an unexpected $500 transfer. The model-generated average values are then compared with available empirical estimates in the literature.

MPC difference of borrowing-constrained individuals between 2008 and 2011 is 8 percent.

In the model, I compute the MPC of a family by calculating the fraction of an unexpected transfer, scaled such that it is equivalent to $500, that the family spends on consumption. This transfer can be interpreted as a one-time unexpected deposit to the family’s bank account. As in Kaplan and Violante (2014), I implement a $500 tax rebate in order to ensure consistency with the above available empirical estimates.

Table A.4 compares the average economy-wide quarterly MPC and the magnitude of the semiannual MPC increase for borrowing-constrained families in recessions in the model to the available empirical estimates discussed above. The results show that the model-generated average quarterly MPC lies in the middle of the range of estimates provided by Parker et al. (2013). However, the cyclicity of the MPC for borrowing-constrained individuals is slightly larger in the model than in the data. This means that the insurance benefits in recessions are slightly overestimated in the model.

In order to quantitatively understand how MPCs differ across heterogeneous families in the economy, Table A.5 presents the average quarterly MPCs of groups of families based on the different employment, wealth, and skill levels of the head. Noticeably, wealth-poor families with an unskilled head exhibit the highest MPC given the absence of self-insurance through savings and low labor earnings of the head. On the other hand, wealth-rich families spend only 2 percent of the tax rebate on

---

55 I group families with non-positive net liquid wealth as borrowing-constrained families. I translate the average quarterly MPCs to the average semiannual MPCs as semiannual MPC = 1 − (1 − quarterly MPC)^2. Then, I report the difference in average semiannual MPC for such families between when labor productivity is strictly below the mean and when it is equal to or above the mean.

56 Nevertheless, the optimal policy is less generous in recessions, implying that even if insurance benefits were to be overestimated in recessions, incentive costs would still exceed insurance benefits.
Table A.5: MPCs across Heterogeneous Households in the Model

<table>
<thead>
<tr>
<th>Family employment: Only head employed</th>
<th>Family employment: Both unemployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head skill</td>
<td>Head skill</td>
</tr>
<tr>
<td>≤ $p_{50}$</td>
<td>$&gt; p_{50}$</td>
</tr>
<tr>
<td>Asset ≤ $p_{50}$</td>
<td>0.58</td>
</tr>
<tr>
<td>Asset $&gt; p_{50}$</td>
<td>0.02</td>
</tr>
<tr>
<td>Asset ≤ $p_{50}$</td>
<td>0.67</td>
</tr>
<tr>
<td>Asset $&gt; p_{50}$</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Note: This table shows the average quarterly MPCs across families grouped by employment status, assets holdings, and skill level of the head. Cutoffs for the asset and skill groups are obtained from the stationary distribution of the economy. The MPC of each family type is calculated by computing the fraction consumed out of an unexpected $500 transfer.

Consumption regardless of the head’s skill and employment status of the spouse.

Asset-to-income distribution

Wealth distribution in the economy is also relevant for both insurance benefits and incentive costs of transfers. Both insurance benefits and incentive costs are larger for wealth-poor families, implying that the model would overstate benefits and costs of transfers if the fraction of such families is much larger in the model than in the data counterpart. For this reason, the fraction of families with non-positive liquid wealth are taken as a calibration target in Table A.3, while the percentiles of the distribution presented below are not.

Table A.6 compares the distribution of net liquid asset to quarterly household labor earnings ratio in the model and the data. Empirical moments are calculated as discussed in Appendix B. The results show that while the model does well in generating the part of the distribution below the median, it misses both the amount of wealth owned by the richest and the dispersion of wealth among the richest families. As I have discussed in Section 3.1, according to the PSID, the displacement risk is much larger for low-income households, which are most likely to be in the left tail of this distribution. Hence, I argue that the model successfully generates the level of self-insurance held by the relevant group of households.

Correlated spells of family members

Finally, if the spouse is also displaced around the year of the head’s displacement and also experiences earnings losses, then we would not expect to observe positive spousal earnings and hours responses upon the family head’s job displacement. In order to test whether this is the case in the data, I estimate the same regression given in Equation (8) in which the outcome vari-
Table A.6: Distribution of Net Liquid Assets relative to Quarterly Labor Earnings

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
<th>Fraction of population with non-positive wealth</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSID 2015</td>
<td>0.05</td>
<td>0.48</td>
<td>1.20</td>
<td>2.88</td>
<td>14.38</td>
<td>0.091</td>
</tr>
<tr>
<td>SCF 2007</td>
<td>0.02</td>
<td>0.48</td>
<td>1.20</td>
<td>2.71</td>
<td>6.45</td>
<td>0.097</td>
</tr>
<tr>
<td>Model</td>
<td>-0.18</td>
<td>0.37</td>
<td>1.10</td>
<td>4.23</td>
<td>4.86</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Note: This table shows the net liquid asset to quarterly family labor earnings distribution both in the model and in the data. The empirical distributions are separately calculated from the PSID 2015 and the SCF 2007.

Table is now a dummy variable that takes a value of 1 if the spouse is displaced, and 0 otherwise. Figure A.4 compares the percentage point change in the spousal displacement probability upon the head’s displacement in both the model and the PSID data. It shows that there is at most a 2-percentage-point increase in the spousal displacement probability upon the head’s displacement. The model successfully generates a similar pattern given that there is no such correlation of unemployment between household members in the model. Overall, this allows me to eliminate the hypothesis that spousal earnings response to the head’s displacement may be muted in recessions if spouses are also displaced.

D. Welfare calculation

This section formally defines the calculation of welfare measures discussed in Section 4.2 in the main text. I use two measures to calculate the changes in welfare due to a government policy reform. The first measure, \( \lambda_1(x) \), is constructed for each individual state \( x \) possible in the economy separately, i.e., \( x \in \mathcal{X} \equiv \{E, U_b, U_n, R\} \times \{E, U_b, U_n, R\} \times \mathcal{A} \times \mathcal{H} \times \mathcal{H} \). This measure allows me to compute the welfare gains/losses for each type of household in the economy and thus makes it possible to analyze the heterogeneous welfare effects of a policy reform. Moreover, it is also possible to aggregate \( \lambda_1(\cdot) \) across all individual states to obtain a welfare measure for the entire economy, which I will call \( \bar{\lambda}_1 \). The second measure, \( \bar{\lambda}_2 \), is motivated by Lucas (1987). This measure provides one aggregated welfare measure for the entire economy and allows a better comparison with the existing literature.
Figure A.4: Change in Spousal Displacement Probability upon Head’s Displacement

Note: This figure plots the changes in the relative spousal displacement upon the head’s job displacement both in the model and in the data. I estimate the percentage point change in the relative spousal displacement probability in the data from a distributed lag-recession model using the PSID. The solid-blue lines show the point estimates and the dashed light-blue lines show the 90 percent confidence intervals. I compare these results to the estimates obtained from the same regression using the model-simulated data, which are aggregated to a yearly period.

I now formally define these two measures. Let \( \{ c^o_t(x), s^o_m(x), s^o_f(x) \}_{t=T}^\infty \) denote the path allocations of an individual with state \( x \) at time \( T \) under the existing (old) policy \( o \) according to the historical patterns of the government transfer programs in the United States. Let \( \{ c^n_t(x), s^n_m(x), s^n_f(x) \}_{t=T}^\infty \) denote the path of allocations of the same individual under a proposed (new) policy \( n \) from time \( T \) onwards.

\( \lambda_1(x) \) is the percent additional lifetime consumption that must be endowed at all future dates and states to a household with individual state \( x \) under the stationary distribution of the economy where policy \( o \) is implemented so that the household’s welfare will be the same as that under an economy where policy \( n \) is instead started to be implemented forever. Formally, for all \( x \in \mathcal{X} \), \( \lambda_1(x) \) satisfies\(^{57}\):

\[
E_T \sum_{t=T}^\infty \beta^{t-T} U \left( c^o_t(x) \left( 1 + \lambda_1(x) \right), s^o_m(x), s^o_f(x) \right) = E_T \sum_{t=T}^\infty \beta^{t-T} U \left( c^n_t(x), s^n_m(x), s^n_f(x) \right),
\]

where \( T \) is the time period when the policy changes from \( o \) to \( n \). Once we obtain \( \lambda_1(x) \) for all \( x \in \mathcal{X} \) by solving this equation, we obtain an aggregate welfare measure.

---

\(^{57}\)Given the functional form of the utility function, there are no closed-form solutions for \( \lambda_1(x) \), \( \bar{\lambda}_1 \), and \( \bar{\lambda}_2 \).
by integrating over the stationary distribution $\Gamma_{ss}^o$ in the economy with policy $o$:

$$\bar{\lambda}_1 = \int_{x \in \mathcal{X}} \Gamma_{ss}^o (x) \times \lambda_1 (x). \tag{A.1}$$

$\bar{\lambda}_2$ is the percent additional lifetime consumption that must be endowed at all future dates and states to all households under the stationary distribution of the economy where policy $o$ is implemented so that the average welfare will be the same as that under an economy where policy $n$ is instead started to be implemented forever. Formally, $\bar{\lambda}_2$ satisfies the following equation:

$$\int_{x \in \mathcal{X}} \Gamma_{ss}^o (x) E_T \sum_{t=0}^{\infty} \beta^t U \left( c_{t}^o (x) \left( 1 + \bar{\lambda}_2 \right), s_{m,t}^o (x), s_{f,t}^o (x) \right) \tag{A.2}$$

$$= \int_{x \in \mathcal{X}} \Gamma_{ss}^o (x) E_T \sum_{t=0}^{\infty} \beta^t U \left( c_{t}^o (x), s_{m,t}^o (x), s_{f,t}^o (x) \right).$$

All of the aggregate welfare gains presented in Section 4 and 5 of the main text are calculated using $\bar{\lambda}_2$, but the results remain similar when calculated using $\bar{\lambda}_1$. Furthermore, heterogeneous welfare gains given in Table 4 are calculated by grouping households by their employment status, asset holdings, and human capital level of the head and the spouse based on the stationary distribution under the current (old) policy $\Gamma_{ss}^o$. Then, for each group $k$, I compute for

$$\bar{\lambda}_{1,k} = \int_{x \in \mathcal{X}_k} \Gamma_{ss,k}^o (x) \times \lambda_1 (x), \tag{A.3}$$

where $\mathcal{X}_k$ is the set of household states in group $k$, and $\Gamma_{ss,k}^o (x)$ is the measure of households with type $x$ within group $k$ of the stationary distribution under policy $o$.

### E. Effects of optimal policy on family upon displacement

In order to better understand what makes for optimal policy, I compare family outcomes under the optimal and current policies.

Previously in Figure 6, I compare the change in spousal earnings upon the head’s job displacement in recessions and expansions in the model under the countercyclical baseline (current) policy and under a procyclical policy. There, the procyclical policy is actually the optimal policy obtained in Section 4.2. Thus, we know from Figure 6 that the optimal policy induces a larger spousal labor supply response upon the
head’s job displacement in recessions, and it does not alter the magnitude of this response much in expansions, due to reasons discussed earlier.

Now, I compare the change in family consumption upon the head’s job displacement in recessions and expansions under the current policy and the optimal policy. I find that families experience a smaller consumption drop under the optimal policy upon the head’s displacement both in recessions and expansions. Moreover, under the optimal policy, family consumption fully recovers 6 years after displacement in recessions and 5 years after displacement in expansions, 2 years earlier in recessions and 1 year earlier in expansions than the current policy. While the earlier recovery in recessions under the optimal policy is explained by a larger spousal labor earnings response, the earlier recovery in expansions is explained by larger transfers during the initial years after displacement. Furthermore, I find that the difference in the drops in consumption upon displacement between recessions and expansions under the optimal policy is 9 percentage points ($0.16 - 0.07 = 0.09$), which is the same as the cyclical gap under the current policy ($0.19 - 0.10 = 0.09$). The optimal policy does not narrow this gap is because the increase in spousal earnings offsets the decline in transfer receipts under the optimal policy in recessions. The main conclusion of this section is that the optimal policy reduces the average drop in consumption both in recessions and expansions but does not alleviate the cyclical gaps from the initial
Figure A.6: Family Labor Earnings upon the Head’s Job Displacement

Note: This figure plots the changes in relative labor earnings of the family upon the head’s job displacement in recessions (left panel) and expansions (right panel) in the model under the countercyclical baseline (current) policy and the optimal policy. I estimate the changes in relative family earnings from a distributed lag-recession model using model-simulated data, which are aggregated to a yearly period.

Next, Figure A.6 compares the change in family earnings upon the head’s job displacement in recessions and expansions under these two policies. There are three results that I want to highlight. First, the magnitudes of initial drops of family earnings upon the head’s job displacement in both recessions and expansions are lower under the optimal policy. This is because of higher spousal labor force participation rates and labor earnings due to the increase in their human capital. Second, the gap between the magnitude of initial drops under the current and optimal policies is larger in recessions ($0.33 - 0.26 = 0.07$) than in expansions ($0.18 - 0.15 = 0.03$). This is because, under the optimal policy, the change in spousal earnings in response to the head’s displacement in recessions is larger than its counterpart in expansions, as shown in Figure 6 in the main text. As a result, the contribution of spouses to their family income under the optimal policy is larger in recessions. Finally, while the recovery of family earnings under the optimal policy is faster than the recovery under the current policy in recessions, they are similar in expansions. This is due to the persistent increase in spousal earnings upon the head’s displacement in recessions under the optimal policy, as shown in Figure 6.

Finally, Figure A.7 compares the change in family assets upon the head’s job displacement in recessions and expansions under these two policies. I find that families
Figure A.7: Assets of the Family upon the Head’s Job Displacement

Note: This figure plots the changes in relative asset holdings of the family upon the head’s job displacement in recessions (left panel) and expansions (right panel) in the model under the countercyclical baseline (current) policy and the optimal policy. I estimate the changes in relative family earnings from a distributed lag-recession model using model-simulated data, which are aggregated to a yearly period.

dissave less upon the head’s displacement in both recessions and expansions under the optimal policy since a larger fraction of spouses is already working at the time of the head’s displacement under the optimal policy, and this allows families to self-insure more through spousal earnings and less through savings. Similarly, this effect is more pronounced in recessions due to a larger spousal labor earnings response. As a result, family assets recover earlier in recessions under the optimal policy. However, the recovery of assets in expansions is a bit slower under the optimal policy due to a slightly smaller increase in spousal earnings upon the head’s displacement than its counterpart under the current policy, as shown in Figure 6.

F. Robustness

Finally, in this section, I provide a detailed discussion on the implementation of robustness exercises presented in Section 5.

Incorporating Medicaid to means-tested transfers In the calibration of means-tested transfers, I did not incorporate Medicaid transfers given that the baseline model does not incorporate extra eligibility requirements such as health status or presence-of-young children requirements. Now, I incorporate Medicaid transfers into the calibration of parameters of means-tested transfers and include a new eligibil-
ity indicator for all means-tested transfers. Means-tested transfers are now given as follows:

\[ \phi(z; a, y, \chi) = \begin{cases} 
\phi(z) & \text{if } y < y_0, a < a_0, \chi = 1 \\
\iota \phi(z) & \text{if } y < y_0, a < a_0, \chi = 0 \\
0 & \text{otherwise,} 
\end{cases} \]

where \( \chi \) is a non-financial eligibility indicator for all means-tested transfers, which can be interpreted as health status or presence-of-young children requirements. In the above specification, if a family is financially eligible but non-financially ineligible (i.e., \( y < y_0, a < a_0, \chi = 0 \)), then I assume that the family receives only SNAP transfers, which typically do not have any non-financial eligibility requirements, and that SNAP is \( \iota \) fraction of total means-tested transfers. The variable \( \chi \) is a state variable representing family type, and a random variable is drawn from a uniform distribution each period to determine the value of \( \chi \).

I assume that 60 percent of families are non-financially eligible for means-tested transfers. I externally calibrate \( \iota = 0.107 \) because total SNAP transfers are around 10.7 percent of total means-tested transfers on average across years. I then recalibrate this model and calculate the welfare gains from the optimal policy obtained in Section 4.2 under this model. Here, I implement this exercise in two different ways given the large difference between the levels of \( \bar{\phi} \) in the baseline model and in this model. First, I compute welfare gains directly from the baseline optimal policy, in which \( \bar{\phi} = 0.13 \). In this case, I find welfare gains of the baseline optimal policy relative to the new calibration of the current policy under this model (i.e., \( \bar{\phi} = 0.51, \omega_\phi = 2.8 \), and so on), as much as 1.84 percent in consumption equivalents. Next, I replace the average generosity of means-tested transfers in the optimal policy from \( \bar{\phi} = 0.13 \) to \( \bar{\phi} = 0.51 \) to understand the effects of changing only the cyclicality of means-tested transfers (from \( \omega_\phi = 2.8 \) in the current policy to \( \omega_\phi = -3.54 \) in the optimal policy, together with the changes in the other policy parameters except \( \bar{\phi} \)). In this case, welfare gains are 0.51 in consumption equivalent, which is the value I report in Table 58.

\[ \text{Table 58: Among the changes to the parameter values, an important one to mention is that the average generosity of means-tested transfers is } \bar{\phi} = 0.51 \text{ instead of } \bar{\phi} = 0.15 \text{ in the baseline calibration given the inclusion of generous Medicaid transfers. Moreover, the cyclicality of means-tested transfers now becomes } \omega_\phi = 2.8 \text{ instead of } \omega_\phi = 0.96 \text{ as in the baseline model. In fact, the standard deviation of detrended means-tested transfers per recipient is still 0.06, as in the baseline calibration, but the increase in the level of means-tested transfers requires adjustments in } \omega_\phi \text{ as well to make it the same value. Finally, the income tax rate that balances the budget is } \tau = 20.6 \text{ percent instead of } \tau = 16.2 \text{ percent.} \]
Both of these exercises show that the less-generous and procyclical means-tested transfer policy is welfare improving, which is consistent with my main results.

**Removing job search requirements for employment-tested transfers** In the baseline model, I assume that the government can observe the search behavior of the unemployed. Here, I remove that assumption and check the implications on welfare gains from the baseline optimal policy. In this case, employment-tested transfers are now given as follows:

\[
b(z; l_i) = \begin{cases} 
  b(z) & \text{if } l_i = U_b \\
  0 & \text{otherwise.}
\end{cases}
\]

Then, I recalibrate the model and calculate welfare gains from the baseline optimal policy. I find that in this model the optimal policy yields 0.48 percent additional lifetime consumption relative to the current policy. Thus, I find smaller welfare gains in this model. This is possibly because of the increase in incentive costs of employment-tested transfers due to the removal of the job search requirement for eligibility.

**Progressive taxation** In the baseline model, I assume that the government levies a flat income tax \( \tau \) to finance the transfer programs. Now, I change this assumption and study the effects of progressive income taxation on the welfare gains from the baseline optimal policy.

Let \( \Upsilon \) be the total taxable family income. For families in the labor force, \( \Upsilon \) includes total labor income and income from employment-tested transfers. For retired families, \( \Upsilon \) includes only retirement income.\(^{59}\) Then, following Heathcote, Storesletten, and Violante (2014), the after-tax income of the family is given by \( \tilde{\Upsilon} = \Phi \Upsilon^{1-\nu} \), where \( \Phi \) determines the level of taxation and \( \nu \geq 0 \) determines the rate of progressivity built into the tax system. Then, tax revenues of the government from a family with total taxable income \( \Upsilon \) is given by \( T(\Upsilon) = \Upsilon - \Phi \Upsilon^{1-\nu} \).

In this case, I recalibrate the parameters of the model, where I set \( \nu = 0.151 \), as in Heathcote, Storesletten, and Violante (2014), and search for \( \Phi \) that balances the government budget in the long run and find \( \Phi = 0.834 \). Then, I calculate welfare gains from the baseline optimal policy, where the progressivity of the tax policy is

\(^{59}\)For a better comparison of results with the baseline model, I assume that \( \Upsilon \) does not include financial income, which is also not taxed in the baseline model.
the same. I find that the optimal policy of this model yields 0.95 percent additional lifetime consumption relative to the current policy, implying larger welfare gains when taxation is progressive. This is intuitive given that most of the welfare gains are enjoyed by wealth-poor families, as shown in Section 4.2. When the tax system is progressive, it is this group of families whose spouses are induced to work more under the optimal policy, and they receive higher net earnings since they now have lower marginal tax rates.

**Non-separable preferences** Next, I consider a utility function in which consumption and leisure are non-separable, following Blundell, Browning, and Meghir (1994) and Attanasio and Weber (1995). I define the preferences as follows:

\[
U(c, s_m, s_f) = \left[ c \times \prod_{i \in \{m, f\}} \exp \left( \eta_i \left( 1 - s_i \right) \right) \right]^{1-\sigma}.
\]

This is similar to the functional form used in Low, Meghir, and Pistaferri (2010). Then, I recalibrate the model and calculate the welfare gains from the baseline optimal policy and find that this policy yields 0.68 percent additional lifetime consumption relative to the current policy, which is similar to the main result.

**Model with endogenous wages** Finally, in the baseline model, I assume that the wage for each human capital level is a fraction of aggregate labor productivity. This assumption implies that wages and firm vacancy posting decisions are exogenous to changes in government policy in the baseline model, which allows me to isolate the effects of transfers on the labor supply.

To analyze the quantitative effects of this assumption on the welfare gains from the optimal policy, I now consider a directed search model in which wage choices of unemployed individuals are endogenous. In this model, submarkets in the labor market are indexed by the wage offer \( w \) of the firm and human capital level \( h \) of the worker. This means that unemployed individuals now direct their search effort toward a specific wage offered by a job that is compatible with their own skill level. In this case, wage levels of the employed members of the household become additional state variables. Household and firm optimization problems are given in the Online Appendix.

I recalibrate the parameters of this model and find that the baseline optimal pol-
icy yields 0.66 percent additional lifetime consumption relative to the current policy. Changes in transfer generosity now affect the wage choice of the unemployed endogenously. Less-generous public insurance in recessions induces unemployed individuals to look for low-paying jobs for which job finding rates are higher. Thus, under the baseline optimal policy, reemployment wages are lower but unemployment duration is shorter than under the current policy. While the former channel reduces the welfare gains from the baseline optimal policy, the latter channel increases welfare gains. As a result, welfare gains from the baseline optimal policy in this model are similar to the welfare gains in the baseline model.