Risk Sharing Or Bargaining?: The Impact of Spousal Labor Supply on Unemployment Duration

Jing Liu *

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Comments are welcome.

Abstract

This paper theoretically studies and empirically estimates (1) how spousal labor supply affects bargaining between the husband and wife over their private consumption, and (2) the impact of this intrahousehold bargaining on their reservation wage and unemployment duration. We consider a model of household job search in which the outcomes of bargaining are determined by the sharing rule of Chiappori (1992), a function defining the dependency of couples’ private consumption on their labor market conditions. This model allows the husband and wife to rationally expect their share of household income and decide on labor supply recursively. Using the panel data of SIPP 2001\(^1\), this work finds that the private consumption of the unemployed husband shrinks to 85% of that of the employed husband in the U.S., indicating that employment is crucial in the husband’ bargaining with his spouse. The estimates have two main implications. First, it suggests asymmetry in household unemployment duration: the more the husband earns, the longer the wife searches for a job; whereas the more the wife earns, the sooner the husband finds a job. Secondly, an increase of $100 in unemployment insurance (UI) per month lowers employment rate of the wife by 0.46% with an employed husband, compared to 3.35% of that with a unemployed husband, suggesting UI benefits crowd out the added worker effect (AWE).

Keywords: Unemployment Spells; Household Job Search; Unemployment Insurance; Intrahousehold Bargaining; The Collective Model; Crowd-Out Effect.

JEL Classification Numbers: D13, E24, E6, J22, J64.

*Jing Liu: Hanqing Institute of Economics and Finance & Department of Finance, Renmin University of China; Email: jliu.bluenta@gmail.com. The author is grateful to Drs. Russell Cooper, Dean Corbae, Burhan Kuruscu, Gerald Oettinger for advice and suggestions. The author is grateful to seminar participants at the university of Texas at Austin and the 2008 North American Summer Meeting for helpful comments.

\(^1\)from the year 2001 Survey of Income and Program Participation (SIPP)
1 Introduction

As U.S. married women are increasingly entering labor force in the past decades, dual-earner families are swiftly replacing the traditional ones of "breadwinner" husband and "homemaker" wife. Under the notion of spousal labor supply as insurance against unemployment risk, [Heckman and Macurdy (1980), Lundberg (1985)] studied the added worker effect (AWE) that the wife enters into the labor force when her husband lose his job, showing spousal labor supply affects the wife’s employment decision. Meanwhile, the dependency of the husband’s unemployment duration on spousal earning and (if any, ) the channel that the interaction takes place remains unclear.

Despite rich literature on individual unemployment duration such as in [Lancaster (1979), Yoon (1981), Lancaster and Chesher (1983), Lynch (1983), Wolpin (1987), Pissarides (1982), Burdett (1979), Narendranathan and Nickell (1985), Meyer (1990), Katz and Meyer (1990a), Katz and Meyer (1990b)], comparatively fewer are estimated of household unemployment duration, and most are empirically tested with non-US data such as [Lentz and Trans (2005)] used Danish data and [Ahn and Ugidos-Olazabal (1995)] used Spanish data. This paper aims to answer how spousal labor supply affects individual unemployment duration. This question is important in evaluating unemployment insurance (UI) since it suggests that as gender roles are taken into account, UI may “crowd out” family self-insurance against income loss during unemployment as in [Cullen and Gruber (2000)].

This paper develops a household search model in which each spouse makes individual employment decision and bargains over their private consumption under the collective setting of [Chiappori (1992)]. The bargaining outcome of the husband’s private consumption, defined by the sharing rule, is Pareto efficient and a function of couples’ employment conditions. Thus this model generates from theory the dependency of unemployment duration on spousal labor supply that is empirically testable. We match this model with the panel data of SIPP 2001 and have the following findings.

First, employment status of the husband plays an important role in intrahousehold al-
location. In particular, the private consumption of the unemployed husband is only 85% of that of the employed husband. This result is similar to that of the static case as [Chiappori, Fortin, and Lacroix(2002)] and robust to different specifications on the sharing rule. This work contributes in theoretically investigating dynamic household behaviors and providing empirical tests. Note that labor supply of a dual-earner household is determined endogenously since income allocation within is subject to the bargaining between the husband and wife as [Lundberg and Pollak(1993)]. Endogeneity here refers to the fact that not only do the husband and wife bargain on their private consumption as in [Chiappori, Fortin, and Lacroix(2002)], but also there is reverse causality from private consumption that is determined by intrahousehold income allocation and affects household labor supply in [Flinn and Boca(2006)]. This paper first attempts to incorporate intrahousehold bargaining with dynamic labor supply in addressing household unemployment duration.

Secondly, the estimates of the sharing rule implies asymmetric household unemployment duration of the U.S. households without children. That is, when husbands earn more, wives search longer for jobs; but if wives earn more, husbands may find jobs sooner. The results obtained highlight that ignoring the effect of spousal labor supply on household labor market performance is misleading in predicting the impact of UI benefits. Few empirical tests are based on the U.S. data partly because direct estimation is infeasible without sizable observations of household unemployment duration. The simulated-based estimation in this paper, utilizing the estimates of household decision rules, provides an alternative that would solves this problem.

Third, the aggregate implication of unemployment insurance is that, a $100 increase in UI reduces employment rate of wives with unemployed husbands by up to 3.35%, showing the crowd-out effect of UI benefits.

The rest of this paper is organized as follows. Section 2 overviews interhousehold bargaining. Section 3 constructs a theoretical framework of household job search and Section 4 presents a simplified version of household decision and gives the properties of reservation
wage. Empirical approach is described and the estimates are discussed in Section 5. Implications of the estimates on household unemployment duration and unemployment insurance are presented in Section 6. Section 7 gives the conclusion.

2 Background of Intrahousehold Bargaining

Increasingly, research on models of household behaviors has incorporated bargaining between individuals within households. Empirical tests are conducted on Pareto efficiency, income pooling and family choices on available theoretical models. Despite improvements in modeling household decision making using individual preference data on expenditures such as personal clothing, labor supply, children care and nutrient intake such as [Chiappori, Fortin, and Lacroix(2002), Thomas(1990), Phipps and Burton(1995), Lundberg, Pollak, and Wales(1997)], it remains unclear how individual preferences and bargaining are involved to form joint family decisions.

Most studies on intrahousehold bargaining are primarily based on relative income of the partners as a measure of bargaining power in household decisions. Though in literature of time use research showed that bargaining and gender norms are crucial in household labor decisions (Brines 1994; Bittman, England, Folbre and Matheson 2001), few works included gender aspects and employment patterns or other factors on specific household decisions due to limited information available from data. Thus, it is well recognized that detailed information on labor division, time use, gender ideology, earnings and private consumption would enhance empirical analysis [Manski(2000), Katz(1997)]. This paper proposes and demonstrates an alternative look at intrahousehold bargaining given the available data, and implies how income is allocated within a family based on household panel information on labor supply.

2Intrahousehold resource/income allocation has been analyzed in models such as unitary models, cooperative bargaining models and noncooperative models. This paper adopts cooperative bargaining models, emphasizes on labor market decisions of married couples and puts aside the issues of marriage formation and dissolution.
3 Dynamic Household Job Search

Before studying the effect of spousal labor supply on the bargaining between husbands and wives and their reservation wages, we initially focus on household job search and interactive decision-making between a married couple. A discrete-time household job search model is developed. The husband and wife simultaneously make employment decisions, taking the spousal response as given. The collective framework is introduced to connect household labor supply with their private consumption.

Environment We only consider married couples – husbands ($m$) and wives ($f$). They are infinitely-lived and discount the future at rate $\beta$, where $\beta \in (0,1)$. Individuals are characterized by their employment status and (if working) wage earnings. Arrival of job offer follows a Poisson process at rate $\lambda_m$ for husbands and $\lambda_f$ for wives. Employed individuals may lose jobs with job destruction rate $\delta$ or choose to quit. There is no on-the-job search.

The Collective Model Introducing the collective model by [Chiappori(1992)] distinguishes this work from existing literature of household job search\(^3\). Here multi-agent household is treated as a decision hub of separate individuals with different preferences, and private consumption of each spouse is an outcome of bargaining within a household.

Let household income ($I$) be the sum of each individual’s wage income and household non-labor income,

$$I = w_m h_m + w_f h_f + y,$$

where $y$, $w_{m(f)}$ and $h_{m(f)}$ denote the exogenous non-labor income of a family, wage rate of the husband (wife), and hours they worked, respectively. The husband and wife share their household income for private consumption, $c_{m(f)}$, which is non-negative and subjected to

\(^3\)Analysis of this paper is based on cooperative equilibrium outcomes (e.g., Manser and Brown (1980), McElroy and Horney (1981), Chiappori (1988)). They focus on outcomes that are Pareto-efficient. The alternative approach is noncooperative Nash equilibrium (see, Leuthold (1968), Bourgignon (1984), Del Boca and Flinn (1995, 2009), Chen and Woolley (2001)) that produces Pareto-dominated outcomes.
budget constraint.

\[ c_m + c_f \leq I, \]
\[ c_i \geq 0, i = m, f. \]

Private consumption of the husband, \( c_m = \phi(\cdot) \), by definition is a function that reflects the dependency of his bargaining power on related factors. In particular, when couples’ labor supply and earning income are included, it is called the sharing rule \(^4\).

**Individual Optimization** It describes the value optimization of each spouse in a family. Individual utility of spouse \( i \) depends on private consumption \((c_i)\) and leisure \((l_i \in [0, 1])\),

\[ u_i(c_i, l_i) = \alpha_i u(c_i) + (1 - \alpha_i) v(l_i), \]

where \( \{\alpha_{i=m,f}\} \) denotes the weights on consumption over leisure, and it’s between 0 and 1. The larger \( \alpha \) puts less weight toward leisure.

The utility from consumption is described by the constant elasticity of substitution (CES) function with risk aversion \( \gamma_{i=m,f} \), \( u(c_i) = \frac{c_i^{1-\gamma_i}}{1-\gamma_i} \), and the utility of leisure is \( v(l_i) = \log(l_i) \). Then the utility of individual \( i \) is

\[ u_i(c_i, l_i) = \alpha_i \frac{c_i^{1-\gamma_i}}{1-\gamma_i} + (1 - \alpha_i) \log l_i. \]

Since private consumption \( c_{m(f)} \) is determined by \( \phi(\cdot) \), the husband maximizes his utility

\(^4\)In Chiappori (1992) the sharing rule is defined as \( \phi = \phi(h_m, h_f, w_m, w_f, y) \). In later versions the form of the sharing rule varies but the presence of employment information is not only due to its importance, but for the robustness of empirical tests. In the Section 5, more details of the sharing rule and the robustness of its form will be discussed.
as:

$$\max_{\{c^t_m, l^t_m\}} \sum \beta^t u_m(c^t_m, l^t_m)$$

s.t. $c^t_m = \phi(\cdot | t)$,

$$l^t_m = 1 - h^t_m.$$ 

Similarly for the wife, the optimization problem is

$$\max_{\{c^t_f, l^t_f\}} \sum \beta^t u_f(c^t_f, l^t_f)$$

s.t. $c^t_f \leq w^t_m h^t_m + w^t_f h^t_f + y^t - c^t_m$,

$$l^t_f = 1 - h^t_f.$$ 

Here $\{c^t_i, l^t_i\}_{i=m,f}$ represents individual $i$’s private consumption and leisure at period $t$. Note that the dynamic decision of each spouse on whether to work is based not only on the realized conditions such as the share of household income and wage earnings, but on their expectation on spousal response and future income. This marks a major difference from the static case in [Chiappori, Fortin, and Lacroix(2002)].

4 A Simplified Model: No Intrahousehold Bargaining

This Section gives a simplified model without intrahousehold bargaining and leaves out the option of part-time jobs. It focuses on dynamic labor supply of married couples and their simultaneous decision-making process. Even without bargaining, the model is rich enough to provide some properties of reservation wage.
4.1 Dynamic Decision-Making Process

Given expectation of spousal response, the husband and wife make simultaneous decision on labor supply recursively. Since no part-time employment is considered, spouse \( i \) has only two states: employed full-time with wage \( w_i \) or non-employed \( w_i = 0 \). Letting non-labor household income \( y \) be exogenous and individual utility function contingent on couples’ earnings, the four possible outcomes of couples are listed in Table 1. The transition from one state to another is left to individual discretion and also determined by economic environments.

<table>
<thead>
<tr>
<th>Employed husband</th>
<th>Non-employed husband</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w_m, w_f )</td>
<td>( w_m, 0 )</td>
</tr>
<tr>
<td>( 0, w_f )</td>
<td>( 0, 0 )</td>
</tr>
</tbody>
</table>

4.2 Value Function

Let \( W^i(w_m, w_f) \) be the value function of spouse \( i \) given the husband’s wage \( w_m \) and wife’s wage \( w_f \). Due to the symmetry of a couple’s decision making, we start with the husband decision. As an example, the case of employed wife and non-employed husband is described by \( (0, w_f) \). The timing of the husband’s decision is displayed in Figure 4.1. Initially at time \( t \), the wife’s employment status is updated since she may lose her job (with probability \( \delta_f \)). After that the husband may be offered a job (with probability \( \lambda_m \)). Based on the newly updated states from case (1) to (4) at time \( t \), the husband sets his reservation wage and decides whether to accept the job offer.

\(^5\)This paper does not distinguishes nonemployment from unemployment. Undoubtedly, this will include individuals out of labor force or not active in job search. But since no good information regarding search intensity, here we aggregate them all into the state of not employed, see, [Flinn and Boca(2006)]. To tamper this effect, in empirical test of Section 5 we keep in data the individuals who claimed are not employed but re-entered labor force and/or got employed within one year.
Figure 1: Timing of husband employment decision given wife with wage $w_f$, $(0, w_f)$

1. If the wife loses her job (with Pr = $\delta_f$) and the husband is offered a job (with Pr = $\lambda_m$), the husband sets his reservation wage based on the unemployment of his wife (with $w_f = 0$). An offer $w'$ is accepted if and only if it is above his reservation wage $R_m(0)$. So (with Pr=$\delta_f \lambda_m$) his future utility is

$$\int_{R_m(0)} W^m(w'_m, 0)dF(w'_m) + \int_{R_m(0)} W^m(0, 0)dF(w'_m).$$

2. If the wife loses her job (with Pr = $\delta_f$) and the husband has no offer at $(1 - \lambda_m)$, both of them are unemployed. His future utility (with Pr = $\delta_f(1 - \lambda_m)$) is $W^m(0, 0)$.

3. If the wife does not lose her job and her husband gets an offer ($w'_m$), the husband’s reservation wage is a function of spousal state ($w_f$). Note that the husband sets his reservation wage with the expectation that his wife may quit her current job $w_f$ when
$w_f < R_f(w'_m)$. His future utility (with $Pr = (1 - \delta_f)\lambda_m$) is

$$
\int_{R_m(w_f)} [((w_f \geq R_f(w'_m)))W^m(w'_m, w_f) + (w_f < R_f(w'_m)))W^m(w'_m, 0)]dF(w'_m) \\
+ \int_{R_m(w_f)} W^m(0, w_f)dF(w'_m).
$$

4. If the wife does not lose her job ($Pr = 1 - \delta_f$) and her husband gets no offer ($Pr = 1 - \lambda_m$), they stick to their current status. With $Pr = (1 - \delta_f)(1 - \lambda_m)$ his future utility is $W^m(0, w_f)$.

Summing up the four possible outcomes, the expected value function of the husband is

$$
W^m(0, w_f) = u_m(0, w_f) + \beta\{\delta_f\lambda_m\int_{R_m(0)} W^m(w'_m, 0)dF(w'_m) + \int_{R_m(0)} W^m(0, 0)dF(w'_m) \\
+ \delta_f(1 - \lambda_m)W^m(0, 0) + (1 - \delta_f)\lambda_m \\
\left(\int_{R_m(w_f)} [(w_f \geq R_f(w'_m)))W^m(w'_m, w_f) + (w_f < R_f(w'_m)))W^m(w'_m, 0)]dF(w'_m) \\
+ \int_{R_m(w_f)} W^m(0, w_f)dF(w'_m) \right) \\
+ (1 - \delta_f)(1 - \lambda_m)W^m(0, w_f)\}.
$$

Similar value functions are obtained as in appendix A for the rest of three states: both non-employed, employed husband and non-employed wife, both employed. By symmetry a similar set of value functions of the wife are obtained, simply swapping indices of the husband for those of the wife in his value functions.

By the cutoff rules, the optimal policies of the husband $R_m(\cdot)$ are

$$
W^m(0, 0) = W^m(R_m(0), 0); \\
W^m(0, w_f) = W^m(R_m(w_f), w_f).
$$
Similarly the optimal policies of the wife are

\[ W_f(0, 0) = W_f(0, R_f(0)); \]  \hspace{1cm} (3)  

\[ W_f(w_m, 0) = W_f(w_m, R_f(w_m)). \] \hspace{1cm} (4)

Take the decision of the wife with employed husband \((w_m)\) as an example. Comparing to the traditional individual job search, the reservation wage of the wife makes her indifferent between working with wage \(R_f(w_m)\) and staying non-employed, a function shown in equation (4). The presence of spousal wage distinguishes her decision from that of singles. Even disregarding intrahousehold bargaining, spousal income as part of household income affects her value function of being employed. Thus, her reservation wage is a function of spousal wage instead of a constant value.

The Nash equilibrium (NE) is defined by reservation functions of the husband \(R_m(\cdot)\) and the wife \(R_f(\cdot)\) satisfying the cut-off rules above. The market equilibrium is a NE that has a balanced flow, making the population of those getting employed and exiting the labor market equal that of those getting unemployed and re-entering the market. Since this model is nonlinear and complex in endogeneity of household labor supply and simultaneity of the couple’s decision, a simple and general close-form solution is hard to obtain. Instead we apply numerical methods to study equilibrium and its properties of the reservation wage.

### 4.3 Simulated Predictions

Without intrahousehold bargaining we simplify private consumption of the husband to be the fraction \((\psi)\) of household income, \(c_m = \psi I\), where \((I)\) is household income. Note that this form is one special case of consumption defined in Section 3. The model constants are set as follows. The time discount factor \(\beta = .996\) and job destruction rate \(\delta = .004\) are at a monthly rate from the U.S. data. Assume (only in this Section) that job arrival rates are the same for couples, \(\alpha_m = \alpha_f = .4\). Numerical analysis is conducted and reservation functions
of a couple have the following properties\(^6\).

**Symmetric Couples: Income Effect Dominates.**

Assume that couples are perfectly symmetric: identical log-normal wage distribution and individual preferences. Household income is equally split between the husband and wife, that is, \(\psi = .5\). Letting risk averse parameter be one, \(\gamma = 1\), the reservation wage as a function of spousal wage is displayed in Figure 2.

![Simulated Reservation Wage as A Function of Spousal Wage](image)

**Figure 2:** Reservation wage as a function of spousal wage. The x axis is spousal wage level, and the y axis the reservation wage.

If couples are identical in individual preferences and private consumption, the model generates the same reservation functions for both the husband and wife. Figure 2 gives the reservation function of any spouse and it is an increasing function of spousal wage compared to the reservation wage of singles – a flat line as in literature. It shows that as one’s spouse earns more, the individual has higher reservation wage.

To further illustrate this increasing trend of reservation function, we compare the cases

\(^6\)The algorithm of numerical process is given in appendix B.
Figure 3: Comparison of Reservation Functions: Risk Averse vs. Risk Neutral.

of risk aversion ($\gamma = 1$) and risk neutrality ($\gamma = 0$). In Figure 3, the reservation function of risk-neutral individuals ($\gamma = 0$, dash line) remains unchanged, and that of those risk averse ($\gamma > 0$, solid line) is an increasing function of spousal wage.

This reveals that if everything else is the same, the risk aversion of an individual alone produces the upward slopping reservation function. So if one’s spouse is employed, the individual is at least partly insured against unemployment by spousal earnings. The income effect is supported by the assumption of individuals being risk averse\(^7\). Additionally, non-labor income of a family (including wealth earnings and home production) reinforces the income effect. So a unemployed individual of dual-earner family can afford to set higher reservation wage. This upward trend of reservation function is the result of risk sharing within a family.

Asymmetric Couples.

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\(^7\)It is widely known that the reservation wage inversely varies with the degree of risk aversion as in Pissarides(1974). Lentz and Trans(2005) stated that if the husband earn more, the wife may experience longer unemployment duration.
Relaxing the previous symmetric assumption of the husband and wife, we study the impact of preferences and income allocation within a household on their reservation functions. The asymmetry of the couple is introduced from two sources: difference in preferences for leisure, and different share of private consumption within a household.

- **More Preference towards Leisure, Lower Reservation Wage Individuals Set.**
  
  The model gives reservation functions with different preferences \( \{\alpha_m, \alpha_f\} \). Since here individual employment status is either full-time employment or nonemployment, preference towards leisure is equivalent to a cost incurred by working \((c_w)\). In Figure 4, when leisure is weighted more (\(\alpha_m\) is smaller) or gets more costly (working cost \(c_w\) is larger), an individual values leisure more and sets higher reservation wage. Meanwhile, similar income effect on reservation function is observed. This extension shows that an individual with different preference for leisure has different reservation wage. Those who favor leisure are more picky in job search and less likely to find jobs soon.

- **More Income Shared, More Likely to Work**
  
  This extension allows the fraction of income allocated to the husband \((\psi)\) to vary and examines its impact on the husband’s reservation function. In Figure 5 the fraction of income shared by the husband, \(\psi\), changes from 53 to 50 and 47 percent of household income. As \(\psi\) increases, the husband is more willing to work, even with a less attractive job offer, because more income is shared by him.

5 **Empirical Approach**

To study the impact of spousal labor supply on individual employment decision and outcomes of intrahousehold bargaining, we need to quantify the sharing rule\(^8\) and bring in data.

\(^8\)By definition in Chiappori (1998, 2002), the sharing rule is a function of couples’ wages and non-labor income as in Chiappori (1998, 2002),

\[
\phi(w_m, w_f, y) = a_0 + a_1 w_m + a_2 \log w_f + a_3 y,
\]
Figure 4: Reservation function with varying working cost: the effect of preference over leisure.
Figure 5: Reservation function with varying fraction of income shared by the husband: the effect of \( \psi \) on reservation wage.

The goal is to empirically estimate some key parameters of the couple’s decisions on labor supply and private consumption. Direct calibration of private consumption and the sharing rule is generally infeasible since individual-level consumption information is hard to obtain in most survey data. Estimating dynamic household labor supply provides an alternative to derive individual consumption (the sharing rule) from their employment information, and to further quantitatively discuss implications of the sharing rule on household labor supply and unemployment durations. With these in mind, we start with a brief description of the U.S. household data used for estimation, and then look at estimation strategy and econometric specification.

where \( w_{m(f)} \) is the husband(wife)’s wage earnings, and \( y \) is the exogenous non-labor household income.
5.1 The Data

We use the year 2001 panel data of Survey and Income Program Participation (SIPP 2001). SIPP data provide accurate and comprehensive income and employment information of household members. People are interviewed at four-month interval for three years and asked of their monthly labor market participation and earnings. Thus, job change and unemployment duration on a monthly basis is feasible. We focus on white couples and exclude households with inconsistent or broken employment records during the three-year survey period. Couples in the sample are not in armed force, not at school, not physically or mentally disable to work, and not enrolling in any welfare program such as Food Stamps, AFDC or TANF. Households with changed composition due to marriage or divorce are excluded. The detailed criteria applied to subtract data are described in appendix C, and households are excluded if any spouse fails to satisfy these restrictions. In the end the sample is left with 2297 households.

Table 2: Education and Employment Information for Household Sample

<table>
<thead>
<tr>
<th></th>
<th>Husband</th>
<th>Wife</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education Attainment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of ≤ High School Graduate</td>
<td>39.1</td>
<td>34.9</td>
</tr>
<tr>
<td>% of Some College / College Graduate</td>
<td>60.9</td>
<td>65.1</td>
</tr>
<tr>
<td><strong>Hourly Wage$^{1}$ with ($)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ High School Graduate</td>
<td>16.94 (13.26)</td>
<td>14.18 (16.46)</td>
</tr>
<tr>
<td>Some College / College Graduate</td>
<td>25.49 (17.32)</td>
<td>20.65 (18.68)</td>
</tr>
<tr>
<td><strong>Employment Status (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment Rate</td>
<td>96.86</td>
<td>86.32</td>
</tr>
<tr>
<td>Employment Rate if Spouse Works</td>
<td>97.12</td>
<td>86.55</td>
</tr>
<tr>
<td>Fraction of Full-Time Employment</td>
<td>95.03</td>
<td>63.11</td>
</tr>
<tr>
<td>Fraction of Full-Time Employment if Spouse Works Full-Time</td>
<td>94.84</td>
<td>62.98</td>
</tr>
</tbody>
</table>

$^{1}$ Within the brackets are the standard errors of hourly wage.

Table 2 shows that 60.9% of husbands and 65.1% of wives obtain some college education or are college graduates. Wives with less than or equivalent to high school degree, on average have hourly pay rate at 14.18 in 2001 dollar, compared to 20.65 of those attending some college. Meanwhile, average hourly rate of husbands with less than or equivalent to
high school degree is 16.94, compared to 25.49 of those receiving some college. The reason we categorize education as such is that (1) on average the hourly wage gap due to education attainment is sizeable at $8.50 for husbands and $6.50 for wives; (2) regarding the positive assortative of married couples, that is, high type people choose to marry each other. Since education is a good approximate of the desirability in sorting, allowing wage distribution to differ by education effectively tampers the impact of self-selection on the sorting of couples’ wage earnings and makes the observed wage correlation between the husband and wife more reflective of their interactive employment decisions.

96.86% of husbands is currently employed, compared to 86.32% of wives. Once employed, 95.03% of husbands works full-time, compared to 63.11% of wives. Since in this sample around one third of wives are employed part-time, during estimation we consider the option of part-time jobs (details in Section 5.2). Meanwhile, with one’s spouse employed, 97.12% of husbands and 86.55% of wives is employed. With one’s spouse being full-time employed, the fraction of full-time husbands rises to 94.84%, compared to 62.98% of wives. These observations present a clear picture that spousal labor supply has a significant impact on individual labor supply and this impact is not necessarily the same for husbands and wives. Further discussion is given in Section 5.3. Table 11 pools the transition rates of employment status of both genders. On average the transition rate from unemployment to full-time employment rises with time. Obvious asymmetry is observed between the husband and wife that one month later, over half of unemployed husbands get full-time jobs, compared to 27% of wives.

5.2 Econometric Specification

Estimation Strategy The model is described by a set of parameters $\theta$ that represent the underlying economic environments\(^9\) given constants $C$. With proper $\theta$ and $C$, the individual optimization problem is solved by the dynamic programming. By aggregating across the

\(^9\)The factors include offer arrival rates, individual preferences, job departure rates, the sharing rule, and etc. In this paper we termed as parameters $\theta$.  

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whole population, model generates simulated variables to match with those observed from sample data.

By simmed method of moments (SMM), the optimal estimates of $\theta^*$ are parameters that minimize the weighted distance between a set of simulated moments and sample moments,

$$
\min_{\theta} (\psi_d - \psi_s(\theta|C))' W_T^{-1} (\psi_d - \psi_s(\theta|C)),
$$

where $C, \psi_d$ and $\psi_s(\theta|C)$ denote constants, sample moments and simulated moments from model given parameters $\theta$, respectively. $W_T$ is the optimal weighting matrix that accounts for the scale difference of moments, and places greater weight to those with less variance. The algorithm of estimation is described in details in appendix B.

**Constants $C$**

The time discount factor is set to $\beta = 0.996$ at a monthly rate of the U.S. data. Since a significant amount (30%) of wives work part-time, here employment status is defined to be either non-employed, or part-time or full-time employed instead of continuous working hours. Individuals are defined to be employed full-time (same as in SIPP) if hours they worked per week are 35 or more, and part-time if less than 35. The average hours of full-time jobs are 44.3 and those of part-time are 20.8. Assume that the total hours endowed per week are 80. A part-time job is denoted as $h_{pt} = \frac{22.8}{80} = 0.28$, and a full-time job is $h_{ft} = \frac{44.3}{80} = 0.54$. If not employed, an individual consumes leisure $l = 1$.

Hourly wage rates of married couples are drawn from a log-normal distribution that differs by education and gender as in Table 10, where $\mu_{i,j}$ and $\sigma_{i,j}$ denote the mean and standard error of wage offer distribution of spouse $i \in \{m, f\}$ with education $j \in \{\text{high school graduate, college graduate}\}$. Note that schooling of the husband is positively correlated with that of the wife as mentioned in [Pencavel(1998)] that there is an increasing tendency for

---

10 Though labor supply (in form of working hours) is continuous, most often it clustered around full-time and part-time employment. The categorization of discrete choice is sensibly imposed to make estimation issues in this paper manageable.

11 From Finn and Heckman (1982) the wage offer distribution are not identified non-parametrically, so here we assume that it is log-normal distributed.
couples to share a common schooling background and this may have consequences for their work behaviors. Letting wage distribution differ by couples’ education, we minimize such self-selection effect from this model. This makes the correlation of the husband and wife’s hourly wage (if both work, positive at .2248) a nice moment to approximate couples’ interaction on work behaviors.

**Parameters** The model is characterized by parameters $\theta$ given constants $C$.

$$\theta = (\lambda_{ft}, \lambda_{pt}, \alpha_m, \alpha_f, \gamma, \delta_m, \delta_f, a_0, a_1, a_2, a_3, D_a, C_k|C).$$

- $\lambda_{ft(pt)}$ denotes the rate of arrival for full-time (part-time) jobs. Note that arrival of jobs follows a Poisson process.
- $\alpha_{m(f)}$ denotes spousal $i$’s preference for leisure over consumption (the weighting index).
- Individual utility has the form of Constant Elasticity of Substitution (CES), where $\gamma$ denotes risk aversion.
- $\delta_{m(f)}$ denotes job destruction rates of men (women).
- $a_0 - a_3, D_a$ and $C_k$ define the sharing rule, the portion of household income shared by the husband for private consumption, as a function of the couple’s wage earnings and non-labor income. In particular, $D_a$ denotes the shrinkage in the husband’s share for private consumption due to nonemployment, and $C_k$ the lump-sum deduction in value with the presence of children.

$$\phi(h_m, h_f, w_m, w_f, y, D_k) = C_k D_k + \begin{cases} a_0 + S_{hm}(a_1 w_m h_m + a_2 \log w_f h_f + a_3 y), & \text{if } h_f > 0; \\ a_0 + S_{hm}(a_1 w_m h_m + a_3 y), & \text{if } h_f = 0. \end{cases}$$

where $D_k$ is the dummy variable of the presence of children in a family that is 1 if children is present and 0 otherwise. Note that $S_{hm}$ gives the share of husband
consumption depending on his employment status,

\[ S_{h_m} = \begin{cases} 
1, & \text{if } h_m > 0; \\
D_a, & \text{if } h_m = 0. 
\end{cases} \]

The sharing rule by definition is in form of semi-log specification. This is a popular form seen in [Blundell, Duncan, and Meghir(1998)], which is not empirically rejected by previous work as in [Chiappori, Fortin, and Lacroix(2002)]. Though not the unique form available, this form is adopted as a starting point to study intrahousehold bargaining.

**Moments and Identification**

The model is characterized by 13 parameters, while 7 out of 13 describe economic environments and 6 define the sharing rule. There is no immediate way to identify parameters in such a complex nonlinear model. Since this model simulates data of spousal labor supply and (if working) their wages at each period, it provides a sample of discrete transition path of any spouse’s employment state, which is also obtainable from sample data. The model is estimated and identified by searching over the space and finding the parameter set that matches best with the observed data.

Employment status is categorized into three states: nonemployment, part-time and full-time employment. Given 72 possible states of the transition path of household from the initial state to the destination, we pick out 20 elements of matrix that are of importance in identification because there is no on-the-job search. The probability of switching employment status depends on 7 parameters that generate household decision rules and 6 parameters of the sharing rule. For instance, \( Pr(ft, ft|ft, U) \) gives the probability of both spouses being full-time employed if their previous state is full-time employed husband and non-employed wife. Letting the transition rate obtained from model equal the empirical hazard rate, we get one equation with several unknown parameters. Similarly, for each element to be estimated
in the transition matrix, one unique equation is defined on the hazard rate.

Meanwhile, the collective model imposes restrictions on household labor supply. Take labor supply of the husband as an example,

\[ h_m = h_m(w_m, h_m, c_m|\phi(\cdot)). \]

Substituting in the sharing rule, it is equivalent to

\[ h_m = h_m(w_m, h_m|Ew_f, Eh_f, y, D_k), \]

where \( h_m \) denotes employment status, \( w_m \) the realized wage of the husband, and \( Ew_f, Eh_f \) the expected wage earnings and labor supply of the wife. Similarly for the wife,

\[ h_f = h_f(w_f, h_f, c_f|\phi(\cdot)), \]

\[ = h_f(w_f, h_f|Ew_m, Eh_m, y, D_k). \]

So the conditional probabilities of individual employment status on spousal labor supply provides identification of the sharing rule. Additionally, the presence of children makes the labor supply of the wife more time-constrained. Thus, the conditional probability of part-time employed mothers is used to identify the impact of children in the sharing rule. Note that the number of moments on conditional probabilities is 15, and that of parameters which characterize the sharing rule is 6. Once at least 6 out of 15 cross-sectional probabilities are independent and at least 7 dense elements of transition matrix are found from data, the model is identified. The full list of moments on transition matrix and couples’ labor supply is provided in Table 11. The comparison of simulated moments and sample moments supports the fitness of this model.

\[\text{12In the static case, Chiappori (2002) discussed identification issues of the sharing rule and the elasticities of labor supply are used to identify the sharing rule.}\]
5.3 Estimation Results

In total, we have 36 moments (20 from transition matrix and 16 from conditional probabilities), and 13 parameters to estimate (7 for economic environments and 6 for the sharing rule). This Section discusses these estimates and their economic interpretations. Overidentification and robustness tests are provided.

The Recovered Sharing Rule

The key parameters of the sharing rule are displayed in Table 3. The standard errors of estimates suggest that most estimates are significantly different from zero at the 5 per cent level. Moreover, the simulated moments relating to the sharing rule match well with sample moments.

Table 3: The Sharing Rule $\phi(h_m, h_f, w_m, w_f, y)$

<table>
<thead>
<tr>
<th>Coefficient of</th>
<th>Definition</th>
<th>Estimated Value</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_0$</td>
<td>Constant</td>
<td>14.5839</td>
<td>1.1033</td>
</tr>
<tr>
<td>$a_1$</td>
<td>Husband wage</td>
<td>0.5208</td>
<td>0.0931</td>
</tr>
<tr>
<td>$a_2$</td>
<td>log of Wife’s wage</td>
<td>-0.1887</td>
<td>0.0038</td>
</tr>
<tr>
<td>$a_3$</td>
<td>Non-labor income</td>
<td>0.5384</td>
<td>0.0035</td>
</tr>
<tr>
<td>$D_a$</td>
<td>Shrinkage in consumption share due to nonemployment</td>
<td>0.8438</td>
<td>0.0647</td>
</tr>
<tr>
<td>$C_k$</td>
<td>Lump-sum transfer to mothers</td>
<td>-4499</td>
<td>1013</td>
</tr>
</tbody>
</table>

The sharing rule $\phi(h_m, h_f, w_m, w_f, y, D_k)$ gives the proportion of household income privately consumed by the husband. In particular for a dual-earner family, the sharing rule is

$$\phi(h_m, h_f, w_m, w_f, y, D_k) = 14.5839 + S_{hm}(0.5208w_mh_m - 0.1887\log w_fh_f + 0.5384y) - 4499D_k.$$ 

If the husband is employed ($h_m > 0$), the more he earns, the more he consumes and the more money is transferred to his wife. One percent increase in the husband’s wage earnings raises his private consumption by .54 percent and he transfers the rest of his earnings including part of non-labor income to his wife. But if he is non-employed, he takes only 45% ($= 0.84 \times 0.54$) of non-labor income. The change in his private consumption shows that employment is important and has impact on outcomes of intrahousehold bargaining.
Employment status of the husband makes difference in the sharing rule, and implies that the tradition of husbands being "breadwinner" still plays an important role. This explains why husbands are more likely to work ceteris paribus. Ignoring this dependency of intra-household income allocation on spousal labor supply bring misleading results.

$C_k$ gives the aggregate effect of children on bargaining between the husbands and wife. With children, the lump-sum deduction of the husband’s private consumption is negative at 4499 in 2001 dollar value, showing that the presence of children has more money transferred from the husband to wife. This may be due to increased wife’s bargaining power over husband or simply part of children expenditures held by wives for children care or both. This paper does not and will not distinguish where this effect comes from. With this in mind, our analysis is focused on the sign of this estimate, not the magnitude. Moreover, due to the variety in the number of children at home in US, which is not the focal point we would address in this paper, our setting is unlikely to have accurate magnitude.

**Economic Environments**

The rest of parameters are presented in Table 4. Offer arrival rate of full-time jobs, $\lambda_{ft}$, is 0.3837, compared to that of part-time jobs, $\lambda_{pt}$, at 0.2029. On average full-time offers arrive every three months, significantly more often than part-time ones (every five months). The individual risk aversion ($\gamma$) is 1.3133 with the standard error 0.004. The weight of individual preferences for consumption over leisure is 0.4488 for the husband ($\alpha_m$), larger than 0.3567 for the wife ($\alpha_f$), revealing $^{13}$ that the husband and wife have different preferences towards

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Estimated Value</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{ft}$</td>
<td>offer arrival rate for full-time job</td>
<td>0.3837</td>
<td>0.0008</td>
</tr>
<tr>
<td>$\lambda_{pt}$</td>
<td>offer arrival rate for part-time job</td>
<td>0.2029</td>
<td>0.0010</td>
</tr>
<tr>
<td>$\alpha_m$</td>
<td>Husbands preference for consumption over leisure</td>
<td>0.4488</td>
<td>0.0013</td>
</tr>
<tr>
<td>$\alpha_f$</td>
<td>Wives preference</td>
<td>0.3567</td>
<td>0.0007</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Risk Aversion Index</td>
<td>1.3086</td>
<td>0.0040</td>
</tr>
<tr>
<td>$\delta_m$</td>
<td>Job Destruction Rate for Husbands</td>
<td>0.0041</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\delta_f$</td>
<td>Job Destruction Rate for Wives</td>
<td>0.0038</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Parameter estimates are obtained by matching with SIPP 2001.

$^{13}$The null hypothesis is tested that husbands and wives have the same preferences over leisure, that is,
leisure, and the wife gives priority for leisure.

5.4 Overidentification Test

Since only 13 moments are required to just identify the set of parameters, this model is over-identified with 39 moments. The remaining restrictions \((39 - 13 = 26 \text{ moments})\) are used to evaluate the model. Under the null hypothesis of the model being the true one, the added moments are supposed to be close to the true value of parameter set. The overidentification test is specified as:

\[
T(\psi_d - \psi_s(\theta))^TW_1(\psi_d - \psi_s(\theta)) \chi^2(39 - 13).
\]

In practice, the computed criterion function at the estimated parameters, 25.99, is less than a chi-square critical value 38.89 at the 5 per cent significance level. So the null hypothesis is not rejected.

5.5 Robustness

Table 5 compares the estimates under different specifications of the sharing rule. We consider the cases (I) that ignores the effect of children, and (II) with the presence of children affecting the sharing rule, respectively. The numerical estimation varies slightly but the main result does not change: The husbands that are unemployed consume less than those employed ones.

whether husbands and wives are different in preferences.

\[
H_0 : \alpha_m - \alpha_f = 0, \\
H_1 : \alpha_m - \alpha_f > 0, \text{ or } \alpha_m - \alpha_f < 0.
\]

Since the t value

\[
\frac{\alpha_m - \alpha_f}{\sqrt{\frac{s_{\alpha_m}^2}{n_m} + \frac{s_{\alpha_f}^2}{n_f}}} = \frac{0.4488 - 0.3567}{\sqrt{\frac{s_{\alpha_m}^2}{n_m} + \frac{s_{\alpha_f}^2}{n_f}}} \gg 1.645 = t_{\infty, 0.05},
\]

the null hypothesis \(H_0\) is rejected.
Table 5: Estimates of The Sharing Rule

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(I)</td>
</tr>
<tr>
<td>$a_0$</td>
<td>9.5710</td>
</tr>
<tr>
<td>$a_1$</td>
<td>0.5197</td>
</tr>
<tr>
<td>$a_2$</td>
<td>-0.1981</td>
</tr>
<tr>
<td>$a_3$</td>
<td>0.5425</td>
</tr>
<tr>
<td>$D_a$</td>
<td>0.8513</td>
</tr>
<tr>
<td>$C_k$</td>
<td>-4499</td>
</tr>
</tbody>
</table>

Children considered? No Yes

6 Implications and Discussion

6.1 Is Household Unemployment Duration Symmetric?

Unemployment durations at the household level are of importance in examining the impact of unemployment insurance and household taxation. Existing job search studies have emphasized on the individual job search, and ignore the effect of spousal labor supply on household labor market performance. However, empirical evidence has shown that individual employment decision is affected by spousal labor supply, at least for wives. So far, this impact on unemployment durations is seldom tested on the U.S. data partly because direct estimation (the dashed lines in Figure 6) requires sizable observations of household unemployment durations which is hard to obtain. The estimates of our model on family decision rules provide an alternative to this problem \(^{14}\), and are used to simulate large observations of household unemployment durations. The simulated data mimic the properties of household sample from SIPP 2001 on wage earnings, job opportunities and employment decisions, and are used to derive the search pattern of those married couples (the solid lines in Figure 6).

This study considers the presence of children rather than the number of children in discussing dynamic household labor supply and the sharing rule. Note that introducing heterogeneity in family size will bring in issues of children rearing and childbirth, making this prob-

\(^{14}\)See Section 5.3. Though like many other available panel data, SIPP 2001 provide insufficient observations, limited unemployed spells of 2297 household, to conduct a direct test. This work efficiently uses employment information from SIPP 2001 and estimates key parameters.
lem intractable. Based on the fact that in this sample 75.3% households have children but the number varies, this simplification focuses on the aggregate impact of children on intrahousehold distribution, and the negativeness of $C_k$ is crucial. Moreover, [Lentz and Trans(2005)] found that household job search is not necessarily related to childbirth. Thus, we leave heterogeneity in this aspect for future research.

Using the simulated data, we estimate the hazard rate of unemployment and its dependency on spousal wage. The hazard model is similar to that in [?] and the duration model is presented in appendix D. The explanatory variables $z_i$ include education level, gender, spousal wage and the interaction term of spousal wage and gender. In Table 6, the regression of hazard rate of remaining non-employed is given for households with (column I) and without children (column II), respectively.

<table>
<thead>
<tr>
<th>Variables</th>
<th>With Children</th>
<th>Without Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is Female</td>
<td>0.0069**</td>
<td>0.0038**</td>
</tr>
<tr>
<td></td>
<td>(0.0027)</td>
<td>(0.0016)</td>
</tr>
<tr>
<td>College Graduate</td>
<td>-0.0664</td>
<td>-0.0426</td>
</tr>
<tr>
<td></td>
<td>(0.0601)</td>
<td>(0.0315)</td>
</tr>
<tr>
<td>Spousal Wage</td>
<td>-0.0002</td>
<td>-0.0011**</td>
</tr>
<tr>
<td></td>
<td>(0.0004)</td>
<td>(0.0004)</td>
</tr>
<tr>
<td>Is Female $\times$ Spousal Wage</td>
<td>0.0089**</td>
<td>0.0046**</td>
</tr>
<tr>
<td></td>
<td>(0.0037)</td>
<td>(0.0009)</td>
</tr>
<tr>
<td>Having Children</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Column (I) denotes households with children and column (II) without children. Standard errors are shown in the parentheses. ** Variables are 5% significant.

The coefficient of the interaction term of being female and spousal wage shows that for wives, higher spousal wages increase the hazard. For households with children, a 10-percent increase in spousal wage is associate with a 0.09 percent increase in the hazard. Meanwhile, the estimate of being female is positive at .0069 for households with children and 0.0038 for those without, suggesting that wives are more likely to stay non-employed compared to husbands, especially with the presence of children.

The impact of spousal wage is mixed. Without children the coefficient is significant at -.0011, showing higher spousal wages decrease the hazard of husbands and they will find
jobs sooner as their wives earn more. In particular, if wives’ wage rises by 10 percent, the hazard falls by .011 percent. Meanwhile, for wives the realized impact of spousal wage is positive at $-0.0011 + 0.0046 = 0.0035$. The increased wives’ hazard rate on spousal labor supply is consistent with the coefficient of the interaction term. But for households with children, the estimates have no conclusive measure about the sign of spousal wage. This may result from the simplified assumption on family size and the complexity of children-related family decisions.

Overall, the simulation predicts that, higher spousal wage raises the hazard of wives, whether they have children or not. The regression estimates also indicate that wives with employed husbands and children have longer employment spells, suggesting that for wives the income effect dominates and the presence of children affects their employment decisions. Additionally, husbands with higher-income wives and no children have lower hazard of staying non-employed. The impact of spousal wage on husbands still needs further evidence and depends on specifications.

6.2 Impact of Unemployment Insurance

Another implication of the sharing rule is to directly test the impact of unemployment insurance (UI) on household labor supply conditioned on spousal labor supply. We focus on the impact on wives’ labor supply in light of the fact that over 97% of husbands are employed and 97% are employed full-time, compared to 86% of employed wives and one third of part-time employed wives, which makes studies on husbands’ labor supply trivial. Note that in this sample both UI and labor supply are measured per month. This Section conducts an experiment to study the impact of UI benefits. Using the estimates obtained in the Section 5.3 we simulate dynamic employment decisions of husbands and wives. Since individuals are eligible for UI that here refers to potential benefits, there may be bias due to selection.

Table 7 gives numerical results of the change in wives’ labor supply conditional on spousal
employment, with UI rising by $100. By numerical changes we refer to changes of both absolute and relative value. The results obtained show a sizable effect of the increase in

Table 7: Impact of Unemployment Insurance on Wives’ Labor Supply (%)

<table>
<thead>
<tr>
<th></th>
<th>Employment Rate</th>
<th>FT Employment Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\Delta E$</td>
<td>$\Delta E/E$</td>
</tr>
<tr>
<td>All</td>
<td>-0.55</td>
<td>-0.66</td>
</tr>
<tr>
<td>With employed husband</td>
<td>-0.46</td>
<td>-0.55</td>
</tr>
<tr>
<td>With unemployed husband</td>
<td>-3.35</td>
<td>-3.76</td>
</tr>
</tbody>
</table>

The middle two columns show the impact of unemployment insurance on wives’ employment rates, and the last two columns wives’ rates of full-time employment. All of the rates are given by percentage.

UI on spousal labor supply. As UI rises by $100, wives’ labor supply falls by around .5%, both measured by employment rates (the middle two columns) and by full-time employment rates (the last two columns). Among all categories of the population, the decomposition of the decline in labor supply into full-time and part-time employment indicates that up to 85 $\sim$ 89\% $^{15}$ comes from the decline of full-time employment, suggesting that the increase in UI benefits relaxes wives’ full-time employment. Meanwhile, compared to wives with employed husband (the middle row), those with unemployed husband (the last row) are more influenced by UI. The rise of $100 in UI benefits per month lowers employment rate of wives by 0.46\% per month with employed husbands and by 3.35\% with unemployed husbands. We interpret this as a proof that spousal labor supply acts as insurance and it shows the crowd-out effect of UI against AWE.

Table 8: Presence of Children: Impact of Unemployment Insurance on Wives’ Labor Supply

<table>
<thead>
<tr>
<th></th>
<th>Employment Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\Delta E$</td>
</tr>
<tr>
<td>Without Children</td>
<td>-0.49</td>
</tr>
<tr>
<td>With Children</td>
<td>-1.17</td>
</tr>
</tbody>
</table>

The last extension examines the impact of family structure, in particular the presence of children, which plays an important role in determining family labor supply. In most static

$^{15}$We use the ratio of the change in full-time employment over that of overall employment $\Delta E_{ft}/\Delta E$ to indicate the portion of the decline in labor supply that is due to the decline of full-time employment.
models, the income elasticity of labor supply of wives rises with their home production and falls with their net wage. Since this model has exogenized the presence of children and home production, we focus on employment decisions of wives. Note that for those with children the income effect dominates partly because they receive more money transfer from husbands. The model thus predicts that for households with children, the increase of UI lowers wives’ labor supply. Table 8 further considers the presence of children and gives model prediction of its impact with the change in UI. The crowd-out effect is similar in cases of wives without (the upper row) and with children (the lower row). Without children, $100 increase in UI causes employment rate to fall by .41% with employed husbands and 2.81% with unemployed husbands.

7 Conclusion

This paper studies the collective behaviors of married couples. By connecting household job search with intrahousehold bargaining, we aim to answer the question of how spousal labor supply affects unemployment durations of the U.S. married couples. The results obtained show this impact is sizeable and significant for both the husband and wife, which is few discussed in literature. In particular for the husband, the estimates suggest that the traditional view of "breadwinner" still exercises its power. The bargaining between the husband and wife, may make it harder for unemployed husbands.

The estimates of the sharing rule and household collective behaviors are of importance in further investigating unemployment duration, unemployment insurance and taxation at the household level. An important implication and the main focus of this paper is on household unemployment duration. The finding shows that married couples without children have asymmetric patterns in job search. For households without children, the husband with higher-income spouse finds a job sooner, contrary to the wife. This pattern, however, is mixed for households with children. Future research is interesting in exploring household
decisions considering children as public goods. The second implication reveals the similar crowd-out effect of UI benefits as in [Cullen and Gruber(2000)].

APPENDIX
A Value Functions

The formulae displayed below are the value functions of husbands in the three other states: both unemployed, husband employed but wife not employed, both employed. The definition of value functions and reservation functions are the same as described in the contexts.

- Both unemployed
  \[ W^m(0, 0) = u_m(0, 0) + \beta \{(1 - \lambda_m)(1 - \lambda_f)W^m(0, 0) \]
  \[ + (1 - \lambda_m)\lambda_f \int_{R_f(0)} W^m(0, w'_f)dF(w'_f) + \int_{R_f(0)} W^m(0, 0)dF(w'_f) \]
  \[ + \lambda_m(1 - \lambda_f)\int_{R_m(0)} W^m(w'_m, 0)dF(w'_m) + \int_{R_m(0)} W^m(0, 0)dF(w'_f) \]
  \[ + \lambda_m\lambda_f \int_{R_m(0)} \int_{R_m(w'_f)} W^m(w'_m, w'_f)dF(w'_m)dF(w'_f) \]
  \[ + \int_{R_f(0)} \int_{R_f(w'_f)} W^m(0, w'_f)dF(w'_m)dF(w'_f) \]
  \[ + \int_{R_f(0)} \int_{R_f(w'_f)} W^m(w'_m, 0)dF(w'_m)dF(w'_f) + \int_{R_f(0)} \int_{R_f(0)} W^m(0, 0)dF(w'_m)dF(w'_f) \]

- Husband employed but wife not employed
  \[ W^m(w_m, 0) = u_m(w_m, 0) \]
  \[ + \beta \{\delta_m[\lambda_f \int_{R_f(0)} W^m(0, w'_f)dF(w'_f) + \int_{R_f(0)} W^m(0, 0)dF(w'_f)] \]
  \[ + (1 - \lambda_f)W^m(0, 0) \]
  \[ + (1 - \delta_m)[\lambda_f \left( \int_{R_f(0)} \max\{W^m(w_m, w'_f), W^m(0, w'_f)\}dF(w'_f) \right) \]
  \[ + \int_{R_f(0)} W^m(w_m, 0)dF(w'_f) \]
  \[ + (1 - \lambda_f)W^m(w_m, 0) \]

- Both employed
  \[ W^m(w_m, w_f) = u_m(w_m, w_f) + \beta \{ \delta_m\delta_f W^m(0, 0) + \delta_m(1 - \delta_f)W^m(0, w_f) \]
  \[ + (1 - \delta_m)\delta_f W^m(w_m, 0) + (1 - \delta_m)(1 - \delta_f)W^m(w_m, w_f) \} \]

B Algorithm

To estimate this model, we need to have the dimension of sample moments no less than that of parameters. The validity of estimation is subject to discussions on robustness test and identification issues.

The algorithm to do estimation is as follows.

1. From the original sample data, calculate moments as mentioned in Table 11.

2. Given a set of parameters, \( \theta \), and constants \( C \) providing demographic information such as education levels of couples and non-labor income, we obtain a unique set of reservation functions conditional on spousal employment status and wage rate by value function iteration. The optimal policy functions are obtained by the fixed point methods.

3. With reservation functions, we simulated data on employment information and (if working) their wages. The generated individuals are subject to random shocks of losing jobs or receiving wage offers. At the initial period, \( t = 1 \), we endow couples with the same labor market conditions as they are in sample data. Then dynamically we generate labor market history for each household \( i \). Thus, we can track their employment status transitions across time, where \( i = 1, \ldots, 2,997 \) and \( t = 2, \ldots, 36 \).

4. Repeating simulation \( N_s = 1,000 \) times, we obtain simulated moments, and thereafter the distance between the simulated moments and sample moments, which is calculated and weighted by the optimal weighting matrix.
5. We keep on updating parameters and search for parameters that deliver the smaller distance until minimum value is obtained.

\[ \theta_{SMM} = \arg\min_{\theta} (\psi_d - \psi_s(\theta))^TW_T(\psi_d - \psi_s(\theta)) \] (5)

Note that the initial weighting matrix is generated by bootstrapping the sample moments \( N_b \) times, where \( N_b = 1,000 \) and taking the inverse of variance matrix of moments. As the set of parameters is updating, we keep updating the newly generated weighting matrix until we arrive at convergence. The standard errors of parameter estimates are calculated using the optimal weighting matrix.

C Data and Selection Criteria

SIPP data provide accurate and comprehensive information about income and program participation of individuals within households in the United States. In SIPP 2001, individuals of households are interviewed every four months for nine consecutive waves, which sum up to a three-year panel data. Interviewed individuals are asked about their monthly information on employment status, job earnings, working hours per week and weeks worked per month. Therefore, information on job change and unemployment duration on a monthly basis is obtainable from data.

The advantage of SIPP data over other available panel data is that (1) 3-year panel is short enough so significant change is unlikely to occur on social institutions, demography and individual preferences, and meanwhile, the frequency of 4-month visit gives more reliable and detailed employment related information on a monthly basis than does of yearly data as PSID; (2) symmetric employment information is available for husbands and wives, compared to NLSY data; (3) large original sample size make it possible to obtain a sizable target sample. In summary, SIPP data give sufficient information on household labor supply and wage earnings from year 2001 to 2003, and provide testable restrictions that are used to recover spousal private consumption.

Selection Criteria

The criteria that we apply to restrict data are described as follows. If any spouse fails to satisfy the restrictions below, the corresponding household is excluded.

1. Only nuclear family, which is composed of married couples.
2. Only couples who gave complete interviews. In case that only one spouse "present", the household is excluded.
3. Husbands aged between 25 to 50 years, and wives aged between 23-48 years at the beginning wave (wave 1).
4. Neither of the couples is in armed force now.
5. Do not have physical or mental limitations to work.
6. Not currently enrolled in school, so no concerns of human capital accumulations.
7. Neither receives welfare program such as Food Stamps or AFDC or TANF.
8. Exclude families with grandparents or other relatives or disabled children.
9. Exclude households whose composition changes due to marriage formation or divorce.
10. Exclude household with a broken history of employment. The husband and wife are required to stay in the sample over all the waves.
D Duration Model

To examine the impact of spousal labor supply on the hazard rate of unemployed individual workers, we use the similar estimation approach discussed in [Meyer(1990)]. The shape of the hazard is estimated by non-parametric methods. The hazard is parameterized using a proportional hazards form,

$$\Lambda_i(t) = \Lambda_0(t)e^{z_i'b},$$

where $\Lambda_0(t)$ is the baseline hazard at time $t$, $z_i$ is a set of explanatory variables of individual $i$, and $b$ a vector of coefficients of explanatory variables.

The probability of a spell lasting until $t + 1$ given that it already lasts $t$ periods is expressed as a function of hazard.

$$P[T_i \geq t + 1 | T_i \geq t] = e^{-e^{z_i'b + \Gamma(t)}},$$

where

$$\Gamma(t) = \ln\int_t^{t+1} \Lambda_0(u)du,$$

where $\Gamma$ is unknown. Let $\Delta_i = 1$ if the unemployment spell is right censored and 0 otherwise, and $k_i$ is the observed unemployment duration of individual $i$. The corresponding log-likelihood function is a function of $\Gamma$ and coefficient vector $b$,

$$L(\Gamma, b) = \sum_{i=1}^{N} \left[ \Delta_i \log(1 - e^{\Gamma(k_i) + z_i'k_i'b}) - k_i - 1 \sum_{t=1}^{k_i-1} e^{\Gamma(t) + z_i't'b} \right].$$

### Table 9: Some Indices for Married Couples

<table>
<thead>
<tr>
<th>Variables</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age gap</td>
<td>1.70</td>
</tr>
<tr>
<td>Average weeks worked per month if employed</td>
<td>4.33</td>
</tr>
<tr>
<td>Average hours worked if part-time working</td>
<td>20.8</td>
</tr>
<tr>
<td>Average hours worked if full-time working</td>
<td>44.3</td>
</tr>
<tr>
<td>Fraction of households with kids</td>
<td>75.3%</td>
</tr>
<tr>
<td>Correlation of Hourly Wage for Husband and Wife</td>
<td>0.2248</td>
</tr>
</tbody>
</table>

### Table 10: Constants

<table>
<thead>
<tr>
<th>Constant</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_{m,h}$</td>
<td>accepted hourly wage for husband by education</td>
<td>16.94</td>
</tr>
<tr>
<td>$\mu_{m,c}$</td>
<td>at least college graduate</td>
<td>25.492</td>
</tr>
<tr>
<td>$\sigma_{m,h}$</td>
<td>high school graduate</td>
<td>(13.26)</td>
</tr>
<tr>
<td>$\sigma_{m,c}$</td>
<td>(17.32)</td>
<td></td>
</tr>
<tr>
<td>$\mu_{f,h}$</td>
<td>accepted hourly wage for wife by education</td>
<td>14.18</td>
</tr>
<tr>
<td>$\mu_{f,c}$</td>
<td>at least college graduate</td>
<td>20.65</td>
</tr>
<tr>
<td>$\sigma_{f,h}$</td>
<td>high school graduate</td>
<td>(16.46)</td>
</tr>
<tr>
<td>$\sigma_{f,c}$</td>
<td>(18.68)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 6: Estimation Strategy. The solid lines give the estimation strategy and the dashed lines are the traditional direct estimation from data.
Table 11: Sample Moments vs. Simulated Moments

<table>
<thead>
<tr>
<th>Moment</th>
<th>Sample Value</th>
<th>Simulated Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of Employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fraction of husbands not working</td>
<td>0.0314</td>
<td>0.0231</td>
</tr>
<tr>
<td>Fraction of wives not working</td>
<td>0.1368</td>
<td>0.1397</td>
</tr>
<tr>
<td>Fraction of husbands employed full-time</td>
<td>0.9503</td>
<td>0.9415</td>
</tr>
<tr>
<td>Fraction of wives employed full-time</td>
<td>0.6311</td>
<td>0.6023</td>
</tr>
<tr>
<td>Fraction of working husbands if wives work</td>
<td>0.9712</td>
<td>0.9177</td>
</tr>
<tr>
<td>Fraction of working wives if husbands work</td>
<td>0.8655</td>
<td>0.8401</td>
</tr>
<tr>
<td>Fraction of working wives with kids if husbands work</td>
<td>0.8447</td>
<td>0.7865</td>
</tr>
<tr>
<td>Fraction of full-time husbands if wives work full-time</td>
<td>0.9484</td>
<td>0.9514</td>
</tr>
<tr>
<td>Fraction of full-time wives if husbands work full-time</td>
<td>0.6298</td>
<td>0.6400</td>
</tr>
<tr>
<td>Fraction of part-time wives if husbands work full-time</td>
<td>0.2348</td>
<td>0.3035</td>
</tr>
<tr>
<td>Fraction of working wives with kids if husbands work full-time</td>
<td>0.9712</td>
<td>0.9177</td>
</tr>
<tr>
<td>Fraction of working wives with kids if husbands work</td>
<td>0.8655</td>
<td>0.8401</td>
</tr>
<tr>
<td>Fraction of full-time husbands if wives work part-time</td>
<td>0.9614</td>
<td>0.9425</td>
</tr>
<tr>
<td>Transition Matrix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>((s^t_{m}, s^t_{f}) \rightarrow (s^{t+1}<em>{m}, s^{t+1}</em>{f}))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>((u, u) \rightarrow (u, pt))</td>
<td>0.0106</td>
<td>0.0087</td>
</tr>
<tr>
<td>((u, u) \rightarrow (u, ft))</td>
<td>0.0317</td>
<td>0.0398</td>
</tr>
<tr>
<td>((u, u) \rightarrow (pt, u))</td>
<td>0.0211</td>
<td>0.0069</td>
</tr>
<tr>
<td>((u, u) \rightarrow (pt, ft))</td>
<td>0.0026</td>
<td>0.0015</td>
</tr>
<tr>
<td>((u, u) \rightarrow (ft, u))</td>
<td>0.3008</td>
<td>0.3173</td>
</tr>
<tr>
<td>((u, u) \rightarrow (ft, pt))</td>
<td>0.0686</td>
<td>0.0714</td>
</tr>
<tr>
<td>((u, u) \rightarrow (ft, ft))</td>
<td>0.1557</td>
<td>0.1070</td>
</tr>
<tr>
<td>((u, pt) \rightarrow (pt, u))</td>
<td>0.0145</td>
<td>0.0374</td>
</tr>
<tr>
<td>((u, pt) \rightarrow (pt, pt))</td>
<td>0.0362</td>
<td>0.0000</td>
</tr>
<tr>
<td>((u, pt) \rightarrow (ft, u))</td>
<td>0.0109</td>
<td>0.0089</td>
</tr>
<tr>
<td>((u, pt) \rightarrow (ft, pt))</td>
<td>0.4293</td>
<td>0.4091</td>
</tr>
<tr>
<td>((u, ft) \rightarrow (pt, u))</td>
<td>0.0009</td>
<td>0.0000</td>
</tr>
<tr>
<td>((u, ft) \rightarrow (pt, ft))</td>
<td>0.0413</td>
<td>0.0582</td>
</tr>
<tr>
<td>((u, ft) \rightarrow (ft, u))</td>
<td>0.0327</td>
<td>0.0301</td>
</tr>
<tr>
<td>((u, ft) \rightarrow (ft, ft))</td>
<td>0.3838</td>
<td>0.4356</td>
</tr>
<tr>
<td>((pt, u) \rightarrow (u, ft))</td>
<td>0.0316</td>
<td>0.0237</td>
</tr>
<tr>
<td>((pt, u) \rightarrow (pt, pt))</td>
<td>0.0211</td>
<td>0.1000</td>
</tr>
<tr>
<td>((pt, u) \rightarrow (pt, ft))</td>
<td>0.0632</td>
<td>0.0620</td>
</tr>
<tr>
<td>((ft, u) \rightarrow (ft, pt))</td>
<td>0.1125</td>
<td>0.1221</td>
</tr>
<tr>
<td>((ft, u) \rightarrow (ft, ft))</td>
<td>0.0776</td>
<td>0.0785</td>
</tr>
</tbody>
</table>

Wage Correlation of Couples

- With high school diploma: 0.2062
- With College diploma: 0.1469

Wage Correlation of Couples

- With high school diploma: 0.2062
- With College diploma: 0.1469
References


