Assortative Mating and Female Labor Supply

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This paper investigates married women’s hours worked disaggregated by the husband’s wage decile. In the United States, this pattern has changed from downward sloping to hump shaped. We show that this development can be explained within a standard household model of labor supply when taking into account trends in assortative mating. A quantitative analysis of our model shows that female wage growth and decreasing fertility are primarily responsible for the overall increase in wives’ hours since the 1970s. The fact that the most pronounced increases are observed for wives married to high-wage men is a result of trends in assortative mating.

I. Introduction

Hours worked of married women in the United States increased substantially over the second half of the twentieth century. However, this increase has not been uniform for all married women. Wives of men with relatively high wages show more pronounced increases in hours worked over time than wives married to low-wage husbands. As a consequence, the economy-wide pattern of wives’ hours by the husband’s wage has changed from downward sloping to hump shaped (see Juhn and Murphy 1997; Morissette and Hou 2008; Schwartz 2010).

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The negative relation between wives' hours and the husband's wage observed until the 1970s fits well into standard models of household labor supply (Chiappori 1988; Apps and Rees 1997; Blundell et al. 2007), where the labor supply of a wife depends negatively on the husband's wage due to intrahousehold specialization. However, since the 1990s, the economy-wide pattern is no longer downward sloping but, instead, is hump shaped, with women married to men with medium wages working the most.

In this paper, we show that these developments can be explained within a standard household model of labor supply when taking into account trends in assortative mating. In particular, we show that, for different degrees of assortative mating in terms of wages, our model explains the different observed patterns of wives' hours by the husband's wage.

In our model, couples face a specialization decision with respect to market work and home production. Within a couple, the efficient time allocation depends on the spouses' wages relative to one another. Accordingly, the economy-wide pattern of wives' hours by the husband's wage depends on the economy-wide distribution of relative wages within marriages, that is, on the joint distribution of wives' and husbands' wages. This joint distribution consists of the gender-specific marginal wage distributions and the association between spouses' wages, that is, who marries whom. The latter is referred to as assortative mating.

To illustrate the effects of assortative mating on the aggregate distribution of female hours, consider first the extreme cases of perfect sorting and random mating, respectively. Under random mating, relative wages are on average lowest for wives of top-wage husbands. As a consequence, these wives work the fewest hours and the aggregate pattern of wives' hours by the husband's wage is downward sloping.

Under perfect sorting, by contrast, there exist only marriages where both wife and husband are from the same quantile in the respective gender-specific wage distribution. However, in the presence of a gender wage gap, their wages are not identical. Accordingly, the pattern of wives' hours by the husband's wage depends on the gender-specific marginal wage distributions, too. For example, for a constant absolute wage gap the wife's relative wage is increasing and concave in the husband's wage, and so are hours worked of wives.

We can imagine intermediate sorting as a combination of the two extreme cases, a fraction of the population marrying randomly and a fraction marrying in a perfectly assortative way (see Kremer 1997). The resulting economy-wide pattern of wives' hours by the husband's wage decile is then a weighted average of the patterns in the two extreme cases. The resulting economy-wide pattern can therefore be hump shaped, as observed in recent years. Trends in assortative mating thus alter the pattern of wives' hours by the husband's wage decile observed in the aggregate and consequently lead to a nonuniform change in hours worked by married women.
From previous studies, there is much evidence that assortative mating in terms of various labor-market characteristics, mostly education, has indeed become stronger over time in the United States. In line with this, we find strong evidence from Current Population Survey data that assortative mating in terms of wages has increased substantially over time.

In a quantitative analysis of our model, we feed the observed distributions of wages into our model. By measuring assortative mating in terms of wage deciles, we can disentangle changes in the marginal distributions of husbands’ and wives’ wages from changes in the association between spousal wages. We also take into account changes in fertility as a further driver of hours worked in our structural model.

The data show a closure of the gender wage gap, a decreasing number of children, and a clear trend toward stronger assortative mating. Our empirical analysis shows that trends in the marginal wage distributions and fertility are responsible for the overall increase in hours worked by wives since the 1970s. By contrast, the fact that wives married to high-wage men experienced the most pronounced increase is a result of trends in assortative mating.

The causal link emphasized in this paper runs from assortative mating to the labor-market behavior of married women. One can, of course, also argue that labor-market outcomes affect behavior on the marriage market. We use a difference-in-differences approach along the age dimension of female labor supply to disentangle the possible directions of causality. In this approach, we consider that the marriage-market outcome is supposedly affected by labor-market behavior before marriage, whereas, in the other direction, the marriage-market outcome affects labor-market behavior after marriage. Therefore, we consider labor-market behavior before and after marriage separately for two cohorts of women. Both cohorts are very similar in terms of their labor supply before marriage but show significant differences in the degree of assortative mating and after-marriage labor supply that are consistent with our model. Differences in marriage patterns in these cohorts can thus not be caused by differences in before-marriage labor supply, as the latter differences do not exist. The observed similarity in singles’ behavior across cohorts is in line with Jones, Manuelli, and McGrattan (2003), Ramey (2008), and Ramey and Francis (2009).

The remainder of this paper is organized as follows. Section II presents empirical facts. Section III presents the theoretical model, which is ana-

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lyzed quantitatively in Section IV. In Section V, we discuss complementary hypotheses and the direction of causality. Section VI concludes.

II. Empirical Background

In this section, we present the empirical facts on married women’s labor supply we aim to explain. We also illustrate that assortative mating in terms of wages has increased substantially over time.

The nonuniform increase in married women’s hours has been documented by, for example, Juhn and Murphy (1997) and Schwartz (2010) and is illustrated in figure 1. The data are from the Current Population Survey (CPS) in the United States. The left panel shows average weekly hours worked of wives married to men in the 10 deciles of the wage distribution of married men. The figure compares two periods of time, the 1970s (1975–79, black bars) and the 2000s (2000–2009, white bars). The sample consists of matched husband-wife pairs of ages 30–50. Details on the data are provided in the online appendix.

In the 1970s, the economy-wide pattern of wives’ hours by the husband’s position in the wage distribution of married men was clearly downward sloping. Women married to high-wage men tended to work fewer hours. In the 2000s, this relationship has changed, with wives of men in the middle of the wage distribution working the most. In other words, the pattern of wives’ hours by the husband’s wage has changed from downward sloping to hump shaped.

The right panel in figure 1 provides a different view of the same information by showing the percentage change in hours between the two periods of time. Hours worked of wives increased substantially among all groups of married women over time. However, the increase has been strongly nonuniform across husband’s wage deciles. Increases in hours have been largest for wives of high-wage men but relatively weak among wives of men in the low wage deciles.

In this paper, we demonstrate that an important determinant of the distribution of female labor supply is assortative mating. While most empirical studies on assortative mating measure spouses’ association along education levels (see, e.g., Mare 1991; Fernández, Guner, and Knowles 2005; Schwartz and Mare 2005; Schwartz 2010), we consider sorting in terms of spouses’ wages or wage potentials for nonworking spouses.2

2 Our baseline approach to handle the missing-data problem for nonworking spouses is to use a Heckman (1976, 1979) selection model for wage imputation (details are provided in the online appendix, sec. B). Alternative strategies are to delete the entire couple from the sample if one of the spouses’ wages is not observed or to use wage predictions from simple ordinary least squares (OLS) estimates. While levels of wages differ between specifications, the trend in the correlation between husband’s and wife’s wage positions is very similar.
FIG. 1.—Wives’ weekly hours by the husband’s wage decile
To measure assortative mating, we calculate the correlation coefficient between husband’s and wife’s decile position in the wage distribution of married individuals of the respective gender. Since the distribution of decile positions is by construction constant over time, changes in the correlation between these relative positions reflect changes in assortative mating.

Figure 2 shows the change in the correlation coefficient between husband’s and wife’s wage decile positions over time. We find a pronounced and steady increase in the correlation coefficient. In fact, the correlation coefficient almost doubled from the 1970s to the 2000s. Put differently, assortative mating in terms of wages has increased substantially over time.

III. The Model

A. Decision Problem of a Couple

We consider an economy populated by couples. First, we present the decision process for individual couples. Thereafter, we will aggregate their decisions.

Preferences and Technology

A couple consists of two spouses, a wife F and a husband M. We denote spouses’ wages by $w_F$ and $w_M$. There are two commodities in the model, a private market consumption good and a home consumption good that is public to the couple. Individuals’ preferences over the two commodities are characterized by the utility function $u_i$, where $i = F, M$ and

$$u_i = \left( \left( \frac{1}{1 + \psi} \right)^{1/\phi} (c_i)^{(\phi - 1)/\phi} + \left( \frac{\psi}{1 + \psi} \right)^{1/\phi} (d)^{(\phi - 1)/\phi} \right)^{\phi/(\phi - 1)}, \quad (1)$$

where $c_i$ denotes consumption of the market good, and $d$ stands for consumption of the home good which does not wear an index $i$ since it is public. The parameter $\psi$ is the relative weight on home consumption, and $\phi$ is the elasticity of substitution between the two goods.

Following, for example, Chiappori, Fortin, and Lacroix (2002) and van Klaveren, van Praag, and Maassen van den Brink (2008), spouses’ utility

3 Correlation coefficients between levels can be poor measures for describing trends in assortative mating (see Mare 1991; Hou and Myles 2007). They are unable to distinguish changes in the gender-specific marginal distributions from changes in the association between spouses and would respond to a nonlinear change in the marginal distributions even when the association is unchanged.

4 Results are similar when calculating the correlation of married spouses’ positions in the overall wage distributions of the specific gender including the wages of singles. This accounts for the effects of changes in marriage rates by wage decile over time.
weight for home consumption, \( \psi \), is assumed to be a function of the number of their children, \( k \),

\[
\psi = \psi_0 + \psi_1 \cdot (k^{(\psi_2 - 1)/\psi_2},
\]

(2)

where \( \psi_0, \psi_1, \) and \( \psi_2 \) are parameters determining the unconditional taste for home consumption, the effect of the first child on this valuation, and the curvature of this effect, respectively.

Market goods can be earned through market labor \( n_i \) by both spouses. The couple’s budget constraint is thus given by

\[
c_F + c_M = \omega_F \cdot n_F + \omega_M \cdot n_M.
\]

(3)

Home goods are produced within the household using both spouses’ time (denoted by \( h_F \) and \( h_M \), respectively) as inputs,

\[
d = (h_F)^\theta (h_M)^{1-\theta}.
\]

(4)

Both spouses have a time endowment of 1 which can be used for market work and home production, that is,

\[
n_i + h_i = 1, \quad i = M, F.
\]

(5)

The couple chooses the time allocations of both spouses and the distribution of the resulting consumption levels, \( h_F, h_M, n_F, n_M, d, c_F, \) and \( c_M \). Constraints are given by equations (3)–(5).

\(^5\) We abstract from leisure as Ramey and Francis (2009) have shown empirically that leisure is stable for individuals in the main working age of both genders. Thus, in a realistically calibrated model, leisure would not interact with other time uses.
Decision Making

In collective models of household behavior, households allocate their resources efficiently (Chiappori 1988, 1992). Consequently, given a desired amount of home consumption, cost minimization determines time spent in home production for both spouses. In our set-up, spouses spend their remaining time on market work.

For efficiency, the marginal costs to produce the public home good (in terms of forgone market consumption) have to equal the sum of both spouses’ marginal rates of substitution (Samuelson 1955),

\[ MRS_F(c_F, d) + MRS_M(c_M, d) = MC(d), \]

where \( MRS_i(c, d) = \frac{(\partial u_i/\partial d)}{(\partial u_i/\partial c_i)} \) is spouse \( i \)'s marginal rate of substitution between home and market goods. The term \( MC(d) \) denotes the marginal costs of home production in terms of forgone market consumption.

As the market good \( c \) is private, household bargaining determines how couples distribute consumption across spouses. In line with theoretical arguments (Browning et al. 1994; Browning, Chiappori, and Lechene 2006; Knowles 2007) and empirical evidence (van Klaveren et al. 2008; Lise and Seitz 2011), we assume that consumption shares are a function of relative wages,

\[ \frac{c_i}{c_M + c_F} = \frac{(w_i)^\mu}{(w_M)^\mu + (w_F)^\mu}, \]

where \( \mu \) determines how strongly consumption shares react to wages.

An Analytical Special Case

In the theoretical part of the paper, we apply two parameter restrictions that allow us to solve the model analytically. First, we assume \( \phi \to 1 \) for which (1) results in log utility. With log utility, marginal rates of substitution are linear and, as the home good is public, can be added up to a function of the couple’s total consumption levels of the two goods independent of the distribution across spouses (7). Second, we use \( \theta = 1/2 \) such that there is no difference between the two spouses’ labor in home production. This implies that hours decisions depend on relative wages only and not on gender. To facilitate the exposition, we will use the indices \( i = 1, 2 \) to identify primary and secondary earner, respectively. In the quantitative part of the paper (Sec. IV), we will relax both these assumptions and calibrate realistic values for \( \phi \) and \( \theta \).

B. Decisions at the Household Level

The marginal rates of substitution depend on spouses’ individual marginal utility of market consumption. With log utility, it holds that
\[ MRS_1(c_1, d) + MRS_2(c_2, d) = \psi \cdot \frac{c_1}{d} + \psi \cdot \frac{c_2}{d} = \psi \cdot \frac{c}{d}, \quad (8) \]

where \( c = c_1 + c_2 \).

The marginal cost function \( MC(d) \) results from the production of \( d \) units of the home good with minimal costs. With \( \theta = 1/2 \), it is

\[
MC(d) = \begin{cases} 
2 \cdot \left( \frac{w_1}{w_2} \right)^{1/2} \cdot \left( \frac{w_2}{w_1} \right)^{1/2}, & d < \left( \frac{w_2}{w_1} \right)^{1/2} \\
2 \cdot w_1 \cdot d, & \left( \frac{w_2}{w_1} \right)^{1/2} < d < 1 
\end{cases} 
(9)\]

The cost-minimal time inputs are

\[
b_2 = \begin{cases} 
\left( \frac{w_1}{w_2} \right)^{1/2} \cdot d, & d < \left( \frac{w_2}{w_1} \right)^{1/2} \\
1, & \left( \frac{w_2}{w_1} \right)^{1/2} < d < 1 
\end{cases} 
(10)\]

and

\[
b_1 = \begin{cases} 
\left( \frac{w_2}{w_1} \right)^{1/2} \cdot d, & d < \left( \frac{w_2}{w_1} \right)^{1/2} \\
d^2, & \left( \frac{w_2}{w_1} \right)^{1/2} < d < 1 
\end{cases} 
(11)\]

A derivation of equations (9)–(11) can be found in the online appendix, sec C.1.

**Hours Worked**

By condition (6), the efficient level of home consumption is at the intersection of (8) and (9). We combine the constraints (3) and (5) to \( c = w_1 + w_2 - C(d) \), where \( C(d) \) is the total opportunity cost function of home production (the antiderivative of \( MC(d) \)). We then solve for the couple’s desired levels of \( c \) and \( d \). For given \( d \), the time allocations of the two spouses are determined by equations (10) and (11).

In the efficient allocation, market hours of the secondary earner are

\[
n_2 = \begin{cases} 
0, & w_2 < \frac{\psi}{2 + \psi} \cdot w_1 \\
\frac{2 + \psi}{2 + 2\psi} - \frac{\psi}{2 + 2\psi} \cdot \frac{w_1}{w_2}, & w_2 \geq \frac{\psi}{2 + \psi} \cdot w_1 
\end{cases} 
(12)\]
and market hours of the primary earner are

\[ n_1 = \begin{cases} 
\frac{2}{2 + \psi}, & \omega_2 < \frac{\psi}{2 + \psi} \cdot \omega_1 \\
\frac{2 + \psi}{2 + 2\psi} - \frac{\psi}{2 + 2\psi} \cdot \frac{\omega_2}{\omega_1}, & \omega_2 \geq \frac{\psi}{2 + \psi} \cdot \omega_1 
\end{cases} \quad (13) \]

(see the online appendix, sec. C.1 for a derivation). The secondary earner only participates in the labor market if his or her relative wage exceeds some threshold value determined by the valuation of home consumption and thus by the couple’s number of children as \( \psi = \psi(k) \). Conditional on participation, hours are an increasing function of one’s own relative wage.

We now return to consider wife \( F \) and husband \( M \). The wife is the secondary earner if \( w_F < w_M \) and vice versa. Summarizing labor-supply decisions at the couple level as described by equations (12) and (13), we can express hours worked by a wife \( F \) as a function of the wage ratio within the couple, \( \omega = w_F/w_M \),

\[ n_F(\omega) = \begin{cases} 
0, & \omega < \frac{\psi}{2 + \psi} \\
\frac{2}{2 + 2\psi} - \frac{\psi}{2 + 2\psi} \cdot \omega^{-1}, & \frac{\psi}{2 + \psi} \leq \omega < \frac{2 + \psi}{\psi} \\
\frac{2}{2 + 2\psi}, & \omega \geq \frac{2 + \psi}{\psi} 
\end{cases} \quad (14) \]

with \( \psi = \psi(k) \) as in equation (2).

**Proposition 1.** For a given own wage, hours of a married woman are decreasing in her husband’s wage. This relation is relatively steep when the wife’s own wage is low and/or the valuation for home consumption is high due to the presence of many children. (See eq. [14].)

As proposition 1 shows, the effects of children and the husband’s wage interact. This view is supported empirically by microeconometric evidence in Bertrand, Goldin, and Katz (2011), who show that there are substantial interaction effects between the presence of children and the husband’s wage as determinants of married women’s hours.

**C. Aggregate Pattern of Wives’ Hours by the Husband’s Wage**

We now determine the aggregate pattern of wives’ hours by the husband’s wage predicted by our model for different degrees of assortative
mating. We use the joint distribution of wages and children as an exogenous input to our model, thereby focusing on the causality toward hours (as Galor and Weil 1996; Jones et al. 2003; Knowles 2007; Attanasio, Low, and Sánchez-Marcos 2008). To highlight the role of assortative mating, we apply the following simplifying assumptions on these distributions (which will be relaxed in Sec. IV):

**Assumption 1:** Marginal wage distributions. We consider uniform marginal distributions with supports normalized to length 1. This implies that the gender wage gap is a constant absolute difference between quantiles of the two distributions. We denote the absolute difference between gender-specific wages by $\alpha$. Consequently, female wages are distributed uniformly on $(w_{\text{min}}, w_{\text{min}} + 1)$ with $w_{\text{min}} \geq 0$, and male wages are distributed uniformly on $(w_{\text{min}} + \alpha, w_{\text{min}} + 1 + \alpha)$.

**Assumption 2:** Joint distribution of wages. We model assortative mating as in Kremer (1997). A fraction $\xi$ of agents marries a spouse from the same wage quantile whereas everyone else marries randomly. Perfect sorting and random mating are special cases where $\xi = 1$ or $\xi = 0$, respectively. For a husband with wage $w_M$, the probability of being married to a wife with wage $w_F = w_M - \alpha$ is $\xi$ while all other wages of the wife are equally likely with a total probability of $1 - \xi$.

**Assumption 3:** Distribution of children. We assume that every couple has the same number of children such that the valuation of home consumption, $\psi$, is constant across the population.

The economy-wide pattern of wives’ hours by the husband’s wage results from (i) the relation between the husband’s wage and the wife’s labor supply at the household level described by equation (14) and (ii) the joint distribution of wages and children. To determine the aggregate pattern, we integrate individual decisions (14), taking into account the density function of wages, $\bar{n}_F(w_M) = \int n_F(w_F/w_M) \cdot f(w_F - w_M) \, dw_F$, where $\bar{n}_F(w_M)$ denotes average hours worked of wives married to husbands earning a wage $w_M$. The conditional densities $f(w_F - w_M)$ depend on assortative mating. Average hours of wives married to husbands earning a wage $w_M$ evaluate as

$$\bar{n}_F(w_M) = \Psi + (1 - \xi) \cdot a(w_M) + \xi \cdot b(w_M), \quad (15)$$

where

$$\Psi = \frac{2}{2 + 2\psi} + (1 - \xi) \cdot \frac{2}{2 + 2\psi} \cdot w_{\text{min}}$$
and

\[
\begin{align*}
a(w_M) &= -\frac{2}{2 + 2\psi} \cdot \left(\frac{2 - \psi}{\psi} + \psi \ln\frac{2 + \psi}{\psi}\right) \cdot w_M, \\
b(w_M) &= -\frac{\psi}{2 + 2\psi} \cdot \frac{w_M}{w_M - \alpha}
\end{align*}
\]

(see the online appendix, sec. C.2 for a derivation). Aggregate hours of wives by the husband’s wage are thus a constant plus the weighted sum of two functions of the husband’s wage. The term \(a(w_M)\) is a downward-sloping and linear function while \(b(w_M)\) is an upward-sloping and concave function for \(\alpha > 0\). The weights for \(a(w_M)\) and \(b(w_M)\) are determined by the parameter \(\xi\) measuring the degree of assortative mating. The overall pattern thus depends on the degree of assortative mating.

To illustrate the mechanics of the model we distinguish between three different degrees of assortative mating \((\xi = 1, \xi = 0, 0 < \xi < 1)\). Consider first the case of perfect assortative mating, \(\xi = 1\). In this situation, there exist only marriages where both wife and husband are from the same quantile in the respective gender-specific wage distribution. In the presence of a gender wage gap, \(\alpha > 0\), the wife’s relative wage, \((w_M - \alpha)/w_M\), is increasing in the husband’s wage. As a consequence, average hours worked by wives are increasing in the husband’s wage. Across the male wage distribution, the pattern is concave. It is strongly upward sloping where wages are low and relative wage differences are thus pronounced, but it is almost flat for couples with high absolute wages. This can be seen formally from equation (15) for \(\xi = 1\) and is illustrated by the black bars in the left panel of figure 3.

In the other extreme case, \(\xi = 0\), mating is completely random. Here, all possible combinations of wages within a marriage exist with equal frequency. Hence, every husband is on average married to the wife earning the average female wage \(w_f\) independent of his own wage position. Therefore, the average wage ratio \(w_f/w_M\) is decreasing in the male wage. As can be seen from equation (15) for \(\xi = 0\), this results in a downward-sloping pattern of wives’ hours by the husband’s wage. This case is illustrated by the white bars in the left panel of figure 3.

For intermediate assortative mating where \(0 < \xi < 1\), both functions \(a(w_M)\) and \(b(w_M)\) are given nonzero weights in equation (15). In the presence of a gender wage gap, \(\alpha > 0\), female hours by male wage decile are the sum of a downward-sloping linear function and a concave upward-sloping function. The function \(n_F(w_M)\) is thus concave and can be hump shaped, depending on the specific value for \(\xi\).
Fig. 3. Patterns of wives’ hours by husbands’ wage deciles for different degrees of assortative mating. ψ = 0.5, ω_{min} = 0.1, α = 0.3. ξ is 1 (left, dark bars), 0 (left, white bars), or 0.5 (right), respectively. Model hours are multiplied by 40.
One constellation that results in a hump-shaped pattern is illustrated in the right panel of figure 3. The white and black parts of the bars illustrate how the subpopulations integrate to a hump-shaped aggregate pattern. We show in the online appendix, sec. C.3 that such a hump can occur for any pair of marginal wage distributions.

The scenarios depicted in figure 3 illustrate the role of assortative mating for the pattern of wives’ hours by the husband’s wage. In all three scenarios, the marginal distributions of gender-specific wages and the distribution of children are identical. However, the patterns in wives’ hours differ depending on the association between spouses’ wages.

**Proposition 2.** The aggregate pattern of wives’ hours by the husband’s wage depends on the degree of assortative mating. The pattern is (a) downward sloping under random mating, (b) upward sloping under perfect sorting, and (c) a combination of these two patterns for intermediate sorting. (See eq. [15].)

Herr and Wolfram (2011) suggest a similar compositional logic. Also these authors regard the wage ratio within the household as decisive for female labor supply and argue that high-earning women do not necessarily experience high relative wages as, in the presence of assortative mating, they are likely to be married to high-earning men.

**Proposition 3.** For any pair of gender-specific marginal wage distributions, there exists a degree of assortative mating for which the pattern of wives’ hours by the husband’s wage is hump shaped. (Proof: see the online appendix, sec. C.3.)

**IV. Quantitative Analysis**

In this section, we evaluate our model quantitatively. We investigate whether, for observed trends in wages and fertility, the model implies patterns in hours that are consistent with the empirical developments. Moreover, we account for the effects of different drivers of hours worked. 6

In the quantitative analysis, we relax the parameter restrictions \((\phi \to 1, \theta = 1/2)\) imposed in the analytical part of the paper and calibrate realistic values for \(\phi\) and \(\theta\). We also relax the restrictions on the distributions of wages and children (assumptions 1–3 in Sec. III.C) and use the empirically observed distributions.

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6 A further important source of increases in married women’s labor supply is technological progress in home production (Greenwood, Seshadri, and Yorukoglu 2005). This channel is important for understanding early rises in female hours (until about 1970) but relatively less important afterward (Greenwood et al. 2005, fig. 8). As our analysis starts in the 1970s, we abstract from changes in home technology.
A. Parameter Choices

We now describe the calibration that we use for the quantitative evaluation of our model. Our parameter choices are summarized in table 1. The female elasticity in home production is set to 0.7 to match relative average home hours of husbands and wives. Rupert, Rogerson, and Wright (1995) report that in the 1980s married women’s time in home production was about four times that of their husbands. In our sample, the average wife-husband wage ratio in the 1980s was 57.3%. This implies that the ratio of female to total opportunity costs of home production, which is equal to $\theta$, is about 70%.

The wage elasticity of consumption shares, $\mu$, is set to 1. This is in line with Lise and Seitz (2011), who estimate a sharing rule with UK consumption data. They find that, on average, the elasticity of the wife’s consumption share to her wage is 1.021.

We set the elasticity of substitution between market and home consumption, $\phi$, to 1.7. For married couples, Rupert et al. (1995) report substitution elasticities ranging from 1.57 to 4. McGrattan, Rogerson, and Wright (1993) find a similar elasticity of 1.62.

The valuation of home consumption is a function of the number of children (see eq. [2]). Our chosen calibration $(\psi_0, \psi_1, \psi_2)$ implies that, without any children, the relative valuation of home consumption is 0.3 $(\psi_0)$. This matches the time devoted to housework by singles in the 1980s relative to their market hours (Rupert et al. 1995). A couple’s first child increases the valuation of home consumption by 0.42 $(\psi_1)$. This matches the estimation result of van Klaveren et al. (2008), which implies that the first child increases the mother’s valuation for home consumption by about 140%. Finally, with $\psi_2 = -1.1$, the valuation for home consumption of the average couple in our sample (having 1.7 children) is about 1.5, which is in the center of the parameter range used by Perli (1998).

B. Model Inputs

The three main determinants of hours worked in our model are the marginal wage distributions $W$, the association between spousal wage positions $S$, and the distribution of children $K$. The model-implied economy-wide pattern of wives’ hours by the husband’s wage decile depends on these three inputs and is denoted by $\pi(q_M\mid\{W, S, K\})$, where $q_M$ denotes the husband’s wage decile.

We measure the association between spouses’ wages in terms of the number of marriages that exist between different deciles of the gender-specific marginal wage distributions. A $10 \times 10$ association matrix $S$ contains the
relative frequencies of the 100 possible combinations of deciles in a marriage. As discussed in Section II, the association between husband’s and wife’s wage has changed toward more pronounced assortative mating (see fig. 2).

We use the gender-specific mean wage levels associated with the deciles, denoted by \( W_F(q) \) and \( W_M(q) \), respectively, where \( q \) is a decile number. We denote the pair of marginal distributions \( (W_F, W_M) \) as \( W \). Empirically, average wages have increased from the 1970s to the 2000s whereas the percentage increase has been stronger for women. For both genders, wages in the upper deciles have grown stronger than wages in the lower deciles. Similarly, the closure of the gender wage gap has been stronger in the upper half of the wage distribution.

We denote by \( K \) the \( 10 \times 10 \) matrix of the average number of children by wage decile combination of the parents. The average number of children has decreased from about 1.9 in the 1970s to roughly 1.6 in the 2000s. Furthermore, the number of children turned slightly increasing in the husband’s wage in the more recent period.

C. Quantitative Results

Figure 4 shows the predictions of our model when we use the empirically observed joint distributions of wages and children in the 1970s and the 2000s, respectively. The dark bars in the left panel show the predicted pattern for the 1970s, \( \pi_F(q_M|\{W_{1970s}, S_{1970s}, K_{1970s}\}) \). The predicted pattern for the 2000s, \( \pi_F(q_M|\{W_{2000s}, S_{2000s}, K_{2000s}\}) \), is shown by the white bars. The right panel shows the relative change in married women’s hours by the husband’s wage decile between the two periods. For comparison, the CPS observations are included as the gray dotted lines.\(^8\)

\(^8\) To calculate the economy-wide pattern of wives’ hours by the husband’s wage decile predicted by our model for given distributions of wages and children \( \{W, S, K\} \), we proceed as follows. We first determine female labor supply for all 100 possible combinations of decile positions in a \( 10 \times 10 \) matrix \( N \). For a specific cell \( n_{ij} \), we use \( w_j = W_F(j) \), \( w_i = W_M(i) \), and \( k = K(i, j) \), solve (6) numerically taking into account (1)–(5) and deduce labor supply decisions. Average hours worked by wives married to men in decile \( i \) are then given by \( (n_i \cdot s_i')/\Sigma_{i=1}^{10} s_i \), where \( n_i \) is the \( i \)th row of the female hours matrix \( N \) and \( s_i \) is the corresponding row in the association matrix \( S \).
Fig. 4.—Predicted wives’ weekly hours by husband’s wage decile. Model hours are multiplied with a weekly time endowment of 40 hours. Changes in percentages. Gray dotted lines: CPS observations as in figure 1.
The figure shows that the model is successful at matching the empirical developments in the distribution of married women’s labor supply. For the 1970s, the model predicts a decreasing pattern of wives’ hours by the husband’s wage decile as in the data. Also the empirical level of hours worked is matched closely. Quantitatively, the difference between model-predicted and empirical average hours is less than 2%. Taking a disaggregated view, the difference between model-predicted hours and empirical hours does not exceed 12% in any wage decile.

For the 2000s, the model matches the higher level of hours worked by wives closely. The overall difference between model and empirical hours is only half a minute per week. In particular, the model also matches the hump-shaped distribution of hours worked. Although the distribution of model-predicted hours is somewhat less spiky than the empirical distribution, differences in the middle of the distribution are rather small and not exceeding 6% in any decile.

From the right panel of figure 4, one can see that the predicted increase in hours is not uniform across husband’s wage deciles. As in the data, wives married to high-wage men experience the strongest increases. Also quantitatively, the model matches the distribution of changes in labor supply well. Only the lowest and the highest wage deciles show a somewhat larger difference between predicted and observed change.

The model is thus able to generate the different patterns of wives’ hours worked by the husband’s wage under a common calibration for both periods (as summarized in table 1). In other words, the marked changes in the distribution of female hours can be rationalized without relying on changes in preference or technology parameters. We use a model of household specialization in which the relation at the household level between the husband’s wage and the wife’s labor supply is negative (see proposition 1). We showed in Section III that such a model can generate the empirically observed hump-shaped pattern at the aggregate when taking into account assortative mating (see proposition 3). Our quantitative results demonstrate that such a hump is actually generated by the empirically observed degree of assortative mating in the 2000s.

We also checked the predictions of our model for other decades. The model is also successful in terms of both the level of married women’s hours and their distribution in the 1980s and 1990s. Details are provided in the online appendix, sec. D.2. Another way of assessing the empirical fit of the

9 We do not claim that such changes have not occurred. For instance, time-use evidence suggests that the valuation of home consumption has become more sensitive to the presence of children over time (see Ramey and Ramey 2010). Yet our results do not change substantially when we change our calibration between decades to match the empirical developments in the distribution of home hours. Details are provided in the online appendix, sec. D.4.
model is to consider the change in men’s hours worked by decile. One may expect that a model of household specialization would predict rising female hours to be accompanied by equal-sized reductions in hours of husbands. In the online appendix, sec. D.3, we show that our calibrated model is successful at generating the relative stability of husbands’ hours jointly with the pronounced increase in wives’ labor supply (a result of changes in bargaining positions and substitution away from home consumption).

D. Accounting for the Increases in Hours

The developments in figure 4 result from effects of changes in the marginal distributions of gender-specific wages, changes in the distribution of children, and changes in the association of spouses’ wages. To disentangle these effects, we perform a series of counterfactual experiments.

In a first experiment, we hold constant the association matrix $S$ at its 1970s level but allow the marginal wage distributions and the distribution of children to change over time. This way, we shut down the effects of trends in assortative mating. In the left panel of figure 5, the resulting distribution of changes in labor supply (white bars) is illustrated along with the distribution predicted by the full model (gray bars) and the empirical distribution of changes (gray dashed line). It can be seen that, when we only allow for changes in the marginal wage distributions and the distribution of children, the model does generate the substantial increase in hours for all wives. Yet, in this scenario, the increase is strongest for wives married to medium-wage men. By contrast, the data show that wives married to high-wage men have experienced the strongest increases in hours worked. To generate this pattern, one has to take into account changes in assortative mating (see gray bars).

The right panel of figure 5 disentangles the changes in the distribution of hours worked into the effects of the three main drivers of hours worked in our model. The black bars show the distribution of changes in labor supply that arises from developments in the marginal wage distributions alone. The results show that developments in the marginal wage distributions, predominantly the closure of the gender wage gap, are an important source of the increase in married women’s hours (as also shown by, e.g., Galor and Weil 1996; Jones et al. 2003; Knowles 2007; Attanasio et al. 2008). Quantitatively, they induce roughly 60% of the increase in married women’s hours since the 1970s. However, the resulting distribution of changes is hump shaped rather than clearly upward sloping as in the data.

The effects are similar when we only allow the distribution of children to change over time but hold constant $W$ and $S$ (white bars in the right panel of fig. 5). The empirical importance of fertility for married women’s hours has previously been documented by Chiappori and Weiss (2006) and Bertrand et al. (2011). Our results show that reductions in fertility are
responsible for about 40% of the rise in married women’s labor supply. Yet changes induced by decreasing fertility also show a hump-shaped pattern by the husband’s wage.

The gray bars in the right panel of figure 5 refer to the case where we allow for changes in the association between spousal wages but hold constant $W$ and $K$. In this scenario, changes in wives’ hours are clearly increasing in the husband’s decile position. Yet the trend in assortative mating does not have a substantial effect on the level of married women’s hours.

These evaluations of our model suggest that changes in the marginal wage distributions and reductions in fertility are responsible for the overall increase in hours worked by wives since the 1970s. By contrast, the fact that wives married to high-wage men experienced the most pronounced increase is a result of trends in assortative mating.

V. Discussion

A. Relation at the Household Level

The economy-wide pattern of wives’ hours by the husband’s wage can change due to two reasons: first, changes in the relation between the husband’s wage and the wife’s labor supply at the household level and, second, effects due to changes in assortative mating. In this paper, we stress the importance of the second channel. Focusing on the first channel, a number of papers have shown that the cross-wage elasticity between a wife’s labor supply and the husband’s wage has grown weaker over time (e.g., Blau and Kahn 2007; Morissette and Hou 2008).

In the quantitative analysis of our model (Sec. IV), even though the household problem is structurally the same, the direct mapping between the husband’s wage and the wife’s labor supply does change over time due to different female wages and changes in fertility (see proposition 1). Figure 6 shows the model-implied hours worked of a married woman with the average female wage and the average number of children as a function of the husband’s wage for the two decades considered. For a given real wage of the husband, the average wife of the 2000s works more than her 1970s counterpart. Furthermore, the relation to the husband’s wage is less steep in the 2000s. In our calibrated model, the cross-wage elasticity of female hours to male wages evaluated at mean wages and mean number of children is about $-0.47$ for the 1970s and $-0.12$ for the 2000s.\(^\text{10}\) As illustrated in the counterfactual analyses, a change in the micro relation of

\(^{10}\) These numbers are in line with the results of Morissette and Hou (2008), who group wives with similar own wages (thereby effectively controlling for the association between husband’s and wife’s wages) for Canadian data. In their study, the cross elasticity is $-0.4$ in the 1980s and about $-0.2$ in the 1990s.
this magnitude is not sufficient to account for the development in the macro
relation when holding constant the degree of assortative mating.\textsuperscript{11}

B. Direction of Causality

While we demonstrate a link from marriage-market outcomes to pat-
terns of labor-market behavior, one may also argue that some causality runs
in the opposite direction. In this section, we ascertain that changes in mar-
rriage market behavior have not been entirely caused by changes in the quan-
tities of female labor supply.\textsuperscript{12}

\textsuperscript{11} An alternative explanation for the changing relation at the household level is
Goldin’s (1990) argument about the anticipation of divorce. Since couples are ex-
posed to a higher risk of divorce in recent years, household specialization that relies
on a stable relationship can be expected to become less important. As a consequence,
the husband’s wage would become a less important determinant of wives’ hours
worked. However, when we restrict the sample to older women, who show a sta-
tistically lower risk of divorce, we observe patterns of wives’ hours by the husband’s
wage which are very similar to those in figure 1.

\textsuperscript{12} We have to distinguish between (a) quantitative dimensions of female labor
supply, such as participation and average hours, and (b) other dimensions of female
labor-market behavior which also change over time, such as the selection of occu-
pations. For instance, Baunach (2002) and Blau, Simpson, and Anderson (1998) re-
port a steady decrease in occupational segregation by gender in the United States.
Our model seeks to explain patterns in the quantity of married women’s labor sup-
ply but does not address what kind of labor they supply. Thus we have to address
point a but may view changes in occupation choices for given quantities of female
labor supply as in point b as exogenous in terms of our model.
A Cohort-Based Difference-in-Differences Approach

We apply a difference-in-differences approach to disentangle the possible directions of causality. The two possible directions of causality can be identified using differences between cohorts along the age dimension of labor-market behavior. The marriage-market outcome is supposedly affected by labor-market behavior before marriage, whereas, in the other direction, the marriage-market outcome affects labor-market behavior after marriage.

For two cohorts of women, we consider
A. differences in labor supply before marriage,
B. differences in assortative mating,
C. differences in labor supply after marriage.

Plausible causal links run from A to B and from B to C. We analyze differences in the differences A, B, and C for cohorts of women born in the 1940s and the 1960s, respectively, in three different stages of the life cycle. We consider single women aged 20–24 for A, married couples in which the wife is aged 25–29 for B, and married couples with the wife aged 30–34 for C.13

Results

Block A of table 2 shows that the two cohorts have been very similar in terms of labor-supply behavior before marriage. Both cohorts show similar participation rates with about the same conditional average hours. Young singles of the two cohorts have also been very similar with respect to the variation of their wages and the relation between wages and hours. This leads us to conclude that the distribution of young female singles on the labor market was rather similar in the late 1960s and the late 1980s so that the difference A does not exist between the two cohorts considered.14

Despite this similarity in labor supply before marriage, the two cohorts show substantial differences in the degree of assortative mating. In the first half of the 1970s, the correlation between the spouses’ wage decile positions in married couples with the wife aged 25–29 was about 0.18. Twenty years later, this number is almost twice as high (see block B of table 2).

13 Considering young single women, we can regard sample A as potential future wives with similar probabilities of marrying. Of all women born in the 1940s, more than 85% have married by the age of 30, for women born in the 1960s this number is about 75% (US Census Bureau). Therefore, our samples B and C capture a substantial part of marriages within a cohort.

14 The relative constancy of single women’s labor supply behavior over time has also been documented by, e.g., Jones et al. (2003), Ramey (2008), and Ramey and Francis (2009). Bertrand et al. (2011) and Herr and Wolfram (2011) make a similar observation and show that, before parenthood and marriage, hours worked are rather similar across time.
Since the two cohorts showed similar quantities of labor supply before marriage, this increase in the correlation is arguably exogenous to the measures of labor supply we seek to explain in our structural model.\(^{15}\)

We now check whether differences in labor-supply behavior after marriage (\(C\)) between the two cohorts are consistent with our model. The older cohort displays a rather downward-sloping pattern of wives’ hours by husband’s wage (dark bars in fig. 7) while the pattern for the younger cohort is hump shaped (light bars), as predicted by our model given the respective degrees of assortative mating. In summary, the results of the cohort analysis support the existence of a causal link from assortative mating to post-marriage labor supply.

**Why Did Assortative Mating Increase Over Time?**

As a final issue, we discuss potential reasons for the observed trends in assortative mating. There have been important social changes in the 1970s such as the legalization of abortion and the increased use of oral contraception. Both developments reduced the gains from marriage for young couples and allowed marriage at older ages (Siow 2006). If positive assortative mating is desired, marriage at older ages allows individuals to sort in a more pronounced way as more wage uncertainty is resolved and as people can date more potential spouses before marriage. Positive assortative mating can be desired for several reasons, which include parental approval (Rose 2001), gains from marriage that arise from household public goods (Becker 1981; Lam 1988), and preferences for matching according to personal characteristics (Becker 1974). Rose (2001) discusses a shift in these preferences as a cause for the observed increase in assortative mating. It is likely that other dimensions of assortative mating (e.g., race and religion)

\(^{15}\) We have performed various robustness checks of the cohort analysis. We found that the results documented in table 2 are robust with respect to the age restrictions applied, the specific cohorts considered, and whether we condition on not being enrolled in school.
have become less important over time, allowing for more pronounced sorting in terms of labor-market characteristics.

VI. Conclusion

This paper has investigated married women’s hours disaggregated by the husband’s wage decile. Empirically, this pattern has changed from downward sloping to hump shaped.

We have presented a theoretical model that explicitly considers the role of assortative mating for understanding these developments. Assortative mating determines the distribution of spouses’ relative wages within individual couples and the distribution of married women’s hours.

Under random mating, the pattern of wives’ hours by the husband’s wage decile is downward sloping. Under perfect sorting and with a gender wage gap, average hours worked by wives are increasing in the husband’s wage. For intermediate sorting, the pattern is a weighted average of the two extreme cases and can be hump shaped as observed in the 2000s. Changes in assortative mating thus alter the pattern of wives’ hours worked by the husband’s wage decile and consequently lead to a nonuniform change in hours worked by wives.

In a quantitative analysis, we have fed the empirical joint distributions of wages and children into our model. For the 1970s, the model predicts a
decreasing pattern of wives’ hours by the husband’s wage decile as observed in the data. For the 2000s, the model-predicted pattern is hump shaped like the empirical pattern. In accordance with empirical developments, changes in wives’ hours are positively related to the husband’s wage.

A series of counterfactual experiments has shown that changes in the marginal wage distributions and reductions in fertility are responsible for the overall increase in hours worked by wives since the 1970s. By contrast, the fact that the strongest increases are observed for wives married to high-wage men is a result of trends in assortative mating.

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