Slowing Women’s Labor Force Participation: The Role of Income Inequality

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Dondena Workshop

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Trends in LFP and Wages

- Slowing female participation and convergence in wages since the mid-1990s in the US.

Gender Wage Gap and Female LFP, married workers

Gender wage gap is computed as mean wage of male workers over mean wage of female workers for full time, full year workers. The values are three-year moving averages.

Source: March Supplement of CPS
Trends in LFP and Wages

Skill premium by sex

- The growth in the skill premium has accelerated for men and slowed for women since the mid-1990s, resulting in a growing divergence.

Ratio of mean hourly wages between workers with college degree and those without a college degree, for FT-FY workers, regardless of marital status. Three year centered moving averages.

Source: March Supplement of CPS
Hypothesis

- Rise in skill premium can explain the lack of convergence in participation and wages across genders since the early 1990s.

- Mechanism:
  - Rise in male earnings generates negative wealth effect on female participation and market hours.
  - Reduced attachment to the labor market, reduces experience and earnings for skilled women relative to skilled men.
    - Positive assortative matching amplifies effect on skilled women.

- Objectives: Document empirical evidence on participation by education and household type. Explore mechanism quantitatively, how much can it explain?
Hypothesis

- Rise in skill premium can explain both the lack of convergence in participation and wages across genders since the early 1990s.

- Preview of findings:
  - Mechanism can account for large fraction of lack of convergence in female participation to male in 1995-2005 for college women and women married to college husbands.
  - Mechanism can partially reproduce the lack of convergence in female wages to males in 1995-2005 and the lower growth in the skill premium for women.
Related Literature

- **Theory**: Fernandez (2013), Fogli and Veldkamp (2011)
  - Rise in female participation due to learning about costs for the household.
  - S-shape as learning slows with most women in the labor force.

- **Empirical**: Blau and Kahn (2013)
  - International comparison, lack of part time and access to daycare.

- **Empirical**: Fortin (2013)
  - Evolution of gender role attitudes.
Outline

➤ Evidence
➤ Model
➤ Quantitative Analysis
➤ Ongoing work
Evidence
Data and Sample

- Adults ages 25 to 64.
- Married (for most of the analysis)
- Labor force participation defined as: working or looking for work at least 40 weeks a year.
Skill Premium
Measuring the Phenomenon

Skill premium, full-time full-year workers

Source: March Supplement of CPS
The acceleration in the male skill premium post-1995 is also associated with a rise in the gender wage gap for college workers.

<table>
<thead>
<tr>
<th></th>
<th>Skill Premium</th>
<th>Male/Female Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Average 1995-2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>1.86</td>
<td>1.64</td>
</tr>
<tr>
<td>Projected</td>
<td>1.75</td>
<td>1.60</td>
</tr>
<tr>
<td>Actual-Projected</td>
<td>0.11</td>
<td>0.04</td>
</tr>
<tr>
<td>Actual-Projected%</td>
<td>6.29</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations from CPS.
Labor supply of women

- The participation of married men has remained mostly stable.

![Graph showing labor force participation rates for married women and married men from 1970 to 2005. The graph indicates a generally increasing trend for married women and a relatively stable trend for married men.](source: PSID)
The slowing of female participation is driven by married women.

- The participation of single women has remained stable (87% pre-1995, 86.5% post-1995).
- The participation of divorced and separated women has remained mostly stable. (77.8% vs 77.3%)

Labor force participation of married women stopped catching up to other groups. LFP by Group

The slowing of female participation is driven by *prime age* married women. Female LFP by Age
Measuring the Phenomenon
Labor force participation of married women

Procedure:
- Use estimated parameters to project female labor force participation from 1995-2009.
- Compare projected and actual series.
Labor supply of women
Participation by household type

- Household types are based on education of the wife and the husband.

Source: March Supplement of CPS

Dashed line corresponds to 1976-1991 participation probit, in and out of sample.
The slowdown in participation has been greatest for high school and college women with college husbands.

<table>
<thead>
<tr>
<th>Household Types (M-F)</th>
<th>Married Women’s Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HS-HS</td>
</tr>
<tr>
<td>Average 1995-2005</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>0.6</td>
</tr>
<tr>
<td>Projected</td>
<td>0.66</td>
</tr>
<tr>
<td>Actual-Projected</td>
<td>-0.06</td>
</tr>
<tr>
<td>Actual-Projected%</td>
<td>-9.8</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations from CPS.
Labor supply of married women
The role of husband’s earnings

Source: March Supplement of CPS

Dashed line corresponds to 1976-1991 participation probit, in and out of sample.

The difference between 1995-2009 average and the projected values over that period is positively related to husband’s earnings.

Alt: Participation by husband’s deciles
The slowdown in participation is more pronounced for women with husband in the top decile of the male labor income distribution, suggesting role of negative income effect.

<table>
<thead>
<tr>
<th></th>
<th>Aggregate</th>
<th>Husb &lt;10%</th>
<th>Husb 50%</th>
<th>Husb &gt; 90%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average 1995-2005</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>0.65</td>
<td>0.75</td>
<td>0.68</td>
<td>0.50</td>
</tr>
<tr>
<td>Projected</td>
<td>0.75</td>
<td>0.80</td>
<td>0.76</td>
<td>0.67</td>
</tr>
<tr>
<td>Actual-Projected</td>
<td>-0.10</td>
<td>-0.05</td>
<td>-0.09</td>
<td>-0.17</td>
</tr>
<tr>
<td>Actual-Projected%</td>
<td><strong>-13</strong></td>
<td><strong>-6</strong></td>
<td><strong>-12</strong></td>
<td><strong>-25</strong></td>
</tr>
</tbody>
</table>

Source: Authors’ calculations from CPS.
Negative Income Effect
One and Two Earner Households

- Average labor earnings of husbands are significantly higher in one-earner households.
- The ratio of average wage of husband in one-earner households over two-earner households went up for college husbands after 1993, and down for less-than-college husbands.

Table Regressions
Negative Income Effect

Household Net Worth

- The corresponding rise in the dispersion of household net worth since the mid-1990s likely also contributed to the negative income effect.

![Net Worth by Household Education Type](image-url)

Source: Survey of Consumer Finances.
EN (participation to non-participation) flow rates increased, while NE flow rates declined after 1995.

<table>
<thead>
<tr>
<th>Yearly transition rates. Source: Authors’ calculations from the PSID.</th>
<th>Household Type</th>
<th>Husband’s Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>HS-HS</td>
</tr>
<tr>
<td>EN 1984-1994</td>
<td>0.060</td>
<td>0.056</td>
</tr>
<tr>
<td>1995-2005</td>
<td>0.073</td>
<td>0.063</td>
</tr>
<tr>
<td>NE 1984-1994</td>
<td>0.212</td>
<td>0.243</td>
</tr>
<tr>
<td>1995-2005</td>
<td>0.209</td>
<td>0.220</td>
</tr>
</tbody>
</table>
Labor Flows

By household type, prime age women

- The rise in EN is more pronounced for women with college husbands.

Core Prime E–to–N Flows by Household Type

Core Prime N–to–E Flows by Household Type

Core Prime encompasses 25-44 year olds.

Source: Authors’ calculations from the PSID.
Summary

- Skill premium for men rises by 6.3% in 1995-2005
  - Male/female wage ratio rises by 11% for college workers
- Labor force participation of married women in 1995-2005 relative to pre-1995 trend
  - 12% lower for college women
  - 14% lower for women with college husbands
  - 25% lower for women with husbands in the to 10% of the earning distribution
- Similar behavior for hours
Quantitative Analysis
Model
Household Labor Supply

- Households:
  - Composed by two married partners of different gender.
  - Partners have independent utility functions.
- Marriage and educational attainment exogenous. No divorce.
- Heterogeneity in individual productivity.
  - Assortative matching by education based on empirical distribution of household types.
- Intensive and extensive labor supply decisions.
- Efficient market and home hours allocation.
- Wages endogenous due to on the job acquisition of human capital.
Model

Household Problem

\[
\begin{align*}
\max_{c_j^s, h_j^s \geq 0, l_j^s \in \{0, [l, \bar{l}]\}, b_{j+1}, k_{j+1}^s \geq 0} & \sum_{j=1}^J \beta_j \sum_{s=f, m} \lambda^s u \left( c_j^s, l_j^s + h_j^s \right) \\
\text{s.t.} & \quad H_j = G(h_j^f, h_j^m) \\
& \quad \sum_{s=f, m} c_j^s + q b_{j+1}^i \leq \sum_{s=f, m} W_j^i l_j^s + b_j^i \text{ for } j = 1, 2, \ldots J \\
& \quad \sum_{s=f, m} c_j^i \leq b_j \\
& \quad k_{j+1}^i = F(l_j^i, k_j^i) \\
& \quad k_0^s = \bar{k}^s \\
& \quad H_j \text{ given for } j = 1, \ldots, J
\end{align*}
\]
Model
Household Problem

- Indivisible labor:
  
  \[ l_{ij}^{is} = \begin{cases} 
  0 & \text{if } p_{ij}^{is} = 0 \\ 
  \geq 1 & \text{if } p_{ij}^{is} = 1 
  \end{cases} \]

- Home hours requirement:
  
  \[ H_j = G(h_j^f, h_j^m) \]

  - \( H_j \) exogenously given for all \( j = 1, 2, \ldots J \)
Wages and Human Capital

Wages:

\[ W_{j}^{is} = \theta^s w^s (1 + \xi_j^s e^{is}) k_j^{is} \]

for \( s = f, m, i = c, hs \), for all \( j = 1, 2, \ldots J - 1 \)

- fixed individual productivity \( \theta^s \), with gender specific distribution
- gender specific baseline wage \( w^f \leq w^m \)
- skill premium, \( \xi_j^s \), indicator for college \( e^{is} \)
- human capital law of motion follows Imai and Keane (2004),
  \[ k_j^i = f(k_{j-1}^i, l_{j-1}^i) \]

Endogenous gender wage gap and skill premium due to on the job acquisition of human capital, even with \( w^s \) and \( \xi_j^s \) exogenous.
Income effects:

- Participation is zero if own productivity is sufficiently low and non-labor income (partner’s income + wealth) is sufficiently high.
- Rise in partner’s wage causes market hours to drop and eventually participation to go to zero.

Gender wage gap causes wives’ participation and market hours to be lower than husbands on average, triggering a decline in both, if the skill premium rises.
Calibration

- Household types (wife-husband):
  \( hs - hs, hs - coll, coll - hs, coll - coll \)

- Four stages: 25-39, 40-54, 55-69, 70+ yo

- Productivity distribution:
  \( \theta^s \sim \log N(\bar{\theta}, \sigma^s) \) for \( s = f, m, \)

- Strategy:
  - Set most parameters based on independent evidence.
  - Set remaining parameters to match 1980 aggregate participation, labor earnings dispersion by gender, home/market hours ratio.
Calibration
Functional Forms

- Utility:

\[ u(c_j^{is}, l_j^{is} + h_j^{is}) = \frac{\left(c_j^{is}\right)^{1-\sigma}}{1 - \sigma} - \phi^s \frac{\left(l_j^{is} + h_j^{is}\right)^{1 + \frac{1}{\gamma^s}}}{1 + \frac{1}{\gamma^s}} \]

- \( \sigma, \phi^s, \gamma^s > 0 \) for \( s = f, m \)

- Home production:

\[ G(h^f, h^m) = \left[ \psi^f \left(h^f\right)^\rho + \psi^m \left(h^m\right)^\rho \right]^{1/\rho} \]

- \( \rho, \psi^s \in (0, 1) \) for \( s = f, m \), \( \sum_s \psi^s = 1 \)
### Calibration

**Table:** Parameters calibrated based on independent evidence

<table>
<thead>
<tr>
<th>Preferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma = 1.1$</td>
</tr>
<tr>
<td>$\beta = 0.978^{15}$</td>
</tr>
<tr>
<td>$\lambda_f = 0.5$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Home production</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\psi_f = 0.5$</td>
</tr>
<tr>
<td>$\rho = 0.65$</td>
</tr>
<tr>
<td>${H_2, H_3} = {1.018, 1.031}$ $H_1$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Human capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imai and Keane(2004)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Labor market</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w^f / w^m = 0.9$</td>
</tr>
<tr>
<td>Time evolution of $\xi$ and $w$: estimated from data.</td>
</tr>
<tr>
<td>Distribution of household types: from data.</td>
</tr>
</tbody>
</table>


Calibration

Table: Parameters calibrated for 1980 to match population moments

<table>
<thead>
<tr>
<th>Utility</th>
<th>Home Production</th>
<th>$\theta$ distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi_t^f$</td>
<td>$\phi_t^m$</td>
<td>$H_1$</td>
</tr>
<tr>
<td>0.169</td>
<td>0.142</td>
<td>2.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\sigma^m$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\sigma^f$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.35</td>
</tr>
</tbody>
</table>

Table: Data/Model Comparison

<table>
<thead>
<tr>
<th>1980</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>Participation</td>
<td>0.44</td>
<td>0.86</td>
</tr>
<tr>
<td>Coeff. var. earnings distribution</td>
<td>1.34</td>
<td>0.84</td>
</tr>
<tr>
<td>Market/home hours</td>
<td>0.922</td>
<td></td>
</tr>
</tbody>
</table>
Exercise 1: Steady state rise in the skill premium

Exercise:

- Increase $\xi_j^s$ to match actual 1995-2005 average skill premium by gender, all other equal.
- Compare 1980 to 1995, as if steady states.

Results:

- Large drop in labor supply of women with college husbands, 60% as in data;
- Large drop in labor supply of women in college-college households, approx. 40% of drop in data;
- Rise in skill premium for men larger than for women, and rise in male/female wage ratio higher for college than high school, as in data.
- Model cannot match decline in participation of HS women, likely due to demographics (aging of population)
Decline in participation in the model greatest for high school women with college husbands, as in data. Participation of college women with high school husbands rises, contrary to data.

<table>
<thead>
<tr>
<th>Household Types</th>
<th>HS-HS</th>
<th>HS-C</th>
<th>C-HS</th>
<th>C-C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td>1980 calibration: 1995-2005 skill premium-actual</td>
<td>0</td>
<td>−16.8</td>
<td>8.1</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td>Average 1995-2005: actual- pre1995 projection</td>
<td>−10</td>
<td>−17</td>
<td>−8</td>
</tr>
</tbody>
</table>
Exercise 1
Response of women’s labor supply

- Higher skill premium reduces participation of women with college husbands. Participation lower both for high school and college women.

<table>
<thead>
<tr>
<th></th>
<th>Married Women’s Participation By Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HS</td>
</tr>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>% change</td>
<td>−3.1</td>
</tr>
<tr>
<td>Data</td>
<td>Average 1995-2005: actual-projected using pre-1995 growth</td>
</tr>
<tr>
<td>% change</td>
<td>−9.5</td>
</tr>
</tbody>
</table>
Exercise 1
Response of wages by gender

- Skill premium rises more for men in the model, as in the data. Male/female wage ratio rises more for college than high school workers, as in the data.

<table>
<thead>
<tr>
<th></th>
<th>Skill Premium</th>
<th>Male/Female Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>% change</td>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td>Average 1995-2005: actual- pre1995 projection</td>
<td></td>
</tr>
<tr>
<td>% change</td>
<td>6.3</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Exercise 2: Cohort simulations

- Simulate model every 5 years between 1965 and 2005, examine behavior of cohorts who are 25-39 in each year throughout their lifetime.
  - Stable decline in $\phi^f$, capturing labor supply forces (matches participation growth between 1965-1995, projected forward)
    - Examples: Home appliances (Greenwood, Sheshadri and Yorugoklu 2005), cultural factors (Fogli and Veldkamp 2011, Fernandez 2013), improvement in maternal health (Albanesi and Olivetti 2016)
  - Trends for $w^f/w^m$ and $w^m$ as in data.

- Skill premium:
  - 1965-1990: Stable process estimated from data.
  - 1995-2005: New process estimated from data, with higher level and higher growth rate.
  - Unanticipated change in the skill premium $\implies$ active households reoptimize in 1995 based on new process.
## Exercise 2

### Inputs

<table>
<thead>
<tr>
<th>Year</th>
<th>Category</th>
<th>Gender</th>
<th>$\xi^f_1$</th>
<th>$\xi^m_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>Level</td>
<td></td>
<td>0.572</td>
<td>0.662</td>
</tr>
<tr>
<td>Pre – 1995</td>
<td>Trend (5 year growth factor)</td>
<td>F</td>
<td>1.036</td>
<td>M</td>
</tr>
<tr>
<td>1995</td>
<td>Level</td>
<td></td>
<td>0.74</td>
<td>0.80</td>
</tr>
<tr>
<td>Post – 1995</td>
<td>Trend (5 year growth factor)</td>
<td>F</td>
<td>1.037</td>
<td>M</td>
</tr>
</tbody>
</table>
Exercise 2
Baseline results

- Participation drops most for women with college husbands, especially those with high school. Participation rises for college women with high school husbands, contrary to data.

<table>
<thead>
<tr>
<th>Married Women’s Participation, 1995-2005 Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Types</td>
</tr>
<tr>
<td>Model</td>
</tr>
<tr>
<td>percent change</td>
</tr>
<tr>
<td>Data</td>
</tr>
<tr>
<td>percent change</td>
</tr>
</tbody>
</table>

Constant $\phi_f$ results
Exercise 2
Baseline results

- Participation drops most for women with college husbands, and for high school women.

<table>
<thead>
<tr>
<th>Married Women’s Participation, 1995-2005 Average</th>
<th>Husband’s education</th>
<th>Wife’s education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>actual - projected pre-1995</td>
<td></td>
</tr>
<tr>
<td>percent change</td>
<td>1</td>
<td>−14</td>
</tr>
<tr>
<td>Data</td>
<td>actual-projected pre-1995 growth</td>
<td></td>
</tr>
<tr>
<td>percent change</td>
<td>−8.9</td>
<td>−14</td>
</tr>
</tbody>
</table>

Constant $\phi_f$ results
Exercise 2
Baseline results

Simulation captures small fraction of the gender divergence in the skill premium and of the slowing convergence in wages across gender for skilled workers.

<table>
<thead>
<tr>
<th></th>
<th>Skill Premium</th>
<th>Male/Female Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995-2005 Average</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>Female</td>
<td>HSchool</td>
</tr>
<tr>
<td>Model</td>
<td>actual - projected pre-1995</td>
<td></td>
</tr>
<tr>
<td>percent change</td>
<td>14.6</td>
<td>16</td>
</tr>
<tr>
<td>Data</td>
<td>actual - projected pre-1995 growth</td>
<td></td>
</tr>
<tr>
<td>percent change</td>
<td>11.4</td>
<td>9.2</td>
</tr>
</tbody>
</table>

Constant $\phi_f$ results
Documented composition effects behind flattening labor force participation of women. These are most related to a decline in growth and level of participation of women married to college and high income husbands, suggesting role for income effects.

Incorporate in quantitative analysis:

- Income effects can account for approx. 60% of the decline in participation of women with college husbands relative to pre-1995 trend for 1995-2005.
- Model does not predict decline in participation of women in HS-HS and HS-C households.
- Model partially captures relative rise in skill premium for men and in male/female wage ratio for college workers.
Most OECD countries display a negative correlation between the growth in inequality and women’s participation.

Figure: Participation and top 10%/average income ratio. Source: OECD
Ongoing work

- Skill premium only or also job polarization?
- Household production: allow for adjustment in household production margin (substitute with market goods, fertility choice).
- Explore trends in $\phi$ versus trends in household production technology.
Back Up Slides
Back up slides

- LFP by household type
- Hours by household type, education
- Intra-household inequality
- Earnings dispersion
- Income effect
- International evidence
- Exercise 2
- Fertility
Labor supply of married women
Participation by household type

Household type corresponds to husband-wife educational attainment.
Source: March Supplement of CPS
Labor supply of married women

Participation by husband’s earnings Actual vs Projected

Graphs by Husband’s earn. percentile

Source: March Supplement of CPS

Dashed line corresponds to 1976-1991 participation probit, in and out of sample.
Labor supply of married women
Hours by household/husband type

Household type corresponds to husband-wife educational attainment.

Source: March Supplement of CPS
Labor supply of married women
Hours by education

Female Labor Market Hours
Married women

Source: March Supplement of CPS
Intra-household inequality

Source: March CPS

Note: the ratio of wife to husband’s earnings was computed for household where both partners worked for at least 45 weeks that year, and each earned at least $5,000 (constant 2005 USD)
Earnings dispersion by gender

Earnings dispersion, 90perc/50perc
full–time, full–year workers

Earnings dispersion, 50perc/10perc
full–time, full–year workers

Source: March Supplement of CPS
Labor supply of men

- Participation of married men has remained stable. **Female LFP**

![Male Labor Force Participation Rate graph](chart.png)

Source: March Supplement of CPS
Labor Supply of Married Women

- Participation has flattened only for prime age married women. Female LFP

LFP of married women by age

Source: March Supplement of CPS
Labor supply of women

- Labor force participation of married women stopped catching up to other groups. **Female LFP**

![Graph showing labor force participation rates for different groups from 1970 to 2005. The graph compares married women, single women, married men, and divorced/separated women. The graph illustrates that the labor force participation rate for married women has remained relatively stable compared to the other groups. Source: PSID.](image-url)
Negative Income Effect

One vs Two Earner Households

Table 3: Average wage of husband, by household types

<table>
<thead>
<tr>
<th>Period</th>
<th>One-earner households</th>
<th>Two-earner households</th>
<th>One-earner hh/Two-earner hh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976-1993</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No College - No College</td>
<td>18.8</td>
<td>16.1</td>
<td>117%</td>
</tr>
<tr>
<td>No Coll Husb - Coll Wife</td>
<td>22.1</td>
<td>17.1</td>
<td>129%</td>
</tr>
<tr>
<td>College Husb - No Coll Wife</td>
<td>29.7</td>
<td>23.0</td>
<td>129%</td>
</tr>
<tr>
<td>College - College</td>
<td>31.2</td>
<td>24.1</td>
<td>130%</td>
</tr>
<tr>
<td>1994-2008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No College - No College</td>
<td>19.4</td>
<td>18.0</td>
<td>108%</td>
</tr>
<tr>
<td>No Coll Husb - Coll Wife</td>
<td>25.2</td>
<td>20.0</td>
<td>126%</td>
</tr>
<tr>
<td>College Husb - No Coll Wife</td>
<td>38.5</td>
<td>29.0</td>
<td>133%</td>
</tr>
<tr>
<td>College - College</td>
<td>44.7</td>
<td>33.1</td>
<td>135%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations from CPS. Two earners
Negative Income Effect

- Strong negative effect of husband’s income on participation.

**Two earners**

<table>
<thead>
<tr>
<th></th>
<th>Coef.</th>
<th>Robust Std. Err.</th>
<th>[95% Conf. Int.]</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.0002</td>
<td>0.0047</td>
</tr>
<tr>
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<td>0.1059</td>
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<td>constant</td>
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<td>0.0136</td>
<td>-1.0552</td>
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</tbody>
</table>

Source: Authors’ calculations from CPS.
Distribution of Household Types

- The fraction of college-college households is above 20% since the mid-1990s.

**Figure:** Fraction of households by education pairs

Household type corresponds to husband-wife educational attainment.

Source: March Supplement of CPS

Calibration
Baseline Results

- Participation drops most for women married to college husbands, especially those with high school. But participation rises for college women with high school husbands, contrary to data.

<table>
<thead>
<tr>
<th>Hh Types</th>
<th>Married Women’s Participation, 1995-2005 Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>actual skill premium – pre-1995 projected skill premium</td>
</tr>
<tr>
<td>% change</td>
<td>0</td>
</tr>
<tr>
<td>Data</td>
<td>actual – projected using pre-1995 growth</td>
</tr>
<tr>
<td>% change</td>
<td>−9.8</td>
</tr>
</tbody>
</table>
Exercise 2
Constant $\phi_f$ results

- Participation drops most for women with college husbands and for women with college.

<table>
<thead>
<tr>
<th>Model</th>
<th>Married Women’s Participation, 1995-2005 Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Husband’s education</td>
<td>Wife’s education</td>
</tr>
<tr>
<td>HS</td>
<td>C</td>
</tr>
<tr>
<td>% change</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-8</td>
</tr>
<tr>
<td>-1.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Data</td>
<td>actual-projected using pre-1995 growth</td>
</tr>
<tr>
<td>change</td>
<td></td>
</tr>
<tr>
<td>-8.9</td>
<td>-14.0</td>
</tr>
<tr>
<td>-9.5</td>
<td>-12.1</td>
</tr>
</tbody>
</table>
Exercise 2
Constant $\phi_f$ results

- Simulation captures the gender divergence in the skill premium. It does not capture the slowing convergence in wages across gender for skilled workers, due to the strong rise in participation and hours of college women with high school husbands.

<table>
<thead>
<tr>
<th></th>
<th>Skill Premium</th>
<th>Male/Female Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995-2005 Average</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>actual skill premium – pre-1995 projected skill premium</td>
<td></td>
</tr>
<tr>
<td>percent change</td>
<td>14.5</td>
<td>15.9</td>
</tr>
<tr>
<td></td>
<td>$-0.4$</td>
<td>1</td>
</tr>
<tr>
<td>Data</td>
<td>actual-projected using pre-1995 growth</td>
<td></td>
</tr>
<tr>
<td>percent change</td>
<td>11.4</td>
<td>9.2</td>
</tr>
<tr>
<td></td>
<td>8.4</td>
<td>10.6</td>
</tr>
</tbody>
</table>

Baseline Results
List
Additional Channels
Fertility choice with quality/quantity trade-off

- Low opportunity cost of additional children in high income one earner households $\implies$ quantity of children may rise in addition to quality.
- Hypothesis is consistent with rise in fertility for college-college households and high income husband households in the mid-1990s.
Fertility
Participation by husband’s earnings & number of children

- Flattening of participation occurs for women with and without children, suggesting decline in participation not driven by higher demand for children.

Graphs by Wife’s own children in household

Female participation rate
by husband’s earnings percentiles

- 10 percentile
- 50 percentile
- 90 percentile

Source: March Supplement of CPS
Fertility by husband

Source: PSID
Fertility by household type

(a) Fertility by household type

(b) Fertility by husband’s earnings
The entry of married women into the labor force and the rise in women’s relative wages are amongst the most notable economic developments of the twentieth century. These phenomena were particularly pronounced in the 1970s and 1980s, when participation of married women grew from 38% in 1975 to a peak of 60% in 1996 and the male to female ratio in hourly wages dropped from 1.60 to 1.34. Since the early 1990s, the growth in these indicators has stalled, especially for college graduates. In this paper, we link the decline in the growth in married women’s participation and relative wages since the early 1990s to the acceleration in the rise of the skill premium starting in those years. Our hypothesis is that the growth in wages for highly educated men generated a negative wealth effect on the labor supply of their female spouses, reducing their labor supply and their wages relative to men. Disaggregated evidence on relative wages and labor force participation of wives by education and income of the husband provides descriptive support for this mechanism. We develop a model of household labor supply which can qualitatively reproduce a negative effect on wives’ participation of a rise in husbands’ earnings. We show that a calibrated version of the model can account for a large fraction of the decline relative to trend in married women’s participation in 1995-2005, for college educated women and women married to college husbands. The model can also account for the rise in the gender wage gap for college graduates relative to trend in the same period.

Keywords: Labor force participation; Married women; Skill premium.
JEL Classification: E24; J2; J3.
1 Introduction

The entry of married women into the labor market and the rise in women’s relative earnings are amongst the most notable economic phenomena of the twentieth century. These phenomena were particularly pronounced in the 1970s and 1980s, when full year participation of married women grew from 38% in 1975 to a peak of 60% in 1996 and the male to female ratio in hourly wages dropped from 1.60 to 1.34. Since then, these indicators have stalled, as shown in figure 1. Moreover, figure 4 illustrates that this development is particularly pronounced for college workers. The gender wage gap of college workers has not been lower than 1.41 since 1991. These observations are puzzling in light of the continued rise in women’s educational investments relative to men and their entry into professional occupations.

In this paper, we propose a mechanism that links the flattening out of women’s participation and wages since the early 1990s to the growth of the skill premium, which substantially accelerated in those years. Specifically, we argue that the rise in the skill premium and resulting increase in top incomes for men, reduced labor supply of women married to college educated and high income husbands. This reduced their participation and labor market experience, which in turn depressed their wage growth. To articulate this hypothesis, we present empirical evidence on married women’s labor supply and wages by education, earnings and education of their husband, and develop a simulated household labor supply to explore the role of income effects quantitatively.

The behavior of the skill premium by gender constitutes a key piece of evidence in this hypothesis. The left panel of figure 2 shows the evolution of the skill premium, measured as the ratio of average wages of college to non-college workers. The rise in the skill premium since the early 1990s has been a greater for male than for female worker. The skill premium rose by 13% from

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1 For reference, see [11].
2 For a reference on women’s educational investments, see [13]. For a reference about women in professional occupations, see [4].
3We restrict attention to full time, full year workers. College workers have at least 4 years of post-secondary education completed.
1.73 to 1.96 between 1993 and 2005 for men, while only by 8% from 1.56 to 1.69 for women over the same period. This difference has accelerated from the mid 1990s on, and has resulted in a sharp rise in the male to female ratio of the skill premium starting in 1993, as shown on the right panel of figure 2.

Our hypothesis is that the rise in skill premium can explain the lack of convergence in both participation and wages across genders since the early 1990s. Specifically, the rise in the skill premium increases earnings for married skilled men and generates a negative wealth effect on participation and market hours for their wives. Positive assortative matching implies that this channel disproportionally affects skilled women. The decline in their attachment to the labor market reduces experience and earnings for skilled women relative to skilled men, thus dampening the growth in the skill premium for women relative to men.

Disaggregated evidence on married women’s participation provides strong descriptive support for this hypothesis. As shown in figure 3, the flattening of labor force participation starting in the early 1990s is limited to married women. Participation of single women has been mostly stable throughout the sample period. Participation of married women differs by education level: while for married women with high school, participation slows down during the 1990s but stays mostly constant, participation for married women with college declines from 79% to 75% between 1995 and 2011.

To reinforce this observation, figure 4 presents the joint behavior of labor force participation for married women and the gender wage gap by educational attainment. Clearly, the gender wage gap completely stopped converging for college workers, as the female labor force participation rate flattened out. For high school women, the gender wage gap continued to close, even as the growth in the labor force participation rate of married women slowed down. In Section 2.3, we show that the decline in the labor force participation of married women is mainly driven by women with college husbands and by those married to high income men, providing further support for the
notion that wealth effects associated to the rise in male top incomes may have played a role.

Our theoretical analysis is based on a model of household labor supply, in the tradition of [6]. Households are comprised by two partners of different genders who live for several stages in life. They are exogenously matched based on education, which is acquired pre-partnership and exogenous. Partners make independent labor supply and consumption decisions but share a common budget constraint. Wages depend on the exogenous level of education and on human capital. Human capital is accumulated according to past work experience, following [15]. There is an exogenous gender wage gap for unskilled workers entering the labor market, though the gender wage gap is endogenous and depends on workers’ labor supply choices. Similarly, there is an exogenous component of the skill premium, which does not depend by on gender. The equilibrium value of the skill premium depends on lifetime labor supply and will vary by gender. We calibrate the model to match key empirical moments in 1980, such as the distribution of household income and spousal earnings and wives’ labor force participation by household type. We then conduct
experiments to gauge the quantitative relevance of our hypothesis. Our findings suggest that the rise in the skill premium can account for more than half the decline relative to trend in married women’s participation in 1995-2005, and more than two thirds for college women. The model can also account for one third of the rise in the gender wage gap for college graduates relative to trend in the same period.

This paper makes both an empirical and a theoretical contribution. Our empirical analysis extensively documents the behavior of labor force participation and wages of married women in relation to the earnings of their husbands by characteristics of the household and educational attainment of the spouses. This detailed level of disaggregation provides a novel perspective on female labor market outcomes, the determinants of household income inequality, and its relation to individual income dispersion. The theoretical analysis is based on a quantitative model of household labor supply. Such a model can qualitatively reproduce a negative effect on wives’ labor supply of a rise in husbands’ earnings even with a individual preferences that do not allow for income effects on labor supply. Here, it is variation in the spouse’s earnings that influence each partner’s labor supply responses. Existing studies of earnings inequality either restrict attention to males or abstract completely from the household structure. Our theoretical model comprises the first attempt to link the rise in the skill premium and top incomes for men to the recent trends in female labor force participation and gender wage inequality.

The existing literature has payed little attention to the slow down of female labor force participation rates in the U.S. [8], [9] develop a learning paradigm to explain the secular rise in female labor force participation, where women update their assessment of the costs for children of being in the workforce based on the experience of past women. In this context, S-shaped learning dynamics imply a slowing down if the growth of female participation as its rate rises. Empirical evidence also suggests that evolving attitudes towards labor force participation plays an important role. [10] uses the General Social Surveys to document the stalling of gender roles attitudes in the mid-1990s and concludes that this development can explain at least a third of the decline in the growth rate of female participation. [3] examine gender identity in determining marriage formation and female labor force participation decisions. They find that couples where the woman has higher earnings potential than the man are less likely to get married, and that within couples, if the wife’s potential income (based on her demographics) is likely to exceed the husband’s, the wife is less likely to be in the labor force and earns less than her potential if she does work. Finally, [5] study the fall in female labor supply in the U.S. compared to other OECD countries, and find that 28% of the difference can be attributable to differences in “family-friendly” policies. Our analysis is complementary to these contributions. We take as given attitudes towards female participation, childcare costs, and gender differences in career possibilities, and focus on the endogenous response of labor supply and its impact of lifetime wages by gender for couples who are already formed.

Section 2 presents the empirical analysis and the main facts and section 3 presents the model. The calibration of the model and the numerical exercises are in section 4, and section 5 concludes.
2 Evidence

2.1 Data and sample

We use monthly waves of the Current Population Survey (CPS) from 1975-2011 and matched waves from the March Supplement of the CPS from IPUMS. The public use CPS is a large nationally representative sample of households. Our sample focuses on adults aged between 21 and 65, all races, and comprises approximately from 23,000 to 35,000 households per year (which translates into 45,700 to 70,600 observations per year).

To study different aspects of the data, we use sub-samples where we condition on marital status and work status. The married category includes everyone who declares to be married with spouse present. With respect to participation in the labor force, in the motivational evidence we use monthly data on participation. In the empirical analysis and calibration, we use a measure of labor force participation throughout the year. For this measure, we define people as participating in the labor force if they have been employed and/or actively seeking employment during at least 45 weeks that year.

We divide the population in two education categories: high school indicates all education levels less than college degree, and college includes those who obtained a college degree or higher.\(^4\)

2.2 Measuring the phenomenon

We document a break in the increasing trend for the labor force participation rate of some married women during the early 1990s. The rate of labor force participation of married women increased up until this point, but it did not converge to that of single women within the same education group. Moreover, this lack of convergence is more noticeable for women with college degree. The rate of labor force participation for single women with less than college was 10 percentage points higher than for married women in this group in 1993, and this difference came down to only 5 percentage points in 2011, whereas the participation rate of single women with college or more remained 10 percentage points higher than that of married women with college from 1993 until 2011.

There are several factors that have contributed to an increasing rate of labor force participation of married women over the last few decades, such as improvements in maternal health \(^2\), progress in home appliances \(^{14}\), diffusion in oral contraception \(^{12}\), and cultural factors \(^{9}\), \(^{8}\). We

\(^4\) To protect the confidentiality of its respondents, the U.S. Census Bureau censors the income of individuals above specified topcoded levels in the public use March CPS data. This peculiarity of the data must be taken into account when using the CPS to address questions regarding earnings dispersion, since inconsistent topcode levels lead to artificial increases or decreases in mean incomes as different fractions of the population are subject to topcoding each year. The CPS has introduced different topcodes during the sample period, and the methodology about the treatment of topcoded observations has changed a few times. Namely, the 1990 IPUMS is topcoded at $140,000 with higher earnings amounts replaced with state medians. After 1995, instead of one uniform value for all topcoded observations, the most recent topcode categories replace topcoded earnings with average earnings across gender-race-work experience cells. These changes in methodology complicate the estimation of properties of the distribution of earnings over time. To address this concern, for surveys before 1995, we replace the topcoded values with the gender-race-work status cell means estimated by \(^{17}\). This way, we use their cell means series in conjunction with cell means provided by the Census Bureau for later years to create a complete set of cell means from 1976-2008.
capture these factors by estimating a common time trend in the evolution of female participation for the period before the observed change in trend, using a probit specification. We follow a similar approach for the skill premium.

Specifically, we estimate a linear trend on 1975-1992 data for the skill premium by gender, and labor force participation of married individuals by education and by household type. We then extrapolate the trend to the years 1993-2008. Finally, we consider the difference between the actual values of each variable for the period 1995-2005 and the predicted values, based on the estimated trend. This gives us a measure of the change in the behavior of the variables of interest in the period 1992-2008. The results from this procedure are displayed in Table 1.

The skill premium for married men was 1.86, 11 percentage points higher than predicted by its prevailing trend in the period 1975-1992, whereas the skill premium for married women was only 4 percentage points higher than the predicted value, 1.60. Correspondingly, the gender wage gap for college graduates was 14 percentage points higher in the data, with male/female wages at 1.46 on average in 1995-2005, then predicted from 1975-1992 behavior. Participation of married women was 0.61 on average during 1995-2005, while it was predicted to be 0.67 based on 1975-1992 data. The difference between predicted and actual values for the 1995-2005 average are higher for women with college husband than for women with high school husbands, and for women with college relative to those with high school.

<table>
<thead>
<tr>
<th>Table 1: Actual and Projected Values 1995-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skill Premium</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1991</td>
</tr>
<tr>
<td>1993</td>
</tr>
<tr>
<td>Actual Average 1995-2005</td>
</tr>
<tr>
<td>Predicted Average 1995-2005</td>
</tr>
<tr>
<td>Actual - Predicted</td>
</tr>
<tr>
<td>Actual - Predicted (as %)</td>
</tr>
</tbody>
</table>

To verify the source of this divergence between actual and projected values for female participation, we estimate a probit model of labor force participation of married women that allows for time dummies instead of linear trend, and for the effects of own education and husband’s earnings to vary over time. Figure 5 shows the coefficients for dummies indicating time, college degree, and husband whose earnings are above the 90th percentile of the distribution.

The underlying trend that drives female participation continues to rise after 1992. What changes since the early 1990s was the college effect and the 'husband in the 90th percentile' effect. The college dummy for participation went down from an average of 0.3 in the 1980s to an average of 0.2 in the late 1990s and 2000s. The 90th percentile husband dummy always has a negative effect on wives’ participation. However, this negative effect falls until 1990, and then flattens. What we observe in the data with respect to the behavior of college women married to a high earning husband is a combination of these two effects.
2.2.1 Skill premium

The skill premium has risen over the entire sample period. However, the growth rate of the skill premium for married male workers has been higher than for the rest of the workers since early 1990s. As seen in the previous section, in figure 2, skill premium is always higher for male than for female workers. But in particular, the growth rate of skill premium for married male workers accelerated in the early 1990s more than for married female workers. For single workers, the evolution of the skill premium by gender seems to follow the same growth path. In figure 6, skill premia were computed as the ratio of mean hourly wages between workers with college degree and those without a college degree, for full-time and full-year workers.

The rise in the skill premium for men is also associated with a sharp rise in earnings dispersion in the top 50% of the earnings distribution over the same period, as can be seen in figure 7. The smaller rise in earnings dispersion for women over the same period has resulted in a growing gender gap in earnings dispersion up until the 2008 recession.
2.3 Female labor force participation by household characteristics

It is important to consider household characteristics in order to better understand the observed behavior of labor force participation of married women. Husband’s earnings are important determinants of wives’ participation in the labor force, and we have shown that there has been a significant increase in dispersion of husbands’ earnings. But there are other factors that also influence labor force participation. In this subsection, we document the trends for several factors in order to rule out a major influence of any aspect other than husbands’ earnings potential.

The role of husband’s earnings  Figure 8 shows the labor force participation rate of women by their husband’s decile in the male earnings distribution. The wives of higher earning husbands are much less likely to work than the wives of lower earning husbands.

Figure 9 shows the average household income by the education type of the household, for
male-only earner households (left panel) and for two-earner households (right panel). The average household income has risen faster for two-earner households than for male-earner only households for all education types, except for the college husband- high school wife type which has grown at approximately the same rate for both types of households.

Figure 10 shows the average wage of the husband for the same groups of households as figure 9. Figure 10 clearly shows that husband’s average wages are much higher in male-earner only households than in two-earner households for all years and education types. This is evidence that the cross-income effects within the household can be very strong.

To test this hypothesis, table 2 shows the results from estimating a maximum likelihood probit model of labor force participation of wives. The controls are age, own education and cross effect of own education and husband’s percentile of earnings. Table 2 shows evidence of significant cross income effects of husband’s earnings on labor force participation decision of the wives.

Table 3 summarizes the information on husband wages for the two time periods in our quantita-
Table 2: Sensitivity of female labor participation to husband’s earnings bracket

<table>
<thead>
<tr>
<th></th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>z</th>
<th>P&gt;z</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
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<td>32.11</td>
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<td>0.006 0.006</td>
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<td>0.088 0.092</td>
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<td>17.30</td>
<td>0.00</td>
<td>0.171 0.215</td>
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<td>-12.46</td>
<td>0.00</td>
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<td>-0.900 -0.853</td>
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<td>constant</td>
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<td>0.0157</td>
<td>-72.19</td>
<td>0.00</td>
<td>-1.162 -1.100</td>
</tr>
</tbody>
</table>

Table 3: Average wage of husband, by household types

<table>
<thead>
<tr>
<th>Period</th>
<th>One-earner households</th>
<th>Two-earner households</th>
<th>One-earner hh/ Two-earner hh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976-1993</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No College - No College</td>
<td>18.8</td>
<td>16.1</td>
<td>117%</td>
</tr>
<tr>
<td>No Coll Husb - Coll Wife</td>
<td>22.1</td>
<td>17.1</td>
<td>129%</td>
</tr>
<tr>
<td>College Husb - No Coll Wife</td>
<td>29.7</td>
<td>23.0</td>
<td>129%</td>
</tr>
<tr>
<td>College - College</td>
<td>31.2</td>
<td>24.1</td>
<td>130%</td>
</tr>
<tr>
<td>1994-2008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No College - No College</td>
<td>19.4</td>
<td>18.0</td>
<td>108%</td>
</tr>
<tr>
<td>No Coll Husb - Coll Wife</td>
<td>25.2</td>
<td>20.0</td>
<td>126%</td>
</tr>
<tr>
<td>College Husb - No Coll Wife</td>
<td>38.5</td>
<td>29.0</td>
<td>133%</td>
</tr>
<tr>
<td>College - College</td>
<td>44.7</td>
<td>33.1</td>
<td>135%</td>
</tr>
</tbody>
</table>

tive analysis below. The most salient findings are: The average wage of the husband in one-earner households is higher than the average wage of the husband in two-earner households for all education pairs matchings. The percentage difference between the average wage of the husband in one and two-earner households is smaller after 1994 than in the previous period for high school husbands, and larger for college husbands. This means that high school men in one and two-earner households have become less different in this last period, whereas college men in one and two earner households are further apart now than what they were before 1994.

Figure 11 shows the labor force participation rates of married women, by household education types. The graph shows the rates relative to 1993. There is a steep increase in participation until 1993, and after that there is a change in trend for all married women, regardless of education level. However, the slow down is more pronounced for married women with college degree, since the slope during the previous decades was steeper than for women without college. The participation of women married to a college degree husband stopped increasing completely after 1993.

The role of fertility Another factor weighing on the observed behavior of married women’s labor force participation could be connected to changes in fertility. Women with children are less likely to participate in the labor force, and hence increases in fertility could affect labor force participation of married women. However, we can rule out this explanation as the only cause of the observed behavior of female labor force participation. As shown in figure 12, the decline
in the growth rate of labor force participation was similar for women with and without children. Most importantly, the evolution in the labor force participation of married women depends on the characteristics of their spouse, since the decline in the rate of growth of participation was largest for women married to men in the 90th percentile of the earnings distribution, followed by those married to men in the 50th percentile and in the 10th percentile. We conclude from this evidence that changes in fertility are not the main driving force behind the observed change in participation trends.

The evolution of marriage rates Married women represented 72.6% of the population in 1975, and that fraction went down to 58.9% by 2008 as shown in figure 13. This decline in marriage rates does not come from a higher rate of divorce but from an increase in the fraction of never married women in the population. The fraction of separated or divorced women in the population stayed approximately constant during these years, varying between a minimum of 16.6% in 1975
and a maximum of 19.6% in 1996, declining back again to 18.5% by 2008. The fraction of women who have never been married has increased from 10.7% in 1975 to 22.4% in 2008. With respect to the composition of the never married, [7] show that younger cohorts of high school dropouts of both genders have shown a steep decline in marriage rates (compared to older cohorts), followed by high school graduates. The proportion of women born after 1967 that never married is lower for people with some college than for groups with less education.

![Figure 13: Marriage rates in the population](image)

The fraction of women in the population with college degree has increased over the entire sample period. This translates into changes of household composition in terms of education that can be seen in figure 14. The fraction of households where both partners have college degree has increased steadily, but so has the fraction of households where the wife has more education than the husband. The other side of this phenomenon is that now less men “marry down”.

![Figure 14: Fraction of households by education pairs](image)

Note: Household type corresponds to husband-wife educational attainment.

**Evolution of household wealth** Figure 15 shows the evolution of net worth for households by education types. It is worth noting that the only household types that display a sustained increase in household net worth are those households where the husband belongs to the college category. In particular, asset accumulation of households where both spouses have at least college degree accelerated more than for other households since mid 1990s.
2.4 Evidence on Labor Flows

To better understand the phenomenon, we also examine the evolution of employment flows for women by household type. For this purpose, we use the PSID, and examine a sample of married women selected along the same criteria as for our CPS sample. We study participation to non-participation or entry (EN) flows, as well as non-participation to participation or exit (NE) flows, for all married women, as well as by household type, by education and by income percentile of the husband. The purpose of this exercise is to assess whether lack of entry or increased entry are responsible for the decline in growth of participation.

Table 4 presents period averages of the entry and exit flows for 1984-1994 and 1995-2005 in the aggregate and by household and husband type for the married women in our sample. In the aggregate, the exit flow rose for all women from 6% to 7.3%, and the entry rate declined only modestly from 21.2% to 20.9%. Disaggregating, we find that there was a substantial rise in exit rate and decline in entry rates for college women with college husbands, as well as for all women with college husbands.

Given the aging of the population over this period and the differences in age distribution for different types of women, we also examine the effects of age on these flows. Figure 16 shows the exit and entry flows by household type for 25-44 (core prime) year old women. The charts clarify that for this age group, there is a marked change in the behavior of both exit and entry rates in the mid 1990s. Specifically, exit rates start to rise while entry rates start to fall in the mid-1990s. The rise in the exit rate is most pronounced for high school women and college women with college husbands starting in the early 1990s, whereas in 2003 high school women with high school husbands also experience a rise in the exit rate. College women with high school husbands do not experience any substantial change in their exit rates over this period.

Entry rates decline starting in the early 1990s, most prominently for college women with college husbands. By the early 2000s, entry rates also decline for the other household types.

To further investigate the role of age composition across groups, we also calculate counterfactual
Table 4: Yearly transition rates. Source: Authors’ calculations from the PSID.

<table>
<thead>
<tr>
<th>Household Type</th>
<th>Husband’s Education</th>
<th>Wife’s Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25th</td>
<td>50th</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>HS</td>
</tr>
<tr>
<td>EN</td>
<td>1984-1994</td>
<td>0.060</td>
</tr>
<tr>
<td></td>
<td>1995-2005</td>
<td>0.073</td>
</tr>
<tr>
<td>NE</td>
<td>1984-1994</td>
<td>0.212</td>
</tr>
<tr>
<td></td>
<td>1995-2005</td>
<td>0.209</td>
</tr>
</tbody>
</table>

Source: Panel Study of Income Dynamics; (Shading represents NBER Recessions)

Figure 16: Annual exit and entry rates for participation, core prime women. Core prime encompasses 25-44 year olds. Source: Authors’ calculations from the PSID.

flow rates by attributing high school women the same age distribution as college women. The hypothesis is that part of the difference in the behavior of flows across women of different groups is due to differences in age composition. The resulting flow rates are displayed in figure 18. The figure shows that exit rates for high school women would have been lower if they had the same age composition of college women, but the difference between the actual and counterfactual exit rates are small and virtually disappear after the mid 1990s. Similarly, entry rates would have been higher for high school women in the counterfactual, but the difference with the actual entry rate is small and disappears by the mid 1990s.

Finally, we explore the role of changing age distribution for each group over time. As is well known, there has been generalized aging of the population, but the rate of aging likely differs by group. We compute counterfactual flow rates by using the 1984 age distribution. The resulting flows are presented in figure 20. For both flow rates and both education groups, the counterfactual rates are above the actual rates, in all periods. However, even for the counterfactual flow rates, we observe a rise in the exit rate and a decline in entry rate for college women. The effect of the
change in the age distribution is most sizable starting in the early 2000s.

3 Model

The model is a non-unitary model of household labor supply, where individuals are egoistic and have independent utility functions, but it is assumed that the household decision-making process is cooperative, so that household decisions are Pareto efficient.\footnote{The model is a particular case of the collective labor supply model in \cite{ChiapporiC06}, where we assume a fixed household welfare function and bargaining weights for all households, whereas in Chiappori’s general case, the household welfare function is allowed to depend on prices, and endowments if any.}

In this economy there is a continuum of measure one of individuals, and each male individual is assumed to be married to a female individual. Each of them draws a (permanent) productivity value $\theta^*$ from their corresponding distributions. The distributions of $\theta^*$s depend on the...
individual’s gender. We consider two possible - exogenously given - education levels: less than college (we call this category high school), and college degree or more (we call this category college). Therefore, there are four kinds of households defined by the skill level of the partners: \( j \in J = \{hs - hs, hs - coll, coll - hs, coll - coll\} \) (measure \( \mu_e \) over the set \( J \) of household types, so that \( \sum_{0}^{1} \sum_{0}^{1} \mu_e(e_m, e_f) = 1 \)). We take the evolution of \( \mu_e \) over time as exogenous.

The model allows for human capital accumulation in the form of learning by doing (cumulative working experience, non specific, subject to depreciation). This implies that workers lose skills when they are unemployed or out of the labor force.

Individual \( i \) is indexed by gender \( s = m, f \) and age \( j = 1, \ldots, J \). Individual labor earnings \( y^{i}_{j,t} \) are a function of hours worked \( (h^i) \), worker’s stock of human capital \( (k^i) \), worker’s skill level \( (\theta^i) \), exogenously time-dependent individual productivity -or efficiency units per hour worked according to market price for skills at time \( t \), \( w_t \).

Individuals derive utility from consumption and disutility from hours worked. Individuals in
the household allocate their time to market work, home production, or both. Each household must meet a required level of home production $H_j$ by spending time producing the home good. The required level of home production varies along the lifecycle to reflect time requirements of child rearing. The utility of the household $i$ in period $j$ is a weighted average of the individual utilities:

$$u(c_{ij}^f, c_{ij}^{im}, l_{ij}^f, l_{ij}^{im}, h_{ij}^f, h_{ij}^{im}) = \lambda^f u(c_{ij}^f, l_{ij}^f + h_{ij}^f) + \lambda^m u(c_{ij}^{im}, l_{ij}^{im} + h_{ij}^{im})$$

We assume the following functional form for the individual utility function of individual of gender $s$ in household $i$ and period $j$:

$$u(c_{ij}^s, l_{ij}^s + h_{ij}^s) = \left(\frac{c_{ij}^s}{l_{ij}^s + h_{ij}^s}\right)^{1-\sigma} - \phi^s \left(\frac{l_{ij}^s + h_{ij}^s}{1 + \gamma^s}\right)^{1+\frac{1}{\gamma^s}}$$

with $\sigma, \phi^s, \gamma^s > 0$ for $s = f, m$.

A household of type $i$ solves the following problem:

$$\max_{c_{ij}^s, h_{ij}^s \geq 0, l_{ij}^{is} \geq 0, \theta^{is} \in \{0,1\}, \delta_{j+1}, k_{j+1}^s \geq 0} \sum_{j=1}^{J} \sum_{s=f,m} \lambda^s \left[\frac{(c_{ij}^s)^{1-\sigma}}{1 - \sigma} - \phi \left(\frac{l_{ij}^s + h_{ij}^s}{1 + \gamma^s}\right)^{1+\frac{1}{\gamma^s}}\right]$$

s.t. $k_{j+1}^s = k_{j}^s (1 - \delta) + (l_{ij}^s)^{\alpha}$

$$y_{ij}^{is} = w_j^s \theta^i c_{ij}^{is} l_{ij}^s$$

Figure 21: Annual exit and entry rates for participation by husband’s education, actual and with 1984 age composition.
Source: Authors’ calculations from the PSID.
\[ i_j^{is} = \begin{cases} 0 & \text{if } p_j^{is} = 0 \\ \geq 1 & \text{if } p_j^{is} = 1, \end{cases} \]

\[ H_j = G(h_j^f, h_j^m), \quad (1) \]

\[ \sum_{s=f,m} c_j^{is} + qb_{j+1} \leq \sum_{s=f,m} \xi_j^{is}l_j^{is} + b_j \quad \text{for } j = 1, 2, \ldots J - 1 \]

\[ \sum_{s=f,m} c_j' \leq b_J, \]

\[ b_{j+1} \geq b_j, \text{ for } j = 1, 2, \ldots J - 1, \text{ and:} \]

\[ k_0^s = \overline{k}^s. \]

### 3.1 Necessary Conditions for Optimality

The first order necessary conditions for the household problem are:

\[ \beta^j \lambda^s u_{c_j}^s = \mu_j \quad (2) \]

for \( j = 1, 2, \ldots J; \) if \( p_j^{is} = 1, \)

\[ \beta^j \lambda^s u_{l_j}^s + \mu_j \xi_j^s + \nu_j^s \alpha (l_j^s)^{\alpha - 1} \leq 0 \]

with equality for \( l_j^s > 1, \) for \( j = 1, 2, \ldots, J - 1, \)

\[ \beta^j \lambda^s u_{l_j}^s + \pi_j G_{h_j^s} \leq 0 \]

with equality for \( h_j^s > 0, \) for \( j = 1, 2, \ldots, J - 1, \)

\[ -q\mu_j + \mu_{j+1} = 0, \]

and

\[ -\nu_j^s + \beta V_{k^s}(b, k_{j+1}^f, k_{j+1}^m, j) = 0, \]

for \( j = 1, 2, \ldots, J - 1. \)

The envelope conditions for this problem are:

\[ V_b(b, k^f, k^m, j) = \mu_j = u_c(c_j), \]

where \( c_j = u_c^{-1}(\lambda^s u_c(c_j^s)), \)

\[ V_{k^s}(b, k^f, k^m, j) = \nu_j^s (1 - \delta) + \mu_j w_j^s \theta_j^s, \]
for $s = f, m$.

Combining the first order necessary conditions for consumption at any $j$:

$$\lambda^f u_{c,j}^f = \lambda^m u_{c,j}^m.$$\[1]\]

At an interior solution with both partners participating in the labor force, the combined first order necessary conditions for labor obtain for $j = 1, 2, ... J - 1$:

$$\frac{\beta^j \lambda^f u_{l,j}^f + \nu^s_j \alpha \left( l_j^f \right)^{\alpha - 1}}{\xi_j^f} = \frac{\beta^j \lambda^m u_{l,j}^m + \nu^s_j \alpha \left( l_j^m \right)^{\alpha - 1}}{\xi_j^m}.$$\[2]\]

At an interior solution for home hours, we have:

$$\frac{\lambda^f u_{l,j}^f}{G_{h,j}} = \frac{\lambda^m u_{l,j}^m}{G_{h,m,j}}.$$\[5]\]

This equation, jointly with (1), can be used to solve for $h_j^s$ for $s = f, m$ for given $l_j^s$, both for two earner and one earner households.

If $p_j^s = 1$, then we can combine the first order necessary condition for consumption and market hours to obtain:

$$\beta^j \lambda^s u_{c,j}^s + \beta^j \lambda^s u_{c,j}^s \xi_j^s + \nu^s_j \alpha \left( l_j^s \right)^{\alpha - 1} = 0,$$\[6]\]

for $s = f, m$ and $j = 1, 2, ... J - 1$.

For a two earner households, equations (5) and (6) define a system that can be used to solve for $h_j^s$ and $l_j^s$ as a function of $c_j^s$.

For one earner households, assuming that male participation is positive and that hours are interior, the following will hold:

$$\beta^j \lambda^m u_{l,j}^m + \beta^j \lambda^m u_{c,j}^m \xi_j^m + \nu^s_j \alpha \left( l_j^m \right)^{\alpha - 1} = 0,$$\[7]\]

while $l_j^f = 0$. Then, equation (7) jointly with equation (5) can be used to solve for $h_j^s$ and $l_j^s$ as a function of $c_j^s$.

Finally, combining the first order necessary condition for home and market hours for each partner in the labor force at an interior solution, we obtain for $j = 1, 2, ... J - 1$:

$$- \pi_j G_{h,s,j} + \mu_j \xi_j^s + \nu^s_j \alpha \left( l_j^s \right)^{\alpha - 1} = 0.$$\[8]\]

We adopt the following specification for the home production function:

$$G(h^f, h^m) = \left[ \psi^f \left( h^f \right)^{\rho} + \psi^m \left( h^m \right)^{\rho} \right]^{1/\rho},$$

with $\rho, \psi^s \in (0, 1)$ for $s = f, m$, $\sum_s \psi^s = 1$. For $1 > \psi^s > 0$ and $\rho < 1$, home hours are always interior for both spouses.
The wealth effects on labor supply can be analyzed from (3). For given female wages, \( \mu_j \) is lower in a household with higher male earnings, causing \( l_j^s \) to be lower, other things equal. Using the Euler equation:

\[
u^s_c,j q + \beta u^s_{c,j+1} = 0,
\]

for \( j = 1, 2, ..., J \). Combining the Euler equation for \( k^s_j \) with the corresponding envelope condition, we obtain:

\[
-\nu^s_j + \beta \left[ \nu^s_{j+1}(1 - \delta) + \mu_{j+1}w^s_{j+1}\theta^s l^s_{j+1} \right] = 0,
\]

for \( j = 1, 2, ..., J - 1 \), with \( \nu^s_j = 0 \) for \( s = f, m \). This implies automatically that \( \nu^s_{j-1} = 0 \). Then:

\[
-\nu^s_{j-2} + \beta \left[ \mu_{j-1}w^s_{j-1}\theta^s l^s_{j-1} \right] = 0,
\]

\[
-\nu^s_{j-3} + \beta \left[ \nu^s_{j-2}(1 - \delta) + \mu_{j-2}w^s_{j-2}\theta^s l^s_{j-2} \right] = 0,
\]

and so on for \( j \) going to 0 according to (9).

### 3.2 Model properties

The labor choice problem allows for income effects at the household level, so that a change in a partner’s labor income affects the other’s labor supply decisions. This is the key property driving the mechanism we want to capture. Additionally, because of the non-convexity in labor supply, that is \( l > 0 \), labor force participation is zero if own productivity is sufficiently low and household wealth is sufficiently high.

Household wealth is an important determinant of labor market decisions of the secondary earner, and it depends positively on partner’s labor income. Therefore, a rise in the partner’s labor income can cause market hours to drop and eventually participation to go to zero.

The assumption of comparative advantage of wives in home production or gender wage gaps is important to reinforce this effects, because it causes wives’ participation and market hours to be lower than husbands’, and home hours to be higher - everything else equal. Even if \( \gamma^f = \gamma^m \), if wives’ home hours are greater than husbands’, they have higher Frisch elasticity of labor supply.

Lastly, from a dynamic point of view, the existence of returns to experience and human capital depreciation help generate diverging earnings paths for the primary and secondary earner. There’s a high return for staying in the labor force, but for those who exit, there is an important share of earnings forgone at the time of re-entering, so some may be discouraged to re-enter and instead decide to remain out of the labor force.

### 4 Calibration and Numerical Analysis

We calibrate the model to match 1993 aggregate statistics on aggregate participation, skill premia, gender wage gap by education, within household female/male market hours ratio. Then, we examine the effect of the rise in the skill premium on female participation and wages and other outcomes. To do so, we simulate two experiments. The first assume that the economy is in stationary allocation corresponding to the 1993 calibration and increase the exogenous component.
of the skill premium to match its average value in the data in 1994-2005. We then compare the stationary allocation corresponding to this higher value of the skill premium to the original allocation. This steady state experiment provides an initial assessment of the role of higher skill premia in the model, however, it is not realistic as the pre-1993 economy was not stationary, on the contrary was characterized by increasing female participation. This motivates our second and main experiment in which we simulate a full transition. Specifically, we simulate the model from 1965 to 2005 adjust the disutility of labor for women to match participation for the period 1965-1990. We introduce the new process for the skill premium starting in 1995 and compare the simulated model to a version of the simulation in which the process for the skill premium remains at pre-1995 values. The results from the transition experiments largely confirm those of the steady state experiments.

4.1 Calibration

We calibrate the model to match 1980 aggregate statistics on participation, skill premia, gender wage gaps by education, and the within household female/male market hours ratio. We select some parameters directly from the data or from independent evidence and determine the remaining parameters to match model moments to the data.

We assume the four stages in life correspond to the following age brackets: 25-39, 40-54, 55-69, 70+ years old. We set the fraction of households in each education type (college-college, high school-college, college - high school, high school-high school) to match empirical values in 1980, reported in Table 5.

Table 5: Parameters Set Based on Data and Independent Evidence

<table>
<thead>
<tr>
<th>Distribution of household types</th>
<th>hs – hs</th>
<th>c – hs</th>
<th>hs – c</th>
<th>c – c</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>63%</td>
<td>12%</td>
<td>7%</td>
<td>18%</td>
</tr>
</tbody>
</table>

We set a log-normal distribution of individual productivities, \( \theta^s \sim logN(\bar{\theta}, \sigma^s) \) for \( s = f, m \).

The parameters set based on independent evidence are reported in Table 6. We set the exogenous gender wage gap for unskilled workers based on [1]. In addition, we set the parameters for the human capital accumulation function based on Imai and Keane (2004). We estimate total household level home hours by age from the PSID and set \( H_s/H_1 \) based on these estimates, and then pin down \( H_1 \) as described below.\(^6\)

We set the remaining parameters, reported in Table 7, to match population moments in 1980 using a minimum distance approach. Specifically, we set the variance of the distribution of \( \theta^f, \theta^m \) to match the dispersion of earnings by gender, \( \phi^f, \phi^m \) to match the level of participation by gender, and set \( H_1 \), the home hours requirement in the first stage of life, to match the aggregate ratio of

\(^6\)The data on home hours is taken from the PSID, as reported by [1]. It is worth noting that the measure of home hours in the PSID is imperfect (respondent reports about hours of home work for self and spouse, no time diaries are used), but it is the best measure available for this period in time, as the American Time Use Survey starts in 2003.
Table 6: Parameters calibrated based on independent evidence

<table>
<thead>
<tr>
<th>Preferences</th>
<th>$\sigma = 1.1$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta = 0.978^{15}$</td>
</tr>
<tr>
<td></td>
<td>$\lambda^f = 0.5$</td>
</tr>
<tr>
<td>Home production</td>
<td>$\psi^f = 0.5$</td>
</tr>
<tr>
<td></td>
<td>$\rho = 0.65$</td>
</tr>
<tr>
<td></td>
<td>${H_2, H_3} = {1.018, 1.031}$</td>
</tr>
<tr>
<td>Human capital</td>
<td>Imai and Keane(2004)</td>
</tr>
<tr>
<td>Labor market</td>
<td>$w^f/w^m = 0.9$</td>
</tr>
</tbody>
</table>

market to home hours in the data.

Table 7: Parameters calibrated for 1980 to match population moments

<table>
<thead>
<tr>
<th>Utility</th>
<th>Home Production</th>
<th>$\theta$ distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi_l^f$</td>
<td>$\phi_m^m$</td>
<td>$H_1$</td>
</tr>
<tr>
<td>0.169</td>
<td>0.142</td>
<td>2.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\sigma^m$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.48</td>
</tr>
</tbody>
</table>

As shown in Table 8, the model matches participation rates and the dispersion in the earnings distribution by gender very well, though it somewhat over predicts the ratio of market to home hours in the data.

Table 8: Data/Model Comparison

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>Participation</td>
<td>0.44</td>
<td>0.86</td>
</tr>
<tr>
<td>Coeff. var. earnings distribution</td>
<td>1.34</td>
<td>0.84</td>
</tr>
<tr>
<td>Market/home hours</td>
<td>0.922</td>
<td>1.23</td>
</tr>
</tbody>
</table>

4.2 Experiment 1: Stationary Allocations

To assess the impact of the rise in the skill premium on female participation, we first perform a steady state experiment. That is, we presume the allocation is stationary at 1980 values and we increase the exogenous component of the skill premium so that it matches 1995-2005 values and examine the impact on model outcomes. We assume the there are no other changes to model parameters and that the new value of the skill premium persists indefinitely. This amounts to comparing to versions of the model, one with a pre-1995 skill premium and one with a 1995-2005 skill premium. To match the average skill premium in 1995-2005 by gender, we increase $\xi^s_j$ for $j = f, m$. The results from this exercise are displayed in Table 9-11.

Table 9 reports the response of female participation by household type. By construction, there is no response in participation of high school women married to high school husbands, as their
Table 9: Response of Participation by Household Type

<table>
<thead>
<tr>
<th>Household Types</th>
<th>Married Women’s Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Model</td>
</tr>
<tr>
<td>percent change</td>
<td>1980 calibration: 1995-2005 skill premium-actual</td>
</tr>
<tr>
<td>Data</td>
<td>Average 1995-2005: actual- pre1995 projection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>HS-HS</th>
<th>HS-C</th>
<th>C-HS</th>
<th>C-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>percent change</td>
<td>0</td>
<td>-16.8</td>
<td>8.1</td>
<td>-7.3</td>
</tr>
<tr>
<td>percent change</td>
<td>-10</td>
<td>-17</td>
<td>-8</td>
<td>-17</td>
</tr>
</tbody>
</table>

potential wages are not affected by a change in the skill premium. The decline in participation in the model greatest for high school women with college husbands, as in data. However, participation of college women with high school husbands rises, contrary to data. This is because the rise in the skill premium encourages college women to increase their labor supply in the model. For those married to college husbands, this effect is offset by the rise in labor supply and income of their husbands, leading to an overall decline in their participation. Instead, for those married to high school husbands, there is no counteracting effect. The magnitude of the response in participation is sizable. For high school wives married to college husbands, participation declines by 17% as in the data. For college women married to college husbands, participation declines by 7% whereas it declines by 17% in the data. By contrast, for college women married to high school husbands, participation rises by 8% in the simulation, while it declines by 8% in the data.

Table 10 reports the results by the wives’ own education and by husbands’ education separately. For high school wives, participation drops in the aggregate by 3.1% in the model, while it drops by 9.5% in the data. For college wives, participation drops by 2% in the model, while it drops by 12% in the data. For all wives married to high school husbands, participation rises by 1.3% in the model, whereas it falls by 9% in the data. For all wives married to college husbands, participation drops by 10.3% in the model, while it drops by 17% in the data.

Overall, the model captures 60% of the drop in labor supply of women with college husbands observed in the data. It also accounts for 40% of the drop in labor supply of college women with college husbands in the data. The model cannot match decline in participation of high school women with high school husbands. This is in part due to demographics in the data, and this factor is excluded from the model. The model is also unable to reproduce the decline in participation of college women with high school husbands. This factor may be due to in part to demographics and in part to changing selection for this group in the data.

Table 10: Response of Participation by Own and Husband’s Education

<table>
<thead>
<tr>
<th></th>
<th>Married Women’s Participation By Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Model</td>
</tr>
<tr>
<td>% change</td>
<td>1980 calibration: at 1995-2005 skill premium-actual</td>
</tr>
<tr>
<td>Data</td>
<td>Average 1995-2005: actual-projected using pre-1995 growth</td>
</tr>
<tr>
<td>% change</td>
<td>-9.5 -12 -9 -17</td>
</tr>
</tbody>
</table>

Table 11 reports the response of wages and skill premia by gender. As we see in the data, the
skill premium rises more for men then for women and the male/female wage ratio rises more for college workers than for high school workers. Thus, the qualitative response of these variables is in line with the data, though the magnitudes are more muted. The male skill premium rises by 2.52 times more than the female skill premium in the data, while it rises 2.27 times more in the model. The male/female wage ratio for high school workers rises by 8.4% in the data but declines by 1.3% in the model. The male/female ratio for college workers rises by 10.6% in the data but only 5.9% in the model.

The more muted response of gender differences in the skill premium and in wages for college workers is due to the fact that in the model college women increase their participation and their hours, which tends to increase their wages.

<table>
<thead>
<tr>
<th>Table 11: Response of Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skill Premium</strong></td>
</tr>
<tr>
<td>% change</td>
</tr>
<tr>
<td><strong>Data</strong></td>
</tr>
<tr>
<td>% change</td>
</tr>
</tbody>
</table>

To summarize, the model predicts a large drop in the labor supply of women with college husbands in response to the rise in the skill premium, approximately 60% of the one observed in the data. The model can also produce a large drop in labor supply of women in college-college households, approximately 40% of the drop observed in the data. The model predicts that the rise in the skill premium for men larger than for women, and generates a rise in the male/female wage ratio that is higher for college workers than high school workers, as in data. However, the wage response are considerably more muted than in the data.

4.3 Experiment 2: Transitional Simulation

The second experiment takes into account the transitional nature of the time period we consider. Since before the early 1990s the participation of married women was on a steep upward rise, we simulate that transition and the response to the rise in the skill premium in the subsequent period. To do so, we simulate model every 5 years between 1965 and 2005, and examine the lifetime behavior of cohorts who are 25-39 in each simulation year. To capture the rise in participation between 1965 and the early 1990s, we allow for a stable decline in $\phi^f$, to capture the forces imparting an upward trend to female labor supply for this time period. Some examples that have been considered in the literature include the diffusion of home appliances (Greenwood, Sheshadri and Yorugoklu 2005), cultural factors (Fogli and Veldkamp 2011, Fernandez 2013), and the improvement in maternal health (Albanesi and Olivetti 2016). The decline in $\phi^f$ is calibrated to match aggregate participation of married women between 1965-1995, and is then projected forward to 2005, under the assumption that these forces have not stopped operating after 1990. The simulations also use empirical estimates for unskilled wages by gender estimated from the
data. These are used throughout the simulation period.

We simulate two version of the model, one in which the process for the skill premium is held constant for the entire simulation period, and one in which it unanticipatedly switches to the post 1995 process in 1995. The cohorts who are active in 1995 who are in stage 2 and 3 of their life will reoptimize their labor supply choices based on the new process for the skill premium. Table 12 reports the skill premium parameters for the simulation. In each period, there are two components of the process for the skill premium, the level and the projected growth factor. The level determines the value of the skill premium in a given year, while the growth factor determines its evolution over time. When college educated individuals in the model make labor supply choices in each stage in life, they take into account the current value of the skill premium and its future evolution, determined by the growth factor. Both the level and the growth factor for the skill premium pre- and post-1995 are estimated from the data. Specifically, we estimate a process for 1965-1990 and a separate process for 1995-2005. Our estimates suggest the both the level and the growth factor for the skill premium grew in the post-1995 period.

Table 12: Variation in Skill Premia: Data and Parameters

| Skill Premium | | | | | |
|---------------|---------------|---|---|---|
| 1980          | Level         | $\xi^1_1$ | 0.572 | $\xi^{10}_1$ | 0.662 |
| pre – 1995    | Trend (5 year growth factor) | F | 1.036 | M | 1.054 |
| 1995          | Level         | $\xi^1_1$ | 0.74 | $\xi^{10}_1$ | 0.80 |
| post – 1995   | Trend (5 year growth factor) | F | 1.037 | M | 1.06 |

Table 13 reports the response of female participation by household type. As in the previous experiment, participation drops most for women with college husbands. For high school wives with college husbands, participation drops by 12% in the model and 17% in the data. For college women married to college husbands, participation drops by 4% in the model and by 17% in the data. Participation rises for college women with high school husbands, contrary to data, as these women respond positively for the rise in the skill premium. By construction, participation does not response for high school women married to high school husbands.

Table 13: Response of Participation by Household Type

<table>
<thead>
<tr>
<th>Married Women’s Participation, 1995-2005 Average</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Types</td>
<td>HS-HS</td>
<td>HS-C</td>
<td>C-HS</td>
<td>C-C</td>
</tr>
<tr>
<td>Model percent change</td>
<td>actual – pre-1995 projected</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data percent change</td>
<td>actual – projected using pre-1995 growth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>-12</td>
<td>7</td>
<td>-4</td>
</tr>
<tr>
<td></td>
<td>-10</td>
<td>-17</td>
<td>-8</td>
<td>-17</td>
</tr>
</tbody>
</table>

Table 14 reports the response of female participation by their own and their husband’s education. Participation drops most for women with college husbands, and for high school women, consistent with the data. The participation of women married to college husbands drops by 14% in the model and in the data. However, participation of women with high school husbands rises
by 1% in the model while it falls by 8.9% in the data. This discrepancy is due to the fact that the participation of college women with high school husbands rises in the model, in response to the rise in the skill premium. For the same reason, participation of college women rises by 5% in the model, while it falls by 12.1% in the data.

Table 14: Response of Participation by Own and Husband’s Education

<table>
<thead>
<tr>
<th></th>
<th>Husband’s education</th>
<th>Wife’s education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>HS</td>
<td>C</td>
</tr>
<tr>
<td>percent change</td>
<td>1</td>
<td>−14</td>
</tr>
<tr>
<td>Data</td>
<td>actual - projected pre-1995</td>
<td>actual-projected pre-1995 growth</td>
</tr>
<tr>
<td>percent change</td>
<td>−8.9</td>
<td>−14</td>
</tr>
</tbody>
</table>

Table 15 reports the response of wages and the skill premium by gender. The simulation captures small fraction of the gender divergence in the skill premium and of the slowing convergence in wages across gender for skilled workers. As in the data, the male/female wage ratio rises more for college workers than for high school workers. But in the model, the skill premium for female workers rises more than for male workers due to the increases in participation of college women with high school husbands.

Table 15: Response of Wages and the Skill Premium by Gender

<table>
<thead>
<tr>
<th></th>
<th>Skill Premium</th>
<th>Male/Female Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995-2005 Average</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>percent change</td>
<td>14.6</td>
<td>16</td>
</tr>
<tr>
<td>Data</td>
<td>actual - projected pre-1995</td>
<td>actual - projected pre-1995 growth</td>
</tr>
<tr>
<td>percent change</td>
<td>11.4</td>
<td>9.2</td>
</tr>
</tbody>
</table>

5 Concluding Remarks

This paper examines the driving factors of the flattening of female labor force participation and the lack of convergence in wage across genders since the early 1990s in the United States. We show that the phenomenon is mainly due to a sharp decline in participation of women married to college educated or high income husbands. We posit that the mechanism driving this pattern is the sharp rise in the skill premium and top earnings for men in the early 1990s. Our hypothesis is that the growth in wages for highly educated men generated a negative wealth effect on the labor supply of their female spouses, reducing their labor supply and their wages relative to men. To evaluate this hypothesis, we develop a model household labor supply the generates this prediction and is consistent with evidence on the behavior of skill premia and wages by gender. A calibrated version of the model accounts for more than half the decline relative to trend in married women’s
dispersion is stable over the sample period and participation grows at a constant rate. In Germany, earnings of inequality, we use the ratio of income for the top 10% of the population to average income, to focus on the growth in top earnings. In addition to the United States, Australia, Canada and Sweden experience a sizable rise in income dispersion in the early 1990s. In all these countries, we observe a flattening of female labor force participation in the subsequent period. For the UK we also observe a rise in inequality in the early 1990s, and a decline in the rate of growth in female participation, by the pre 1990 data series is too short to establish the slowing trend conclusively. In Spain, a reduction in income inequality starting in the early 1990s is associated with an acceleration of the rise in female labor force participation over the same period. In Germany, earnings dispersion is stable over the sample period and participation grows at a constant rate.\footnote{The discontinuity in 1989 corresponds to German unification.}

Figure 22: Participation and top 10%/average income ratio. Source: OECD

participation in 1995-2005, and more than two thirds for college women. The model can also account for one third of the rise in the gender wage gap for college graduates relative to trend in the same period.

The link between rising incomes at the top for men and flattening participation of married women is based on a simple economic mechanism that we expect would hold in other countries. Many advanced economies have experienced a rise in the growth in top earnings, and it is instructive to consider the joint behavior of female participation in those countries. Figure ?? reports data on the labor force participation rate of prime age women and income inequality in eight OECD economies for which the both variables are available at least since the early 1980s. As a measure of inequality, we use the ratio of income for the top 10% of the population to average income, to focus on the growth in top earnings. In addition to the United States, Australia, Canada and Sweden experience a sizable rise in income dispersion in the early 1990s. In all these countries, we observe a flattening of female labor force participation in the subsequent period. For the UK we also observe a rise in inequality in the early 1990s, and a decline in the rate of growth in female participation, by the pre 1990 data series is too short to establish the slowing trend conclusively. In Spain, a reduction in income inequality starting in the early 1990s is associated with an acceleration of the rise in female labor force participation over the same period. In Germany, earnings dispersion is stable over the sample period and participation grows at a constant rate.\footnote{The discontinuity in 1989 corresponds to German unification.}
The international evidence suggests that income effects may play a large role on participation of married women and should be considered when examining questions related to labor market performance by gender and household level inequality.
References


