Occupation Gender Segregation: Evidence from an Empirical Matching Model with Transfers

Miriam Larson-Koester

January 31, 2018
Motivation

- Persistent sorting
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- Decreases in segregation have recently slowed (Blau et al., 2013)
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- Occupation gender segregation is increasingly important in explaining the gender wage gap (Blau & Kahn, 2017)
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- Recent evidence shows women are happier in female occupations
  
  (Lordan & Pischke, 2015)
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- Wages go down for men and women as the fraction female goes up
Motivation

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  \cite{LordanPischke2015}

- Wages go down for men and women as the fraction female goes up

- Tipping: Rapid acceleration in movement in the fraction female

\begin{itemize}
  \item Graphical
  \item Example
\end{itemize}
Mechanisms of Gender Segregation

Potential factors that affect gender sorting patterns:

- Worker preferences over non-wage amenities and gender composition
- Firm preferences for men vs. women
- Wages
Mechanisms of Gender Segregation

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Policy Implications
For designing policy, all these factors must be taken into account.
Mechanisms of Gender Segregation

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Goal of Paper:
Understand why occupations are predominantly male or female
... and what if anything should be done about it
Overview

1. **Structural model**
   - for workers’ reservation wages and firm preferences

2. **Shift-share IV**
   - for worker utility from amenities vs. gender composition
Why a Structural Model?

- Data: worker-job matches reflect selection by firms AND workers
Why a Structural Model?

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Wages

Need a model of equilibrium wages to disentangle worker and firm preferences.
Why a Structural Model?

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**Wages**

Need a model of equilibrium wages to disentangle worker and firm preferences.

\[ Wages = f(\text{firm and worker preferences, number of workers and jobs}) \]

\[ \text{Share of gender in occupation} = g(\text{Non-wage attributes, Fraction female, Wages}) \]
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Wages

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\[ Wages = f(\text{firm and worker preferences, number of workers and jobs}) \]

\[ Share \ of \ gender \ in \ occupation = g(\text{Non-wage attributes, Fraction female, Wages}) \]

- Transferable utility matching with wages as transfers.
Why a Structural Model?

- Possible to simulate dynamics of wide-ranging shocks, eg:
  - Job amenities requirements
  - Shock to labor supply or demand
  - Any context where group preference exists in two-sided market
Key Results

Preferences over fraction female could cause rapid changes in segregation

Result
- I find women prefer higher fraction female occupations
Key Results

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Firm preferences can accelerate or mitigate tipping dynamics

Results
- Firm preferences mitigate tipping female and accelerate tipping male
- This is due to firms valuing women less than men
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- I find women prefer higher fraction female occupations

Firm preferences can accelerate or mitigate tipping dynamics

Results
- Firm preferences mitigate tipping female and accelerate tipping male
- This is due to firms valuing women less than men

Occupation fraction female can be stable or unstable

Results
- Current sorting is relatively stable and not history dependent
Key Model Assumptions

- We observe the unique market clearing wage vector
  - *Needed:* workers and firms optimize, perfect information, large markets
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- Observed wage dispersion reflects job amenity heterogeneity
  - *Needed:* jobs are indifferent over individual workers of a given gender
Key Model Assumptions

- We observe the unique market clearing wage vector
  - *Needed*: workers and firms optimize, perfect information, large markets

- Observed wage dispersion reflects job amenity heterogeneity
  - *Needed*: jobs are indifferent over individual workers of a given gender

- Simulate dynamics through overlapping cohorts
  - *Needed*: workers are myopic and choose lifetime occupations
Data

- Shares of workers by gender in each occupation
  - Census 1960-2000, 2012 3-year ACS (IPUMS)

- Estimates of lifetime income in each occupation
  - SIPP 2004 and 2008 panels (NBER)
  - First order Markov transition matrix through income quantiles by age
  - Income quantiles from Census

- Estimates of unfilled jobs by occupation
  - Projection of industry into occupation
  - Fixed over time
Roadmap
Three Steps

1. Transferable utility matching model
   - Map worker and job choices into observed wages and matches
   - Separate worker and firm preferences

2. Worker non-wage utility decomposition through IV
   - Exploit variation in occupation exposure to industries
     - Different wages, fractions female, and growth rates
   - Changes in male and female labor force attachment
   - Willingness to pay of firms (model parameters)

3. Simulate dynamics through overlapping cohorts
   - Fixing non-wage attributes and willingness to pay of firm
   - Endogenous wages, fraction female, and occupation size
Literature Overview

- Preferences for amenities and tasks
- Matching (transferable utility)
  - Galichon and Salanié (2015)
  - Choo and Siow (2006)
- Tipping (rapid movement to segregation)
  - Pan (2010)
- Structural estimation of occupation preferences
  - Olivieri (2014)
Outline

1. **Empirical Model:**
   1. Step 1: Transferable utility matching for worker vs. firm preferences
   2. Step 2: Decomposition of worker gender preference

2. Estimation results

3. Simulations
Step 1: Matching Model
Step 1: Matching Model

Job Payoff

Log payoff to job $j$:

$$\pi_j^G = \overline{WTP}_O^G - \log(Wage_i^j)$$

$$\overline{WTP}_O^G = \text{log willingness to pay worker type } G$$

Log payoff to worker $i$:

$$u_i^j = \bar{\alpha}_O^G + \gamma^G F_O + \log(Wage_i^j) + \eta_i^O - \bar{\xi}_j^G$$

$$\bar{\alpha}_O^G + \gamma^G F_O = \text{non-wage log utility of occupation } O, \text{ gender } G$$

$F_O = \text{Fraction female in occupation } O$

$\eta_i^O = \text{Worker taste for occupation}$

$\bar{\xi}_j^G = \text{Job amenity value}$
Step 1: Matching Model

Wages

The wages that will make workers and jobs indifferent to matches $i$ and $j$ within observable types $O$ and $G$ will have the structure

$$\log(Wage_i^G) = \bar{W}_O^G + \xi_j^G$$

This wage will support the pairwise stable matching.
Payoffs in the stable matching for workers are therefore:

\[ \bar{u}^i_G = \bar{\alpha}^G_O + \gamma^G F_O + \bar{W}^G_O + \eta_i^O \]

and for jobs:

\[ \bar{\pi}^G_j = \bar{WTP}^G_O - \bar{W}^G_O + \xi_j^G \]
Step 1: Matching Model

Additive Separability

- A worker $i$’s choice depends on own taste for occupation ($\eta^i_O$), not on specific job $j$
- A job $j$’s choice of gender of worker depends on the job amenity ($\xi^G_j$), not on specific worker $i$

Therefore the job and worker problems can be separated into two discrete choice problems.
Step 1: Matching Model

Identification

- Assume job heterogeneity, $\xi_X$, distributed lognormal
  - $\log(\xi^G_j) = \bar{\xi}^G_j$ distributed normal
  - scale parameters $\sigma^G_\xi$

- Assume worker taste heterogeneity, $\eta^i_O$, distributed extreme value type 1 (gumbel maxima)
  - scale parameters $\sigma^G_\eta$

Now we can leverage observed wages for identification.
Step 1: Matching Model
Identification Intuition

- Depending on the relative values of $\bar{WTP}_O^F$ and $\bar{WTP}_O^M$ we see a longer right tail in the wage distribution of women or men.
- The shape of the observed wage distribution pins down the center of the reservation wage distribution $\bar{W}_O^G$

Equilibrium wages can now be used to identify worker utility functions.
Step 2: Worker Utility Estimation
Step 2: Worker Utility
Gender Preference

Assumption

Workers choosing non-employment receive idiosyncratic taste for non-employment $\eta_N^i$.

$$\ln(s_O^G) - \ln(s_N^G) = \frac{\bar{\alpha}_O^G + \gamma^G F_O + \bar{W}_O^G}{\sigma_{\eta}^G}$$

$s_O^G$  Share of workers employed in O
$s_N^G$  Share of workers non-employed
Step 2: Worker Utility

Gender Preference

Let worker utility in occupation $O$ at time $t$ be given by

$$\ln(s^G_O,t) - \ln(s^G_N,t) = \frac{\bar{\alpha}_O^G}{\sigma_\eta^G} + \frac{\beta_t^G}{\sigma_\eta^G} + \frac{\gamma^G F_{O,t}}{\sigma_\eta^G} + \frac{1}{\sigma_\eta^G} \bar{W}_{O,t}^G + \epsilon^i_{O,t}$$

Estimation is done separately by gender.

- Occupation-specific intercept $\bar{\alpha}_O^G$
- Year effects $\beta_t^G$
- Fraction female $F_{O,t}$
- Wage offer in the occupation $W_{O,t}^G$
- Parameters of interest are $\gamma^G$ and $\frac{1}{\sigma_\eta^G}$
Step 2: Worker Utility

Challenges to identification

- Omitted variables
  - Unobserved occupation amenities or attributes correlated with the fraction female, wage and the worker utility
  - Expect positive coefficient on fraction female for women, negative for men
  - Expect negative coefficient on wage due to compensating differentials

- Confounding labor supply and labor demand
  - Skill requirements of occupations are outside the model
  - Expect negative coefficient on wage
Step 2: Worker Utility
Estimation of Gender Preference

- Fixed effects
  - Control for time-invariant unobserved occupation attributes

- Instrumental variables for fraction female and wage
  - Control for time-varying unobserved attributes
  - Isolate changes in wage and fraction female that can be used to trace out the supply curve (worker utility)
Step 2: Worker Utility

Instruments

- **Bartik-style instruments:**
  - Changes in industry wages and gender ratios over time
  - Changes in industry size
  - Changes in gender ratio of the labor force

- **Internal model instruments:**
  - Willingness to pay parameters
Instruments: Industry Wage and Gender Ratios

Assumption

Demand for industry output drives changes in industry wages and fraction female

- Use industry variation to predict occupation variation

\[
\hat{F}_{O,t} = \sum_I p_{IO,initial} \times \hat{F}_{IO,t}
\]

\[
\hat{W}_{O,t} = \sum_I p_{IO,initial} \times \hat{W}_{IO,t}
\]

\(p_{IO,initial} = \) fraction of occupation \(O\) in industry \(I\) in initial period

\(\hat{F}_{IO} = \) fraction female in industry \(I\) excluding workers in occupation \(O\)

\(\hat{W}_{IO} = \) mean wage in industry \(I\) excluding workers in occupation \(O\)
Instruments: Industry Growth

Assumption

Demand for industry output drives industry growth

\[
\hat{F}_{O,t} = \sum_I p_{IO,initial} \times F_{IO,initial} \times \frac{\text{size}_{IO,t}}{\text{size}_{IO,initial}}
\]

\[
\hat{W}_{O,t} = \sum_I p_{IO,initial} \times W_{IO,initial} \times \frac{\text{size}_{IO,t}}{\text{size}_{IO,initial}}
\]

\(p_{IO,initial}\) = fraction of occupation \(O\) in industry \(I\) in initial period

\(F_{IO,initial}\) = initial fraction female in industry \(I\) excluding occupation \(O\)

\(W_{IO,initial}\) = initial mean wage in industry \(I\) excluding occupation \(O\)

\(\text{size}_{IO,t}\) = total employment industry \(I\) excluding \(O\) in year \(t\)
Instruments: Employment by Gender

Assumption

There are exogenous shifters to the value of non-employment for men vs. women over time

Define the relative growth in female vs. male employment $r_t$ as

$$
r_t = \frac{\# F_t}{\# M_t} \cdot \frac{\# F_{initial}}{\# M_{initial}}
$$

Then the fraction female in occupation $O$ predicted by the instrument in time $t$, $\hat{F}_{O,t}$ is as follows:

$$
\hat{F}_{O,t} = F_{O,initial} \cdot r_t
$$
Assumption

Job willingness to pay parameters do not directly enter worker utility

Then

\[ WTP_O^G \quad \text{and} \quad \frac{WTP_O^F}{WTP_O^M} \]

are natural instruments for the wage offer and fraction female respectively.
Results
Results: Gender Preference

Estimated functional form under linear, quadratic and cubic specifications

![Graphs showing estimated functional forms for different specifications: Linear, Quadratic, and Cubic. The graphs depict the change in log utility against the fraction female, with lines representing male and female preferences.]
## Results: Female Gender Preference

### Table: Decomposition of Utility for Female Workers: Panel Evidence

<table>
<thead>
<tr>
<th></th>
<th>FE</th>
<th>FEIV1</th>
<th>FEIV2</th>
<th>FEIV3</th>
<th>FEIV4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction Female (\gamma_F/\sigma_F - \eta)</td>
<td>2.870***</td>
<td>11.11</td>
<td>8.206**</td>
<td>4.363*</td>
<td>4.569**</td>
</tr>
<tr>
<td></td>
<td>(0.577)</td>
<td>(47.53)</td>
<td>(3.001)</td>
<td>(1.808)</td>
<td>(1.540)</td>
</tr>
<tr>
<td>Squared distance from parity</td>
<td>-4.383***</td>
<td>16.67</td>
<td>-6.907</td>
<td>-6.980</td>
<td>-7.328</td>
</tr>
<tr>
<td></td>
<td>(0.915)</td>
<td>(283.6)</td>
<td>(6.724)</td>
<td>(4.274)</td>
<td>(3.772)</td>
</tr>
<tr>
<td>Cubed distance from parity</td>
<td>-4.506</td>
<td>-86.89</td>
<td>-36.70</td>
<td>7.749</td>
<td>6.664</td>
</tr>
<tr>
<td></td>
<td>(2.605)</td>
<td>(678.1)</td>
<td>(23.72)</td>
<td>(9.780)</td>
<td>(9.718)</td>
</tr>
<tr>
<td>Latent Wage Offer</td>
<td>-0.151</td>
<td>7.630</td>
<td>1.037</td>
<td>1.843*</td>
<td>1.932</td>
</tr>
<tr>
<td></td>
<td>(0.299)</td>
<td>(72.56)</td>
<td>(2.165)</td>
<td>(0.886)</td>
<td>(1.039)</td>
</tr>
<tr>
<td>Constant</td>
<td>-5.165***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.224)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Year dummies: Yes Yes Yes Yes Yes

Observations: 204 204 204 204 204

KP rk F= 0.00234 0.759 5.255 10.03

* Standard errors in parentheses are clustered at the occupation level. 
* \(p < 0.05\), ** \(p < 0.01\), *** \(p < 0.0001\)

Linear  Quad  Male
Interpretation of Results
Average Marginal Effects on Labor Supply

Table: Effect of moving wage from 10 to 20 percent

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>% change male entry</td>
<td>11.402</td>
<td>5.436</td>
<td>1.296</td>
<td>18.472</td>
</tr>
<tr>
<td>% change female entry</td>
<td>9.103</td>
<td>5.329</td>
<td>2.57</td>
<td>21.195</td>
</tr>
<tr>
<td>N</td>
<td>204</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table: Effect of moving fraction female from 10 to 20 percent

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<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>% change male entry</td>
<td>-0.127</td>
<td>0.053</td>
<td>-0.196</td>
<td>-0.025</td>
</tr>
<tr>
<td>% change in female entry</td>
<td>51.254</td>
<td>5.398</td>
<td>36.419</td>
<td>57.825</td>
</tr>
<tr>
<td>N</td>
<td>204</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Interpretation of Results
Average Marginal Effects on Labor Supply

Table: Effect of moving wage from 80 to 90 percent

<table>
<thead>
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<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>% change male entry</td>
<td>7.92</td>
<td>5.517</td>
<td>0.413</td>
<td>18.257</td>
</tr>
<tr>
<td>% change female entry</td>
<td>4.663</td>
<td>4.705</td>
<td>0.73</td>
<td>20.881</td>
</tr>
</tbody>
</table>

N: 204

Table: Effect of moving fraction female from 80 to 90 percent

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<thead>
<tr>
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<th>Max.</th>
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</thead>
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<tr>
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<td>-0.127</td>
<td>0.053</td>
<td>-0.196</td>
<td>-0.025</td>
</tr>
<tr>
<td>% change in female entry</td>
<td>20.909</td>
<td>14.338</td>
<td>3.746</td>
<td>55.635</td>
</tr>
</tbody>
</table>

N: 204
Dynamics
Introduction: Counterfactual Dynamics

Assumption

- Workers are myopic and make lifetime occupation choices
- Workers are divided into 4 generations: 25-34, 35-44, 45-54, 55-64
  - Only the youngest make occupation choices in a given period
- Current fraction female ($F_O$) is taken as given by the young cohort when making their decisions.

$$F_O = \frac{n_{O,c-1}F_{O,c-1} + n_{O,c-2}F_{O,c-2} + n_{O,c-3}F_{O,c-3}}{n_{O,c-1} + n_{O,c-2} + n_{O,c-3}}$$
Segregation dynamics with market clearing wages

- Teachers, Except Postsecondary
- Protective Service
- Management Related Occupations
- Math, Computer, and Natural Science
- Sales Workers, Retail and Personal Services
- Food Preparation and Service Occupations
- Engineers, Architects, and Surveyors

Year:
- 1960
- 1990
- 2020
- 2050
- 2080
- 2110
Includes: Physicians, Dentists, Veterinarians, Optomotrists, Podiatrists, Other health
Adjusters and Investigators

Fraction Female

Year

1960 1990 2020 2050 2080 2110
Segregation dynamics with fixed wages
Dynamics: Interpretation

- We do not see movement to female dominated with equilibrium wages
  - Even though wages are going down, there is still overlap with the male reservation wage distribution.
  - \textit{WTP} gap also pushes jobs to continue to hire men
- We see some movement to male dominated
  - Wages adjust enough such that it becomes unprofitable to hire even one female worker (no overlap of male and female reservation wage distributions)
  - \textit{WTP} gap also pushes jobs to hire fewer women
Conclusion
Conclusion

I apply a transferable utility matching model to the labor market and use wage as observed transfers to separately identify job and worker payoffs.

I separate a preference for the fraction female from other non-wage utility in lifetime occupation choice.
Conclusion

- I find no evidence of preferences on the part of men, but strong preferences on the part of women to work in female occupations.
- These preferences produce long run dynamics across cohorts as the fraction female evolves as an endogenous attribute.
- Market clearing wages moderate the impact of the gender preferences in producing single-sex dominated occupations.
- Given wage adjustment, overall segregation today would be similar even if all occupations were at parity in 1960.
Future Work

- Examine the consequences of integrative policies such as
  - wage subsidies
  - revenue subsidies
  - amenity requirements
- on long run sorting patterns and welfare
Thank you!
mrl236@cornell.edu
Outcomes: Job satisfaction and mobility

Data: NLSY, British Workplace Employment Relations Survey, Russian Longitudinal Monitoring Survey, and British Household Panel Survey

Control variously for individual fixed effects, occupation content (People Brains and Brawn), and firm controls

Content matters but still leaves room for work environment in explaining higher satisfaction and lower mobility in more female occupations (primarily for women).
Stylized Facts

Women strongly prefer to work with women:

Source: Pan (2010)
Stylized Facts

Source: Pan (2010) “Notes: The lines with a circle indicate the fraction male in each occupation at each time period. The lines with a triangle indicate the overall fraction male across all occupations in each year (identical for all occupations).”
Stylized Facts

Source: Pan (2010) “Notes: The lines with a circle indicate the fraction male in each occupation at each time period. The lines with a triangle indicate the overall fraction male across all occupations in each year (identical for all occupations).”
Persistence of Sorting

Pharmacists under age 30

fraction Female

Share of Employed Males

Share of Employed females

Census year

1940 1960 1980 2000 2020
Persistence of Sorting

Insurance adjusters, examiners, and investigators under age 30

Fraction Female  Share of Employed Males  Share of Employed females

Persistence of Sorting

# occupations by sex ratio

![Graph showing the number of occupations by sex ratio for 2012 and 1970. The graph displays a significant disparity in the distribution of occupations across different sex ratios for the two years.]
<table>
<thead>
<tr>
<th>Occupation</th>
<th>offergap</th>
<th>revgap</th>
<th>wagegap</th>
<th>lifeincgap</th>
<th>gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers, Postsecondary</td>
<td>0.76</td>
<td>0.62</td>
<td>0.59</td>
<td>0.53</td>
<td>0.39</td>
</tr>
<tr>
<td>Teachers, Except Postsecondary</td>
<td>0.51</td>
<td>0.88</td>
<td>0.62</td>
<td>0.58</td>
<td>0.77</td>
</tr>
<tr>
<td>Social Scientists, Lawyers, Judges, Urban</td>
<td>0.91</td>
<td>0.82</td>
<td>0.60</td>
<td>0.66</td>
<td>0.42</td>
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<tr>
<td>Social, Recreation, and Religious Worker</td>
<td>0.60</td>
<td>0.72</td>
<td>0.75</td>
<td>0.54</td>
<td>0.47</td>
</tr>
<tr>
<td>Writers, Artists, Entertainers, and Athletes</td>
<td>0.85</td>
<td>0.66</td>
<td>0.52</td>
<td>0.57</td>
<td>0.44</td>
</tr>
<tr>
<td>Health Technologists and Technicians</td>
<td>0.41</td>
<td>0.81</td>
<td>0.59</td>
<td>0.51</td>
<td>0.85</td>
</tr>
<tr>
<td>Technicians except health</td>
<td>0.99</td>
<td>0.54</td>
<td>0.59</td>
<td>0.52</td>
<td>0.24</td>
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<tr>
<td>Sales Representatives, Finance and Business</td>
<td>0.94</td>
<td>0.60</td>
<td>0.50</td>
<td>0.55</td>
<td>0.34</td>
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<tr>
<td>Sales Workers, Retail and Personal Service</td>
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<td>0.63</td>
<td>0.32</td>
<td>0.51</td>
<td>0.56</td>
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<tr>
<td>Administrative Support</td>
<td>0.36</td>
<td>0.97</td>
<td>0.49</td>
<td>0.53</td>
<td>0.89</td>
</tr>
<tr>
<td>Records Processing Occupations, Except Finance</td>
<td>0.50</td>
<td>0.94</td>
<td>0.54</td>
<td>0.59</td>
<td>0.77</td>
</tr>
<tr>
<td>Financial Records Processing Occupations</td>
<td>0.36</td>
<td>0.88</td>
<td>0.57</td>
<td>0.51</td>
<td>0.89</td>
</tr>
<tr>
<td>Mail and Material Distribution</td>
<td>0.98</td>
<td>0.60</td>
<td>0.60</td>
<td>0.56</td>
<td>0.32</td>
</tr>
<tr>
<td>Adjusters and Investigators</td>
<td>0.55</td>
<td>0.76</td>
<td>0.57</td>
<td>0.54</td>
<td>0.57</td>
</tr>
<tr>
<td>Miscellaneous Administrative Support Occ</td>
<td>0.45</td>
<td>0.85</td>
<td>0.52</td>
<td>0.54</td>
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<tr>
<td>Protective Service</td>
<td>1.30</td>
<td>0.49</td>
<td>0.55</td>
<td>0.54</td>
<td>0.13</td>
</tr>
<tr>
<td>Food Preparation and Service Occupations</td>
<td>0.60</td>
<td>0.74</td>
<td>0.49</td>
<td>0.55</td>
<td>0.74</td>
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<tr>
<td>Health Service Occupations</td>
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<td>1.05</td>
<td>0.60</td>
<td>0.55</td>
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<tr>
<td>Cleaning and Building Service Occupation</td>
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<td>0.51</td>
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<td>Private Household and Personal Service</td>
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<td>0.44</td>
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<td>Agriculture, Forestry and Fishing</td>
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<td>Mechanics and Repairers</td>
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<td>Construction and Extraction</td>
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<td>0.46</td>
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<td>0.45</td>
<td>0.50</td>
<td>0.51</td>
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<tr>
<td>Machine Operators, Fabricators, Assemble</td>
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<td>0.52</td>
<td>0.57</td>
<td>0.41</td>
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<td>Road, Rail and Water Transportation</td>
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<td>0.46</td>
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<tr>
<td>Material Moving, Laborers</td>
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<td>0.53</td>
<td>0.54</td>
<td>0.17</td>
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<td>Executive, Administrative, and Manageria</td>
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<td>0.61</td>
<td>0.52</td>
<td>0.55</td>
<td>0.31</td>
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<td>Management Related Occupations</td>
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<td>0.58</td>
<td>0.55</td>
<td>0.41</td>
</tr>
<tr>
<td>Engineers, Architects, and Surveyors</td>
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<td>0.53</td>
<td>0.68</td>
<td>0.62</td>
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<tr>
<td>Math, Computer, and Natural Science</td>
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<td>0.65</td>
<td>0.59</td>
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<td>Health Diagnosing Occupations</td>
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<td>0.70</td>
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<td>1.14</td>
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<tr>
<td>Total</td>
<td>0.95</td>
<td>0.67</td>
<td>0.55</td>
<td>0.55</td>
<td>0.45</td>
</tr>
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</table>
List of Occupations

Adjusters and Investigators; Administrative Support; Agriculture, Forestry and Fishin; Cleaning and Building Service Oc; Construction and Extraction; Engineers, Architects, and Surve; Executive, Administrative, and M; Financial Records Processing Occ; Food Preparation and Service Occ; Health Assessment and Treating a; Health Diagnosing Occupations; Health Service Occupations; Health Technologists and Technic; Machine Operators, Fabricators,; Mail and Material Distribution; Management Related Occupations; Material Moving, Laborers; Math, Computer, and Natural Scie; Mechanics and Repairers; Metal, Wood, Plastic, Print, Tex; Miscellaneous Administrative Sup; Precision Production Occupations; Private Household and Personal S; Protective Service; Records Processing Occupations,; Road, Rail and Water Transportat; Sales Representatives, Finance a; Sales Workers, Retail and Person; Social Scientists, Lawyers, Judg; Social, Recreation, and Religiou; Teachers, Except Postsecondary; Teachers, Postsecondary; Technicians except health; Writers, Artists, Entertainers,
Payoff to job $j$:

$$\pi^G_j = \frac{WTP^G_O}{\text{Wage}^i_j}$$

$WTP^G_O = \text{willingness of job in } O \text{ to pay to hire worker type } G$
Payoff to worker $i$:

$$u_j^i = \frac{\alpha_O^G * e^{\gamma F_O} * Wage_j^i * e^{\eta_i^O}}{\xi_j^G}$$

\[\alpha_O^G * e^{\gamma F_O}\] = non-wage utility of occupation type $O$ for worker type $G$

$F_O = \text{Fraction female in occupation } O$
We have from Shapley and Shubik (1972) and Galichon and Salanié (2015) that a stable matching must satisfy

1. Feasibility
2. Pairwise stability

and that the wage vector supporting this matching

1. Will be unique given uncountably infinite workers of each type
How do we arrive at the wage vector that supports the stable equilibrium?

- Crawford and Knoer (1981) and Roth and Sotomayor (1990) describe bidding mechanisms.
  - Open-ended ascending price auction where firms bid on workers and workers are free to switch jobs until bidding stops
- The wage vector will:
  - Make workers and firms indifferent to matches within observable type on the other side of the market
  - Equate supply and demand of types of workers and jobs
Step 1: Matching Model
Identification from Lifetime Wages

Figure: Sales Representatives, Finance, and Business Services: Observed vs. Model Reservation Wages

[Graph showing wage distributions for male and female workers in different occupations.]

Miriam Larson-Koester
Occupation Gender Segregation: Evidence from an Empirical Matching Model with Transfers

14 / 0
Step 1: Matching Model
Identification from Lifetime Wages

**Figure:** Health Service occupations: Observed vs. Model Reservation Wages

```
Miriam Larson-Koester
Occupation Gender Segregation: Evidence from an Empirical Matching Model with Transfers
```
## Table: Decomposition of Utility for Female Workers: Panel Evidence

<table>
<thead>
<tr>
<th></th>
<th>FE</th>
<th>FEIV1</th>
<th>FEIV2</th>
<th>FEIV3</th>
<th>FEIV4</th>
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<tbody>
<tr>
<td>Fraction Female ( \frac{\gamma F}{\sigma F - \eta} )</td>
<td>2.637***</td>
<td>2.974</td>
<td>4.307</td>
<td>8.131</td>
<td>8.599*</td>
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<tr>
<td></td>
<td>(0.587)</td>
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<td>(5.088)</td>
<td>(4.262)</td>
<td>(3.991)</td>
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<td>Latent Wage Offer</td>
<td>-0.374</td>
<td>1.673</td>
<td>6.301</td>
<td>1.800</td>
<td>1.955</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Observations</td>
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<td>204</td>
<td>204</td>
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<tr>
<td>KP rk F=</td>
<td>0.0191</td>
<td>0.239</td>
<td>1.562</td>
<td>1.338</td>
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</table>

Standard errors in parentheses are clustered at the occupation level.  
* \( p < 0.05 \), ** \( p < 0.01 \), *** \( p < 0.0001 \)
## Results: Female Gender Preference

### Table: Decomposition of Utility for Female Workers: Panel Evidence

<table>
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<tr>
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<th>FEIV2</th>
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<th>FEIV4</th>
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<tr>
<td>Fraction Female ($\gamma_F^{\sigma_F-\eta}$)</td>
<td>2.457***</td>
<td>4.403</td>
<td>3.623</td>
<td>6.077**</td>
<td>5.615**</td>
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<td></td>
<td>(0.459)</td>
<td>(2.940)</td>
<td>(6.524)</td>
<td>(1.856)</td>
<td>(1.567)</td>
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<td>Squared distance from parity</td>
<td>-4.041***</td>
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<td>-11.07*</td>
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<td>(0.965)</td>
<td>(30.06)</td>
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<td>(4.475)</td>
<td>(4.542)</td>
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<td>-0.0310</td>
<td>3.120</td>
<td>4.951</td>
<td>2.383*</td>
<td>2.289*</td>
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<td>(8.895)</td>
<td>(8.878)</td>
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<td>Yes</td>
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<td>Yes</td>
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<td>204</td>
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<td>2.000</td>
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Standard errors in parentheses are clustered at the occupation level.  
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.0001$
# Results: Male Gender Preference

## Table: Decomposition of Utility for Male Workers: Panel Evidence

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<tr>
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<th>FEIV2</th>
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<tbody>
<tr>
<td>Fraction Female ( \frac{\gamma^M}{\sigma^M, \eta} )</td>
<td>0.360</td>
<td>-0.229</td>
<td>-4.177</td>
<td>0.110</td>
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<td></td>
<td>(0.698)</td>
<td>(4.434)</td>
<td>(19.10)</td>
<td>(1.559)</td>
<td>(1.448)</td>
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<td>Squared distance from parity</td>
<td>-2.714*</td>
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<td>(1.279)</td>
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<td>(105.8)</td>
<td>(4.301)</td>
<td>(4.504)</td>
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<td>3.148</td>
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<td>Yes</td>
<td>Yes</td>
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<td>204</td>
<td>204</td>
<td>204</td>
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<tr>
<td>KP rk F=</td>
<td>0.0397</td>
<td>0.559</td>
<td>2.129</td>
<td>3.920</td>
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Standard errors in parentheses are clustered at the occupation level.

* \( p < 0.05 \), ** \( p < 0.01 \), *** \( p < 0.0001 \)
**Table: Decomposition of Utility for Male Workers: Panel Evidence**

<table>
<thead>
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<th>FEIV4</th>
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<tbody>
<tr>
<td>Fraction Female ($\frac{\gamma_M}{\sigma_M \eta}$)</td>
<td>1.532**</td>
<td>-0.908</td>
<td>4.598*</td>
<td>0.583</td>
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<td>(1.753)</td>
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<td>Squared distance from parity</td>
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<td>(46.46)</td>
<td>(8.955)</td>
<td>(12.99)</td>
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Year dummies: Yes, Yes, Yes, Yes, Yes
Observations: 204, 204, 204, 204, 204
KP rk F=: 0.0169, 0.789, 3.749, 3.238

Standard errors in parentheses are clustered at the occupation level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.0001$
## Results: Male Gender Preference

### Table: Decomposition of Utility for Male Workers: Panel Evidence

<table>
<thead>
<tr>
<th></th>
<th>FE</th>
<th>FEIV1</th>
<th>FEIV2</th>
<th>FEIV3</th>
<th>FEIV4</th>
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</thead>
<tbody>
<tr>
<td>Fraction Female ( \frac{\gamma^M}{\sigma^M - \eta} )</td>
<td>0.666</td>
<td>0.549</td>
<td>1.605</td>
<td>0.00397</td>
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<td>(1.179)</td>
<td>(1.049)</td>
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</table>

Year dummies: Yes, Yes, Yes, Yes, Yes

Observations: 204, 204, 204, 204, 204

KP rk F=: 0.533, 1.930, 1.857, 8.622

Standard errors in parentheses are clustered at the occupation level.

* \( p < 0.05 \), ** \( p < 0.01 \), *** \( p < 0.0001 \)
Managerial and Professional

No wage updating

Wage updating

Fraction Female

Year

1960 1990 2020 2050 2110

1960 1990 2020 2050 2110

1960 1990 2020 2050 2110

Back
Social, Recreation, and Religious Workers

Fraction Female vs Year

Year

1960 1990 2020 2050 2080 2110
Sales Representatives, Finance and Business Services

Fraction Female

Year

1960 1990 2020 2050 2080 2110

0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1
Sales Workers, Retail and Personal Services

Fraction Female

Year

1960 1990 2020 2050 2080 2110
Records Processing Occupations, Except Financial

Fraction Female vs. Year

Year:
- 1960
- 1990
- 2020
- 2050
- 2080
- 2110

Fraction Female:
- 0
- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
- 0.6
- 0.7
- 0.8
- 0.9
- 1

The graph shows the fraction of females in Records Processing Occupations, Except Financial over a range of years from 1960 to 2110.
Adjusters and Investigators

Fraction Female over Years

Year
Protective Service

Year

Fraction Female

1960 1990 2020 2050 2080 2110
Food Preparation and Service Occupations

Fraction Female

Year

Occupation Gender Segregation: Evidence from an Empirical Matching Model with Transfers
23. Sales Workers, Retail and Personal Services

![Graph showing wage offers or fraction of female workers over time. The graph compares male and female wage offers over the years 1960 to 2110.]

- **Male Wage Offer**
- **Female Wage Offer**
- **1 What**
- **2 What**
42. Food Preparation and Service Occupations

![Graph showing wage offer and fraction female over years for different categories.]

- **Male Wage Offer**
- **Female Wage Offer**
- **1 What**
- **2 What**

Year range: 1960 to 2110.
Health Assessment and Treating and Therapists

- Male Wage Offer
- Female Wage Offer

Year:
- 1960
- 1990
- 2020
- 2050
- 2080
- 2110

Wage Offer/Fraction Female:
- 1
- 0.5
- 0
- -0.5
- -1
Machine Operators, Fabricators, Assemblers, Testers

Year

1960 1990 2020 2050 2080 2110

Wage Offer/Fraction Female

Male Wage Offer

Female Wage Offer

1 What

2 What
Dynamics: Counterfactual

- Examine the impact of inertia on current sorting patterns:
- Simulate segregation patterns if all occupations were at parity in 1960
Segregation dynamics with market clearing wages

Year | Occupation
--- | ---
1960 | Teachers, Except Postsecondary
1990 | Protective Service
2020 | Management Related Occupations
2110 | Math, Computer, and Natural Science

Sales Workers, Retail and Personal Services
Food Preparation and Service Occupations
Engineers, Architects, and Surveyors
Figure: Shock to Male Nurses: Simulated Occupation Segregation Patterns
Figure: Shock to Male Nurses: Simulated Occupation Segregation Patterns
Figure: Shock to Male Nurses: Simulated Occupation Segregation Patterns
Figure: Shock to Female Mechanics: Simulated Occupation Segregation Patterns


