Marriage and Divorce under Labor Market Uncertainty

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Motivation

- Why do individuals get or stay married?
  - Mutual affection (non-economic dimension of marriage).
  - Value of spouse's market/home production (economic dimension of marriage).
- Why do couples break up?
  - A change of mutual affection (e.g. a match-specific "love" shock).
  - A change in the economic dimension (e.g. a labor market transition).
  - These two channels might interact.
- In this research project, we propose a search-theoretic model of intertwined marriage and labor markets, featuring both channels.
- We focus on their interaction.

Literature

Research Questions and Status

- Questions:
  - Does the individual labor market status influence marriage and divorce decisions?
  - Specifically, how important is the extensive employment margin?
  - How do changing aggregate labor market conditions and marriage market sorting interact?
- Status of the project:
  - We observe significant changes in the composition of married couples.
  - These changes appear to be related to outflows (divorces).
  - A decomposition suggests a link to changing labor market conditions.
  - We propose a new model that allows disentangling labor and marriage market specific contributions to the observed compositional changes.
  - Ongoing work: structural estimation.

Data

- We study reunified Germany in the years 1993–2013.
- Data sources:
  (1) The German Microcensus, the largest household survey in Europe.
    - Detailed information on education, income, etc. for all household members.
    - MC is not a panel, we do not observe individual transitions.
    - Classify individuals based on observable characteristics (84 states).
    - We follow the population shares of these classes over time.

    Details of Classification | Distribution of Individuals

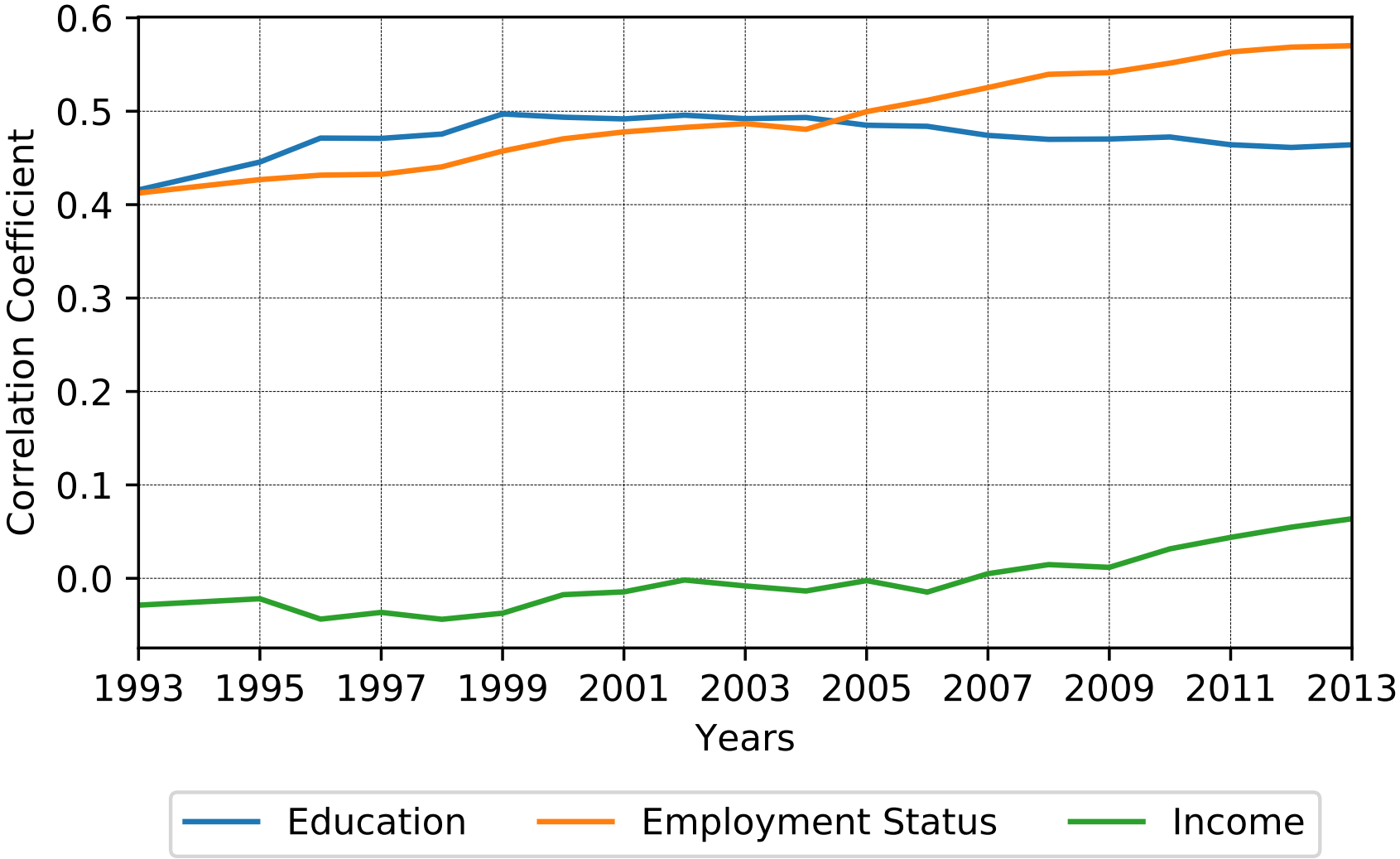
  (2) Two sources of labor market data:
    - Register data (SIAB): Transitions conditional on gender and education.
    - NEW: IAB-PASS & GSOEP combined: condition on marital status, time use, etc.
    - Estimate unobserved ability: source of permanent heterogeneity in the model.

    Transition Plots | Wage and Ability Distributions

  (3) Marriage and divorce register data.
    - Provides flows into and out of marriage.

    Marriage and Divorce Rates

Observation: Marital Sorting over Time



Let's Add Some Structure

- Men (i) and women (j) are heterogeneous in terms of ability (ex ante).
- Male type i (female type j) has a wage offer distribution $F_i(w_i)$ ($F_j(w_j)$).
- Individuals can be in four different states: single/married and employed/unemployed.
- A married couple is characterized by the types of both partners and their labor market status (i, j, l, l), where $ll \in \{ee, ue, eu, uu\}$.
- In steady state, the flows between these states need to be balanced.

Let's Add Some Structure

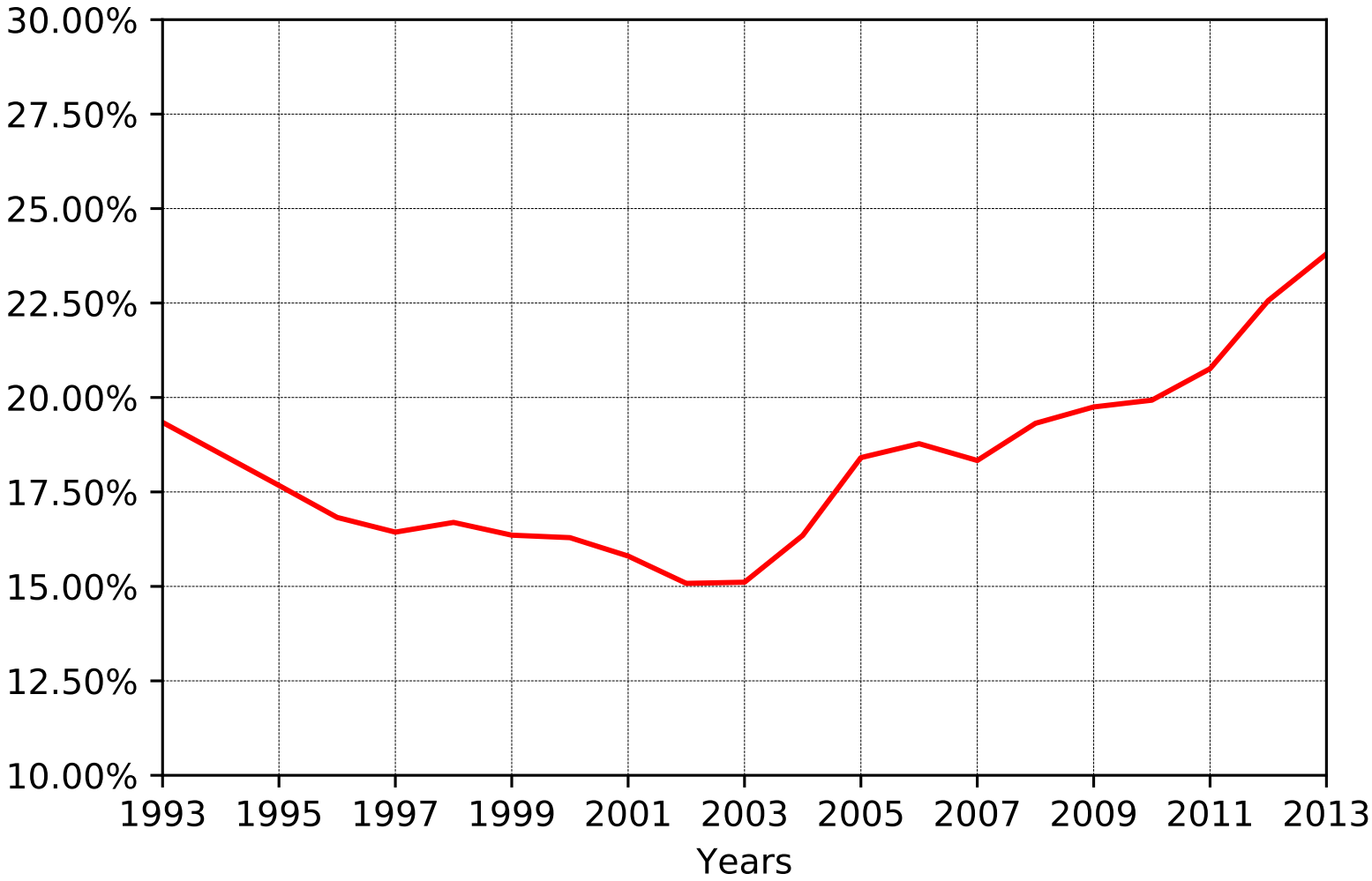
- System of four steady state flow equations, one for each ll:

$$\begin{aligned}\lambda_{ij}\alpha_{ij}^{ll}\frac{s_i^l s_j^l}{2} &+ \tau_i^{l'}\min\left[\left(\alpha_{ij}^{ll}/\alpha_{ij}^{l'l}\right),1\right]m_{ij}^{l'l}\\ &+ \tau_j^{l'}\min\left[\left(\alpha_{ij}^{ll}/\alpha_{ij}^{ll'}\right),1\right]m_{ij}^{ll'}\\ &= \left[\delta\left(1-\alpha_{ij}^{ll}\right)+\tau_i^l+\tau_j^l\right]m_{ij}^{ll}.\end{aligned}$$

- λ_{ij} is the meeting rate in the marriage market.
- α_{ij}^{ll} is the probability that a "dating" couple of type ij and labor market status ll is getting married.
- $\alpha_{ij}^{ll} = 1 - G(z_{ij}^{ll})$ depends on z_{ij}^{ll}, mutual affection threshold.
- δ is the "love shock" arrival rate. Divorce with probability $1 - \alpha_{ij}^{ll}$.
- The parameters of this flow equation system can be estimated.

Estimation Details Estimation Results

A Decomposition: Share of “Labor Market Divorces”



Breakdown I Breakdown II

Theory: Model Summary

- Two-sided marriage market model with transferable utility, random search, and ex-ante heterogeneous men and women, who make endogenous labor search decisions on and off the job.
- Marriage market:
  - Singles search for partners in the marriage market.
  - Married couples consider whether or not to stay married.
  - No commitment, efficient divorce (separation) in case of negative surplus.
  - Surplus responds to match-specific shocks and labor market transitions.

Theory: What is new?

- In the labor market, individuals are either employed or unemployed, exogenous separations.
- Endogenous search intensity and reservation wages depend on
  - employed married/single: current wage.
  - unemployed single: UI, home production, marriage market option value.
  - if unemployed married: UI, home production (labor market status and type of spouse, match-specific shock), divorce potential.

Utility and Home Production | Bargaining

The Value of Singlehood | The Value of Marriage | Marital Surplus

Equilibrium | Solution Algorithm | Graphical Illustration

Optimal Search Intensities

- Given the sharing rule, the optimal search intensity for singles solves

$$\mu_j \int_{R\left(I_j^l\right)} \left[V_j^e\left(w_j'\right) - V_j^l\left(I_j^l\right)\right] dF_j\left(w_j'\right) = c'\left(\widehat{\sigma}_j^l(I_j^l)\right).$$

- $R\left(I_j^l\right)$ is the reservation wage of a female (male) single with income I_j^l.
- For married women (men)

$$\begin{aligned}&\mu_j \int_{R_j^{l,-l}\left(z,I_i^{-l},I_j^l\right)} \left[V_j^e\left(w_j'\right) - V_j^l\left(I_j^l\right)\right. \\ &\left. + \max\left[0, S_{ij}^{-le}(z)\right] - S_{ij}^{-ll}(z)\right] dF_j\left(w_j'\right) = c'\left(\widehat{\sigma}_{j,i}^{l,-l}\left(z, I_i^{-l}, I_j^l\right)\right)\end{aligned}$$

- $R_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right)$ is the reservation wage of a married woman (men).

Reservation Wages: Singles

- While employed, the reservation wage is equal to the current wage irrespective of marital status, i.e., $R_j^{l,-l}\left(z, I_i^{-l}, w_j\right) = R\left(w_j\right) = w_j$.
- The reservation wage of an unemployed single is defined by $V_j^e\left(R_j^u\right) = V_j^u\left(b_j\right)$, that is

$$\begin{aligned} R_j^u &= b_j + g\left(0, T_j^u\right)^{\alpha_3} - g\left(0, T_j^e\right)^{\alpha_3} \\ &+ \lambda_{ij}\beta_j \int_i \sum_{-l\in\{u,e\}} s_i^{-l} \left[\int_{z_{ij}^{-lu}}^{\infty} S_{ij}^{-lu}\left(z'\right) dG\left(z'\right) \right. \\ &- \left. \int_{z_{ij}^{-le}}^{\infty} S_{ij}^{-le}\left(z'\right) dG\left(z'\right) \right] di. \end{aligned}$$

Reservation Wages: Married

- Unemployed married female j with a partner of type i and emp. status $-l$.
- Definition: $V_j^e\left(R_{j,i}^{u,-l}(z)\right) = V_j^u(b_j) + S_{ij}^{-lu}(z) - \max\left[0, S_{ij}^{-le}(z)\right]$.
- This implies two cases,

$$R_{j,i}^{u,-l}(z) = R_j^u + \frac{r}{r+\delta}\left[g(T_i^{-l}, T_j^u)^{\alpha_2} - g(T_i^{-l}, T_j^e)^{\alpha_2}\right]\left[z - z_{ij}^{-lu}\right],$$

for $z_{ij}^{-lu} > z_{ij}^{-le}$ (will stay married) and

$$\begin{aligned} R_{j,i}^{u,-l}(z) &= R_j^u + \frac{r}{r+\delta}\left[g(T_i^{-l}, T_j^u)^{\alpha_2} - g(T_i^{-l}, T_j^e)^{\alpha_2}\right]\left[z - z_{ij}^{-le}\right] \\ &\quad + \frac{r}{r+\delta}\left[f(a_i, a_j)^{\alpha_1} \times g\left(T_i^{-l}, T_j^u\right)^{\alpha_2}\right]\left[z_{ij}^{-le} - z_{ij}^{-lu}\right], \end{aligned}$$

for $z_{ij}^{-lu} \leq z_{ij}^{-le}$ (will divorce).

Reservation Wages: Married

- Note two things:
  1. The couple is currently married, so $S_{ij}^{-lu}(z) > 0$. Thus, reservation wage of unemployed married is (weakly) higher compared to unemployed single.
  2. But, the lower the love shock z, the lower is current marital surplus. Thus, the reservation wage is lower and search intensity higher...

- Through this mechanism, a negative love shock will...
  - decrease the reservation wage (due to lower marital surplus),
  - increase the labor market search intensity of the unemployed spouse.
  - make a transition into employment more likely.

Flow Equation System

- Now, let's revisit the initial flow equation system:

$$\begin{aligned}
\lambda_{ij}\alpha_{ij}^{-ll}\frac{s_i^{-l}s_j^{l}}{2} &+ \tau_{i,j}^{-l',l}\min\left[\left(\alpha_{ij}^{-ll}/\alpha_{ij}^{-l'l}\right),1\right]m_{ij}^{-l'l} \\
&+ \tau_{j,i}^{l',-l}\min\left[\left(\alpha_{ij}^{-ll}/\alpha_{ij}^{-ll'}\right),1\right]m_{ij}^{-ll'}, \\
&= \left[\delta\left(1-\alpha_{ij}^{-ll}\right)+\tau_{i,j}^{-l,l}+\tau_{j,i}^{l,-l}\right]m_{ij}^{-ll}.
\end{aligned}$$

- where the labor market transition probabilities now become

$$\tau_{i,j}^{e,l} = q_i \text{ or } \tau_{i,j}^{u,l} = \mu_i\int_{z_{ij}^{ul}}^{\infty}\widehat{\sigma}_{i,j}^{u,l}\left(z'\right)\left[1-F_i\left(R_{i,j}^{u,l}\left(z'\right)\right)\right]dG\left(z'\right),$$

$$\tau_{j,i}^{e,-l} = q_j \text{ or } \tau_{j,i}^{u,-l} = \mu_j\int_{z_{ij}^{-lu}}^{\infty}\widehat{\sigma}_{j,i}^{u,-l}\left(z'\right)\left[1-F_j\left(R_{j,i}^{u,-l}\left(z'\right)\right)\right]dG\left(z'\right).$$

Sketch of Identification

$$\{r, \alpha_1, \alpha_2, \alpha_3, \delta, \lambda, \mu_i, \mu_j, q_i, q_j, \beta_i, \beta_j, \mu_z, \sigma_z, \kappa, \vartheta_i, \vartheta_j, b_i, b_j, \bar{w}_i, \bar{w}_j\}$$

Sketch of Identification

$$\{r, \alpha_1, \alpha_2, \alpha_3, \delta, \lambda, \mu_i, \mu_j, q_i, q_j, \beta_i, \beta_j, \mu_z, \sigma_z, \kappa, \vartheta_i, \vartheta_j, b_i, b_j, \bar{w}_i, \bar{w}_j\}$$

- $\{r, q_i, q_j, b_i, b_j, \bar{w}_i, \bar{w}_j\}$: Set/estimated outside the model.
- $\{\delta, \lambda\}$: From flow equation estimation.
- $\{\alpha_1, \alpha_2, \alpha_3, \mu_i, \mu_j, \beta_i, \beta_j, \mu_z, \sigma_z, \kappa, \vartheta_i, \vartheta_j\}$: left to be estimated.
- Available data moments:
  - $\tau_{i,j}^{u,l}$, $\tau_{j,i}^{u,-l} \Rightarrow \alpha_1, \alpha_2, \alpha_3, \mu_i, \mu_j, \kappa$
  - Type-specific wage offer distribution $\Rightarrow \vartheta_i, \vartheta_j, \mu_i, \mu_j, \kappa$
    and via the reservation wage equations $\Rightarrow \alpha_1, \alpha_2, \alpha_3, \beta_i, \beta_j$
  - Unemployed married individuals who do not search $\Rightarrow \mu_z, \sigma_z$

Conclusions I

- For Germany, the data suggest that education-based sorting in the marriage market has stopped increasing around the mid 2000s and decreased somewhat thereafter.
- A structural decomposition of divorce flows suggests that an increasing share of divorces is associated with transitions of married women into employment.
- This might be driven by changing aggregate labor market conditions and institutional reforms.
- The nature of this link (causality) is unclear but critical for the interpretation and policy relevance of this finding.

Conclusions II

- And that's where the model comes in!
- We endogenize transitions into employment, they depend on a search intensity choice which takes into account current marital surplus.
- A negative "love shock" increases the labor market search intensity of unemployed married individuals and, thus, makes transitions into employment more likely.
- This mechanism can explain the documented trend in "labor market divorces" and the reversal around the time of the Hartz reforms.
  - Before the reforms, labor market conditions were deteriorating. Higher search intensity in response to negative shocks had limited effect.
  - The reforms lowered reservation wages b_i, b_j, e.g. due to lower/shorter receipt of unemployment benefits and stricter means testing.
  - At the same time, institutional changes, e.g. increased matching efficiency, increased μ_i, μ_j.

Thank you for your attention.

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Literature

- Unemployment, especially male unemployment, is associated with an increase in the divorce rate (e.g. Jensen and Smith, 1990; Hansen, 2005; Amato and Beattie, 2011).
- Marriage/divorce rates negatively correlated with unemployment over the business cycle (e.g. Schaller, 2013; González-Val and Marcén, 2017a/b).
- Does female labor market participation decrease or increase marital stability? (Newman and Olivetti, 2017 vs. Folke and Rickne, 2016)
- Assortative matching is on the rise with potential implications for inequality (e.g. Greenwood et al., 2014, 2016; Eika et al., 2018).
- Large literature on marriage market matching (with and without frictions, TU/NTU) and their estimation: Becker (1973/74), Burdett and Coles (1997), Shimer and Smith (2000), Choo and Siow (2006), Choo (2015), Chiappori et al. (2015), Goussé et al. (2017).

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Classification of Individuals

- Individuals are characterized by gender, education, marriage market and labor market status (84 possible states).
  - gender $g \in \{1, 2\}$, m or f.
  - education $e \in \{1, 2, 3\}$
  - partner's education $-e \in \{0, 1, 2, 3\}$, 0 if single
  - employment $l \in \{1, 2\}$
  - partner's employment $-l \in \{0, 1, 2\}$, 0 if single

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Labor Market Transition Rates by Gender/Education

Gender	Education	Job-Finding rate (UE)		Separation rate (EU)	
		Mean	STD	Mean	STD
All	-	4.579	0.158	0.639	0.083
Men	All	5.160	0.126	0.711	0.094
	Low	5.122	0.128	0.759	0.102
	Medium	5.689	0.328	0.453	0.033
	High	4.366	0.960	0.312	0.029
Women	All	3.880	0.260	0.552	0.067
	Low	3.654	0.272	0.565	0.069
	Medium	6.043	0.367	0.445	0.034
	High	5.773	1.019	0.450	0.048

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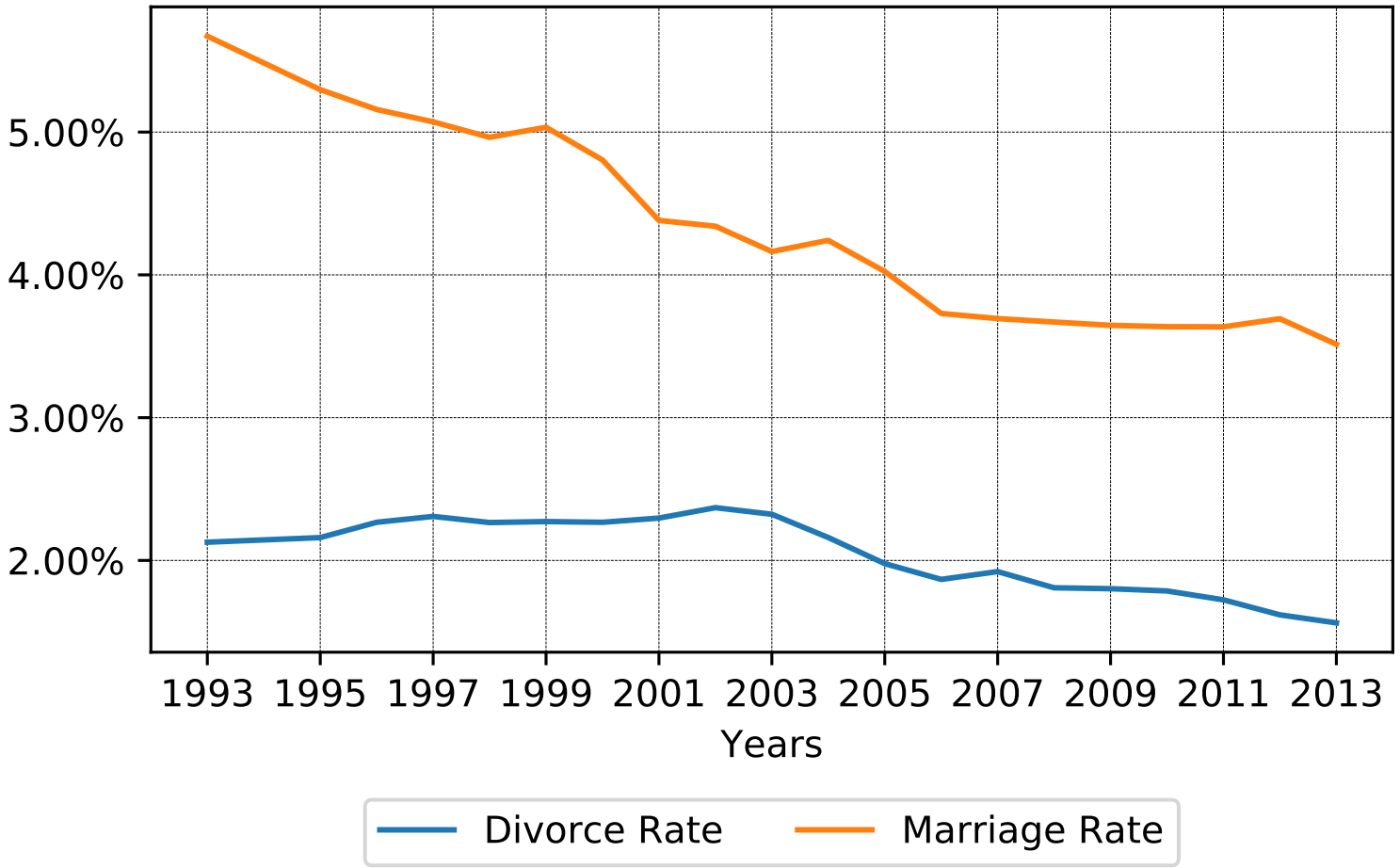
Marriage and Divorce Rates



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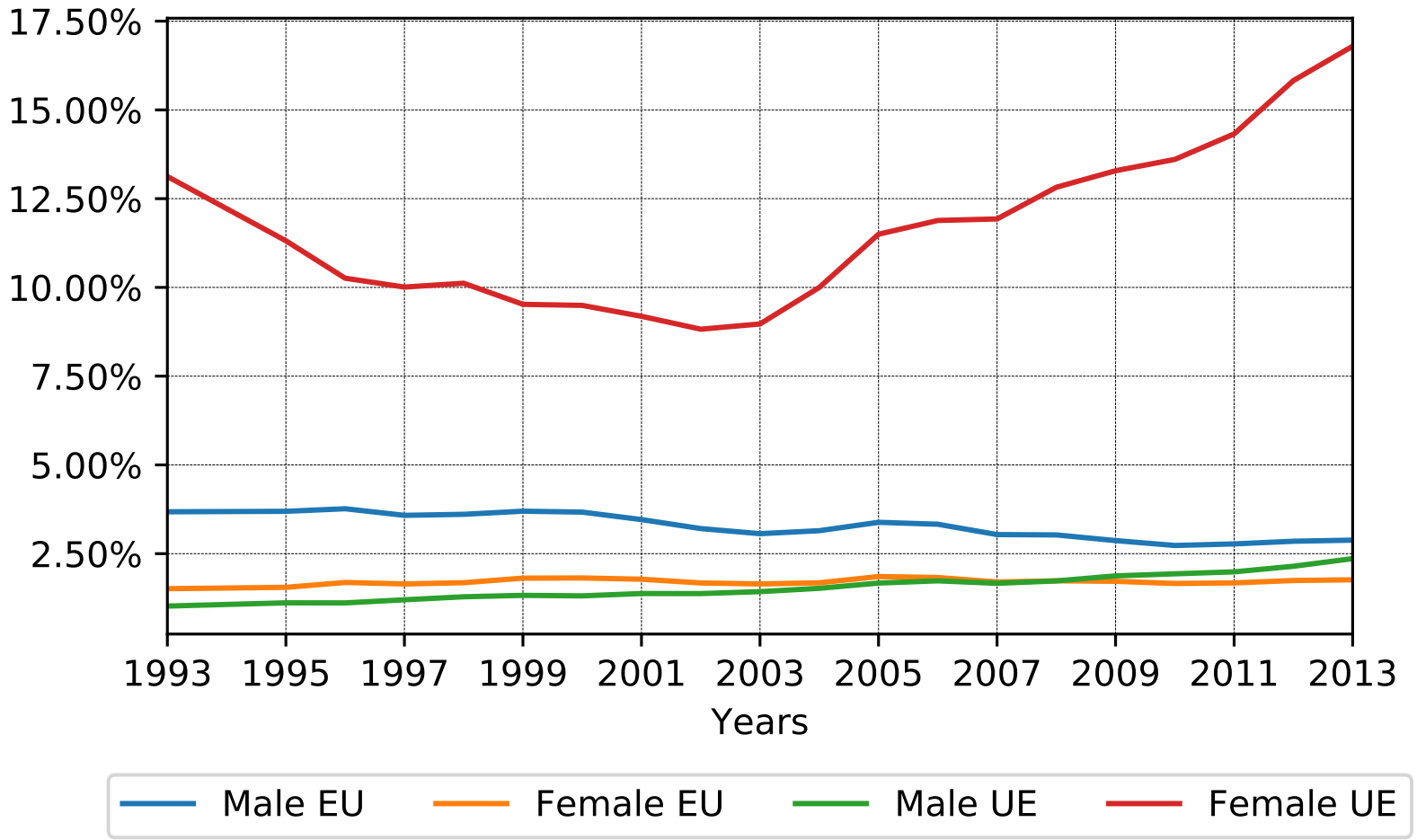
Breakdown of Labor Market Divorces I



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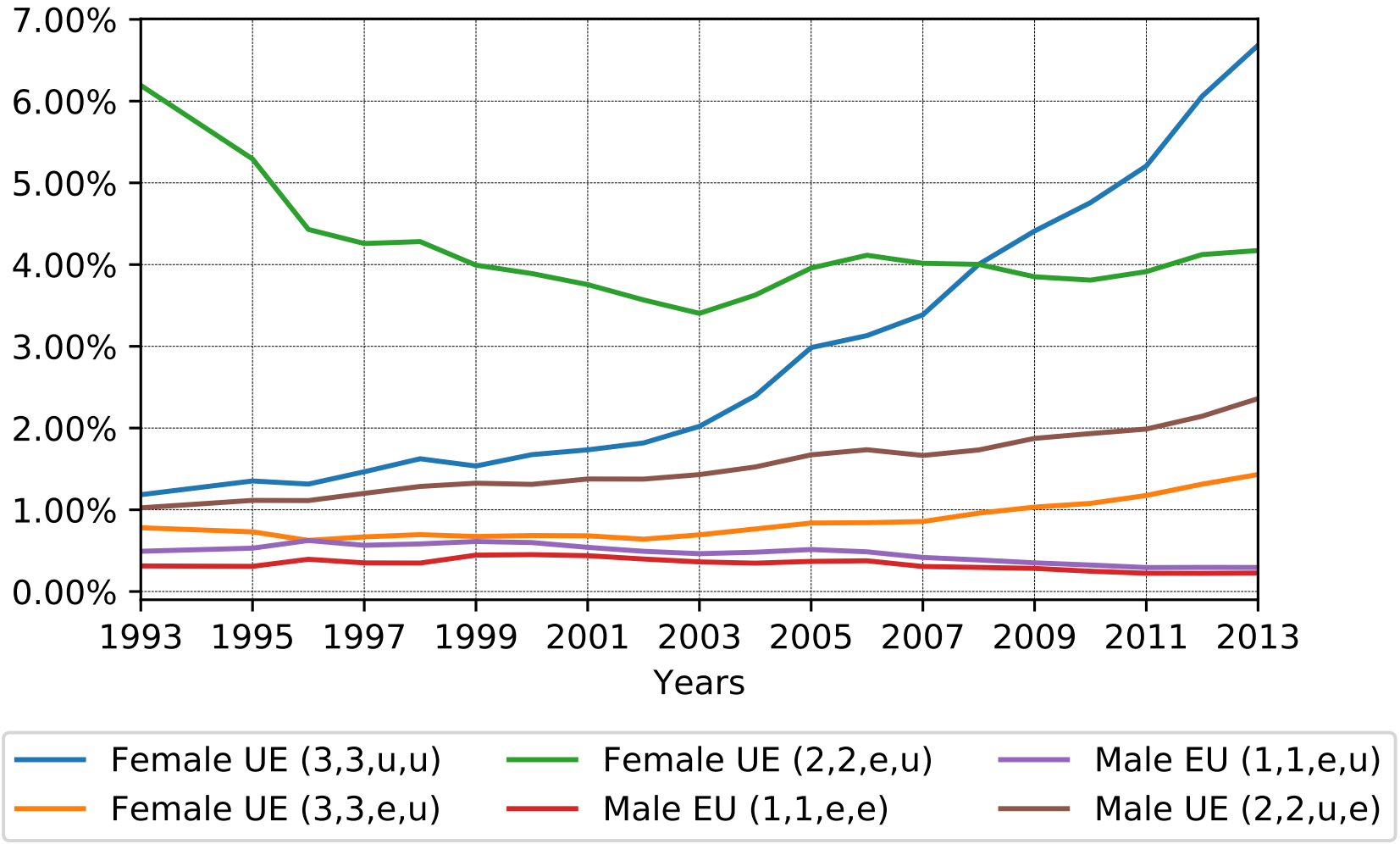
Breakdown Labor Market Divorces II



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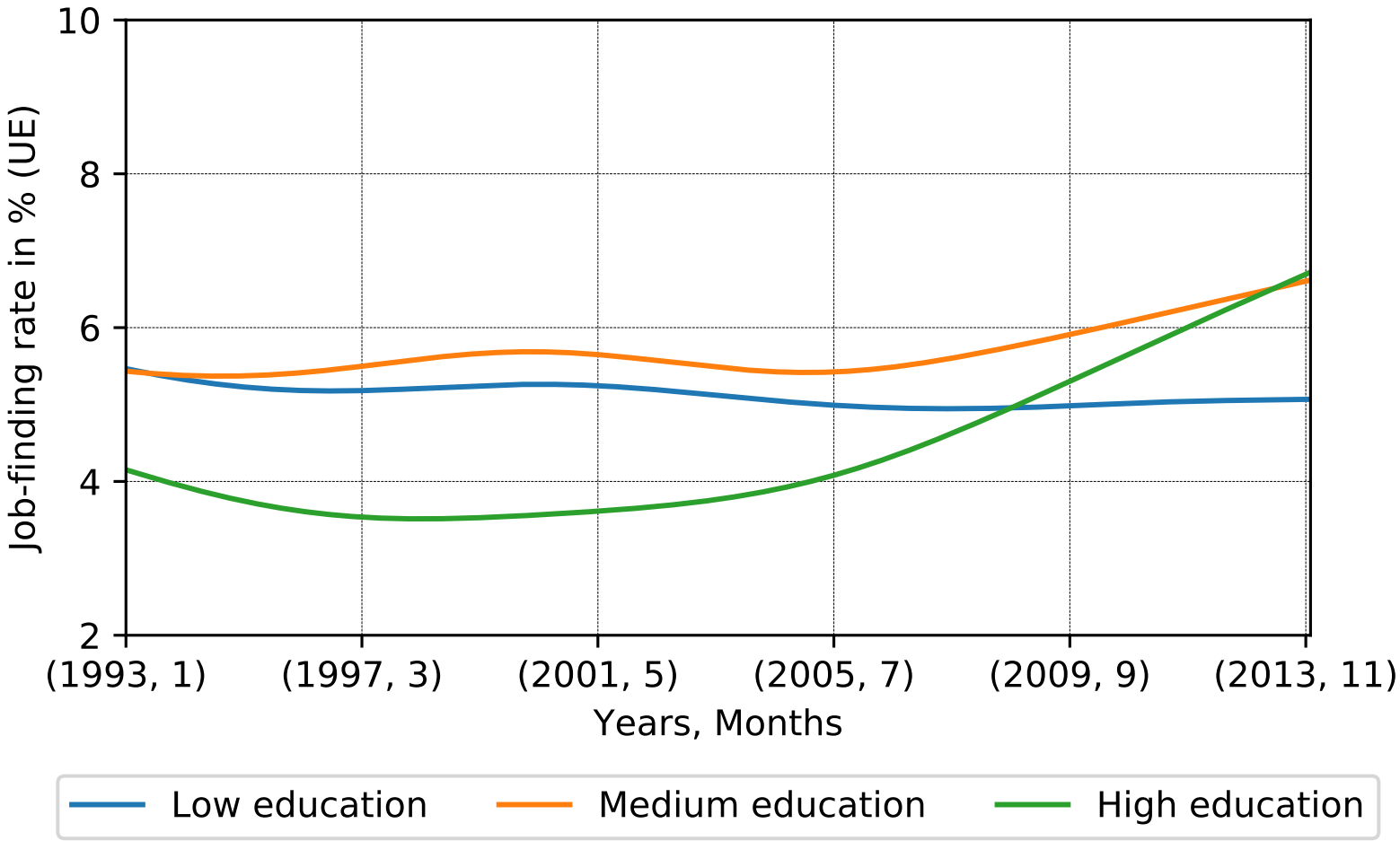
Job-finding rate men



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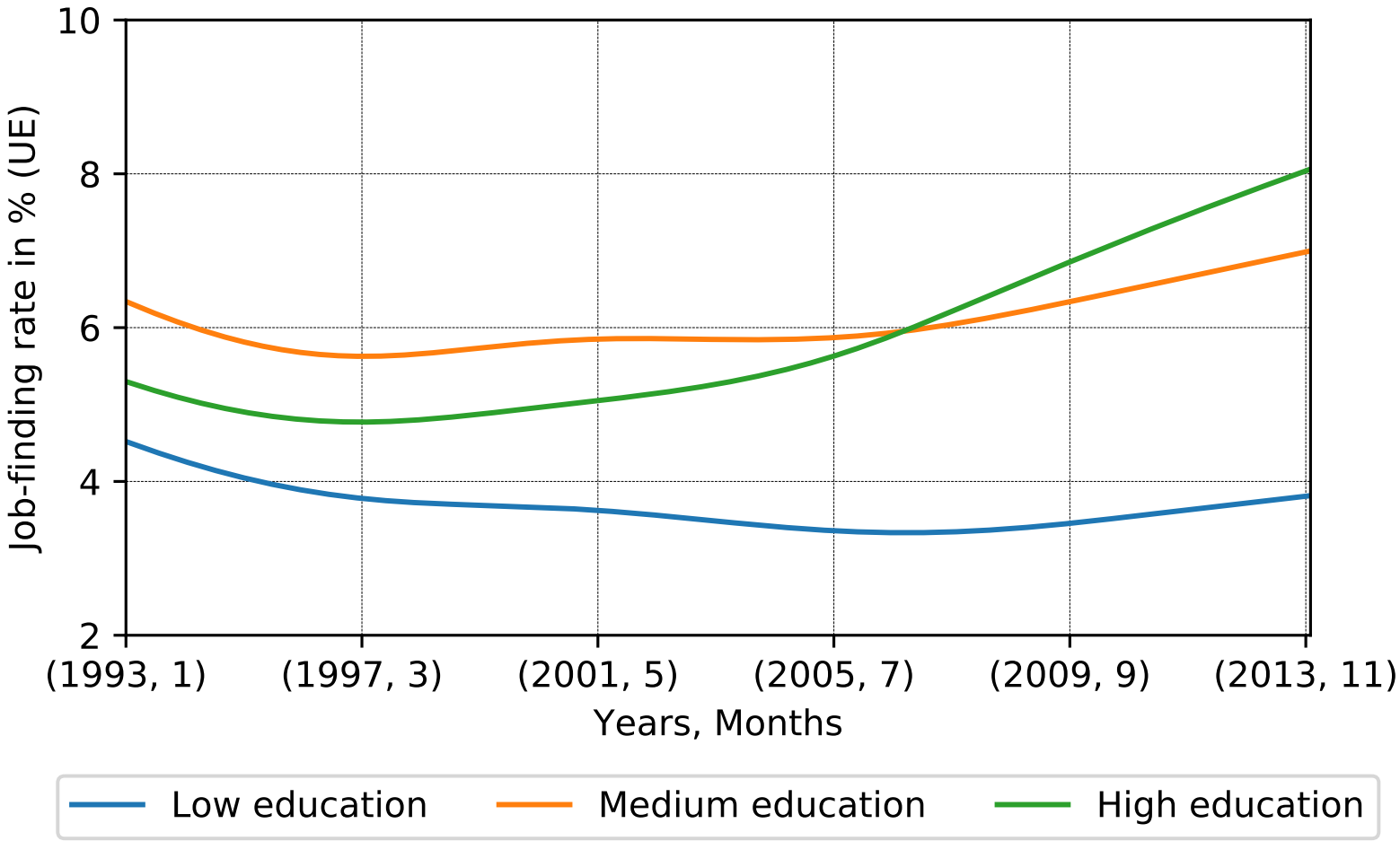
Job-finding rate women



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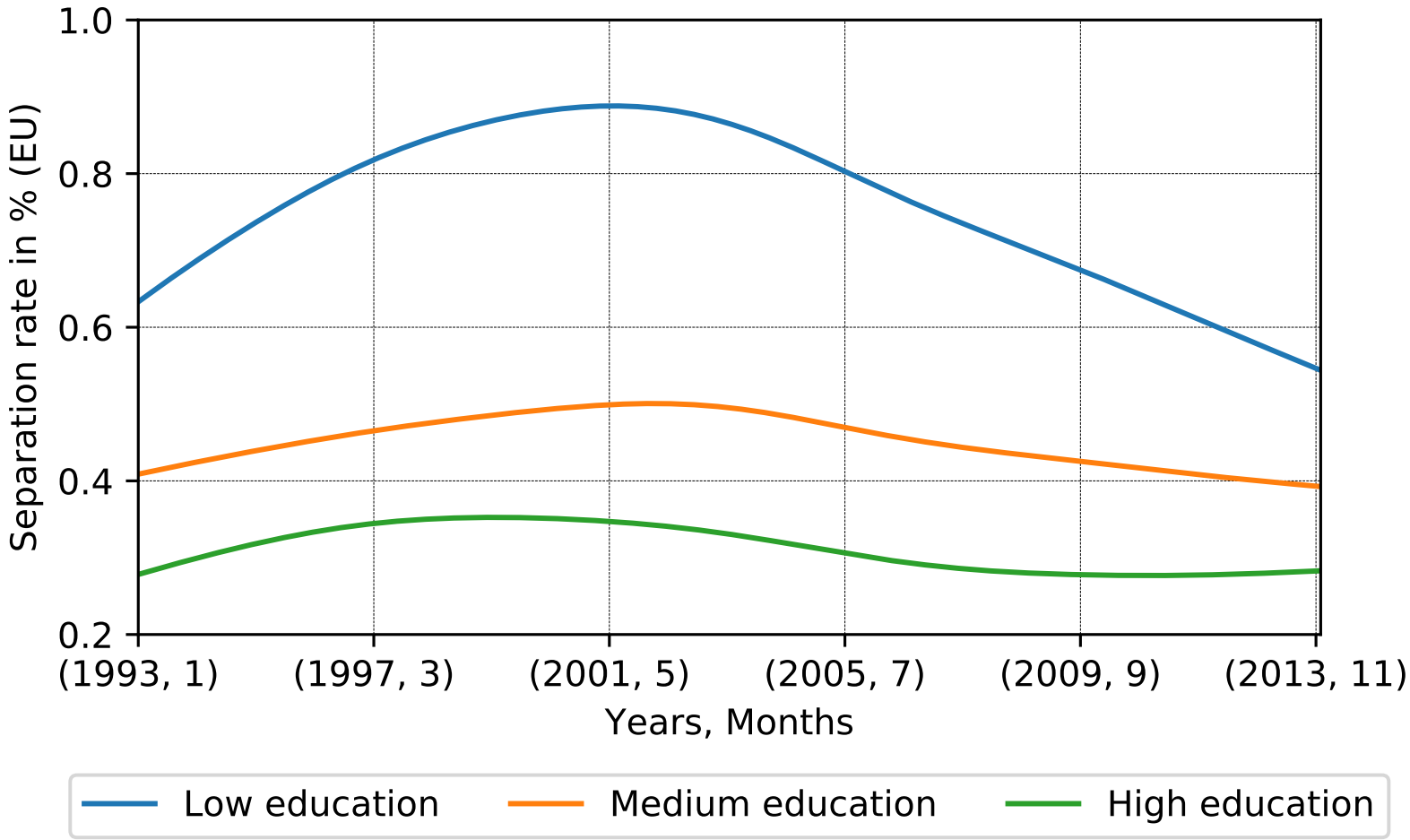
Separation rate men



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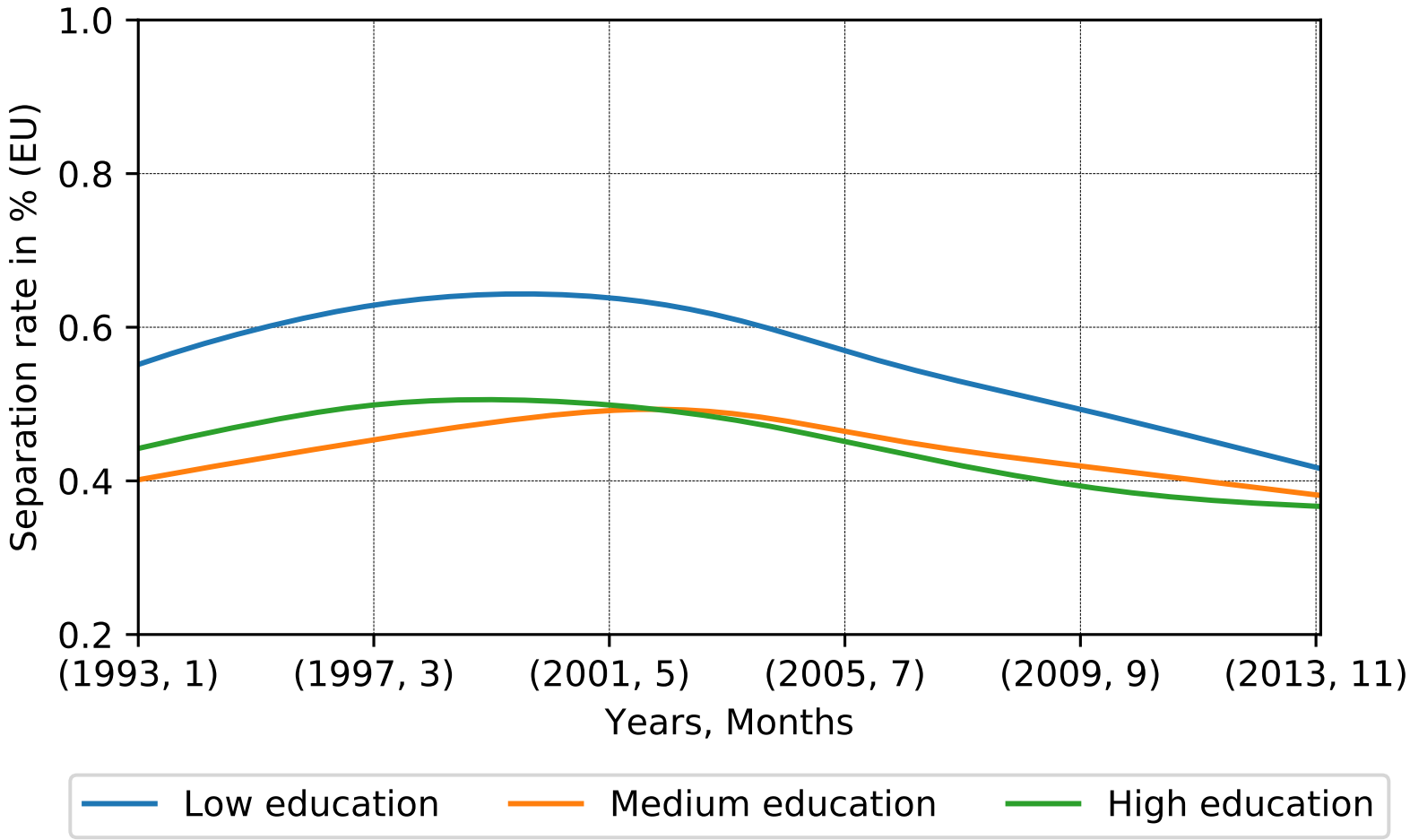
Separation rate women



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Data: Distribution of Individuals

	$M_{ij}^{ee}(\%)$	i: low	medium	high
	low	0.85	0.97	0.27
j	medium	0.40	6.12	2.46
	high	0.07	0.95	2.45

	$M_{ij}^{eu}(\%)$	i: low	medium	high
	low	0.79	0.97	0.26
j	medium	0.20	2.51	1.16
	high	0.02	0.20	0.66

	$M_{ij}^{ue}(\%)$	i: low	medium	high
	low	0.26	0.28	0.05
j	medium	0.11	0.97	0.27
	high	0.02	0.15	0.26

	$M_{ij}^{uu}(\%)$	i: low	medium	high
	low	1.70	2.39	0.55
j	medium	0.29	3.34	1.35
	high	0.02	0.19	0.61

$S^{e}(\%)$	low	medium	high
male	0.94	4.66	2.72
female	1.05	4.16	2.31

$S^{u}(\%)$	low	medium	high
male	1.10	2.50	1.26
female	5.26	4.52	1.31

Change 1993–2013 Go back

Data: Distribution of Individuals: Change 1993–2013

	$M_{ij}^{ee}(\Delta pps)$	i low	i medium	i high
	low	-0.36	-0.62	-0.22
j	medium	-0.02	0.26	0.18
	high	0.02	0.64	1.19

	$M_{ij}^{eu}(\Delta pps)$	i low	i medium	i high
	low	-0.48	-1.06	-0.36
j	medium	-0.14	-2.10	-0.91
	high	0.01	0.02	-0.08

	$M_{ij}^{ue}(\Delta pps)$	i low	i medium	i high
	low	-0.05	-0.08	-0.02
j	medium	0.01	0.29	0.06
	high	0.00	0.12	0.12

	$M_{ij}^{uu}(\Delta pps)$	i low	i medium	i high
	low	-0.48	-0.85	-0.20
j	medium	-0.10	0.64	0.55
	high	0.00	0.16	0.54

$S^{e}(\Delta pps)$	low	medium	high
male	0.25	1.13	1.27
female	-0.07	1.14	1.76

$S^{u}(\Delta pps)$	low	medium	high
male	0.34	0.85	0.59
female	-1.55	0.24	0.7

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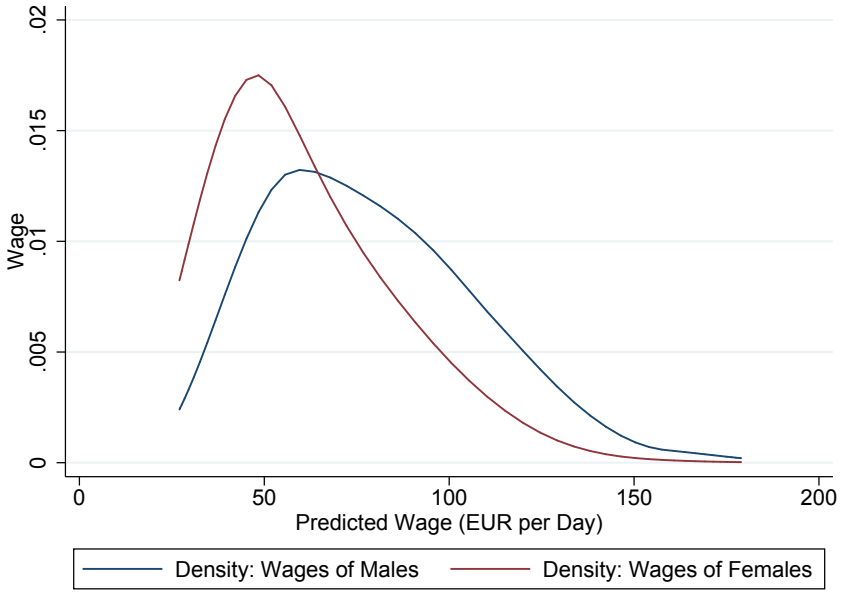
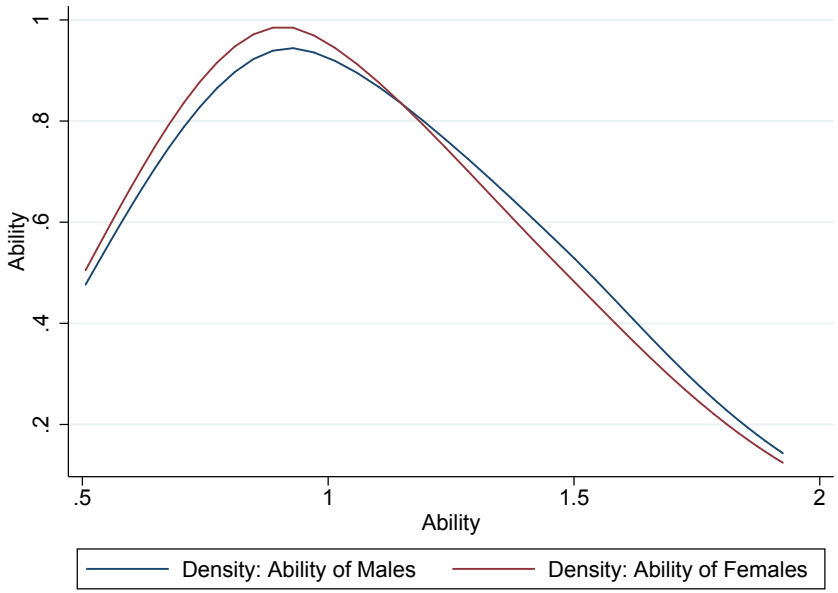
Data: Wage and Ability Heterogeneity

- Run Mincer-type wage regression on worker-fixed effect and all interactions of age^2, age^3, education, year, gender.





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Utility and Home Production

- The flow utility of a (male) married individual depends on
  - the labor market status and ability of both spouses, augmented with an idiosyncratic match-specific "love" shock.
  - private consumption, which is income minus a transfer to the spouse.
- We assume the following functional form, which is linear in income.

$$u_i^{l,-l}\left(z, I_i^l\right) = \underbrace{z}_{\text{"love shock"}} \times \underbrace{\left[f\left(a_i, a_j\right)^{\alpha_1} \times g\left(T_i^l, T_j^{-l}\right)^{\alpha_2}\right]}_{\text{household public good}} + \underbrace{c_i^l}_{\text{private consumption}}$$

  - $z \sim \ln \mathcal{N}(\mu_z, \sigma_z^2)$ with CDF $G(z)$
  - $f\left(a_i, a_j\right)$ captures ability homophily, (log)supermodular function.
  - $g\left(T_i^l, T_j^{-l}\right)$ is the contribution of time inputs, (perfect) substitutes.
  - $c_i^{l,-l} = I_i^l - t_i$, with $I_i^e = w_i$, $I_i^u = b_i$.

- Flow utility of single (male) individuals (z is unity)

$$u_i^l(I_i^l) = g\left(T_i^l, 0\right)^{\alpha_3} + I_i^l.$$

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Bargaining - No Commitment

- Bargaining powers are (β_i, β_j), with $\beta_i + \beta_j = 1$.
- Search intensities and transfers are chosen such that the Nash-Product,

$$\left[V_j^{l,-l}\left(z, I_i^{-l}, I_j^{l}\right) - V_j^{l}\left(I_j^{l}\right)\right]^{\beta_j} \left[V_i^{-l,l}\left(z, I_i^{-l}, I_j^{l}\right) - V_i^{-l}\left(I_i^{-l}\right)\right]^{\beta_i},$$

  is maximized subject to participation and feasibility constraints.
- If a labor market transition or a love shock occurs, search intensities $(\sigma_{i,j}^{-l,l}(.), \sigma_{j,i}^{l,-l}(.))$ and transfers (t_i, t_j) are (re)negotiated.
- Marital Surplus is defined as the gain from marriage for both spouses:

$$\begin{aligned} S_{ij}^{-ll}\left(z, I_i^{-l}, I_j^{l}\right) \quad &\equiv \quad \left[V_j^{l,-l}\left(z, I_i^{-l}, I_j^{l}\right) - V_j^{l}\left(I_j^{l}\right)\right] \\ &+ \quad \left[V_i^{-l,l}\left(z, I_i^{-l}, I_j^{l}\right) - V_i^{-l}\left(I_i^{-l}\right)\right] \end{aligned}$$

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The Value of Singlehood

- The present value of being a single female with $l \in \{e, u\}$ satisfies:

$$rV_j^l\left(I_j^l\right) = \underbrace{u_j^l\left(I_j^l\right)}_{\text{Flow utility}} + \underbrace{q_j\left[V_j^u\left(b_j\right) - V_j^l\left(I_j^l\right)\right]\mathbb{1}\left[l=e\right]}_{\text{Job separation if employed}}$$

$$+ \underbrace{\max_{\sigma_j}\left[\sigma_j\mu_j\int\max\left[V_j^e\left(w_j'\right) - V_j^l\left(I_j^l\right), 0\right]dF_j\left(w_j'\right) - c\left(\sigma_j\right)\right]}_{\text{Search intensity choice}}$$

$$+ \underbrace{\lambda_{ij}\iiint\max\left[V_j^{l,-l}\left(z', I_i^{-l}, I_j^l\right) - V_j^l\left(I_j^l\right), 0\right]dG\left(z'\right)s_i d\widehat{H}_i^s\left(I_i\right)di}_{\text{Option value of finding a (male) partner}}$$

- $\widehat{H}_i^s\left(I_i\right)$ is the income distribution for singles of type i, incorporating the wage earnings distribution $H_i^s\left(w_i\right)$ and the unemployment rate u_i^s.
- Unemployed and employed singles choose their search intensity σ_j given a convex search cost function $c(\sigma_j) = \frac{\sigma_j^{1+1/\kappa}}{1+1/\kappa}$.

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The Value of Marriage

$$
\begin{aligned}
& rV_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right) = u_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right) \\
+ \quad & \delta \int \left[\max\left[V_j^l\left(I_j^l\right), V_j^{l,-l}\left(z', I_i^{-l}, I_j^l\right)\right] - V_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right)\right] dG\left(z'\right) \\
+ \quad & \widehat{\sigma}_{j,i}^{l,-l}\mu_j \int_{R_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right)} \left[\max\left[V_j^e\left(w_j'\right), V_j^{e,-l}\left(z, I_i^{-l}, w_j'\right)\right]\right. \\
- \quad & \left. V_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right)\right] dF_j\left(w_j'\right) - c\left(\widehat{\sigma}_{j,i}^{l,-l}\right) \\
+ \quad & \widehat{\sigma}_{i,j}^{-l,l}\mu_i \int_{R_i^{-l,l}\left(z, I_i^{-l}, I_j^l\right)} \left[\max\left[V_j^l\left(I_j^l\right), V_j^{l,e}\left(z, w_i', I_j^l\right)\right]\right. \\
- \quad & \left. V_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right)\right] dF_i\left(w_i'\right) \\
+ \quad & q_j\left[\max\left[V_j^u\left(b_j\right), V_j^{u,-l}\left(z, I_i^{-l}, b_j\right)\right] - V_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right)\right] \mathbb{1}\left[l = e\right] \\
+ \quad & q_i\left[\max\left[V_j^l\left(I_j^l\right), V_j^{l,u}\left(z, b_i, I_j^l\right)\right] - V_j^{l,-l}\left(z, I_i^{-l}, I_j^l\right)\right] \mathbb{1}\left[-l = e\right]
\end{aligned}
$$

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The Surplus of Marriage

- is independent of income due to quasi-linearity of the utility function.
- is strictly increasing in z.

$$
\begin{aligned}
\left[r+\delta+q_i+q_j\right] S_{ij}^{-ll}\left(z\right) &= zf\left(a_i,a_j\right)^{\alpha_1} g\left(T_i^{-l},T_j^{l}\right)^{\alpha_2} - g\left(T_i^{-l},0\right)^{\alpha_3} \\
&- g\left(0,T_j^{l}\right)^{\alpha_3} + \delta\int_{z_{ij}^{-ll}}^{\infty} S_{ij}^{-ll}\left(z'\right) dG\left(z'\right) \\
\textit{Gains from search for } i \Leftarrow &+ \frac{c'(\widehat{\sigma}_{i,j}^{-l,l})^{1+\kappa}}{1+\kappa} - \frac{c'(\widehat{\sigma}_{i}^{-l})^{1+\kappa}}{1+\kappa} \\
\textit{Gains from search for } j \Leftarrow &+ \frac{c'(\widehat{\sigma}_{j,i}^{l,-l})^{1+\kappa}}{1+\kappa} - \frac{c'(\widehat{\sigma}_{j}^{l})^{1+\kappa}}{1+\kappa} \\
&+ q_i \max\left[0, S_{ij}^{ul}\left(z\right)\right] + q_j \max\left[0, S_{ij}^{-lu}\left(z\right)\right] \\
&- \lambda_{ij}\beta_i \int_j \sum_{l\in\{u,e\}} s_j^{l} \int_{z_{ij}^{-ll}}^{\infty} S_{ij}^{-ll}\left(z'\right) dG\left(z'\right) dj \\
&- \lambda_{ij}\beta_j \int_i \sum_{-l\in\{u,e\}} s_i^{-l} \int_{z_{ij}^{-ll}}^{\infty} S_{ij}^{-ll}\left(z'\right) dG\left(z'\right) di
\end{aligned}
$$

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Search Equilibrium

- The equilibrium is characterized by:
  - a set of surplus functions $S_{ij}^{ll}(z)$,
  - search intensities for unemployed married and single individuals $\{\widehat{\sigma}_i^{u,l}(z), \widehat{\sigma}_j^{u,-l}(z)\}$ and $\{\widehat{\sigma}_i^{u}, \widehat{\sigma}_j^{u}\}$,
  - love shock threshold values z_{ij}^{ll},
  - the distributions of married couples m_{ij}^{ll} for each type ij and labor market status ll combination,
  - and single distributions s_i^l, s_j^l.

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Solution Method

- Chebyshev grid with 20×20 nodes.
- Two fixed point systems, alternating solution algorithm.
  1. Initialize the model.
  2. Find fixed point of first system of equations:
     - 16 integrated surplus equations.
  3. Find fixed point of second system of equations:
     - Compute reservation wages and search intensities.
     - Find the z_{ij}^{ll} thresholds at the point where the surplus is zero.
  4. z_{ij}^{ll} determine $\alpha_{ij}^{ll} \equiv \left(1 - G\left(z_{ij}^{ll}\right)\right)$, which determine m_{ij}^{ll}.
  5. Use flow equations and exog. distributions of i, j to find s_i^l, s_j^l.
  6. Go back to step 2. Repeat until convergence.
- Takes < 10 minutes to solve on my laptop.

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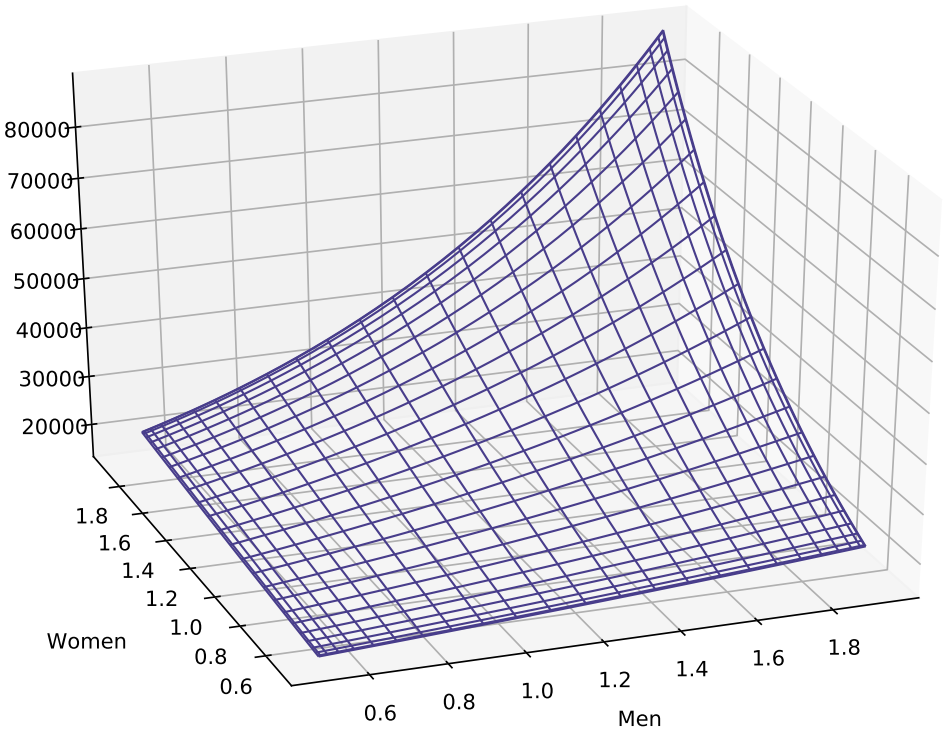
Surplus function (ee)



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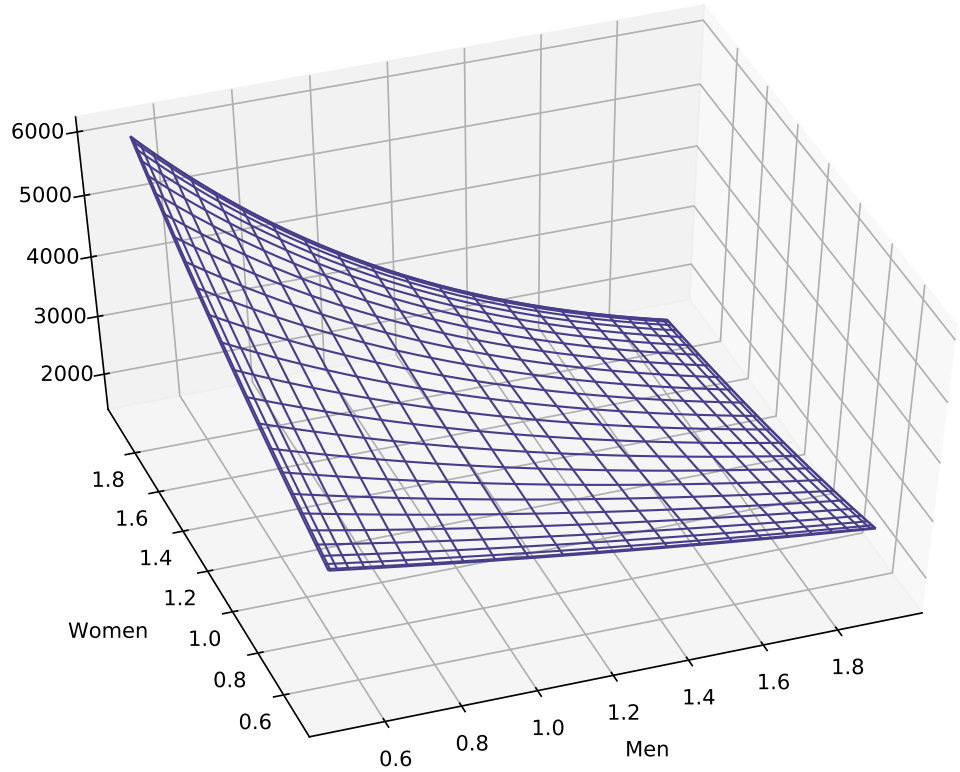
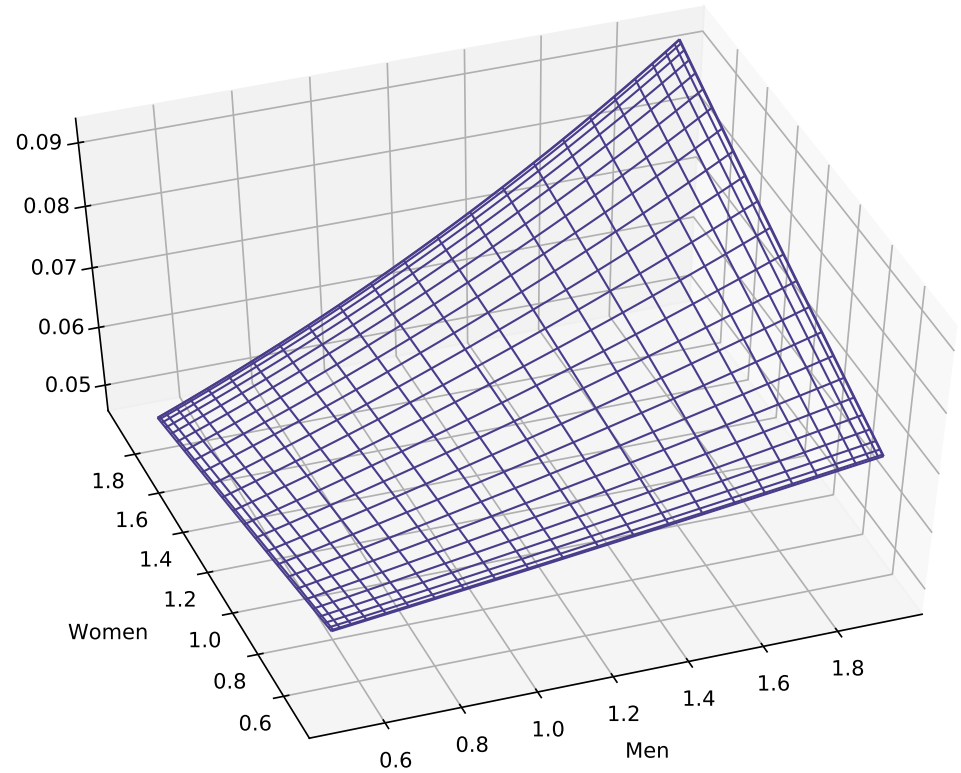
z cutoff (ee)


6000
5000
4000
3000
2000
1.8
1.6
1.4
1.2
1.0
0.8
0.6
Women
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Men

Matching probability $\alpha\ (ee)$



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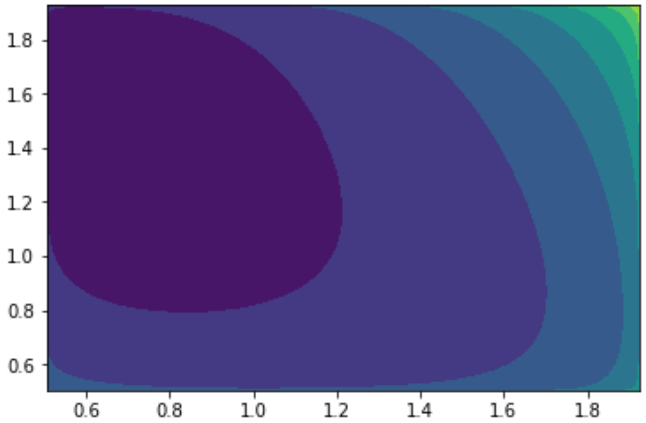
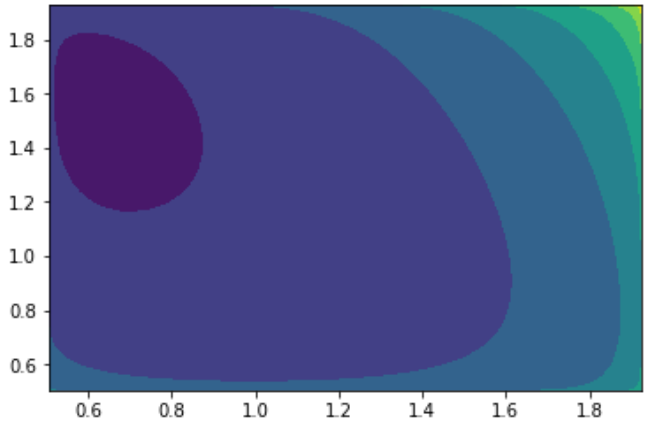
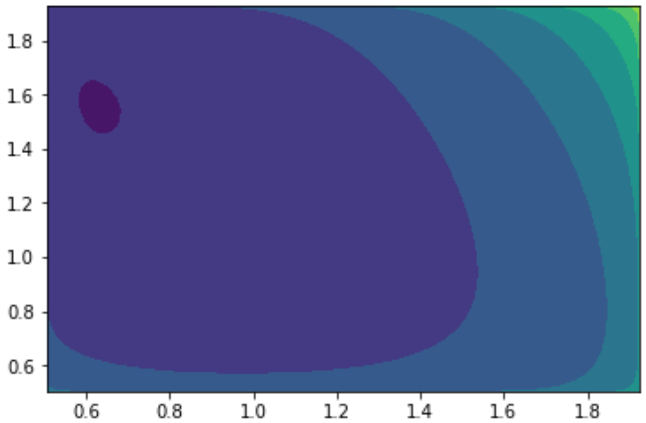
Joint distributions



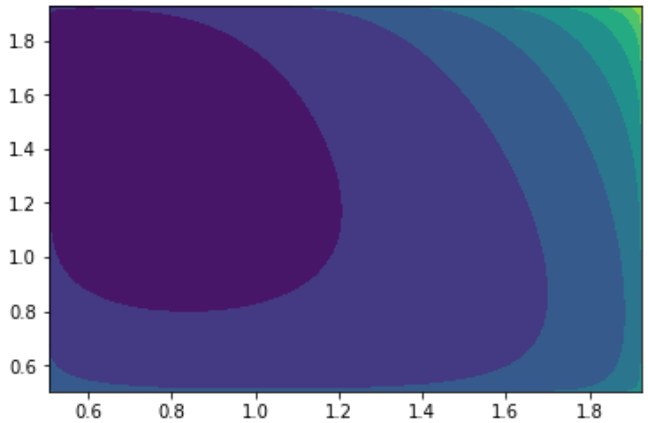
ee



ue



eu



uu

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Flow equation estimation

- We estimate this system of four flow equations using as data inputs the empirical counterparts of $\tau_i(l)$, $\tau_j(l)$, $m(i,j,l,l)$, $s(i,l)$, and $s(j,l)$.
- Our estimation procedure uses a large number of linear and non-linear parameter constraints derived from the model.
- We get estimated meeting rates ($\hat{\lambda}_{ij}$), marriage probabilities ($\hat{\alpha}_{ij}^{ll}$), and separation rates ($\hat{\delta}_{ij}$), differentiated by individuals' type and labor market status (where applicable).
- Our model implies that the observed flow of divorces must be consistent with the following aggregated flow equation:

$$\begin{aligned}\widetilde{\Delta}_t \quad = \quad & \iiiint \delta_{ij}\left(1-\alpha_{ij}^{l''l}\right)\widetilde{m}_{ijt}^{l''l}didjdl''dl \\ & + \iiiint \widetilde{\tau}_{it}^{l''}\max\left[1-\left(\alpha_{ij}^{l'l}/\alpha_{ij}^{l''l}\right),0\right]\widetilde{m}_{ijt}^{l''l}didjdl''dl \\ & + \iiiint \widetilde{\tau}_{jt}^{l}\max\left[1-\left(\alpha_{ij}^{l''l'}/\alpha_{ij}^{l''l}\right),0\right]\widetilde{m}_{ijt}^{l''l}didjdl''dl.\end{aligned}$$

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Estimates of matching probability α_{ij}^{ll}

	$\hat{\alpha}_{ij}^{ee}$	j low	j medium	j high
i	low	0.96	0.62	0.53
	medium	0.99	0.72	1.00
	high	0.53	1.00	0.78

	$\hat{\alpha}_{ij}^{eu}$	j low	j medium	j high
i	low	0.01	0.79	0.89
	medium	0.88	1.00	1.00
	high	0.89	0.01	1.00

	$\hat{\alpha}_{ij}^{ue}$	j low	j medium	j high
i	low	0.45	0.14	0.05
	medium	0.20	1.00	1.00
	high	0.05	1.00	0.24

	$\hat{\alpha}_{ij}^{uu}$	j low	j medium	j high
i	low	0.00	0.05	0.45
	medium	0.06	1.00	0.07
	high	0.45	0.00	1.00

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Estimates of meeting rates λ_{ij}^{ll}

	$\hat{\lambda}_{ij}^{ee}\bar{s}_i^e\bar{s}_j^e$	j low	j medium	j high
	low	1.33e-04	5.50e-05	4.19e-04
i	medium	8.51e-04	2.80e-03	1.90e-01
	high	5.46e-04	3.38e-02	8.24e-04

	$\hat{\lambda}_{ij}^{eu}\bar{s}_i^e\bar{s}_j^u$	j low	j medium	j high
	low	2.45e-02	2.44e-05	1.39e-04
i	medium	1.01e-03	7.73e-04	9.55e-03
	high	1.59e-03	1.00e-04	7.29e-05

	$\hat{\lambda}_{ij}^{ue}\bar{s}_i^u\bar{s}_j^e$	j low	j medium	j high
	low	1.56e-04	6.44e-05	4.91e-04
i	medium	4.58e-04	1.51e-03	2.83e-03
	high	2.53e-04	5.42e-04	3.84e-04

	$\hat{\lambda}_{ij}^{uu}\bar{s}_i^u\bar{s}_j^u$	j low	j medium	j high
	low	2.88e-02	2.86e-05	1.63e-04
i	medium	5.42e-04	1.31e-04	5.19e-03
	high	7.37e-04	4.65e-05	5.94e-06

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