

Job Loss, Remarriage, and Marital Sorting

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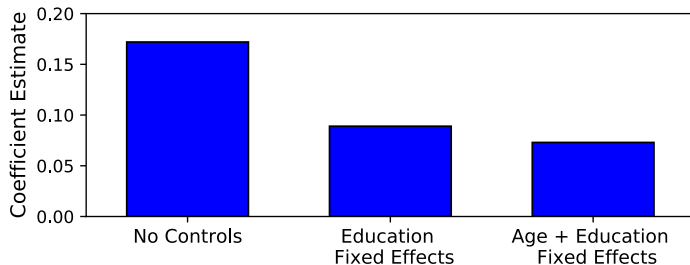
Motivation

- Marriage has important economic implications (Becker 1973)
 - Whom people marry affects their household income (and wealth), and contributes to economic inequality
 - Sorting patterns have been studied empirically...
e.g., Eika et al. (2019), Greenwood et al. (2015)
 - ...and through the lense of (search and) matching models
e.g., Choo and Siow (2006), Chiappori et al. (2018), Pilossoph and Wee (2020)
 - **Policy implications:** taxation, social insurance, education subsidies
e.g., Gayle and Shephard (2019), Persson (2019), Anderberg et al. (2020)
- Marital sorting may **amplify** or **dampen** policy effects on inequality

Related Literature

Correlations

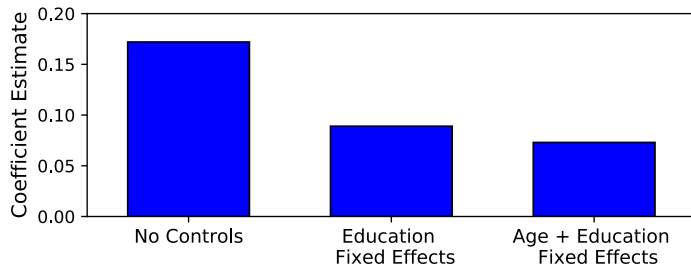
- Regressing wife's on husband's income + controls (Denmark, 1980–2007)



- Positive assortative matching (PAM) on income?
- Driven by sorting on other observed/unobserved characteristics?

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- Positive assortative matching (PAM) on income?
- Driven by sorting on other observed/unobserved characteristics?
- **How do income shocks affect whom a person marries?** (empirical question)
- **Can we learn something w.r.t. search and matching in the marriage market?**

This Paper I

- We provide quasi-experimental evidence:

How do income shocks affect whom a person marries?

- Leverage plant closures in Denmark, 1980–2007:

Job loss \Rightarrow \uparrow existing couple's **separation risk**

Job loss \Rightarrow \uparrow prob. of switching to a **higher earning new partner**, relative to a control group

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- We show: 1D-models that exhibit either **PAM** or negative assortative matching (**NAM**) are hard to reconcile with both empirical regularities
 - ① Upon job loss men switch to **higher** earning partners \rightarrow *inconsistent with PAM*
 - ② $\text{Corr}(\text{male earnings, female earnings}) > 0 \rightarrow$ *inconsistent with NAM*

This Paper II

- Propose **multidimensional** framework, capable of reconciling evidence and theory
 - Consider **2D**-model: income + other characteristics (including **unobservables**)
 - **Negative sorting** on income \Rightarrow men switch to higher earning partners upon job loss
 - **Positive sorting** on other characteristics
 - $Corr(\text{income, other characteristics}) > 0$
 \Rightarrow spurious correlation: $Corr(\text{male income, female income}) > 0$

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 - $\text{Corr}(\text{income}, \text{other characteristics}) > 0$
 \Rightarrow spurious correlation: $\text{Corr}(\text{male income}, \text{female income}) > 0$
- Illustrate implications:
 - Potentially severe implications for policies aimed at reducing inequality!
 - To show this, we contrast tax policy reforms in **1D** and **2D**-models.

Outline

- ① Conceptual framework
- ② Empirical analysis
- ③ Multidimensional matching
- ④ Policy implications

Conceptual Framework

Shimer and Smith (2000)

- General 1:1 matching framework with **search frictions** and **transferable utility (TU)**
 - Frictions \rightarrow it takes time to find a match (consistent with data)
 - Most suitable for modeling separations and remarriage
- Assume: People match on labor income (consistent with our empirical findings)
 \rightarrow Changes in income (e.g., due to job loss) **affect matching**
- Equilibrium partner income in matched couples:
 - Under **PAM**: $\mathbb{E}[q_f|q_m]$ weakly **increasing** in $q_m \Rightarrow \text{Corr}(q_f, q_m) \geq 0$
 - Under **NAM**: $\mathbb{E}[q_f|q_m]$ weakly **decreasing** in $q_m \Rightarrow \text{Corr}(q_f, q_m) \leq 0$

Setup

Link to our empirical analysis:

- q_f, q_m : labor incomes
- **Job loss**: $q_m \rightarrow \tilde{q}_m = q_m - d$
- Aside: can allow for other attributes that vary one-to-one with q_m
- Matches dissolve endogenously iff $S(q_f, \tilde{q}_m) < 0$
 - Under **PAM**: Matching sets shift downwards, couples at the upper end separate.
 - Under **NAM**: Matching sets shift upwards, couples at the lower end separate.
- Matches also dissolve exogenously at rate δ
 - Men re-enter the marriage market with shifted matching set.

Job Loss and Remarriage

- Empirically we leverage establishment closures to identify:

$$\underbrace{\mathbb{E}[q_{f\tau} - q_{f0} | q_{m\tau} = q_{m0} - d, R = 1]}_{\text{Impact of job displacement on partner income}} - \underbrace{\mathbb{E}[q_{f\tau} - q_{f0} | q_{m\tau} = q_{m0}, R = 1]}_{\text{Non-displaced control group}}$$

q_{ft} income of period t partner

R partner switch indicator (between $t = 0$ and $t = \tau$)

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Proposition

Consider a matching environment in steady state equilibrium.

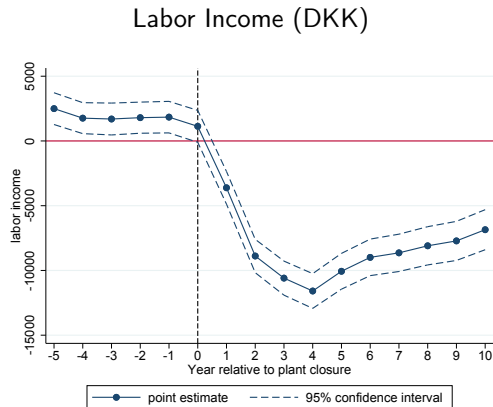
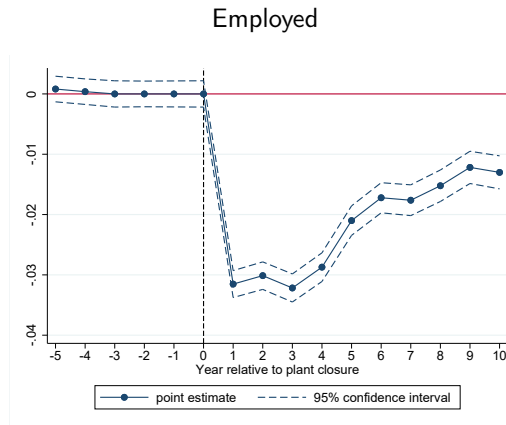
$$\text{PAM} \Rightarrow \mathbb{E}[q_{f\tau} - q_{f0} | q_{m\tau} = q_{m0} - d, R = 1] \leq \mathbb{E}[q_{f\tau} - q_{f0} | q_{m\tau} = q_{m0}, R = 1]$$

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Empirical Analysis

- Danish register Data, **population level, 1980–2007**
- Draw on tax and social security records
- Study **married and cohabiting** couples
- **Establishment closures** (Browning and Heinesen, 2012)
 - Year establishment stops operating, or one of the 2 preceding ones
 - Take first year with workforce reduction $\geq 10\%$
 - Exclude establishments with less than 5 employees
- **Treated:** men with tenure ≥ 3 years, and of age 25-45 at plant closure
- **Control:** draw from men with tenure ≥ 3 years at non-closing establishments

Job Displacement, Employment and Income

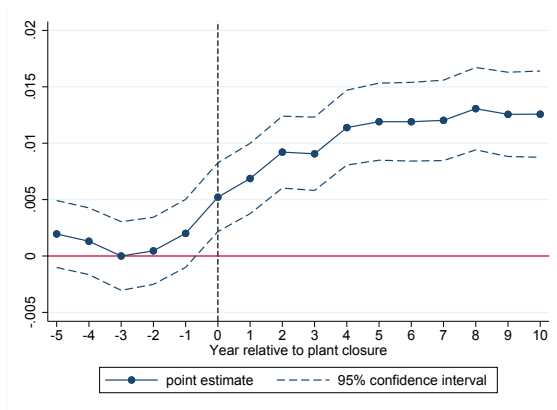


Relative to control group:

- Persistent reduction in employment and labor income

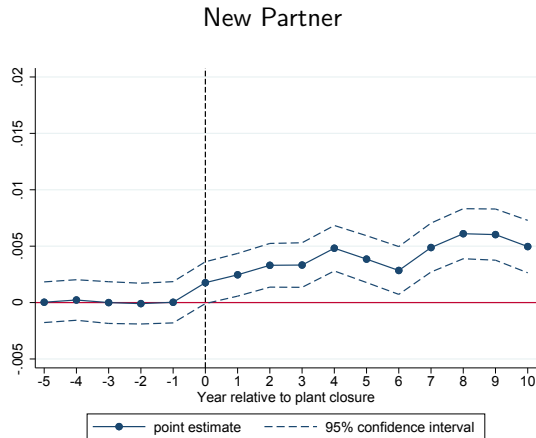
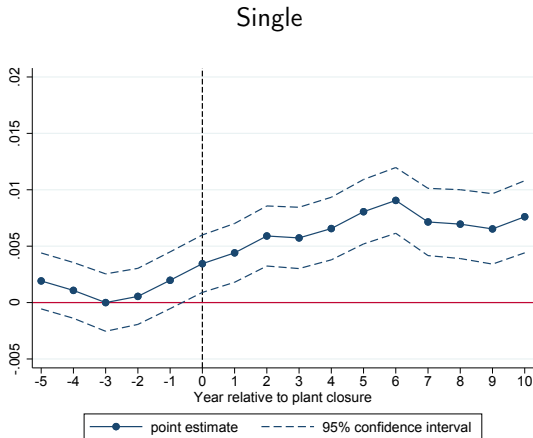
Job Displacement and Break-ups

Separated (from $t = -3$ partner)



- Separated: single or cohabiting with new partner.
- 10 years post displacement: 1.2 p.p. (5.7%) increase relative to control group

Job Displacement, Singles and Rematched



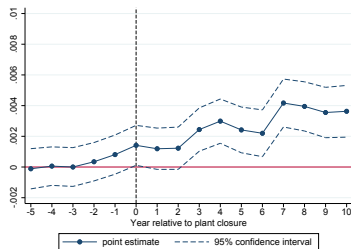
10 years post displacement:

- $\approx 40\%$ of increase in separations are men with a new partner

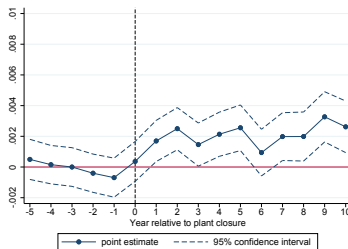
Job Displacement, New Partner Income

- Compare **new partner's** period t income to **initial partner's** period t income.

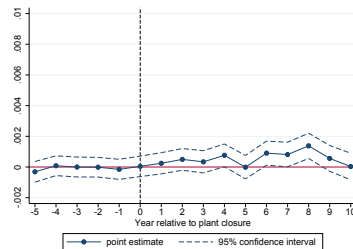
New partner higher inc. $> 5\%$



New partner same inc. $\pm 5\%$



New partner lower inc. $< -5\%$



Increase in men having a new partner by $t = 10$

- $\approx 65\%$ due to men w new partner who outearns their previous partner
- $\approx 35\%$ due to men w new partner with similar earnings as their previous partner
- 0% due to men w new partner who earns less than their previous partner

Job Displacement, New Partner Income/Wages/Work Hours

	Income (DKK)	Hourly wage	Weekly hours
Constant (γ_0)	-1237.2 (936.2)	-7.731*** (0.827)	0.312** (0.129)
Displaced dummy (γ_1)	3013.3** (1299.1)	3.629*** (1.150)	0.194 (0.180)
<i>N</i>	62246	60018	47780

Standard errors in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$

- “Elasticity”: -1% own income → switch to roughly +1% higher earning partner

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- “Elasticity”: -1% own income \rightarrow switch to roughly +1% higher earning partner
- $\gamma_1 = \mathbb{E}[q_{f\tau} - q_{f0} | S = 1, R = 1, D = 1] - \mathbb{E}[q_{f\tau} - q_{f0} | S = 1, R = 1, D = 0]$
- $\gamma_1 > 0 \Rightarrow \neg PAM$ (from proposition 1)

Robustness Checks

Additional Outcomes

Multidimensional Matching

Multidimensional Matching

- We show that our empirical findings can be reconciled with theory under [multidimensional matching](#)
- Extension of Shimer and Smith (2000) to multidimensional settings
- Consider 2-D types: (q_g, x_g) , $g \in \{f, m\}$
- q_g : labor income, x_g : other characteristics (will argue unobservables play a key role)

Definitions

Expected Partner Earnings

- We show that the analog of proposition 1 holds up in the bidimensional case

Proposition

Consider a 2-D matching environment in steady state equilibrium.

$$\text{PAM } (1,1) \Rightarrow \mathbb{E}[q_{f\tau} - q_{f0} | q_{m\tau} = q_{m0} - d, R = 1] \leq \mathbb{E}[q_{f\tau} - q_{f0} | q_{m\tau} = q_{m0}, R = 1]$$

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2D-Matching

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- NAM (1,1) \Rightarrow Displaced men switch to higher earning **new partners**, relative to control group \Rightarrow consistent with our empirical evidence

Correlation in partners' earnings

- Next, consider the **sign** of $\text{Corr}(q_f, q_m)$
- Note: $\mathbb{E}[q_f|q_m]$ increasing in $q_m \Rightarrow \text{Corr}(q_f, q_m) > 0$
- Decomposition: consider $q_m'' > q_m'$

$$\begin{aligned}\mathbb{E}[q_f|q_m''] - \mathbb{E}[q_f|q_m'] &= \underbrace{\int \mathbb{E}[q_f|q_m'', x_m] - \mathbb{E}[q_f|q_m', x_m] dG(x_m|q_m'')}_{:= \text{DE (Direct effect)}} \\ &+ \underbrace{\int \mathbb{E}[q_f|q_m', x_m] dG(x_m|q_m'') - \int \mathbb{E}[q_f|q_m', x_m] dG(x_m|q_m')}_{:= \text{IE (Indirect effect)}}\end{aligned}$$

2D-Matching

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Proposition

In a bidimensional steady state matching equilibrium the following implications hold:

$$\text{PAM}(1, 1) \Rightarrow DE \geq 0$$

$$\text{NAM}(1, 1) \Rightarrow DE \leq 0$$

$$\text{PAM}(2, 2) \text{ and } G(x_m|q_m) \text{ is increasing in } q_m \Rightarrow IE \geq 0$$

$$\text{NAM}(2, 2) \text{ and } G(x_m|q_m) \text{ is increasing in } q_m \Rightarrow IE \leq 0$$

Taking Stock

Our 2D framework under

- 1 Negative sorting on income, q_g (NAM (1,1))
- 2 Positive sorting on other characteristics, x_g (PAM (2,2))
- 3 $G(q_m|x_m)$ increasing in x_m ($\Rightarrow \text{Corr}(q_m, x_m) > 0$)

is consistent with our empirical findings:

- 1 $\mathbb{E}[q_{f\tau} - q_{f0} | q_{m\tau} = q_{m0} - d, R = 1] - \mathbb{E}[q_{f\tau} - q_{f0} | q_{m\tau} = q_{m0}, R = 1] > 0$
- 2 $\text{Corr}(q_f, q_m) > 0$

Policy Implications

Tax Policy Effects

- Why is PAM or NAM in the income dimension important for tax policy?
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- Consider a progressive tax system. Mechanisms:
 - Progressive taxation compresses the distribution of net income.
 - Given **income-PAM**, it becomes more likely that *high-income* individuals match with *low-income* partners. → Additional inequality reduction, supports policy effect
 - Given **income-NAM**, it becomes more likely that *high-income* individuals match with *high-income* partners. → Inequality rises, opposite direction of intended policy effect

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 - Given **income-NAM**, it becomes more likely that *high-income* individuals match with *high-income* partners. → Inequality rises, opposite direction of intended policy effect
- We study the impact of different tax policies in steady state equilibria of calibrated 1D and 2D marriage market matching models.

Model Setup

Household Production

Equilibrium

Calibration

Fit

Policy Experiment: US Tax Schedule in Denmark

- Use OECD data to fit a simple parametric tax functions (Heathcote et al., 2017)
- Use US tax parameters in model calibrated for DK.

Policy Simulations: Impact of Tax Reforms on Inequality

	$\text{Var}[\log(q_f^{\text{net}} + q_m^{\text{net}})]$
	1D model
(1) Danish Tax Schedule	0.033
(2) U.S. Tax Schedule, marital sorting fixed	0.043
(2) U.S. Tax Schedule	0.045
Fraction due to marital sorting	0.11

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Conclusion

- Novel empirical evidence: men switch to **higher** earning partners upon job loss
→ Not driven by: labor supply, partner search in new firm/location, equilibrium effects
- Use a general marriage market search and matching framework to derive implications:
 - ① Our empirical findings point towards multidimensional matching
 - ② Incomes are substitutes, rather than complements on the marriage market
 - ③ A substantial part (42%) of the within-couple correlation in incomes arises from sorting on unobservables (not shown)
- Potentially important policy implications for the impact of taxes on inequality!

Thank you for your attention.

Working paper will be out soon!

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- **Marital sorting and inequality:**

Eika et al. (2019), Greenwood et al. (2015), Chiappori et al. (2020)

→ New evidence on income based sorting vs. sorting on other characteristics

- **Multidimensional matching:**

Lindenlaub (2017), Lindenlaub and Postel-Vinay (2020), Chiappori et al. (2012), Chiappori et al. (2017)

→ Extend frictional marriage market model to multidimensional settings

- **Structural matching models:**

Pilossoph and Wee (2020), Chiappori et al. (2018), Choo and Siow (2006)

→ Calibrate model to fit QE-estimates, provide new evidence on counterfactuals

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Setup

- Time is continuous, discounted at rate r
- Male income $q_m \in [\underline{q}_m, \bar{q}_m]$, female income $q_f \in [\underline{q}_f, \bar{q}_f]$
- Search is random, potential partners are sampled at rate λ_f, λ_m
- If male type q_m meets female type q_f , he decides: **accept/reject**
- Likewise type q_f female decides: **accept/reject**

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Setup II

- Upon matching couples enjoy marriage surplus

$$S(q_f, q_m) = V_f^C(q_m, q_f) + V_m^C(q_f, q_m) - V_f^S(q_f) - V_m^S(q_m)$$

- V_g^C : values of being matched; V_g^S : values of being single, $g \in \{f, m\}$

Match formation/ dissolution:

- Distribute marriage surplus by **Nash-Bargaining**
- Matches are formed iff $S(q_f, q_m) \geq 0$
- Matches dissolve exogenously at rate δ

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Treatment/Control Group

- **Treated:** men with tenure ≥ 3 years, and of age 25-45 at plant closure
- **Control:** draw from men with tenure ≥ 3 years at establishments who do not experience a plant closure during our sample period
- **Coarse and exact matching:** discretize continuous variables and match one-to-one

Treatment/Control Group

- **Treated:** men with tenure ≥ 3 years, and of age 25-45 at plant closure
- **Control:** draw from men with tenure ≥ 3 years at establishments who do not experience a plant closure during our sample period
- **Coarse and exact matching:** discretize continuous variables and match one-to-one
- **Matching variables:**
 - marital status (cohabiting/married)
 - exact age
 - calendar year
 - occupation (6 categories)
 - industry (9 groups)
 - establishment size quintiles 5 years before plant closure
 - tenure quintiles
 - children

Summary Statistics in $t = -3$

	Treatment	Control	P-value
Labor income (in DKK)	316,045	314,483	0.002
Partner's labor income (in DKK)	169,344	170,180	0.116
Partner's age	34.25	34.29	0.233
Education (years)	12.58	12.63	0.000
Partner's education (years)	12.12	12.17	0.000
Tenure (years)	4.43	4.40	0.144
No. of children	1.51	1.52	0.124
No. observations	78,193	78,193	

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Event Study Specification

$$Y_{it} = \sum_{\tau=-3}^{10} \alpha_{\tau} 1\{t = \tau\} + \sum_{\tau=-3}^{10} D_i \beta_{\tau} 1\{t = \tau\} + e_{it}$$

i individual index

t time relative to plant closure

Y_{it} outcome

D_i treatment indicator

e_{it} error term

- Coefficients of interest: β_{τ}
- Identifying assumption: trend in Y_{it} would have been parallel across treatment vs. control group in absence of plant closure

Additional Outcomes

	Age	Education	Kids
Constant (γ_0)	6.484*** (0.0398)	0.355*** (0.0102)	-0.228*** (0.00736)
Displaced dummy (γ_1)	-0.150*** (0.0552)	-0.0219 (0.0142)	0.0259** (0.0106)
N	68081	64564	67544

Standard errors in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$

- Study additional outcomes: no sizable effects!

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- Our results do not seem to be driven by **meeting probabilities**.
- Specifically, we rule out the following drivers:
 - Men **switching to firms** with higher earning women [more](#)
 - Men **moving to areas** with higher earning women [more](#)
 - Men **moving to areas** with higher sex ratios $\#women/\#men$ [more](#)
- Argue that marriage market equilibrium effects are negligible, based on back-of-the-envelope calculation [more](#)

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Expected Partner Earnings

We show that, in equilibrium:

- Under **PAM(1,1)**: $\mathbb{E}[q_f | q_m, x_m] = \mathbb{E}[q_f | a(q_m, x_m, x_f) \leq q_f \leq b(q_m, x_m, x_f)]$,
with a, b weakly **increasing** in q_m
- Under **NAM(1,1)**: $\mathbb{E}[q_f | q_m, x_m] = \mathbb{E}[q_f | a(q_m, x_m, x_f) \leq q_f \leq b(q_m, x_m, x_f)]$,
with a, b weakly **decreasing** in q_m

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Model: Calibration

Calibrated parameter values

Parameter	Symbol	Value 1D	Value 2D	Comment
Discount rate	β	0.97	0.97	fixed
Separation rate	δ	0.024	0.024	data estimate
Meeting rate	λ	0.180	0.151	calibrated
Match flow value parameter, 1D model	γ_{1D}	0.065	–	calibrated
Match flow value parameter, 2D model	γ_{2D}	–	0.142	calibrated
$Corr(q_s, x_s)$	ρ	–	0.481	calibrated
Love shock mean	μ_ξ	-0.205	0.326	calibrated
Love shock standard deviation	σ_ξ	0.044	0.000	calibrated

Correlation in partners' earnings

- Next, consider the **sign** of $\text{Corr}(q_f, q_m)$
- Note: $E[q_f|q_m]$ increasing in $q_m \Rightarrow \text{Corr}(q_f, q_m) > 0$
- Decomposition: consider $q_m'' > q_m'$

$$\begin{aligned}\mathbb{E}[q_f|q_m''] - \mathbb{E}[q_f|q_m'] &= \underbrace{\int \mathbb{E}[q_f|q_m'', x_m] - \mathbb{E}[q_f|q_m', x_m] dG(x_m|q_m'')}_{:= \text{DE (Direct effect)}} \\ &+ \underbrace{\int \mathbb{E}[q_f|q_m', x_m] dG(x_m|q_m'') - \int \mathbb{E}[q_f|q_m', x_m] dG(x_m|q_m')}_{:= \text{IE (Indirect effect)}}\end{aligned}$$

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Proposition

In a bidimensional steady state matching equilibrium the following implications hold:

$$\text{NAM}(1, 1) \Rightarrow DE \leq 0$$

$$\text{PAM}(2, 2) \text{ and } G(x_m|q_m) \text{ is increasing in } q_m \Rightarrow IE \geq 0$$

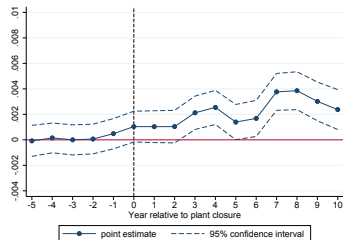
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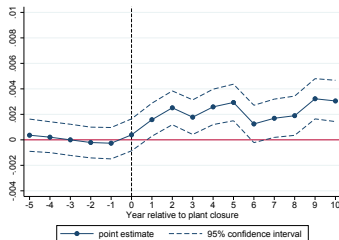
Robustness I

Excluding individuals who find a partner at the establishment they work at:

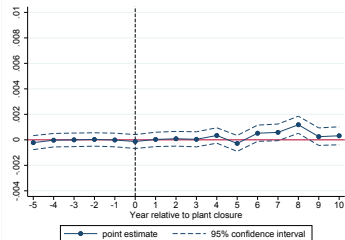
New partner higher inc. $> 5\%$



New partner same inc. $\pm 5\%$



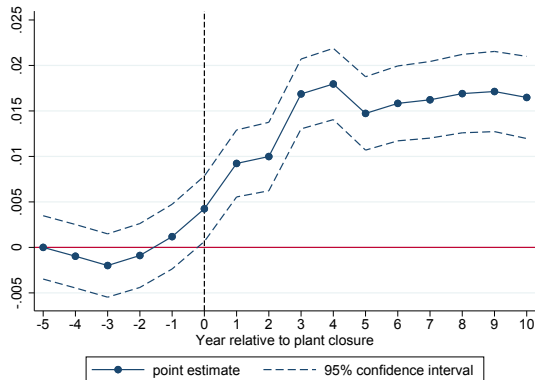
New partner lower inc. $< -5\%$



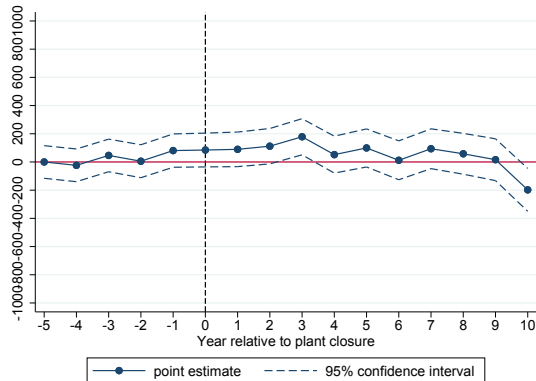
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Robustness II

Men "has moved"



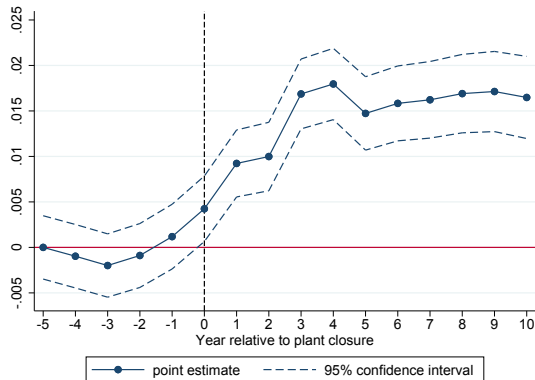
Local single women's earnings



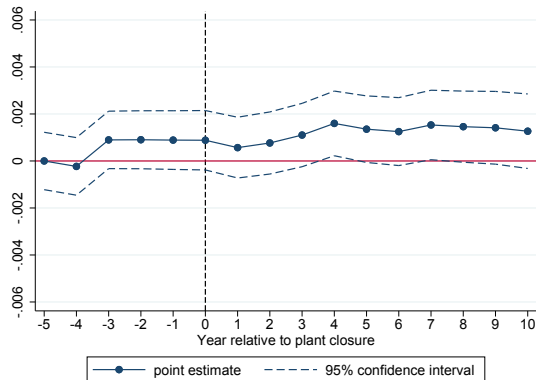
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Robustness III

Men "has moved"



Local sex ratio # women/ # men



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Robustness IV

- Workforce of the avg. closing establishment in our sample: 270 workers.
 - At the avg. closing establishment 15% of workers are singles
 - Displaced workers break-up rate 10 years after displacement: 0.2
 - Inflow of displaced singles into the marriage market $\approx 0.3 \times 270 = 54$
 - Increases pool of singles in the avg. municipality by $\approx 2.4\%$
- Small influx of displaced singles into the marriage market
- Conservative approximation:
 - long time horizon (10 years)
 - local marriage markets likely larger than municipality

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Definition

PAM: Consider $q'_f < q''_f$, $q'_m < q''_m$: There is PAM if $q'_f \in \mathcal{M}(q'_m)$, $q''_f \in \mathcal{M}(q''_m)$, whenever $q'_f \in \mathcal{M}(q''_m)$, and $q''_f \in \mathcal{M}(q'_m)$.

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Definition

PAM in dimension (1,1): Consider $q'_f < q''_f$, $q'_m < q''_m$: There is PAM in dimension (1,1) if $(q'_f, x_f) \in \mathcal{M}(q'_m, x_m)$, $(q''_f, x_f) \in \mathcal{M}(q''_m, x_m)$, whenever $(q'_f, x_f) \in \mathcal{M}(q''_m, x_m)$, and $(q''_f, x_f) \in \mathcal{M}(q'_m, x_m)$.

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Model: Setup

- Men and women are characterized by heterogeneous types: x (male), y (female)
- In the 1D case, type is just the income, $x = q_m$, $y = q_f$.
- In the 2D case, type is tuple of income and attractiveness, $x = (q_m, a_m)$, $y = (q_f, a_f)$.

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- Let $n_m(x)$ ($n_f(y)$) denote the exogenous type distribution of men (women).
- Income densities estimated, linked to attractiveness using copula and correlation ρ .
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- S_m and S_f are the respective measures of singles.
- “Love shock” z with CDF $G(z)$ and mean/standard deviation (μ_z, σ_z) .
- $\alpha(x, y)$ is the marriage probability conditional on meeting (λ), determined by $G(z)$.
- $V_m^0(x)$ ($V_f^0(y)$) is the option value of singlehood for men (women).

Model: Household Production

- In both 1D and 2D, the first term of the household production function is submodular and induces income-NAM
- In 1D, the second term is supermodular and induces income-PAM

$$f(x, y) = \gamma_1 \ln(q_m + q_f) + \gamma_2 q_m q_f$$

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- $f(q_s) = \ln(q_s)$, $s \in \{m, f\}$, is the home production of singles in both cases

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Model: Equilibrium

- Final assumption: spouses share resources cooperatively, transfers determined by Generalized Nash Bargaining, with bargaining power parameter β .
- A fixed point of the quadruple $(V_m^0(x), V_f^0(y), s_m(x), s_f(y))$ characterizes the equilibrium.

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$$s_m(x) = \frac{n_m(x)}{1 + \frac{\lambda}{\delta} \int s_f(y) \alpha(x, y) dy}$$

$$s_f(y) = \frac{n_f(y)}{1 + \frac{\lambda}{\delta} \int s_m(x) \alpha(x, y) dx}$$

$$V_m^0(x) = \frac{f(q_m) + \frac{\lambda\beta}{r+\delta} \iint \max\{z + f(x, y) - s_f(y), s_m(x)\} dG(z) s_f(y) dy}{1 + \frac{\lambda\beta}{r+\delta} S_f}$$

$$V_f^0(y) = \frac{f(q_f) + \frac{\lambda(1-\beta)}{r+\delta} \iint \max\{z + f(x, y) - s_m(x), s_f(y)\} dG(z) s_m(x) dx}{1 + \frac{\lambda(1-\beta)}{r+\delta} S_m}$$

Calibrated parameter values

Parameter	Symbol	Value 1D	Value 2D	Comment
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Targeted moments and fit

Moment	Value 1D	Value 2D	Target
Income correlation	0.102	0.103	0.102
$Var(\log(q_f + q_m))$	0.06	0.054	0.063
Share married,	0.783	0.795	0.784
Marriage probability	0.101	0.078	0.102
$Corr(q_s, x_s)$	-	0.643	-

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