Job Loss, Remarriage, and Marital Sorting

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Motivation

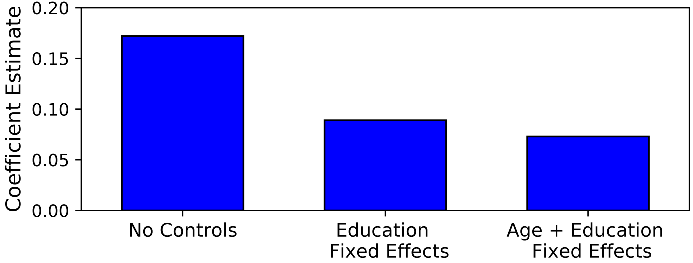
- Marriage has important economic implications (Becker, 1973).
- Marital sorting, i.e., who marries whom affects household income and contributes to economic inequality.
- Sorting patterns have been studied empirically...
  e.g., **EikaEtal19**, **GreenwoodEtal15**
- ...and through the lense of (search and) matching models
  e.g., **ChooSiow06**, **ChiapporiEtal18**, **PilossophWee20**
- Policy implications: taxation, social insurance, education subsidies
  e.g., Gayle and Shephard (2019), Persson (2019), **Anderberg2020**

$\rightarrow$ Marital sorting may amplify or dampen policy effects.

Related Literature

Correlations

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



- Positive assorative matching (PAM) on income?
- Driven by sorting on other observed/unobserved characteristics?
- Becker (1981): Positive correlation may arise due to sorting on correlates of income, even if sorting on income itself is negative, e.g. due to household specialization.

This Paper I

- To learn about income sorting, we rely on quasi-experimental evidence:

  How do income shocks affect whom a person marries?

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  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: models with 1D-heterogeneity 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. $Corr(\text{male earnings}, \text{ female earnings}) > 0 \rightarrow$ *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
  - $Corr(\text{income}, \text{ other characteristics}) > 0$

    $\Rightarrow$ spurious correlation: $Corr(\text{male income }, \text{ female income}) > 0$

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- 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

Conceptual Framework

Conceptual Framework

- General 1:1 matching framework with search frictions and transferable utility (TU)
  - Frictions $\rightarrow$ it takes time to find a match.
  - Suitable for modeling separations and remarriage.
- In this setting, individuals form matching sets (Shimer & Smith, 2000)
- Assume: Individuals match on labor income.

  $\rightarrow$ Changes in income (e.g., due to job loss) affect the matching sets
- Equilibrium partner income in matched couples:
  - Under PAM: $\mathbb{E}[q_f | q_m]$ weakly increasing in $q_m \Rightarrow Corr(q_f, q_m) \geq 0$
  - Under NAM: $\mathbb{E}[q_f | q_m]$ weakly decreasing in $q_m \Rightarrow Corr(q_f, q_m) \leq 0$

Setup

Job Loss

Link to our empirical analysis:

- q_f, q_m: labor incomes
- Job loss: $q_m \rightarrow \tilde{q}_m = q_m - d$
- 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:

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

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.

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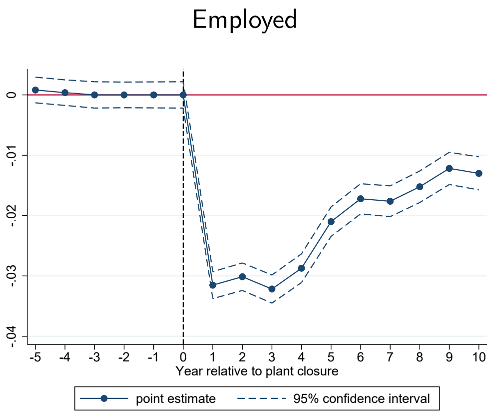
Empirical Analysis

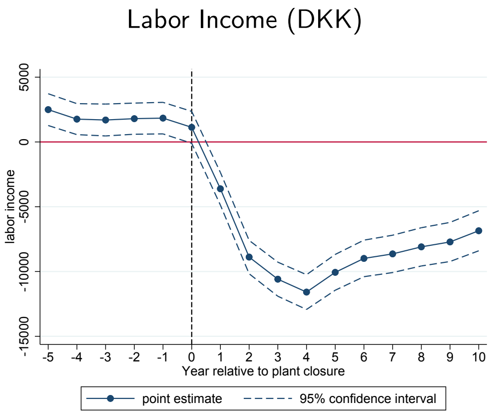
Data

- 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 $\geq$ 3 years, and of age 25-45 at plant closure
- Control: draw from men with tenure $\geq$ 3 years at non-closing establishments

Empirical Matching | Summary Statistics in t=-3 | Event Study Specification

Job Displacement, Employment and Income



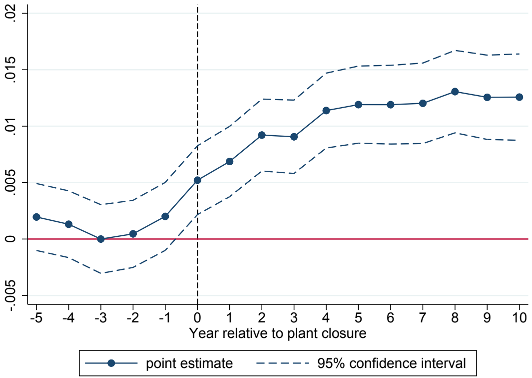


Relative to control group:

- Persistent reduction in employment and labor income

Job Displacement and Break-ups

Separated (from $t = -3$ partner)

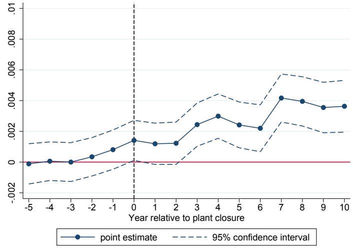


- Separated: single or cohabiting with new partner. Decomposition
- 10 years post displacement: 1.2 p.p. (5.7%) increase relative to control group

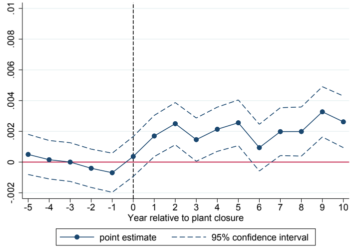
Job Displacement, New Partner Income

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

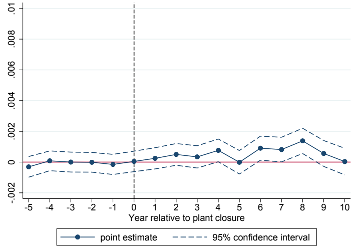
New partner higher inc. $> 5\%$



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	-7.731^{***}	0.312^{**}
	(936.2)	(0.827)	(0.129)
Displaced dummy (γ_1)	3013.3^{**}	3.629^{***}	0.194
	(1299.1)	(1.150)	(0.180)
N	62246	60018	47780

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

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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 **ShimerSmith2000** 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

2D-Matching

- 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.

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

NAM (1,1) $\Rightarrow \mathbb{E}[q_{f\mathcal{T}} - q_{f0} | q_{m\mathcal{T}} = q_{m0} - d, R = 1] \geq \mathbb{E}[q_{f\mathcal{T}} - q_{f0} | q_{m\mathcal{T}} = q_{m0}, R = 1]$

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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 $Corr(q_f, q_m)$
- Note: $\mathbb{E}[q_f|q_m]$ increasing in $q_m \Rightarrow Corr(q_f, q_m) > 0$
- Decomposition: consider $q''_m > q'_m$

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

2D-Matching

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Proposition

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

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\begin{aligned}
PAM(1,1) \quad & \Rightarrow \quad DE \geq 0 \\
NAM(1,1) \quad & \Rightarrow \quad DE \leq 0 \\
PAM(2,2) \text{ and } G(x_m|q_m) \text{ is increasing in } q_m \quad & \Rightarrow \quad IE \geq 0 \\
NAM(2,2) \text{ and } G(x_m|q_m) \text{ is increasing in } q_m \quad & \Rightarrow \quad IE \leq 0
\end{aligned}
$$

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 ($\Rightarrow Corr(q_m, x_m) > 0$)

is consistent with our empirical findings:

1. $\mathbb{E}[q_{fT} - q_{f0}|q_{mT} = q_{m0} - d, R = 1] - \mathbb{E}[q_{fT} - q_{f0}|q_{mT} = q_{m0}, R = 1] > 0$
2. $Corr(q_f, q_m) > 0$

Policy Implications

Tax Policy Effects

- Why is PAM or NAM in the income dimension important for tax policy?
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- Consider the introduction of 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. $\rightarrow$ Additional inequality reduction, supports policy effect
  - Given income-NAM, it becomes more likely that *high-income* individuals match with *high-income* partners. $\rightarrow$ Inequality rises, opposite direction of policy effect

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  - Given income-NAM, it becomes more likely that *high-income* individuals match with *high-income* partners. $\rightarrow$ Inequality rises, opposite direction of 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 Producton | Equilibrium | Calibration | Fit | US experiment

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 of the within-couple correlation in incomes arises from sorting in other dimensions
- 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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Related Literature

- **Marital sorting and inequality:**
  EikaEtal19, **GreenwoodEtal15**, **ChiapporiEtal20**

  → 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**:
  PilossophWee20, **ChiapporiEtal18**, **ChooSiow06**

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

back

Setup

- Time is continuous, discounted at rate r
- Male income $q_m \in \left[\underline{q}_m, \overline{q}_m\right]$, female income $q_f \in \left[\underline{q}_f, \overline{q}_f\right]$
- 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

back

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

back

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

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- Control: draw from men with tenure $\geq$ 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

back

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	

back

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

back

Additional Outcomes

	Age	Education	Kids
Constant (γ_0)	6.484^{***}	0.355^{***}	-0.228^{***}
	(0.0398)	(0.0102)	(0.00736)
Displaced dummy (γ_1)	-0.150^{***}	-0.0219	0.0259^{**}
	(0.0552)	(0.0142)	(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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Robustness

- 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

back

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

back

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

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$$+ \underbrace{\int \mathbb{E}[q_f|q'_m, x_m] dG(x_m|q''_m) - \int \mathbb{E}[q_f|q'_m, x_m] dG(x_m|q'_m)}_{:=\textbf{IE (Indirect effect)}}.$$

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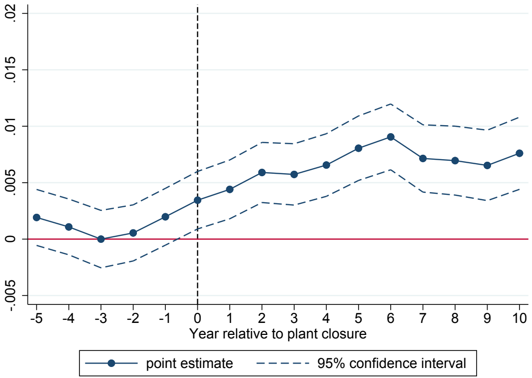
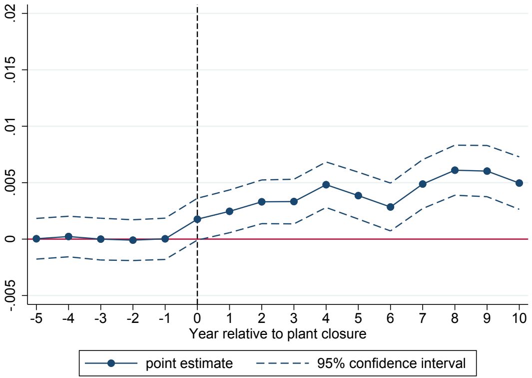
Job Displacement, Singles and Rematched

Single



New Partner



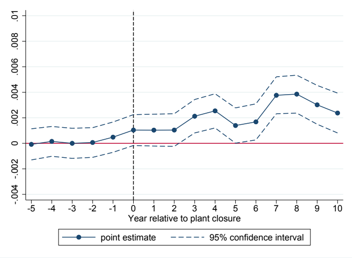
10 years post displacement:

- ≈ 40% of increase in separations are men with a new partner Go back

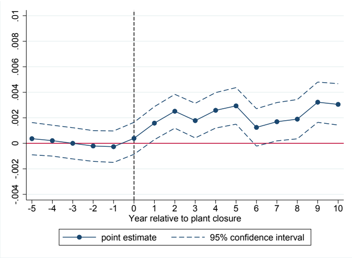
Robustness I

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

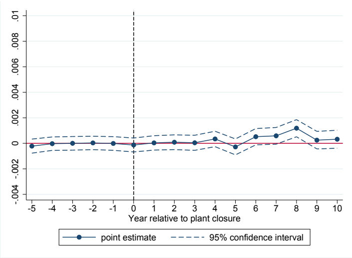
New partner higher inc. $> 5\%$



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



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



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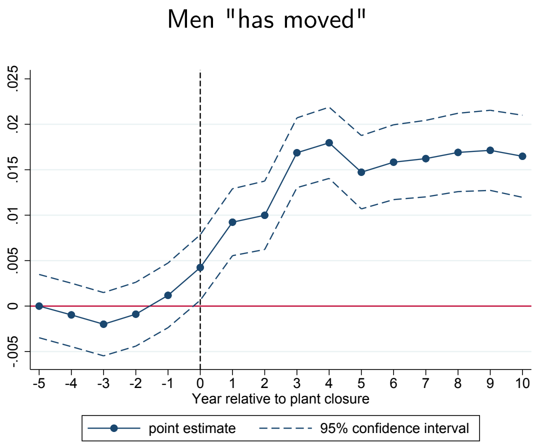
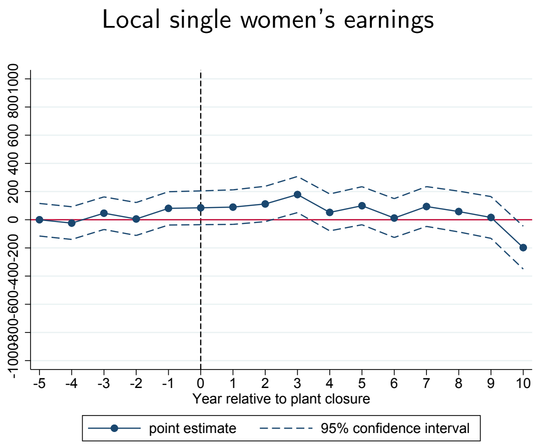
Robustness II





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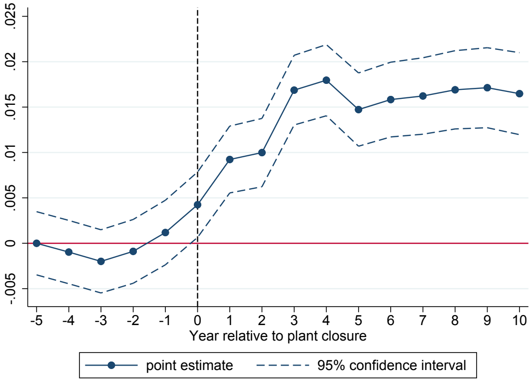
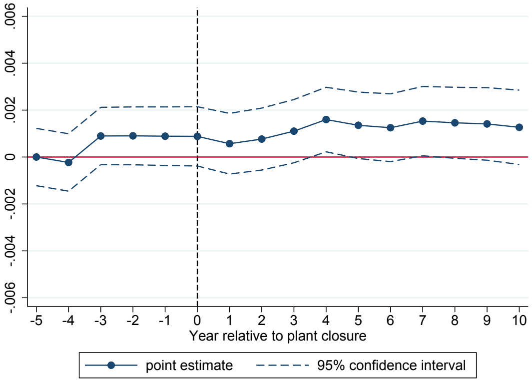
Robustness III

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 $\approx 2.4\%$

$\rightarrow$ 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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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.

(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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PAM

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 $q''_f \in \mathcal{M}(q'_m)$.

back

PAM (1,1)

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 $(q''_f\, x_f) \in \mathcal{M}(q'_m, x_m)$.

back

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).

$\rightarrow$ Income densities estimated, linked to attractiveness using copula and correlation ρ.

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- "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).

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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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- In 2D case, the second term is supermodular and induces attractiveness-PAM

$$f(x, y) = \gamma_1 \ln(q_m + q_f) - \gamma_3 (a_m - a_f)^2$$

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

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

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

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

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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

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Fit

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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