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Directed search on the marriage market

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Introduction

Person of your dreams $\Leftrightarrow$ Second best option

Smaller share of resources $\Leftrightarrow$ Higher share of resources

Low matching probability $\Leftrightarrow$ High matching probability

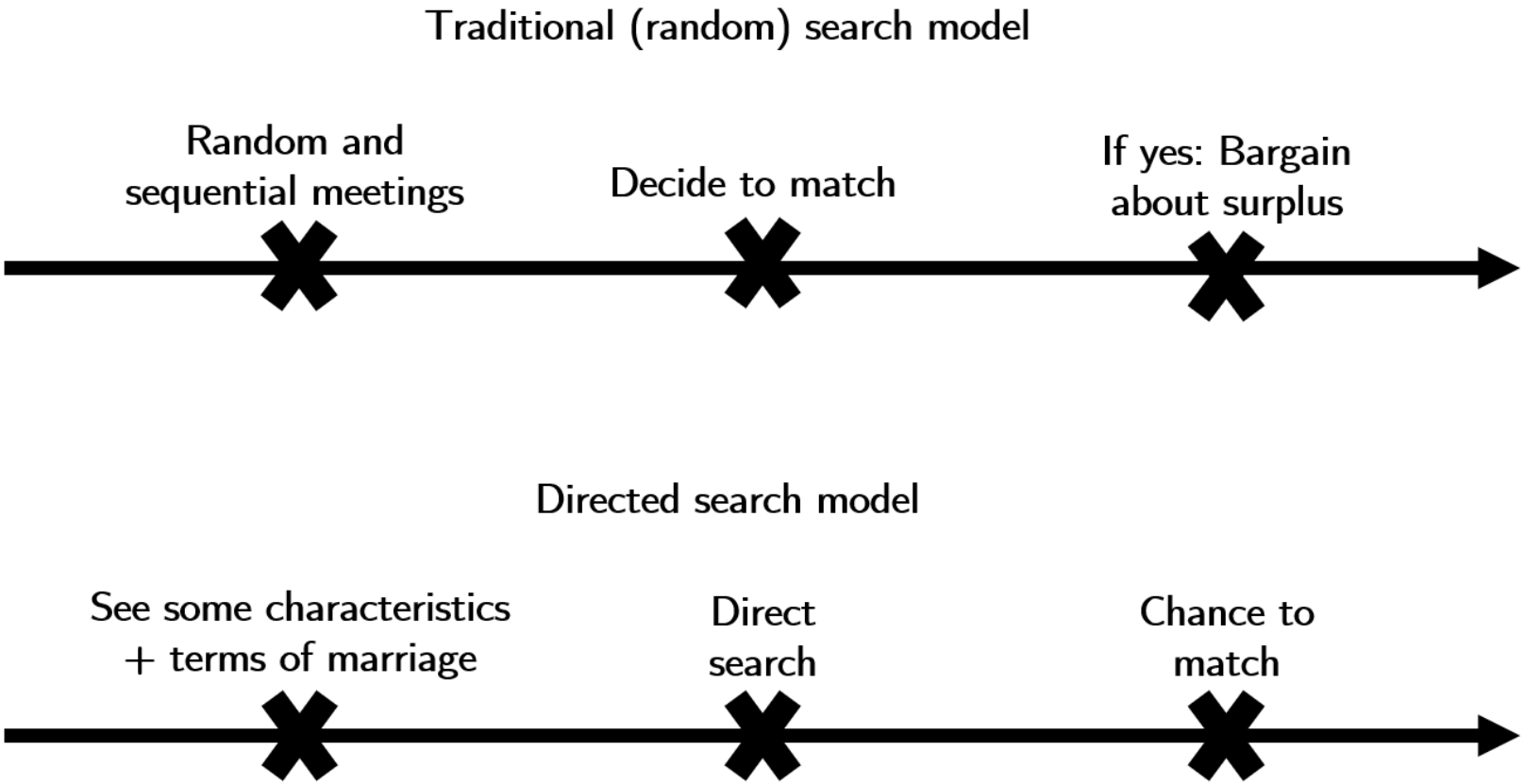
Introduction

In general

- Static two-sided directed search model applied to marriage market
- Trade-off between
  - Partner characteristics (i.e., race and education)
  - Marriage terms (i.e., labor supply division)
  - Matching probability
- Unravel male and female preferences (given observed matches)
  - Variation in gender ratios across regions

Introduction

Directed search vs. Traditional random search



Introduction

Contributions

- Literature applying directed search to marriage market
- Modeling advantages compared to random search model
  - NTU: individual-specific preferences separately identified ▸ Details
  - Modeled behavior is more efficient and realistic
  - Including market tightness
- Terms of marriage = Labor supply division
  - Individuals can commit to certain terms,
    $\Rightarrow$ e.g., man works FT, woman works FT

Chade, Eeckhout and Smith (2017)

"Consider for example the market for executives. In the random search framework, executives must randomly be paired with janitor jobs, to only reject those."

Model

1. Individuals

- Each male (female) is characterized by several observed traits, summarized by a type m (f), where m $(f) \in \{1, 2, ..., M$ $(F)\}$
- Let im stand for the i-th member of type m
- R possibilities to specify terms of marriage, where one particular possibility will be $r \in \{1, 2, ..., R\}$

- Every man (woman) makes a discrete choice to search in one of the $F \times R$ $(M \times R)$ markets, within his (her) own region ▸ Details
  - Terms are determined and fixed once market is chosen
  - No (re)negotiation
  - Marriage contract

Model

1. Individuals

- Expected utility of an m-type man searching for an f-type woman with marriage terms r depends on
  - Matching probability P_m^{fr}
  - Deterministic part of utility conditional on matching μ_m^{fr}
  - Individual-specific preference term ϵ_{im}^{fr}

$$E(U_{im}^{fr}) = P_m^{fr} \cdot e^{\mu_m^{fr} + \epsilon_{im}^{fr}} \tag{1}$$

$$\ln(E(U_{im}^{fr})) = \mu_m^{fr} + \ln(P_m^{fr}) + \epsilon_{im}^{fr} \tag{2}$$

- Utility of not matching $= 0$

Model

1. Individuals

- Man i of the m-type men decides to search on the $\{f,r\}$-market when

$$\{f,r\} = \arg\max_{f',r'} \mu_m^{f'r'} + \ln(P_m^{f'r'}) + \epsilon_{im}^{f'r'} \tag{3}$$

- ϵ_{im}^{fr}'s are i.i.d. type I extreme value errors

$$\Pr(f,r|m) = \phi_m^{fr} = \frac{\exp\left(\mu_m^{fr} + \ln[P_m^{fr}]\right)}{\sum_{f'}\sum_{r'} \exp\left(\mu_m^{f'r'} + \ln[P_m^{f'r'}]\right)} \tag{4}$$

Model

2. Matching

- X_{mfr} = Number of matches in $\{m,f,r\}$-market
  - Matching function
  - Inputs = Number of searching men and searching women
  - Ouput = Number of matches
- $\phi_m^{fr} N_m$ and $\phi_f^{mr} N_f$ = Number of searching men and women
  - ϕ_m^{fr} and ϕ_f^{mr} = Searching probabilities
  - N_m and N_f = Number of m-type men and f-type women

$$X_{mfr}(\phi_m^{fr} N_m, \phi_f^{mr} N_f) = A[(\phi_m^{fr} N_m)^\rho + (\phi_f^{mr} N_f)^\rho]^{1/\rho} \quad (5)$$

- A = Matching efficiency/Search frictions
- ρ = Substitution parameter

Model

Substitution parameter ρ

- $\rho \leq 1 \Rightarrow \rho < 0$
- If $0 < \rho \leq 1$
  - "Too many" matches (i.e., more matches than available partners)
  - Not possible
- If $\rho \to 0$, CES function $=$ Cobb-Douglas
  - Gender ratio drops out of matching prob.
  - Not desirable

Model

2. Matching

- By assuming that all m-type men searching in the same market have the same matching probabilities, P_m^{fr} can be written as

$$P_m^{fr} = \frac{X_{mfr}}{\phi_m^{fr} N_m} = \frac{A[(\phi_m^{fr} N_m)^\rho + (\phi_f^{mr} N_f)^\rho]^{1/\rho}}{\phi_m^{fr} N_m}$$
$$= A\left[1 + \left(\frac{\phi_f^{mr} N_f}{\phi_m^{fr} N_m}\right)^\rho\right]^{1/\rho} \quad (6)$$

- $\ln[P_m^{fr}]$ enters ϕ_m^{fr} = Influence of gender ratio on search decisions

Model

3. Equilibrium

- Whether or not searching on a market ⇒ Matching probabilities
- Matching probabilities ⇒ Search probabilities
  - Amount of competitors on particular market
  - Amount of potential partners on particular market
- Search probabilities become

$$\phi_m^{fr} = \frac{\exp\left(\mu_m^{fr} + \ln[P_m^{fr}(\phi_m^{fr}, \phi_f^{mr})]\right)}{\sum_{f'}\sum_{r'} \exp\left(\mu_m^{f'r'} + \ln\left[P_m^{f'r'}(\phi_m^{f'r'}, \phi_f^{m'r'})\right]\right)} \tag{7}$$

- Equilibrium obtained by solving for the fixed point defined by Equation 7

Model

4. Identification

- Two marriage markets: $\{m, f, r\}$ and $\{m, f, r'\}$

Theorem

Take $G_{mf} = N_m/N_f$. *If* $\rho < 0$ *and* $\mu_f^{mr'} - \mu_f^{mr} > \mu_m^{fr'} - \mu_m^{fr}$, *it holds that:*

$$i) \quad \frac{\phi_f^{mr}}{\phi_m^{fr}} < \frac{\phi_f^{mr'}}{\phi_m^{fr'}},$$

$$ii) \quad P_f^{mr} > P_f^{mr'} \text{ and } P_m^{fr} < P_m^{fr'}, \text{ and}$$

$$iii) \quad \frac{\partial(\phi_f^{mr'}/\phi_f^{mr})}{\partial G_{mf}} > 0 \text{ and } \frac{\partial(\phi_m^{fr'}/\phi_m^{fr})}{\partial G_{mf}} > 0.$$

Model

4. Identification

Elasticity of the probability of matching wrt the gender ratio:

- $G_{mf} = 1,\ \phi_m^{fr} = \phi_f^{mr} = \phi_m^{fr'} = 0.5,\ \phi_f^{mr'} = 0.6,\ \rho = -2$

$$\frac{\partial \ln P_m^{fr}}{\partial G_{mf}} = -\left[\left(\frac{\phi_m^{fr}}{\phi_f^{mr}}\right)^{\rho} G_{mf}^{\rho+1} + G_{mf}\right]^{-1} = -0.5 < -0.41 = -\left[\left(\frac{\phi_m^{fr'}}{\phi_f^{mr'}}\right)^{\rho} G_{mf}^{\rho+1} + G_{mf}\right]^{-1} = \frac{\partial \ln P_m^{fr'}}{\partial G_{mf}}$$

$$\frac{\partial \ln P_f^{mr}}{\partial G_{mf}} = \left[\left(\frac{\phi_f^{mr}}{\phi_m^{fr}}\right)^{\rho} G_{mf}^{-\rho+1} + G_{mf}\right]^{-1} = 0.5 < 0.59 = \left[\left(\frac{\phi_f^{mr'}}{\phi_m^{fr'}}\right)^{\rho} G_{mf}^{-\rho+1} + G_{mf}\right]^{-1} = \frac{\partial \ln P_f^{mr'}}{\partial G_{mf}}$$

Data

Dataset individuals

- ACS Public Use Microdata Sample (PUMS): 5y-estimates
  - 2015-2019
- Sample size (25-65 years old + married or cohabiting)
  - (Heterosexual) Couples: 2 288 182
  - Singles: 1 775 807

Gender ratios

- ACS: Sample gender ratios
- 51 US regions (50 states + District of Columbia)

▸ Descriptive statistics

▸ Matching distributions

Estimation

Utility functions

$$\mu_m^{fr} = \alpha_1^m SE_{mf} + \alpha_2^m PE_f + \alpha_3^m SR_{mf} + \sum_{j=1}^{4} I(PR_f = j)\alpha_{4j}^m + \sum_{k=1}^{9} I(ToM_{mf} = k)\alpha_{5k}^m \quad (8)$$

$$\mu_f^{mr} = \alpha_1^f SE_{mf} + \alpha_2^f PE_m + \alpha_3^f SR_{mf} + \sum_{j=1}^{4} I(PR_m = j)\alpha_{4j}^f + \sum_{k=1}^{9} I(ToM_{mf} = k)\alpha_{5k}^f \quad (9)$$

with

- $SE \in \{0, 1\} \Rightarrow$ Same education
- $PE \Rightarrow$ Partner's education
- $SR \in \{0, 1\} \Rightarrow$ Same race
- $PR \Rightarrow$ Partner's race
- $ToM \Rightarrow$ Terms of marriage: labor supply division

Estimation

Labor supply division

		Man	
Woman	HW	PT	FT
HW	{HW,HW}	{HW,PT}	{HW,FT}
PT	{PT,HW}	{PT,PT}	{PT,FT}
FT	{FT,HW}	{FT,PT}	{FT,FT}

Estimation

Likelihood function

$$\mathcal{L}_{if}(\theta) = I(y_{if}=1)\left[\sum_m \sum_r I(d_{if}=\{m,r\})(\ln[\phi_f^{mr}(\theta)] + \ln[P_f^{mr}(\theta)])\right]$$
$$+ I(y_{if}=0)\ln\left[\sum_m \sum_r \phi_f^{mr}(\theta) \times (1 - P_f^{mr}(\theta))\right] \quad (10)$$

with

- $\theta = \{\alpha, \rho, A\} \Rightarrow$ Needs to be estimated
- $y_{if} = 1 \Rightarrow i$-th woman of type f is matched
- $d_{if} =$ Search decision; $s \in \{1, ..., 51\} =$ Regions

$$\hat{\theta} = \arg\max_\theta \left(\sum_s \sum_f \sum_{i=1}^{N_f^s} \mathcal{L}_{if}^s(\theta) + \sum_s \sum_m \sum_{i=1}^{N_m^s} \mathcal{L}_{im}^s(\theta) \right) \quad (11)$$

Results

Structural model estimates	
A. Matching parameters	
ρ	-9.1472
	(0.5496)
A	0.9127
	(0.0064)
-log(L)	16462200
Time	+/- 5 days

Results

Structural model estimates

Preferences	**B. Men**	**C. Women**
Same education (α_1^m)	0.5946	0.8589
	(0.0045)	(0.0131)
Partner's education (α_2^m)	0.0690	-0.1824
	(0.0093)	(0.0191)
Same race (α_3^m)	2.3406	2.1509
	(0.0228)	(0.1066)
Partner White (α_{41}^m)	-1.2006	-1.1927
	(0.5004)	(0.5016)
Partner Black (α_{42}^m)	-4.1403	-3.8536
	(0.5066)	(0.5093)
Partner Hispanic (α_{43}^m)	-2.1641	-2.0503
	(0.5026)	(0.5106)
Partner Other (α_{44}^m)	-0.5040	-0.9055
	(0.5193)	(0.5446)

Results

Structural model estimates

Preferences	**B. Men**	**C. Women**
HW,HW (α^m_{51})	-2.0965	-2.4517
	(0.3365)	(0.3337)
HW,PT (α^m_{52})	-2.9926	-3.4310
	(0.3964)	(0.3649)
HW,FT (α^m_{53})	-0.5277	-1.0127
	(0.3352)	(0.3343)
PT,HW (α^m_{54})	-3.2394	-3.3588
	(0.4675)	(0.4945)
PT,PT (α^m_{55})	-3.2006	-3.2581
	(0.5988)	(0.6806)
PT,FT (α^m_{56})	-0.9136	-1.0804
	(0.3351)	(0.3364)
FT,HW (α^m_{57})	-2.2968	-1.8106
	(0.3348)	(0.3414)
FT,PT (α^m_{58})	-2.7004	-2.0388
	(0.3335)	(0.3347)
FT,FT (α^m_{59})	-0.0550	0.4358
	(0.3347)	(0.3336)

Conclusion

To Do list

- Specification of utility function
- Interpretation of results
- Counterfactual analysis

Model

Directed search - goods market

Return

- Random search: prices dictate how surplus is shared between buyers and sellers
  - Trading partners meet first and then negotiate prices
- Directed search: Also direct impact on meeting process
  - Sellers establish and publicly declare prices upfront
  - Buyers make informed decisions about which sellers they want to engage with
  - Allow buyers to direct search towards sellers who offer more attractive pricing

- Agents must not only consider terms of trade (i.e., prices), but also probability of trade

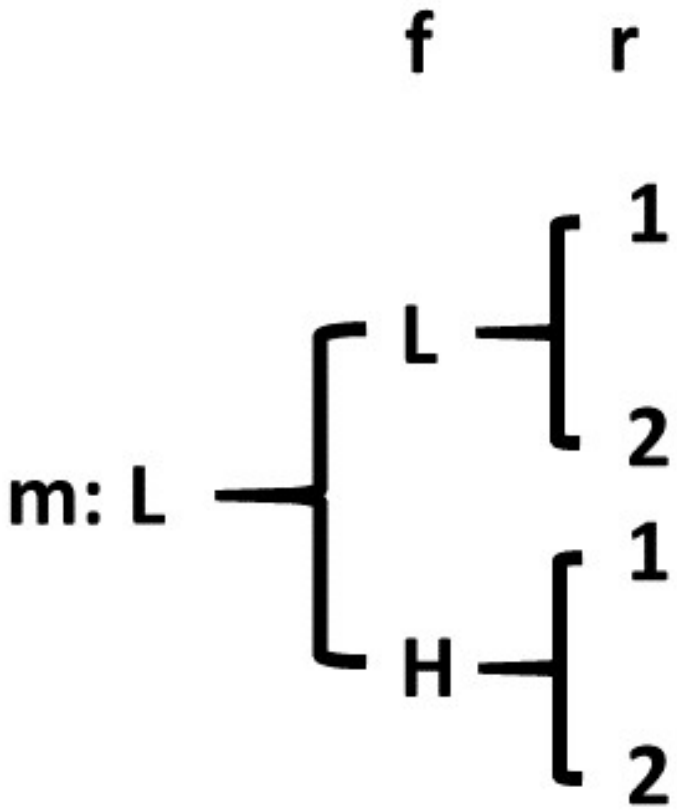
Transferable utility

Return

- Individuals can "bid" for their favorite partner by lowering own gain obtained from match such that partner can have a higher gain (Chiappori, 2017)
- Only joint gains from matching can be identified
  - Assume gender ratios do have impact on search behavior
  - Not clear in what way utilities are influenced by gender ratios because individuals might make transfers unobserved by econometrician

Markets

Return



Descriptive statistics

Return

Descriptive statistics

	Mean	SD	MIN	MAX
A. Couples				
Male age	47.59	10.92	25	65
Female age	45.65	10.92	25	65
Male has at least undergraduate degree	0.46	0.50	0	1
Female has at least undergraduate degree	0.52	0.50	0	1
Male work hours	38.24	15.96	0	69
Female work hours	27.68	18.59	0	69
B. Singles				
Male age	47.12	12.05	25	65
Female age	47.72	11.82	25	65
Male has at least undergraduate degree	0.42	0.49	0	1
Female has at least undergraduate degree	0.46	0.50	0	1
Male work hours	33.37	18.77	0	69
Female work hours	29.46	18.44	0	69

Note: Wages are net hourly wages in dollars. Work hours are hours per week.

Matching distributions

Return

Matching distribution across education

	Female education			
Male education	$\leq$ High school	Associate or Bachelor	Master $\leq$	Total
$\leq$ High school	37.07	13.60	3.31	53.97
Associate or Bachelor	8.90	16.17	6.05	31.12
Master $\leq$	2.05	6.21	6.65	14.91
Total	48.01	35.98	16.01	100.00

Note: The sample consists of 2 288 182 couples. The numbers in this table are displayed as percentages.

- +/- 60% same education
- +/- 23% wife higher educated than husband
- +/- 17% husband higher educated than wife

Matching distributions

Return

Matching distribution across race

	Female race				
Male race	White	Black	Hispanic	Other	Total
White	69.94	0.30	2.56	1.71	74.51
Black	0.80	5.13	0.25	0.11	6.29
Hispanic	2.25	0.10	9.89	0.21	12.46
Other	0.78	0.03	0.15	5.80	6.75
Total	73.76	5.55	12.85	7.84	100.00

Note: The sample consists of 2 288 182 couples. The numbers in this table are displayed as percentages.

- +/- 90% same race

Matching distributions

Return

Matching distribution across employment status

	Female employment			
Male employment	Unemployed	Part time	Full time	Total
Unemployed	4.31	1.57	5.07	10.95
Part time	1.70	1.69	3.55	6.94
Full time ($\geq$ 35h)	19.03	15.65	47.43	82.11
Total	25.05	18.91	56.04	100.00

Note: The sample consists of 2 288 182 couples. The numbers in this table are displayed as percentages.

- Majority couples have full time working husband

Matching distributions

Return

Gender ratios across race and education categories

Gender ratio (+25 years)	MIN	MEAN	MAX
All regions	0.89	0.95	1.09
White			
$\leq$ High school	0.93	1.02	1.27
Associate or Bachelor	0.77	0.88	1.03
Master $\leq$	0.68	0.89	1.51
Black			
$\leq$ High school	0.80	1.17	2.99
Associate or Bachelor	0.51	1.90	19.63
Master $\leq$	0.33	0.73	1.70
Hispanic			
$\leq$ High school	0.75	1.10	1.30
Associate or Bachelor	0.48	0.86	1.55
Master $\leq$	0.39	0.90	1.60
Other			
$\leq$ High school	0.54	1.28	1.51
Associate or Bachelor	0.32	0.43	1.45
Master $\leq$	0.54	1.22	2.46

Note: The gender ratio is defined as the ratio of total m-type men over total f-type women.

- Considerable variation across categories and US states