Learning in the Marriage Market: The Economics of Dating

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Matching with Search Frictions

- Choosing a partner is one of the most important decisions in a person's life
- Large literature on matching with search frictions studies related questions.

E.g., McNamara and Collins (1990), Bergstrom and Bagnoli (1993), Morgan (1996), Burdett and Coles (1997), Eeckhout (1999), Bloch and Ryder (2000), Shimer and Smith (2000), Chade (2001,2006), Adachi (2003), Atakan (2006); Smith (2006), Lauermann and Nöldeke (2014), Coles and Francesconi (2019), Bonneton and Sandmann (2019), Lauermann, Nöldeke and Tröger (2020), Antler and Bachi (2022)...

Basic framework

- A two-sided market.
- Agents randomly meet potential partners and, upon meeting, immediately decide whether to accept or reject the match.
- In reality, marriage is often preceded by period of *dating*: spending time to learn about compatibility before marrying.

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What we do

- Develop model of matching with search <u>and learning</u> frictions.
- Departing from existing matching-with-search-frictions literature, potential partners need not immediately decide whether to accept/reject their match, but instead may date in order to <u>gradually learn</u> about its merits.
- Dating is <u>mutually exclusive</u> (at least to some extent).
- <u>Tradeoff</u> between becoming better informed about one's compatibility with a potential partner and meeting other, more promising, potential partners.

What we do

Main Economic Questions:

1. Are dating and matching patterns efficient?
2. Under what conditions dating gives rise to assortative matching?
3. How are dating/marriage patterns affected by advances in search and in learning technologies (e.g., dating apps)?

Model Sketch

- Two-sided matching with nontransferable utility.
- Continuous time, discount rate r.
- Each agent characterized by observable *pizzazz* $x \in [0, 1]$.
- Pizzazz distributed according to $g(x)$ on both sides.
- At any point in time, each agent is either single, dating, or married. We focus on the steady state.
- Agents meet others at random:
  - Quadratic search technology with meeting rate μ (e.g., if the measure of women with pizzazz in Y is u, then each man meets single women with pizzazz in Y at a rate μu).

Compatibility and payoffs

- Every pair is either compatible or not.
- (Lack of) compatibility determines flow payoff from marriage:
  - from marriage to compatible partner $= 1$.
  - from marriage to incompatible partner $= -z < 0$.
  - Assume $z(1 - q_0(1,1)) > q_0(1,1)$: no marriage without dating.
- Agents x and y are compatible with probability $q_0(x,y)$.
  - strictly increasing, symmetric, differentiable, bounded derivative.
  - $q_0(0,0) > 0$ and $q_0(1,1) < 1$

Dating and marriage

- Pizzazz is observable, Compatibility is not.
- Upon meeting, agents can date before deciding whether to marry – dating requires mutual consent and is mutually exclusive. In the paper: direct cost of dating is allowed.
- Classic "no-news-is-bad-news" learning tech. (Keller Rady Cripps '05):
  - while dating, compatible couples "click" at rate λ.
  - incompatible couples never click.
- To maintain steady-state population of singles, marriages dissolve at rate δ (e.g., Shimer and Smith, 2000; Smith, 2006).

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Steady-state equilibrium

- Strategies: $T_x(y)$ amount of time agent x is willing to date agent y. If agents x and y meet, they date for (at most) $\min\{T_y(x), T_x(y)\}$:
  - if they click while dating, they marry immediately.
  - otherwise, they separate and return to singles market.
- Steady-state equilibrium:
  - Agents' strategies are optimal w.r.t. the endogenous composition of the singles market.
  - Distributions of agents that are single $u(\cdot)$, dating $d(\cdot)$, and married $g(\cdot) - d(\cdot) - u(\cdot)$ are stationary (balanced-flow condition) and consistent with agents' strategies.

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Plan

- Preliminary analysis $\leftarrow$
- Homogeneous pizzazz
    - Equilibrium: uniqueness and closed-form solution
    - Inefficiency
    - Comparative statics
    - Asymmetric dating costs
- Heterogeneous pizzazz
    - Existence of equilibrium
    - Assortative matching
    - Inefficiency
    - (limit) Comparative statics

Preliminary Analysis: Continuation Values

- Denote the continuation value of a single agent x by $W_s(x)$.
- Flow value of being single, $rW_s(x)$.

Preliminary Analysis: The dating problem

- Marginal value of dating a potential partner y, conditional on the partner's consent, is

$$\lambda q_t(x,y)\frac{1-rW_s(x)}{r+\delta}-rW_s(x), \qquad (1)$$

where $q_t(x,y)$ is belief about compatibility after having dated for t units of time. (full Problem)

$$\frac{dq_t}{dt}=-\lambda q_t(1-q_t)<0.$$

- Marginal value of dating is decreasing $\Rightarrow$ unique breakup threshold.

$$q^\star(x,y)\equiv\frac{rW_s(x)}{1-rW_s(x)}\times\frac{r+\delta}{\lambda}. \qquad (2)$$

Partial Equilibrium: Optimal dating

The break-up threshold

$$q^\star(x) \equiv \frac{rW_s(x)}{1 - rW_s(x)} \times \frac{r + \delta}{\lambda}.$$

induces optimal dating times:

$$T_x^\star(y) = \max\left\{0, \frac{1}{\lambda}\log\left(\frac{q_0(x,y)(1-q^\star(x))}{(1-q_0(x,y))q^\star(x)}\right)\right\}.$$

The greater y is, the longer it takes to reach x's breakup threshold:

$\rightarrow$Agents spend more time with high-pizzazz singles.

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Simple version: Homogeneous pizzazz

Suppose all agents have same pizzazz x_0.

Proposition

There exists a unique steady-state equilibrium. In equilibrium, agents date longer than is socially optimal.

Inefficiency arises because agents don't internalize their unavailability to others while dating.

Closed-form solution: allows us to derive comparative statics.

Impact of search frictions on marriage/dating patterns

What happens when the meeting rate μ increases?

1. Fixing the size of singles market, agents become more picky $\Rightarrow q^\star \nearrow$
2. Fixing agents' strategies, a higher μ reduces size of singles market $\Rightarrow$ less picky $\Rightarrow q^\star \searrow$

Proposition

The breakup threshold $q^\star$ is strictly increasing in μ.

E.g., dating apps that facilitate meeting partners (e.g., Tinder) reduce time invested in dating each potential partner.

Impact of learning frictions on marriage/dating patterns

On the other hand, reducing learning frictions (i.e., increasing λ):

1. Fixing the size of singles market, the higher marginal value of dating (more likely to click) makes agents learn more $\Rightarrow q^\star \searrow$
2. Fixing the breakup threshold, decreases time of dating and, hence, increases size of singles pool, which makes being single more attractive $\Rightarrow$ more picky $\Rightarrow q^\star \nearrow$

Proposition

If δ is sufficiently small then the breakup threshold $q^\star$ is strictly decreasing in λ.

Plan

- Preliminary analysis
- Homogeneous pizzazz
  - Equilibrium: uniqueness and closed-form solution
  - Inefficiency
  - Comparative statics
  - Asymmetric dating costs
- Heterogeneous pizzazz←
  - Existence of equilibrium
  - Assortative matching
  - Inefficiency
  - (limit) Comparative statics

Heterogeneous Pizzazz

Agents are heterogeneous, with pizzazz distributed according to a distribution with continuous density $g(\cdot)$.

Equilibrium existence

Theorem

A steady-state equilibrium exists.

- We follow the approach pioneered by Shimer Smith (2000, TU) and Smith (2006, NTU) and prove existence in the value function space.
- Main differences:
  - Existence proofs in the literature typically rely on "acceptance sets" (as agents' decision are binary – accept/reject). In our model, agents choose for how long to date their potential partners.
  - Smith (2006): distinction between existence proof method of TU and NTU search models lies in discontinuity of the value functions.

    In our model, continuous choice of dating times replaces continuous surplus division in smoothing the value functions.

Continuity of value function and breakup threshold

Lemma

$W_s(x)$ and $q^\star(x)$ are continuous.

Intuition:

- Since y uses breakup threshold and prior belief that (x, y) is compatible is continuous in x, if x and x' have similar pizzazz, then y is willing to date them for a similar amount of time.
- By mimicking x''s behavior, x can obtain a similar payoff.

$\Rightarrow$ $W_s(x)$ must be close to $W_s(x')$.

- Continuity of $q^\star(x)$ follows from continuity of $W_s(x)$.

Sorting: failure of block segregation

- Matching with NTU often leads to "block segregation": agents are partitioned into classes, and marry only within their class.
  - Agents with similar pizzazz may have an entirely disjointed sets of marriage partners.

- In our model, block segregation fails. Intuition:
  - Value functions are continuous.
  - Agents of similar pizzazz cannot belong to different classes.

Probabilistic notion of assortative matching

Matching is probabilistic: it matters not only who dates whom, but also with what probability such dating leads to marriage.

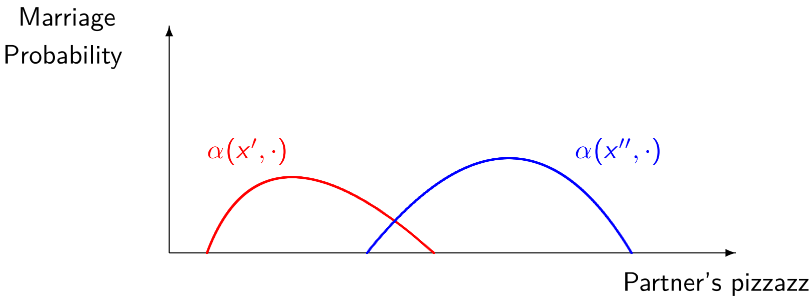
Denote by $\alpha(x, y)$ the probability that agents x and y marry, conditional on meeting ("conversion rate").

New, probabilistic, notion of assortative matching.

Single-crossing in marriage probabilities

Fix $x' < x''$. There exists a critical pizzazz level $y^\star$ such that agent x'' has a higher probability of marrying agents with pizzazz $y > y^\star$ and agent x' has a higher probability of marrying agents with pizzazz $y < y^\star$.

*



High-pizzazz agents are more likely to marry other high-pizzazz agents, but on occasion may marry low-pizzazz agents.

Assortative matching: single-crossing

Theorem

If $q_0(\cdot,\cdot)$ is supermodular, then every equilibrium marriage-probability function satisfies single-crossing.

Comparison: q_0 can be thought of the payoff/production function in the standard setting.

- Smith (JPE, 2006) shows that without prematching learning supermodularity of the production/payoff function is insufficient for assortative matching.
- In the standard setting the sufficient condition is stronger: log-supermodularity.

Vanishing learning frictions

Proposition

As $\lambda \to \infty$, agents are willing to date everyone: $q^\star(x) \underset{\lambda\to\infty}{\longrightarrow} 0$ for every x. Hence, as learning frictions vanish, dating becomes non-assortative.

- Dating becomes so effective that, in essence, compatibility is observable.
- (recall that $q^\star(x) = \frac{rW_s(x)}{1-rW_s(x)} \times \frac{r+\delta}{\lambda}$. Since $W_s(\cdot)$ is bounded away from $\frac{1}{r}$, $\lim_{\lambda\to\infty} q^\star(x) = 0$)

Vanishing search frictions

Proposition (Dating Apocalypse)

- *As search frictions vanish, agents are only willing to date agents of their own pizzazz and above:* $q^\star(x) \underset{\mu\to\infty}{\longrightarrow} q_0(x,x)$ *for every* x.
- *There is full assortative matching: agents only date (and marry) agents of their own pizzazz.*
- *Amount of time each couple dates before marrying goes to zero.*
- *Average # of partners an agent dates before marrying goes to infinity.*

Conclusions

- We introduce dating into the canonical model of the marriage market.
- Dating leads to probabilistic positive assortative matching.
- Dating choices are inefficient:
  - Dating times are excessively long.
  - Sorting may be inefficient.
- Search and learning frictions have qualitatively different affects on equilibrium outcomes, in particular, on sorting.
- The symmetric model is equivalent to a TU model.
  - Prematching learning (due diligence, hiring processes) is excessively long)

Thank you!