DATING MARKET, FAMILIARITY GRAPHS, AND SELECTIVITY

ALEXANDER NESTEROV†

Abstract. I study how modern dating technologies affect the dating market outcome when agents' preferences are correlated and selective. I find that when men and women are equally selective, the average size of the induced stable matching does not depend on how many potential partners people know. But when men and women have different selectivity, the more potential partners people know, the smaller is the matching, and the more men and women remain single.
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Extended abstract

The world is experiencing a change in the dating technologies in forms of smartphone apps, dating websites, and richer social networks. These technologies reduce the search costs and make their users familiar with more potential matching partners than they would otherwise be. How does this expansion of the choice set affect the resulting matching? Given the standard economic intuition as well as the popularity of these dating technologies, it appears that as every user gets a wider choice set, the overall well-being should increase. In contrast to this, I show that under two realistic assumptions, wider choice sets on average induce a smaller matching and leave more people single.[1]

The two assumptions are about people's preferences. First, I assume correlated preferences: men have similar preferences over women and women have similar preferences over men. In an extreme version, all agents on one side have the same homogeneous preferences over the agents on the other side. Second, I assume selective preferences: among all familiar partners, each agent deems only a fraction of partners as acceptable, meaning that matching with them is more preferred than to remaining single. In an extreme version, each man has the same selectivity s_m that is equal to the fraction of acceptable women among all familiar women, and each woman has selectivity s_w that is equal to the fraction of acceptable men among all familiar men.[2]

This dating market is modelled using the classical marriage market model (Gale and Shapley, 1962) with a little twist: there is a set M of n men, a set W of n women, and an undirected **familiarity graph** F that determines who is (mutually) familiar with whom. For simplicity, I take the familiarity graph to be very symmetric: each man is familiar with exactly k women and each woman is familiar with exactly k men. Then, due to selective

†Department of Economics and Game Theory Lab, HSE University, 16, Soyuza Pechatnikov st., 190121, St. Petersburg, Russia, nesterovu@gmail.com
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[1] Antler and Bachi (2022) come to similar conclusions in a two-sided search model and assuming that agents are overconfident.

[2] Fisman et al. (2006) find that in small groups men and women reject about half of potential partners; in larger groups men behave the same while women become more selective.

preferences, each man among his k familiar women deems $\lfloor s_m k \rfloor$ more preferred women as acceptable, and each woman among her k familiar men deems $\lfloor s_w k \rfloor$ more preferred men as acceptable. The degree $k \in (1, \ldots, n)$ of the familiarity graph is the main parameter of interest; the lower are search costs on a dating market, the higher is k.

The solution concept for this dating market is stability. A one-to-one matching of men and women μ is **stable** if (1) in each matched pair a man and a woman are matched to their acceptable partners, and (2) there does not exist a (blocking) pair of a man and a woman who are not matched to each other under μ, but both prefer being matched to each other over what they received under matching μ. Once we assume homogeneous preferences for at least one side, each dating market always has a unique stable matching. We are interested in $\langle |\mu^k| \rangle$ – the average size of the stable matching in a dating market with a random familiarity graph of degree k.

I obtain two theoretical results. The first result shows that if men and women have the same selectivity, the average matching size is the same for the random *sparse graph* where each man and each woman knows $k = \lceil 1/s \rceil$ partners (so that exactly one partner is acceptable) and for the *complete graph* where each man and each woman know all $k = n$ partners.

Proposition 1. *Let men and women have homogeneous preferences and the same selectivity, $s_m = s_w = s$. Then the stable matching for a random sparse familiarity graph and for the complete graph has the same average size, $\langle |\mu^{\lceil 1/s \rceil}| \rangle = |\mu^n| = \lfloor sn \rfloor$.*

Empirical simulations generalize this result and show that the average matching size does not depend on the density of the familiarity graph k for intermediate values of $k \in [\lceil 1/s \rceil, \ldots, n]$.

The intuition behind this result is as follows. As the familiarity graph becomes denser, two effects are at play. First, each agent receives a larger set of acceptable potential partners, which should be beneficial for the matching size. This is true even for less preferred agents, who do not receive a stable partner in the complete graph. The second effect is that as k increases, these less preferred agents receive a higher chance of being unacceptable for all of their acceptable partners because of homogeneous preferences. Perhaps surprisingly, these two effects on average perfectly countervail each other, and it occurs only when selectivity for men and women is the same.

The second result shows that if men and women have different selectivity, and let w.l.o.g women be more selective than men, $s_w < s_m$, then for the same random *sparse graph*, $k = \lceil 1/s_w \rceil$, where each woman has exactly one acceptable man (and each man might have more than one acceptable woman), the average stable matching size is higher than for the *complete graph*.

Proposition 2. *Let men and women have homogeneous preferences and let women be more selective than men, $s_w < s_m$. Then the stable matching for a random sparse familiarity graph has a larger average size than for the complete graph, $\langle |\mu^{\lceil 1/s \rceil}| \rangle > |\mu^n|$.*

The intuition behind the second result is the following. Consider some man m and his best acceptable woman w. This woman has only one acceptable man, and the probability of m matching with w is exactly the same as in the case of Proposition 1, where men have the same selectivity as women. But this time men are less selective, and in case w does not find m acceptable, he has a second chance with his second best acceptable woman, and then with his third best acceptable woman, and so on. Empirical simulations show that the average size of a stable matching monotonically decreases as k increases from $\lceil 1/s \rceil$ to n.

Finally, I present the empirical results for a simulated dating market with general preferences. Let each agent x's utility $u_x(y)$ from matching with partner y have three random components distributed uniformly on $[0,1]$: the common component of partner y denoted as v_y^{common} (which was the sole component in the model considered above), the random idiosyncratic component $v_{xy}^{idiosyncratic}$, and the mutual preference component, $v_{xy}^{mutual} = v_{yx}^{mutual}$,

$$u_x(y) = \alpha v_y^{common} + (1-\alpha)(\beta v_{xy}^{random} + (1-\beta) v_{xy}^{mutual}).$$

The parameters chosen for simulations are $n = 1024$, k takes values $k = 2^i$ where $i \in \{0, 1, ..., 10\}$, selectivity is $s_m = 0.5, s_w = 0.15$.[3]

When preferences are homogeneous ($\alpha = 1$), the average matching size for a sparse graph is around 300 (out of 1024), and as k grows, the size steeply decreases to around 150. In general, the size-maximizing value of k depends on the values of α and β: the less homogeneous and thus more random or more mutual the preferences become, the higher is the size-maximizing degree k.

To conclude, these results provide a novel theoretical explanation how lower search costs on a dating market can result in a larger number of unmatched individuals.

References

Antler, Y. and Bachi, B. (2022). Searching forever after. *American Economic Journal: Microeconomics*, 14(3):558–90.

Fisman, R., Iyengar, S. S., Kamenica, E., and Simonson, I. (2006). Gender differences in mate selection: Evidence from a speed dating experiment. *The Quarterly Journal of Economics*, 121(2):673–697.

Gale, D. and Shapley, L. S. (1962). College admissions and the stability of marriage. *American Mathematical Monthly*, 69(1):9–15.

[3]This is close to the statistics of Tinder users, according to the New York Times https://www.nytimes.com/2014/10/30/fashion/tinder-the-fast-growing-dating-app-taps-an-age-old-truth.html