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Missing Links: Referrer Behavior and Job Segregation (Appendix)

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APPENDIX

There are some ways this simulation version of the model would be expected to differ from the mathematical version. The most notable difference arises from the discrete nature of agents in the simulation compared to the continuous nature of the mathematical model. That is, the mathematical model can accommodate fractions of employees while the simulation model cannot. This difference is most clearly an issue for referring asymmetries by referral status. Both models begin with no referrals in the firm. With the mathematical model, the first generation of hires necessarily includes some fractional proportion of male and female network hires as well as male and female non-network hires, even if the turnover rate is such that the first vacancy being filled was only a fraction of an individual. With the simulation model, an agent must exit before another can be hired, and the hired agent can only be one of four worker categories (male or female and network or non-network hire). In the simulation model, if referring is to take place when there is only one referral hire in the firm, then only either 0% or 100% of referral hires can refer. In the mathematical model, fractional individuals can refer fractional network applicants. If a category of worker that would refer in the mathematical version is not present in the simulation version, then the simulation version simply selects a referrer at random among the agents in the firm. This implementation biases the simulation of the mechanism towards representative rather than asymmetric referring behavior. This issue would also affect the asymmetry in referring by sex if we were to initialize our model with an all-male or all-female firm, but we do not. We can minimize, but not wholly eliminate this issue by making a large firm size. There are computation time costs to this as well. Our simulation model sets the firm size to 333 agents.

Figure A1 presents paired results from the mathematical model and our agent-based simulation using both the neutral and the extreme parameter values for the two referring asymmetry mechanisms. For *a*, the asymmetry in referring by sex parameter, a value of 1 represents no bias, a value of 1.4 represents a bias where women have a relative probability of referring 40% greater than that for men, and a value of 0.8 represents a bias where men have a relative probability of referring 20% greater than that for women. For *r*, the asymmetry in referring by referral status, a value of 1 represents no bias and a value of 7 represents a bias where network hires have a relative probability of referring 600% greater than that for non-network hires. These are the extreme values around the observed values documented in the empirical cases discussed above.

Panel I of Figure A1 shows model outputs from network recruitment with segregated contact networks when both asymmetries are neutral (a=1, r=1). Panel II shows the cases when the referring asymmetry by sex is at its upper and lower bounds while the asymmetry by referral status is neutral (a=0.8 or 1.4, r=1). Panel III shows the case when referring asymmetry by referral status is at is upper bound and the asymmetry by sex is neutral (*a*=1, *r*=7), and Panel IV shows when both parameters are at their extreme bounds of the parameter space (*a*=0.8 or 1.4, *r*=7). As expected, the simulation results are very close to those of the mathematical model. Where the two models differ are in the presence of the asymmetry in referring by referral status, and in those cases, the simulation results are biased to less of an effect from the mechanism than the mathematical model. These results are precisely as we expected, and reflect both that the simulation model is faithfully implementing the network recruitment dynamics as we have described them, and that the differences entailed by the discrete nature of the simulation model tend to make its results even more conservative (i.e., in the direction of less of a segregating effect) than those of the mathematical model. Because individuals are discrete, the simulation results are more realistic in addition to being more conservative. For both of these reasons, and because of the model validity suggested by the successful docking of our simulation model to our mathematical model (Burton 2003), we hereafter present model results exclusively from our simulation model.

Figure A1: Comparison of Mathematical and Simulation Model results for extreme values of the referring asymmetry a (by sex) and r (by referral status) parameters. Basic network recruitment model parameters are fixed as follows: b (baseline composition) = 0.65, x (turnover rate) = 0.01, p (proportion network applicants in applicant pool) = 0.5.