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Reduced-Form Estimation vs. Structural Modeling in Labor Economics

This analysis is to compare and contrast two labor papers presented at the IZA Young Professionals program at Georgetown University last week. They are *Explaining Charter School Effectiveness* by Angrist, Pathak and Walters and *Matching, Sorting and Wages* by Lise, Meghir and Robin. The first one uses a reduced-form approach to study the treatment effect of charter school attendance while the second one develops a structural search-matching model to study optimal labor market policies. As will be discussed below, these two papers ask very different questions; and thus utilize very different empirical approaches, both well-suited for the purposes of each paper.

In the *Explaining Charter School Effectiveness* paper, the authors ask the following questions: Do charter schools generate achievement gains? What are the causes of charter school treatment effect heterogeneity?

They conduct a semi-parametric investigation of heterogeneous potential outcomes, and estimation of LATE gives mixed results for urban and non-urban charter schools. This charter school treatment effect heterogeneity is referred by the authors as “urban charter advantage”: urban charter schools boost student achievement while charter schools in other setting do not. Then they seek to isolate sources of charter effect heterogeneity through both student-level and school-

level explanatory variables. On the student-level, student demographics explain some of the urban charter advantage because urban charters are most effective for non-whites and low-baseline achievers; in other words, there is a big gap between urban non-treated counterfactuals and non-urban ones, and going to charter schools bridges this gap because urban charter schools push the scores of their students from a typically low level up to a level much closer to the achievement seen among non-urban charter students. On the school level, they find that over-subscribed charter schools with high-quality lottery records seem more effective than non-lottery schools, and they also find strong evidence supporting the effectiveness of No Excuse.

The reduced form approach used in this paper is well-tailored for the purpose of the paper--investigating the effectiveness of one specific policy which was implemented through lottery and has a clear treatment effect interpretation. The charter school admission lotteries provide a random experiment for the study, and the authors can use the sample of lotteried applicants to investigate potential outcomes of compliers and counterfactuals. The choice of a reduced form treatment model is natural having a random sample (to some extent), and also intuitive based on the nature of the question, that is, the policy at question has clear impacts that can be quantified (student achievement), and outcomes on the treated are observed while potential outcomes on the counterfactual non-treated can be found through matching. In addition, it has the advantage of being able to identify and decompose causal effects.

However, the choice of reduced form approach also inevitably suffers from sample selection bias because of the nature of the sample. Specifically, the sample used in the paper are students that won charter school enrollment lotteries, which means that they would all potentially go to the over-subscribed (and thus better) charter schools; as a result, the estimation of treatment ef-

fect on the treated will be boosted in the sense that it actually measures the treatment effect of a subsample, or the "better" charter schools. Moreover, as the authors have also point out, schools that keep better lottery records seem more effective than non-lottery schools, thus one might reasonably argue that better school management may also partly contribute to the positive treatment effect of urban charter schools. As for the drastically different treatment effect of urban and non-urban charter schools, one might also argue that, since $Y_{0i\text{-urban}} < Y_{0i\text{-nonurban}}$, the charter effect heterogeneity may simply be due to a non-linear treatment function, i.e. average treatment effects are larger for student with lower pre-treatment scores, and charter schools are non-effective for non-urban compliers who started off with higher pre-treatment scores. A similar line of argument can be drawn on the school-level explanation. "Urban charter advantage" may be explained by worse urban public school system or better non-urban public school system. Overall, in terms of the policy questions, such a reduced form approach suffices to answer the questions raised and the paper successfully identifies the difference in charter school effects; however, in terms of finding the causal effects of "urban charter advantage", the reduced form approach is limited. Although the estimated moments give a lot information, the implications are mixed and without a structural model, one cannot make causal statements merely based on estimated moments.

In the *Matching, Sorting and Wages* paper, the authors consider more complex questions: What are the effects of labor market policies? What are the optimal policies? They incorporated a macro equilibrium model of wage determination and employment with micro search-matching model to estimate potential gains and redistributive effects from optimal policies in a labor market with heterogeneous agents.

To justify the existence of any labor market regulations, the model in this paper is built for the purpose of the question: a frictional environment. The model offers an empirical framework for understanding employment and wage determination in the presence of firm-worker complimentarities, search frictions and productivity shocks, and offers a way for evaluating the extent to which regulations can be welfare improving and for analyzing the effects of regulation on the distribution of wages and profits thus showing who pays and who benefits from such a policy in this non-competitive environment. The wage dispersion are generated by the nature of search-matching models and additional components such as heterogeneous agents and productivity shocks.

A structural model in the context of this paper is not only suitable, but also necessary. The analysis of labor market policies is essentially a study of potential effects of perturbations or interventions that can have impacts on the entire labor market dynamics; thus a equilibrium model suits the purposes of this paper well. In addition, not all endogenous elements in the wage dynamics are observed. For example, the authors argue the need of considering sorting on unobserved characteristics, which requires a structural model to recover the true underlying joint distribution of characteristics. More importantly, by having a structural model, one can have a detailed and well-defined analysis of the wage dynamics because it is generated by the structure of the model.

Without doubt, the validity of the model depends on how well it explains the reality (at least for key parameters). For this reason, the authors check the fit of the model by simulating the model and see if it has comparable key parameters as documented data, i.e. if the structural model dynamics can replicate the observed dynamics. Here, the advantage of having a well-fit structural model is most prominent; that is, when the model is more thoughtfully constructed and

better mimic the reality, the implications from hypothetical policy experiments on the model will be more reliable and indicative. The convenience of having a structural model also lies in that one can trace the details of labor market dynamics through the lens of the model; in the example of this paper, the structural interpretations based on productivity shocks and behavioral response in wage setting, all of which are stepping stones for policy designs and analysis. One, however, cannot overlook the computational burdens, identification complexity, and parametric restrictions that a structural model like this would encompass.

Comparing the two papers discussed above, they both study policy implications; however, they are in different settings and of different levels of complexity. Angrist et. al. evaluate the impacts of a specific education/human capital policy that has been implemented in reality, while Robin et. al. seek to find the optimal labor market regulations through experiments in a structural model. Because of the difference of natures of the questions asked in these two paper (the former is a more clear-cut cause-effect question, while the latter is a much more complicated question in a environment that contains numerous components, observed and unobserved, interacting with each other), two distinct methods are used. I do think that both methods are well-suited for the topics and the data sets at interest. Reduced form approach is a natural choice for studying the treatment effect of charter schools since this question is inspired by a specific policy event that has taken place in real life and good data sets are at hand. Interesting, yet, limited implications can be drawn from the analysis based on the observed data and technique used. On the other hand, it is not realistic to run through all possible labor market regulations in reality; nor is it possible to analyze policy effects since there are unobserved endogeneity. Thus, building a structural model is good and possibly only solution to study the impacts of hypothetical labor market

policies and look for the optimal, efficiency-promoting one. In conclusion, each of the reduced-form and structural methodologies has its merits and restrictions, and the choice of which approach to use depends on the questions being raised.

Reference:

J. Angrist, P. Pathak, and C. Walters (2011) Explaining Charter School Effectiveness NBER working paper 17332.

J. Lise, C. Meghir and J. Robin (2012) Matching, Sorting and Wages Working paper