Problem Set #1
MACS 30000, Dr. Evans
Yutao Chen

It is unexpected for me to realize that structural econometrists have confronted with so many doubts at present after reading papers from (Keane 2010) and (Rust 2010). Though as a supporter of data-driven analysis, I still agree that some pre-knowledge or theories are important and sometimes necessary for impactful research. Structural models are usually built from a more deductive perspective while reduced form ones tend to be more inductive, both of which can be helpful for certain research questions. I think there is no absolute advantage for either of them.

From my research experience, structural models are still widely applied in fields like industrial engineering, operational research (IEOR) as (Rust 2010, 21) suggests, especially when incorporating dynamic processes or even games. For these issues, we need to consider the behaviors of not only ourselves but also other agents, whose data might be insufficient or unavailable until they have already made their decisions. Therefore, inferring from the root is sometimes the best way to get a solution. Also, another advantage for structure models is their better Interpretation. (Keane 2010, 9-10) gives quite explicit explanations for the application of structural functions to study the impact of mother's behaviors on child cognitive developments. As a comparison, when substituting part of the function with the instrumental variable of welfare policy, researchers can barely get a simple conclusion but unable to figure out the detailed mechanisms in it. Meanwhile, this example also reveals the dependency on assumptions in structural models. For most quantitative social science research, I think assumptions are kind of necessary, regardless of structural or reduced-form models. Just like what has been mentioned by (Keane 2010, 5-6) in the study of the effect of military service on subsequent earnings, the use of draft lottery numbers as the instrument actually presumes that other factors like schooling or expected self-investment would not have a systematic influence. Compared with reduced-form models, the assumptions for structural models are usually more concrete. For instance, the establishment of child cognitive ability production function assumes that " Mothers know their child's cognitive ability endowment" and "Mothers know the form of the cognitive ability production function" (Keane 2010, 11), which are already too quantitative in reality. Furthermore, structural functions' assumptions are often attached to their deduction and calculation as (Keane 2010, 9) mentioned: "One can only distinguish production from utility function parameters using prior theoretical assumptions." These assumptions sometimes heavily restrict the usability of those structural models, making them poorly fit real data. However, if assumptions could be made caterer to real life through model validation, there should be new opportunities for structural models to develop.

Reduced-form models, on the contrary, has grown to be quite popular in academic fields these days. As mentioned above, reduced-form models also need assumptions,

but most of which are statistical assumptions like normal distribution assumption, which are usually less strict than those of structural models. Despite (Keane 2010)'s intense refutation, the use of instrumental variables is still one big advantage of reduced-form models, allowing researchers to make causal inferences beyond existing theories and at the same time, supported by real-world data. Finding new relationships that are kind of "indirect" is what structural models are hard to achieve since these models generally require few prior theories. A major concern for reduced-form models, especially those involving sampling and treatment, is the effectiveness of samples in different groups, according to (Keane 2010, 12). Though we might not be able to completely eliminate the impact of the differences or heterogeneity, some frameworks (Salganik 2018, section 3.3) have been proposed to analyze these possible errors and only certain types of heterogeneity, which might cause systematic bias, would invalidate the results. Besides avoidance, resolutions like post-stratification are also put into practice, which can largely alleviate the bias even after the samples are acquired. However, as the theory requirements are also "reduced", these models also sacrifice part of their interpretability. For those built on instrumental variables, what we can interpret on are just these instrument variables, which can not fully satisfy mechanism oriented questions. Even worse are for machine learning methods. Despite their popularity, it is very difficult to understand or explain why some results occur, such as those generated from neural networks. One thing I agree with (Rust 2010, 22) on the attitude of reduced-form models is the motivation to use them, not just for entertaining or eye-catching topics. Instead, we should use their advantages to discover some hints for new theories or make completion to existing ones, and to validate some relevant theoretical models.

In conclusion, I think academia should acknowledge the value of both types of models since they are largely complementary from some mentioned aspects above. Our goal is supposed to flourish both of them rather than make only one of them survive.

References

Keane, Michael P., "Structural vs. atheoretic approaches to econometrics," *Journal of Econometrics*, May 2010, *156* (1), 3–20.

Rust, John, "Comments on: âStructural vs. atheoretic approaches to econometricsâ by Michael Keane," *Journal of Econometrics*, May 2010, *156* (1), 21–24.

Salganik, Matthew J., *Bit by bit: social research in the digital age*, Princeton: Princeton University Press, 2018. OCLC: on1012406622.