Research Statement

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Introduction

I am an econometrician with a particular interest in the interface between theory and practice. My perspective on econometric issues is informed by a desire to improve the methods available to practitioners in applied microeconomics. The three main topics of my recent and ongoing research are model selection and averaging, measurement error, and models with social interactions. Two important themes underlie much of my work: an interest in issues of model mis-specification, and the use of instrumental variables to identify causal effects. I also work on substantive applications with a significant econometric component, primarily in applied microeconomics.

Model Selection and Averaging

What makes a good model? How should we choose between different assumptions? These are crucial questions faced by any applied researcher. The dominant paradigm for model selection research in econometrics has been to establish conditions under which it is possible to achieve consistent model selection. This term refers to the idea of selecting the "true" set of assumptions from a large set of candidates with very high probability as we accumulate more and more data. In empirical practice, however, it is far from clear that consistent model selection is a desirable goal. For one, the true model may not be among the candidates we are considering. But even more fundamentally, even if a model is true that does not imply that we should use it. Models based on weaker assumptions are clearly more plausible, but are also noisier: all else equal, stronger assumptions squeeze more information out of the same data. But if these assumptions are incorrect, this information could be seriously misleading. My work on model selection develops methods to navigate this tradeoff in the context of Generalized Method of Moments (GMM) estimation.

The basic idea is as follows. A researcher is interested in learning about a particular quantity, call it μ, and needs to decide which assumptions to use in estimation. On the one hand are the "baseline" assumptions. These are weak enough to be uncontroversial, but accordingly provide less information about μ. On the other hand are the "suspect assumptions." These stronger assumptions are highly informative, but less plausible. If we knew that the suspect assumptions were correct, we would certainly wish to impose them for the additional information they provide. But even if they were *slightly incorrect*, we would still want to use the suspect assumptions if they decreased the variance of our estimate of μ by more than they increased its bias. A crucial aspect of this idea is that the choice of assumptions depends explicitly on the quantity of interest, μ. Two different researchers asking two different questions based on the same data may find it optimal to select different assumptions. This is a possibility that the consistent model selection paradigm overlooks. I develop this approach in two papers. DiTraglia (2016) considers the problem of moment selection for GMM models, with a particular focus on choosing instrumental variables. Chang and DiTraglia (2018) considers the more general problem of simultaneous model and moment selection for GMM, which is especially relevant in dynamic panel models. Each of these papers uses the existence of a set of correctly specified assumptions to carry out selection over another set of potentially mis-specified assumptions in a local mis-specification framework that ensures a meaningful bias-variance tradeoff in the limit. The resulting selection criteria, the Focused Moment Selection Criterion (FMSC) and the Generalized Focused Information Criterion (GFIC), perform well both in simulations and empirical applications. Selection, however, is a somewhat crude procedure as it requires that an assumption is either fully incorporated into estimation or fully excluded. As a consequence, small changes in the dataset could could have large effects, causing us to switch from one assumption to another and generating noisy estimators. Accordingly, both DiTraglia (2016) and Chang and DiTraglia (2018) also consider a class of *averaging* estimators that smoothly combine the information contained in different assumptions, and show that they perform well in practice.

While model selection can produce superior point estimates in empirically relevant settings, these improvements come with with a cost: after carrying out model selection, the textbook formulas for statistical inference fail to apply. This problem, usually referred to as post-selection inference, emerges from using the same data twice: first to select a model and then to carry out inference. Correctly accounting for this double use of data presents a substantial practical and technical challenge. As a complement to my work on model selection, DiTraglia (2016) and Chang and DiTraglia (2018) also develop tools for carrying out valid post-selection inference for a broad class of model selection and averaging techniques, and show how to implement them in practice.

Measurement Error

It is an unfortunate reality that the quantities of greatest interest in applied economic research are typically measured with error. To estimate the effect of institutions on economic growth, one first needs a good measure of institutions; to estimate the effect of smoking on birthweight, one first needs to know which mothers *truly* smoked during pregnancy. A number of my recent and ongoing research projects address aspects of the problem of measurement error in economic data.

When students first encounter measurement error in an introductory econometrics course, they are taught that a valid instrumental variable can serve double-duty: it corrects for both endogeneity and classical measurement error in a treatment variable of interest. But many treatments in applied work are binary – e.g. union vs. non-union employee or smoker vs. non-smoker – and a binary variable *cannot* be subject to classical measurement error. This is because a true one can only be mis-measured downwards as a zero, while a true zero can only be mis-measured upwards as a one, resulting in a negative correlation between the error and the truth. Measurement error in discrete variables, more typically called "misclassification," has generated a large literature, but virtually all of this research assumes that the treatment is exogenous. In microeconomic applications, however, endogeneity is the rule rather than the exception. Accordingly, in DiTraglia and Garcia-Jimeno (2019b) we ask a simple question: can a discrete instrument, as would be available in an experiment with non-compliance, be used to identify the causal effect of an endogenous, mis-measured, binary treatment? We begin by showing that the only existing point identification result for this case is incorrect. We go on to derive sharp bounds under standard assumptions from the literature. While these bounds can be quite informative in practice, we show that they fail to point identify the treatment effect of interest. This motivates us to consider an alternative approach. Under slightly stronger assumptions, we show how to use additional features of the data, essentially variances and skewness, to point identify the treatment effect.

DiTraglia and Garcia-Jimeno (2019b) relies upon the availability of a valid instrument, a variable that only affects the outcome of interest through its effect on the treatment. But valid instruments are difficult to find in practice: indeed a key motivation for my work in DiTraglia (2016) and Chang and DiTraglia (2018) was the reality that many instrumental variables proposed in applied work are likely invalid. For this reason, in DiTraglia and Garcia-Jimeno (2018) we explore the problems of measurement error and instrument invalidity *jointly* in a setting where the goal is to learn the causal effect of an endogenous treatment variable. Without data from a randomized controlled experiment, there is simply no way to estimate causal effects without incorporating researcher beliefs: strong, and in general untestable assumptions. Researchers are well aware of this fact and the typical applied economics paper that uses instrumental variables features an extended discussion of the likely direction of any selection effects that may be present, as well as possible concerns about instrument invalidity and measurement error. Yet even when applied papers explicitly state their authors' beliefs about the direction of selection effects and give some idea of the magnitude of measurement error that they suspect may be present, this information is never used to actually estimate the causal effect of interest. At best it is used informally to discuss the statistical results under different assumptions. This comes not from a lack of understanding on the part of applied researchers, however, but from a lack of appropriate econometric tools. In DiTraglia and Garcia-Jimeno (2018) we address this gap in the literature by developing a framework that allows researchers to elicit, discipline, and incorporate their problem-specific beliefs when studying causal effects in a workhorse linear model.

We begin by deriving the full set of joint restrictions between regressor endogeneity, instrument invalidity, and measurement error. Our results show that any beliefs that researchers may hold over these three dimensions of the problem are mutually constrained by each other and the data. Holding a particular belief about the likely extent of measurement error and the direction of a selection effect, for example, may in fact *rule out* the possibility of a valid instrument. We propose a Bayesian partial identification framework that yields inference for causal effects by combining the data with research beliefs in a coherent and transparent way. By applying it to several well-known examples from empirical microeconomics, we show that imposing even relatively weak subject-specific beliefs can yield surprisingly informative bounds for the causal effect of interest.

Both DiTraglia and Garcia-Jimeno (2018) and DiTraglia and Garcia-Jimeno (2019b) assume that measurement error is *non-differential*, restricting its relationship with the outcome variable. While reasonable in many settings, non-differential measurement error rules out forms of strategic misreporting that may be important in some contexts. Self-reported levels of education provide a particularly salient example. Because employers cannot perfectly verify educational credentials, individuals may face an incentive to misreport their level of education. For this reason an individual's self-reported education could have a *direct* causal effect on her wage, completely separate from her true level of education. This is the example that my co-author and I examine in DiTraglia and Lewbel (2019), an on-going research project using data from the National Longitudinal Survey of the High School Class of 1972 (NLS-72) and the Post-Secondary Education Transcript Survey (PETS). We consider a model in which the outcome of interest depends on a true treatment variable as well as an individual's self-report. The goal of the exercise is to identify the "returns to lying," the causal effect of self-reported treatment holding true treatment fixed. We provide two alternative approaches to identification. The first relies upon an instrumental variable with a known relationship to the true treatment variable. This relationship could be estimated, for example, using an auxiliary administrative dataset. Provided that individuals' propensity to misreport varies with the instrument, we show that the returns to lying are point identified. Our second approach relies on the availability of a regressor that is unaffected by an individual's self-report. In the education example, test scores play this role: while they are likely affected by true education, they should not depend on self-reported education. Provided that misreporting is one-sided, i.e. individuals do not understate their true level of education, we show how to use such a regressor to identify the returns to lying.

Social Interactions

Two of my most recent ongoing projects involve models with social interactions: one theoretical, and one applied. DiTraglia et al. (2019) develops methods for estimating direct and indirect causal effects in settings where one individual's treatment may spill over to other nearby individuals, a violation of the "no interference" assumption commonly used in experimental studies. Consider, for example, a job-seeker assistance program. If Alice receives job placement services, she will be more likely to find a job. This is the direct effect of Alice's treatment. If Bob is a worker in the same region as Alice, he may be less likely to find a job now that Alice is more competitive in the labor market. This is the indirect or spillover effect of Alice's treatment. In this example, it is crucial that policymakers consider both direct and indirect causal effects to avoid implementing a program that benefits Alice entirely at Bob's expense. In DiTraglia et al. (2019) we consider data that arise from so-called "randomized saturation" experiments, a design that has become popular in recent years. The idea is as follows. Suppose that individuals are clustered such that social interactions may occur within but not between groups. In the job placement example these groups would be local labor markets. The randomized saturation design proceeds in two steps. First, each group is randomly assigned a *saturation*: a fraction of individuals who will be offered treatment. Next, the individuals in a given group are randomly offered treatment with probability equal to their group's saturation. By generating exogenous variation in treatment assignment at both the individual and group levels, the randomized saturation design allows researchers to estimate both direct and indirect causal effects provided that subjects comply with their randomly assigned treatments. Unfortunately, compliance in randomized saturation experiments is often quite low. In the real-world study upon which the job placement example from above is based, just over 30% of the individuals offered treatment took it up. In principle one could still estimate intent-to-treat effects in settings with non-compliance. But with take-up rates as low as 30%, intent-to-treat effects will tell us little about the underlying causal effects of interest. In DiTraglia et al. (2019) we treat the random saturation design as a source of instrumental variables: one at the group level and another at the individual level. We consider a flexible random coefficients model in which individual potential outcomes depend on one's own treatment and the distribution of treatment take-up within one's group. We go on to characterize the assumptions under which one can identify average direct and indirect causal effects for well-defined subsets of individuals, and propose a simple estimator based on kernel smoothing.

Whereas DiTraglia et al. (2019) is primarily a theoretical paper that studies social interactions from a reduced form perspective, DiTraglia and Garcia-Jimeno (2019a) is an applied paper that takes a structural approach. My co-author and I consider the phenomenon of mass population displacement in response to paramilitary violence in rural Colombia during the 1990s and 2000s. Migration decisions are a setting with significant scope for social interactions, likely in the form of global complementarities: my decision to migrate will undoubtedly be influenced by the decisions of the others in my community. In the paper we propose and empirically test the predictions of a model that rationalizes the form and distribution of the paramilitary violence observed as well as the dynamics of population displacement. Land expropriation requires coercion. In the context of rural Colombia, it also required the implicit acquiescence of local political elites. Population losses, however, are costly for these local elites, and these costs are amplified when the migration decisions of families are subject to social interactions. As a result, it is only in municipalities with relatively low levels of land inequality – hence a large number of mid-sized landowning families – that land expropriation through coercion is cost effective. We find that the time-series patterns of population displacement, and the cross-sectional patterns of correlation between land inequality and paramilitary violence across municipalities, are consistent with the idea that population displacement was not a byproduct of the civil conflict, but rather had the purpose of expropriating land from rural families. Our empirical methodology allows us to detect complementarities in migration decisions – tipping points in displacement flows – in precisely those municipalities where land inequality was sufficiently low. Although primarily an applied paper, DiTraglia and Garcia-Jimeno (2019a) also involves a substantial econometric component. A crucial challenge of estimating social interactions in migration is that population displacement flows are mis-measured. Five agencies report data on population displacement in Colombia over our sample period. While the measures are strongly positively correlated, they differ substantially in overall magnitude, and exhibit censoring: a value of zero could indicate zero measured displacement or that no measurement was recorded. To overcome this challenge, we augment our economic model with a statistical model of the measurement process that accommodates censored observations. Our model allows for measure-specific biases – a given agency systematically over-reports or under-reports displacement – in addition to a common component of year-specific bias.

Other Empirical Work

In addition to the theoretical and applied econometrics projects described above, I have also worked on applications in empirical finance and experimental economics. In DiTraglia and Gerlach (2013) my co-author and I consider the question of how investors should hedge against extreme market downturns, such as the financial crisis of 2007–2008. We begin by constructing a theoretical asset pricing model based on the "rare disaster framework." Using this model, we show that risk averse investors will pay a premium for assets with low *tail dependence*. Tail dependence is a concept from extreme value theory that can be viewed as a kind of limiting conditional Value at Risk. In a portfolio allocation context, it captures the probability that a given portfolio will suffer losses beyond its s^{th} quantile given that the market portfolio has suffered equivalently large losses. Calibrating our model to US consumption and dividend data, we show that the premium that investors will pay to eliminate tail dependence from their portfolios is considerable: between 1% and 5%. We go on to estimate the tail dependence between a large number of test portfolios and the S&P 500 index using a semi-parametric estimator based on monthly minimum returns. Empirically, we show that tail dependence captures different information from more traditional risk measures and is relatively stable over time. In an out-of-sample exercise, portfolios constructed to have low tail dependence outperform those with high tail dependence, as well as the market index, and the mean return of the stocks in our sample, suggesting that tail dependence provides useful information for portfolio selection.

My two earliest papers are in the field of experimental economics. In Anderson, DiTraglia, and Gerlach (2011), my co-authors and I estimate a quantal response equilibrium model of decision error and altruism using data from a public goods experiment carried out in the Czech Republic and the US. Many studies have used contributions to laboratory public goods experiments as a measure of differences in altruism across groups. But contributions to a one-shot laboratory public good, in violation of the Nash equilibrium prediction, can arise from at least two sources: genuine other-regarding preferences, and decision error. For this reason, simple comparisons of contributions across groups could be seriously misleading. Using a structural model to control for differences in decision error, we find substantial variation in estimated levels of altruism across sex and nationality. In particular, Czech subjects show a stronger preference for altruism then American subjects, but female subjects show a *weaker* preference for altruism than male subjects in both countries. This finding holds under a number of alternative utility specifications. Anderson et al. (2007), likewise employs data from laboratory experiments but addresses a question from empirical finance. The January Effect is a well-documented asset pricing anomaly in which stocks exhibit higher returns during the month of January after controlling for standard variables. While researchers have proposed a number of competing fundamentals-based explanations for the January Effect, such as tax-loss selling or increased year-end liquidity, none of these has withstood scrutiny. Our paper uses experimental data to test a competing psychological explanation for the January Effect originally proposed by Shiller. In a series laboratory experiments designed to mimic key features of real-world asset markets, we find substantially higher prices in January than December, holding market fundamentals fixed.

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