Four essays in econometrics and policy evaluation

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To my parents, Regina and Urs

Preface

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Chapter 1

Introduction

This thesis is a collection of four separate and self-contained papers, which implies that repetitions are unavoidable. Chapter 4 is based on joint work with Andreas Bachmann and Chapter 5 is co-authored by Daniel Burkhard and Christian Schmid. My goal is to publish all chapters in scientific journals, the prospective reader is thus referred to the corresponding articles.

The first half of the thesis is devoted to econometric models for identifying and estimating quantile treatment effects (QTE). QTE allow researchers to evaluate the distributional impact of policy variables beyond simple averages, which is of substantial interest in many areas. In economics and social sciences more generally, the policy variables of interest are often endogenous, rendering standard quantile regression inconsistent for estimating QTE.[1] A popular approach to overcome this problem is to use instrumental variable (IV) methods.

Chapter 2 analyzes and compares the two most used IV quantile models: the instrumental variable quantile regression (IVQR) model (Chernozhukov and Hansen, 2005) and the local quantile treatment effects (LQTE) model (Abadie *et al.*, 2002). On the surface, these two models do not seem to be connected. They rely on different non-nested assumptions and identify QTE for different (sub)populations. The principal feature of the IVQR model is the rank similarity assumption, a restriction on the evolution of individual ranks across treatment states under which QTE for the overall population are identified. In contrast, the LQTE model achieves identification through a monotonicity assumption in the selection equation. As this model allows for unrestricted treatment effect heterogeneity, only QTE for the subpopulation that responds to the instrument – the compliers – are identified. However, the LQTE model has been attacked because in many policy evaluation problems other subpopulations such as the treated or the overall population are of primary interest. Thus, researchers face a fundamental trade-off

[1] Quantile regression was introduced in seminal work by Koenker and Bassett (1978).

between the LQTE model that allows for unrestricted treatment effect heterogeneity but only identifies causal effects for the compliers on the one hand, and the IVQR model that substantially restricts treatment effect heterogeneity by imposing rank similarity but identifies population treatment effects on the other hand.

Chapter 2 shows that even if the rank similarity assumption fails, the IVQR estimators are consistent for QTE for the compliers at transformed quantile levels. Moreover, the IVQR estimand of the average treatment effect can be decomposed into a convex combination of the local average treatment effect and a weighted average of QTE for the compliers. These results establish a close connection between both models and provide a characterization of the IVQR model under misspecification. The main ingredients for deriving these results are analytic closed form representations for the IVQR estimands of the potential outcome distributions. Chapter 2 confirms that with unrestricted treatment effect heterogeneity all the information about treatment effects has to come from the compliers and demonstrates that the IVQR model achieves identification for the overall population by extrapolating from the compliers based on the rank similarity assumption.

In **Chapter 3**, I study estimation of conditional and unconditional QTE based on the IVQR model. I introduce a class of regression-based semiparametric plug-in estimators based on the analytic closed form solutions derived in Chapter 2. These estimators do not rely on separability of the structural quantile function, while retaining computational tractability and $\sqrt{n}$-consistency. Functional central limit theorems and bootstrap validity results for the estimators of the QTE and other functionals are provided. I apply my method to reanalyze the effect of 401(k) plans on individual savings behavior. My estimates suggest that 401(k) participation has a moderate effect on individual assets at lower quantiles while having a substantive impact at higher quantiles. Comparing these results to the estimates from separable linear models (cf. Chernozhukov and Hansen, 2006), I find substantive differences between both approaches, which highlights the importance of analyzing more flexible nonseparable models.

The second half of this thesis is concerned with applied policy evaluation. Evaluating and forecasting the effect of policies including their effect on individual welfare – these fundamental problems have long been and still are at the heart of the research in economics and econometrics (e.g., Heckman and Vytlacil, 2007a; Heckman, 2008). Chapters 4 and 5 exemplify two fundamentally different approaches to policy evaluation. Chapter 4 combines a dynamic structural model with aggregate reduced form estimates to predict the macroeconomic welfare implications of a change in the payroll tax used to finance pension benefits, while Chapter 5 investigates the effect of physician dispensing regulations on individual behavior using comprehensive mirco data. These conceptual differences require fundamentally different economic and econometric tools, demonstrate the variety of policy evaluation problems, and highlight the importance of developing appropriate

application-specific methods.

Chapter 4.[2] Many developed countries rely on pay-as-you-go systems for old-age provision. Because of demographic changes such as the growing fraction of retirees, reforms of these social security systems are increasingly discussed. Previous studies have typically analyzed the welfare effects of different policies using structural overlapping generations (OLG) models. While this approach provides a flexible framework for welfare analysis, it requires parameterizing and calibrating the structure of the model, which involves many assumptions on functional forms and deep model parameters. Chapter 4 introduces a complementary method for welfare analysis of pay-as-you-go systems. Using an OLG model, we derive a simple formula for the welfare consequences of a permanent marginal change in the payroll tax rate used to finance transfers to retirees. The formula is valid under weak assumptions about the deep structure of the economy. In particular, our approach requires neither a full specification of preferences and technology, nor knowledge of the individual savings behavior. We show that the formula can be implemented using reduced form estimates of a vector autoregression model and predictions for key quantities of the model. We apply our method to evaluate the current pay-as-you-go social security system in the United States. The results suggest that an increase in the payroll tax rate along with higher pension benefits leads to an overall welfare increase due to welfare gains of today's retirees, but it also induces a distributional conflict as today's workers and future generations are negatively affected. A decomposition analysis reveals the predominant channels through which welfare is influenced: besides the direct channel through different taxes and benefits, induced changes in factor prices (i.e., wage and interest rates) are important determinants of the welfare effect. In contrast, only minor welfare consequences result from adjustments in labor supply.

Chapter 5.[3] In many healthcare markets, physicians can influence the volume (volume response) and the composition of the services provided (substitution response). The goal and main contribution of this chapter is to empirically assess the relative importance of these two behavioral channels. Our analysis is based on the market for ambulatory care in Switzerland in which different drug dispensing regimes (banned/allowed) co-exist at the regional level but many important other features are regulated at the federal level. Dispensing creates financial incentives for physicians to sell more drugs and to substitute towards more expensive drugs thus providing an ideal setup for our empirical analysis. We combine regional variation in the dispensing regime with comprehensive physician-level prescription data to empirically disentangle the volume and the substitution response. The estimated average effects suggest that physician dispensing increases drug costs on the order of 25% for general practitioners and 15% for medical specialists. A decomposition

[2] This chapter is co-authored by Andreas Bachmann.
[3] This chapter is co-authored by Daniel Burkhard and Christian Schmid.

of this overall effect indicates that the cost increase can mainly be attributed to a volume increase, while average drug prices are not or even negatively affected. In addition, we document substantial effect heterogeneity along the outcome distributions. From a policy perspective, the most relevant insight of our paper is the relative importance of the volume response, indicating that policies that regulate the volume are likely to be more effective than price regulations for containing healthcare costs.

Selbständigkeitserklärung

Ich erkläre hiermit, dass ich diese Arbeit selbständig verfasst und keine anderen als die angegebenen Quellen benutzt habe. Alle Koautorenschaften sowie alle Stellen, die wörtlich oder sinngemäss aus Quellen entnommen wurden, habe ich als solche gekennzeichnet. Mir ist bekannt, dass andernfalls der Senat gemäss Artikel 36 Absatz 1 Buchstabe o des Gesetzes vom 5. September 1996 über die Universität zum Entzug des aufgrund dieser Arbeit verliehenen Titels berechtigt ist.

Bern, 25. November 2015

Kaspar Wüthrich