A Structural Analysis of Simple Contracts

Yonghong An[1]; Shengjie Hong[2]; Daiqiang Zhang[3]
[1]Texas A&M University, [2]Tsinghua University, [3]SUNY Albany

Abstract

This paper provides an econometric framework for analyzing simple contracts where an agent chooses between a fixed-price option and a cost-reimbursement option provided by a principal in each contracting period during possibly multiple periods.

We propose a consistent procedure for testing the null hypothesis of a corresponding cost function being linear, which is widely assumed for tractability in the literature. Motivated by the rejection of such a null based on empirical data, we establish nonparametric identification and propose semiparametric estimation, without the constraint of linear cost functions.

In our empirical study, we find that the welfare assessment of this contract is very sensitive to the specification of cost function.

Introduction

Simple menu contracts, which specify the payment scheme simply as a function of only the agent's observed cost or even as a constant, are widely adopted in practice.

The main finding is that welfare performance of simple contracts can be very sensitive to whether the cost function is linear or not, where the assumption of linear cost functions has widely been adopted for tractability.

Econometric methodology

The econometric model is based on a contract model, which extends the model in Gagnepain et al. (2013) by relaxing the linear cost condition (LCC). We propose a consistent procedure for testing a null hypothesis that is directly implied by the LCC.

Motived by the rejection of LLC in the data, we develop identification strategies for the model primitives without imposing the LCC. These primitives include agent's cost function, agent's disutility function (from exerting cost-reducing effort), distribution of agent's efficiency type, and parameters of agent's bargaining power and intertemporal preference.

These identifications are achieved through the following steps: First, by adopting a recent method on measurement error by Schennach and Hu (2013), we recover the distribution of the unobserved optimal effort from the joint distribution of two observable effort-related proxies.

Next, we require the existence of an exclusion variable that is independent from agent's type but affects the disutility from exerting cost-reducing efforts. Our strategy to identify the cost function is to match quantiles of the cost and effort distributions conditioned on different values of the exclusion variable, according to the corresponding quantiles of the type distribution, which are invariant to the variable.

Third, with the cost function identified, we exploit the structural link between the agent's efficiency type and the corresponding optimal effort level to recover the type value associated with any given observed cost under FP contracts. Based on what have been identified, we identify the remaining primitives. Following the identification strategies, we propose consistent methods to estimate all model primitives.

We apply our methods to study transportation procurement contracts in France. The testing result rejects of the hypothesis of LCC. We estimate the welfare with and without imposing the LCC. The results suggest the welfare assessment to be sensitive to the specification of cost function. Thus, one needs to be cautious on deciding whether or not to impose linearity, since mis-specification could lead to substantial bias.

Contact

Daiqiang Zhang
SUNY Albany
dzhang6@albany.edu

Summary statistics

Variables	Mean	Std. Dev.	Median	Min	Max
NO. of Contracts	543				
NO. of FF	281				
NO. of CF	88				
NO. of CC	174				
Cost	16860	15954	10347	2397	93993
Subsidy	18794	18236	12039	2265	114483
NO. of employees	413	364	267	68	1772
NO. of drivers	278	216	144	47	1182
Labor fee	10740	10241	6650	716	53178
Rolling stock	165	121	84	33	724
Right wing	0.52	0.50	1.00	0.00	1.00

Note: The units of cost, subsidy and labor fee are in 1000 euros. FF means fixed-price (FP) contracts in both periods, CF means cost-reimbursement (CR) contracts in the first period and FP contracts in the second period, and CC means CR contracts in both periods.

Assessments of welfare under different specifications

	Model specification	Assessment
	Nonlinear cost	57.596***
$(1+\lambda)Q$		(15.942)
(i.e., social cost)	Linear cost	17.749*
		(9.367)
	Difference $(\Delta(1+\lambda)Q)$	39.847**
		(19.320)
	Nonlinear cost	13.793**
αU		(6.124)
(i.e., informational rent)	Linear cost	7.833***
		(2.426)
	Difference $(\Delta\alpha U)$	5.960
		(6.673)
Welfare difference	$\Delta SW = \Delta\alpha U - \Delta(1+\lambda)Q$	-33.887*
		(18.661)

Standard errors in parentheses are bootstrapped 1000 times.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
All estimates are in million euros.

References

[1] Gagnepain, P., M. Ivaldi and D. Martimort, "The Cost of Contract Renegotiation: Evidence from the Local Public Sector," *American Economic Review*, 103 (2013), 2352–2383.

[2] Schennach, S. M. and Y. Hu, "Nonparametric Identification and Semiparametric Estimation of Classical Measurement Error Models without Side Information," *Journal of the American Statistical Association*,108 (2013), 177–186.