Essays on Quantile Regressions

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（様式３）

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論　文　内　容　の　要　旨

To deal with the persistence to the central position of the dependent variable and ill-effect of observable outliers in ordinary least squares (OLS) analysis, many studies have examined the quantile regression (QR) methodology, which broadens the target of the effect from the conditional mean of distribution to practically any point one wants to evaluate. Furthermore, due to the recent developments in computational tools and the necessity of policy-effect analysis on the specific point of response, QR technique is receiving considerable attention recently.

However, owing to its novelty, the QR method faces several problems such as the scarcity of comprehensive survey both on theory and applications, different interpretation between coefficients estimated by conditional quantile regression (CQR) of Koenker and Bassett (1978), and unconditional quantile regression (UQR) of Firpo *et al.* (2009) according to their identification strategies, and the obscure validity of a solution for endogenous regressors in the context of UQR.

This dissertation contributes to the literature on QR by addressing these issues. For the first and the second issues, the thesis provides a review on CQR and UQR from the standpoint of both methodological and empirical perspectives. Furthermore, we examine the applications of QR to hedonic price analysis and the relationship between real economic activity and land prices with some recent technique of QR. For the third issue, we perform the Monte-Carlo simulation study of UQR under endogeneity to illustrate the sensitivity of parameter estimation with and without control-function approach in UQR-context. The thesis contains six chapters studying the quantile regressions from the viewpoint both of econometric theory and empirical applications.

Chapter 1 presents the introduction consisting of a brief background of literature on quantile regression, the motivation of the thesis and discusses the outline and structure of the thesis.

Chapter 2 provides a comprehensive overview of quantile regressions. The chapter is broken down into two parts according to their identification strategy: CQR and UQR, which the

previous surveys on QR have not discussed (Yu *et al.*, 2003; Buhai, 2005; Hao and Naiman, 2007; Davino *et al.*, 2014; Koenker *et al.*, 2017; Koenker, 2017; Furno and Vistocco, 2018). We survey definitions of QRs, inference scheme, additional models, endogeneity issues and empirical applications that appear in various fields. The comparison between CQR and UQR, focusing on their interpretations, is also investigated.

In Chapter 3, we discuss the empirical analysis using CQR to investigate hedonic prices in Japan. Unlike the existing land price literature with QRs (Mak *et al.*, 2010; Liao and Wang, 2012; Worku, 2017), the chapter conducts the analysis using a geographic information system (GIS) data for more information on microeconomic variables and performs variable selection procedure by elastic-net penalties for dimensional reduction. The result demonstrates that the microeconomic factors have different effects depending on the part of the conditional distribution of land price in Japan.

Chapter 4 offers a simulation study regarding endogeneity issues in the UQR context, focusing on the control variable UQR (CVUQR) (Ghosh, 2016) as a solution for the existing biases in estimated coefficients of UQR. The chapter conducts Monte-Carlo experiments based on the data generating processes with various settings of the strength of endogeneity and instrumental variables. The simulation results reveal the inconsistency of CVUQR estimates in relation to weak-instruments regardless of the strength of endogenous regressors.

In Chapter 5, we conduct the empirical application of UQR to analyse the relationship between real economic activity and land prices in Japan. Contrary to the literature on the same issue (Suzuki, 2004; Liu *et al.*, 2013), the chapter exposes the heterogeneous effects of land prices across the unconditional distribution of the unemployment rate. Through the comparison between the results produced by CQR and UQR, we also examine the differences in their interpretation and magnitude of coefficients; CQR exposes monotonically increasing impact of land price across the conditional distribution of unemployment rate whilst UQR exposes the impact only on the lower-tail of the unconditional counterpart of it.

Chapter 6 provides general conclusions and plans for the future work of the dissertation. First, the findings in the thesis strengthen the conclusion that QRs are becoming increasingly popular amongst researchers not only in economics but also in other fields. By virtue of their intriguing property allowing practitioners to observe heterogeneous effect depending on the part of response variable distribution, the thesis shows that QRs underline the possibility of better policy evaluation on the specific part of the target population such as the extremely lower part of the wage distribution and the higher part of the educational performance distribution. Second, the thesis finds that their novelty leads several necessities of complementary studies in future research such as the development of diagnostics for valid instrumental variables in the context of CVUQR, and its robust inference with endogenous regressors if one has only weak instruments.