Economics Bulletin

Volume 31, Issue 1

Economic Growth and Government Size in OECD Countries: New Evidence from the Quantile Regression Approach

Sheng-Tung Chen
Assistant Professor, Department of Public Finance, Feng Chia University

Chi-Chung Chen
Professor, Department of Applied Economics, National Chung-Hsing University

Yoonbai Kim
Associate Professor, Department of Economics, University of Kentucky

Abstract

The purpose of this paper is to employ the quantile regression methodology to investigate the relationship between government size and economic growth using a panel data set for 24 OECD countries. We find that the magnitude of the effect of government size on economic growth varies through the quantiles. When the economic growth is low, increasing the size of the government may have a positive effect and stimulate economic growth. However, as the economic growth rate increases, such an effect declines and has a negative effect on economic growth.

Citation: Sheng-Tung Chen and Chi-Chung Chen and Yoonbai Kim, (2011) "Economic Growth and Government Size in OECD Countries: New Evidence from the Quantile Regression Approach", *Economics Bulletin*, Vol. 31 no.1 pp. 416-425.
Submitted: Aug 17 2010. **Published:** January 24, 2011.

1. Introduction

The purpose of this paper is to identify the relationship between government size and economic growth by employing the quantile regression approach based on a panel data set for 24 OECD countries. By having a complete picture of all quantiles, it is possible to consider several different regression curves that correspond to the various percentage points of the distributions and not only the conditional mean distribution which neglects the extreme relationship between variables. In addition, while this approach has never been applied to this issue, the estimation results obtained using this approach could provide us with more details regarding the relationship between government size and economic growth.

Perotti (1999) provides a theoretical model and empirical evidence to indicate that the effects of fiscal policy depend on the initial conditions. He first lays out a simple model where government expenditure shocks are positively correlated with private consumption in normal times, but are negatively correlated with them in bad times. Besides, Easterly and Rebelo (1993) show that there is a strong positive relationship between government size and per capita income both across a large sample of countries at a point in time and for a panel of 28 countries from 1870 to 1988. It seems that the effect of expanding government size should be correlated with different economic conditions, such as the scale of the economy, the economic growth and private consumption. Furthermore, the quantile regression model can consider several different regression curves that correspond to the various percentage points of the distributions and can help us to determine whether the effect of expanding government size will lead to changes in the different economic growth conditions.

Previous studies indicate that the results vary widely even when they deal with the same groups of countries in the OECD. While some studies find that the relationship is negative (Landau, 1985; Saunders, 1985, 1986; Fölster and Henrekson, 2001; Dar and AmirKhalkhali, 2002), other studies report mixed results (Conte and Darrat ,1988; Ghali,1998). The relationship between the two variables may vary in different regression curves that correspond to the various percentage points of the distributions and not only to the conditional mean distribution of a given sample. In this paper, we employ the quantile regression model to examine the whole spectrum of the relationship between government size and economic growth in 24 OECD countries, and provide plausible explanations for the divergent outcomes reported in previous empirical studies.

The remainder of the paper is organized as follows. Section 2 provides the methodology underlying quantile regression while Section 3 explains the empirical model and the variables. The empirical results are reported and analyzed in Section 4. Section 5 concludes with policy implications.

2. Methodology

Based on the study by Koenker (2005), a general method used to estimate models of conditional quantile functions can be expressed as the solution to a simple optimization problem underlying the least squares model. If the least squares regression model is set as in equation (1):

$$y_i = x_i^{'}\beta + u_i \tag{1}$$

then the estimation of β can be expressed in terms of solving the following function:

$$\min_{\beta \in \mathbb{R}^p} \sum_{i=1}^{n} (y_i - x_i^{'}\beta)^2 \tag{2}$$

Similarly, Koenker and Bassett (1978) point out that the τth sample quantile, $\hat{\alpha}(\tau)$, can be found by solving equation (3):

$$\min_{\alpha \in \mathbb{R}} \sum_{i=1}^{n} \rho_\tau (y_i - \alpha) \tag{3}$$

where for any $0 < \tau < 1$, $\rho_\tau(u) = u \cdot (\tau - I(u < 0))$. $Q_y(\tau \mid x)$ is the τth linear conditional quantile function, and $Q_y(\tau \mid x) = x'\beta(\tau)$. Then, we can find $\hat{\beta}(\tau)$ by solving equation (4):

$$\min_{\beta \in \mathbb{R}^p} \sum_{i=1}^{n} \rho_\tau (y_i - x_i^{'}\beta) \tag{4}$$

The estimation of the quantile regression asymptotics is quite involved. In the following, we employ the reliable bootstrap method of Bilias et al. (2000) to build the confidence interval of $\hat{\beta}(\tau)$. We also accept that the above indicators provide the significance level needed to test the significance of the estimation of $\hat{\beta}(\tau)$.

3. The Empirical Model and Data

The empirical model used in this study is based on the study by Dar and AmirKhalkhali (2002) who adopt the basic growth accounting model of Solow (1956) in which economic growth is a function of capital and labor accumulation and total factor productivity growth. The production function is of the Cobb-Douglas type:

$$Y_{it} = F(L_{it}, K_{it}, A_{it}) = A_{it}^{v1} L_{it}^{v2} K_{it}^{v3} \tag{5}$$

where Y is real output; L is the aggregate labor force; K is the aggregate real capital stock; and A is a measure of technology. The subscripts $i, (i = 1, \cdots, n)$ and

$t, (i = 1, \cdots, T)$ index the country and time period, respectively. The standard growth accounting model can be written as:

$$GY_{it} = \beta_1 GK_{it} + \beta_2 GL_{it} + A_{it} \quad (6)$$

where *GY* stands for the growth rate of output. *GK* and *GL* refer to the growth rate of the real capital stock and the labor force, respectively. AmirKhalkhali and Dar (1995) point out that export growth has a favorable impact on the efficiency of resource use, innovative activity and the rate of technical progress, all of which in turn enhance total factor productivity growth and economic growth. Dar and AmirKhalkhali (1999 and 2002) suppose that government spending might be similar to export expansion in terms of its effect on economic growth. In their models, total factor productivity depends upon the rate of export expansion, *GE*, and the total government size, *TGS*:

$$A_{it} = \beta_0 + \beta_3 GE_{it} + \beta_4 TGS_{it} + e_{it} \quad (7)$$

where *GE* refers to the growth rate of exports. *TGS* is the ratio of total government expenditure to GDP. The latter is a usual measure of government size. Substituting eq.(7) into (6) yields an empirical growth model as follows:

$$GY_{it} = \beta_0 + \beta_1 GK_{it} + \beta_2 GL_{it} + \beta_3 GE_{it} + \beta_4 TGS_{it} + e_{it} \quad (8)$$

Eq. (8) is a panel model setting. The method usually adopted in this approach involves eliminating the individual effect of panel data by removing the individual-specific means (or demeaning the series).[1]

The quantile regression of equation (8) can be estimated using the procedure illustrated in equations (1) to (4) which produces the estimates of the τ-th percentage quantile coefficients, $\hat{\beta}_1(\tau)$, $\hat{\beta}_2(\tau)$, $\hat{\beta}_3(\tau)$ and $\hat{\beta}_4(\tau)$.

Annual data for the 24 OECD countries are obtained from *International Financial Statistics* (IFS, 2005) and *World Development Indicators* (WDI, 2004).[2] The panel is unbalanced since data availability differs across countries. We adopt Hansen's (1999) demeaned approach to eliminate the individual effect between countries and then estimate the quantile regression result for an unbalanced panel data set. The data periods and the names of the 24 OECD countries are listed in Table 1. There are a total of 658 observations in the sample.

4. Empirical Results

Table 2 reports the results of the classical least squares estimation of the

[1] Hansen (1999) points out that one traditional method used to eliminate the individual effect is to remove the individual-specific mean. This method of demeaning to consider the panel model is also mentioned by Baltagi (1995) in the context of the fixed effects model.

[2] The total government expenditure is obtained from International Financial Statistics (2005) and other variables are obtained from WDI (2004). In the absence of capital stock data, we accept the advice of Dar and AmirKhalkhali (2002) to use the growth rate of investment as the proxy to capture the wide fluctuations in investment activities.

conditional mean models (OLS) of equation (8) with three sets of panel data. Since the data are demeaned, the constant term is omitted. Both capital and export growth have positive and significant effects on economic growth which are consistent with some standard growth studies. However, the government size affects the economic growth negatively and significantly in the case of the overall sample.

Table 3 reports the estimates for the quantiles $\tau \in \{0.05,\ 0.25,\ 0.50,\ 0.75,\ 0.95\}$.

Figure 1 shows the marginal effects of government size for all quantiles within the (0, 1) range of the economic growth distribution. The red line refers to the OLS coefficient and the difference between the OLS and the marginal effects of government size for all percentage points of the quantiles in the economic growth distribution tell us that one can not just consider the relationship between economic growth and government size in the conditional mean model. The effect of government size is positive and significant for the 0.05 quantile and becomes significantly negative from the 0.50 quantile to the 0.95 quantile. The magnitude of the effect exhibits a decreasing trend which means that as economic growth occurs in the higher quantiles, expanding government size will damage the economy but the phenomenon will lead to the opposite effect when the economy is in the lower quantiles.

5. Concluding Remarks

The effect of government size on economic growth is controversial when considered from a theoretical point of view. The relationship is also ambiguous in existing studies. A reasonable conjecture is that the direction of the relationship may depend on the size of the government in the different quantile distributions of economic growth. In this paper, with a panel data set encompassing 24 OECD countries, we provide a reasonable explanation for the divergent results of the prior studies. The effect of government size changes with different quantiles. When the economic growth rate is low, increasing the government size may have a positive effect and stimulate economic growth. However, as the economic growth rate further increases, the positive effect on economic growth may start to weaken and eventually turn negative. As Figure 1 shows, the coefficient of total government size is positive among the low quantiles, but declines rapidly and becomes negative among the high quantiles.

References

AmirKhalkhali, S. and A. A. Dar (1995) “A varying-coefficients model of export expansion, factor accumulation, and economic growth” *Economic Modelling* **12(4), 435-441.**

Baltagi, B. H. (1995) *Econometric Analysis of Panel Data*, John Wiley and Sons Ltd.

Bilias, Y., S. Chen and Z. Ying (2000) "Simple resampling methods for censored regression quantiles" *Journal of Econometrics* **99, *3*73-386.**

Conte, M. A., A. F. Darrat (1988) "Economic growth and the expanding public sector: A reexamination" *The Review of Economics and Statistics* **70(2), 322-330.**

Dar, A. A., and S. AmirKhalkhali (1999) "On the impact of government size on the economic growth: A time series cross-country study" *Development Policy Review* **17, 65-76.**

Dar, A. A. and S. AmirKhalkhali (2002) "Government size, factor accumulation, and economic growth: Evidence from OECD countries" *Journal of Policy Modeling* **24, 679-692.**

Easterly, W. and S. Rebelo (1993) "Fiscal policy and economic growth: An empirical investigation" *Journal of Monetary Economics* **32, 417-458.**

Fölster, S. and M. Henrekson (2001) "Growth effects of government expenditure and taxation in rich countries" *European Economic Review* **45, 1501-1520.**

Ghali, K. H. (1998) "Government size and economic growth: Evidence from a multivariate cointegration analysis" *Applied Economics* **31, 975-987.**

Hansen, B. E. (1999) "Threshold effects in non-dynamic panels: Estimation, testing, and inference" *Journal of Econometrics* **93, 345-368.**

IFS (2005) *International Financial Statistics*, International Monetary Fund, Washington D.C.

Koenker, R. (2005) *Quantile Regression*, Cambridge University Press.

Koenker, R. and G. Bassett (1978) "Regression quantiles" *Econometrica* **46, 33-50.**

Landau, D. (1985) "Government expenditure and economic growth in the developed countries: 1952-76" *Public Choice* **47, 459-477.**

Perotti, R. (1999) "Fiscal policy in good times and bad" *The Quarterly Journal of Economics* **114(4), 1399-1436.**

Saunders, P. (1985) "Public expenditure and economic performance in OECD countries" *Journal of Public Policy* **5(1), 1-21.**

Saunders, P. (1986) "What can we learn from international comparisons of public sector size and economic performance?" *European Sociological Review* **2(1), 52-60.**

Solow, R. M. (1956) "A contribution to the theory of economic growth" *Quarterly Journal of Economics* **70, 65-94.**

WDI (2004) *World Development Indicators*, World Bank: Washington D.C.

Table 1 Basic average statistics for 24 OECD countries (%)

OECD Countries	Time period	GY	GK	GL	GE	TGS
Korea	1971-1997	10.29	2.62	12.14	15.09	16.25
Japan	1971-1993	3.37	0.92	2.59	3.11	16.62
United States	1972-2001	2.47	1.66	2.77	4.80	21.40
Switzerland	1971-2000	1.48	0.92	-0.65	2.93	21.42
Australia	1971-1999	3.03	2.02	2.49	4.67	22.97
Canada	1974-2001	2.61	1.96	2.35	5.17	23.07
Germany	1972-1998	2.35	0.49	1.33	4.81	28.48
Spain	1972-1997	2.95	1.12	2.68	5.84	28.75
Iceland	1972-1998	3.77	1.97	3.40	3.82	29.32
Finland	1972-1998	3.12	0.60	2.02	5.36	31.33
Greece	1972-1998	2.72	1.02	2.49	5.83	34.06
New Zealand	1972-2001	2.00	1.85	1.82	3.86	34.46
Portugal	1975-1998	3.25	1.33	3.56	5.02	35.98
Norway	1972-1999	2.99	1.23	2.15	3.79	35.99
Austria	1972-1999	2.63	0.61	2.19	4.29	37.25
Denmark	1971-2000	2.14	0.71	1.73	3.90	37.36
Sweden	1971-1999	2.09	0.86	1.22	4.55	37.43
United Kingdom	1971-1999	2.38	0.48	2.09	3.11	37.97
Luxembourg	1971-1997	4.14	1.21	4.82	5.39	38.15
Ireland	1972-1997	4.72	1.10	4.80	8.39	40.14
France	1972-1997	2.27	0.68	1.01	4.35	40.67
Italy	1973-1999	3.17	0.67	2.34	4.86	43.36
Belgium	1971-1998	2.32	0.57	1.77	3.91	47.89
Netherlands	1973-1997	2.19	1.51	1.57	3.79	49.85
ALL		3.07	1.17	2.70	5.02	32.99

Note: The order of the countries follows the sequence for the TGS from low to high.

Table 2 The OLS results of government size (total government expenditure / GDP) and economic growth with three kinds of panel data set

	Data set
Independent Variables	All
GK_{it}^{*}	0.275 (25.877)**
GL_{it}^{*}	-0.097 (-0.620)
GE_{it}^{*}	0.119 (11.560)**
TGS_{it}^{*}	-0.045 (-2.245)**
Number of observations	658
Adjusted R square	0.605
DW statistics	2.011

Note: "**" indicates significance at the 5% level. The figures in the parentheses are t-values

Table 3 The quantile regression results of government size (total government expenditure / GDP) and economic growth with panel data sets for all 24 OECD countries

Dependent Variables	Quantile Regression				
Quantile τ	0.05	0.25	0.50	0.75	0.95
Intercept	-3.258	-1.142	0.061	1.104	3.253
	(-11.276)**	(-10.668)**	(0.704)	(10.129)**	(16.227)**
GK_{it}^{*}	0.287	0.272	0.274	0.244	0.255
	(12.378)**	(16.321)**	(17.246)**	(12.634)**	(10.285)**
GL_{it}^{*}	-1.038	-0.176	0.016	0.114	0.786
	(-2.204)**	(-0.872)	(0.066)	(0.526)	(1.800)*
GE_{it}^{*}	0.133	0.126	0.101	0.101	0.087
	(4.338)**	(8.114)**	(7.126)**	(5.607)**	(3.694)**
TGS_{it}^{*}	0.089	-0.003	-0.077	-0.129	-0.104
	(1.399)	(0.091)	(-3.264)**	(-4.701)**	(-1.566)

Note: "**" indicates significance at the 5% level. Furthermore, the data in the parentheses are t-values that are obtained from the bootstrapped standard errors.

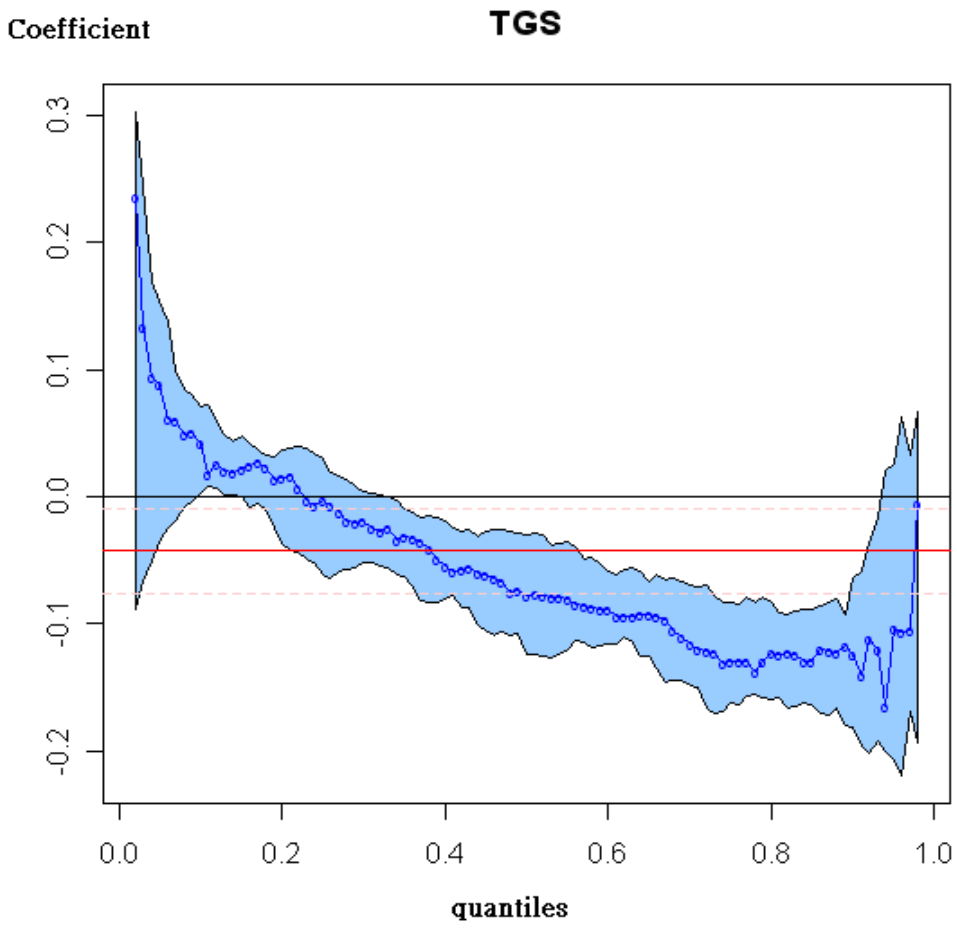

Figure 1 The coefficients of TGS for all quantiles using the full data set.