The role of institutions in private participation in infrastructure revisited

Taguchi, Hiroyuki

Saitama University

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Hiroyuki Taguchi, Saitama University
Yasushi Sunouchi, Saitama University

Abstract

This paper aims to examine institutional effects on the private participation in infrastructure (PPI) projects during the recent period for 2002-2017 with 117 sample economies, by using the PPI and the Worldwide Governance Indicators database of the World Bank. The study contributes to enriching the evidence by updating the sample time-horizon and by widening the coverage of sample economies. The main findings of this study are summarized as follow: the institutional role in promoting the PPI projects are clearly identified in terms of government governance indicators such as government effectiveness, regulatory quality, rule of law and control of corruption; in particular, the control of corruption, which is the controversial issue in the previous studies, is confirmed to be one of the important factors to boost the PPI projects; and the macroeconomic stability is also a significant contributor for the PPI projects.

Keyword: Private Participation in Infrastructure, Institution, Worldwide Governance Indicator, Control of Corruption, and Multicollinearity

JEL Classification Codes: H54, O43 and K20

1. Introduction

There has been and will be an enormous demand for infrastructure in emerging market and developing economies. McKinsey Global Institute (2016), for instance, estimates that the infrastructure investment in the world would grow from 31.4 trillion US dollars (at constant 2015 prices) for 2000-2015 toward 49.1 trillion US dollars for 2016-2030, and also shows that the majority of the investment, around 60 percent of the total investment for 2016-2030, would be required in emerging market economies. In accordance with the growing trend in infrastructure investment, the "private participation" in infrastructure (PPI, hereafter) has represented a significant presence from financial and operational perspectives. Figure 1 demonstrates the increasing trends in PPI in terms of number of projects and total investment commitments for the period between 1984 and 2017 based on the PPI database of the World Bank. Regarding the total investment commitments, their values have grown from 1990 to 2017 by 7.3 times while the world GDP has increased during the same period by 3.4 times.

The PPI is considered to be one of the styles of public-private partnerships, and its original concept seems to come from the so-called New Public Management in the United Kingdom. Advanced countries have adopted this management in their infrastructure development for the purpose of enhancing managerial skills of public organizations and reducing public sectors' inefficiency. The recent PPI emergence for emerging-market and developing economies, however, seems to have a different background. They have faced a growing infrastructure demand and at the same time a lack of fiscal space to deal with it. The PPI has helped fill the so-called infrastructure gap by leveraging financial resources with private sectors.

The question then arises at to what characterizes countries that have been successful in attracting the PPI in infrastructure projects. Banerjee et al. (2006) argues that the "institution" plays an important role in supporting the PPI, since the infrastructure investment has such unique nature as high sunk costs, economies of scale, high levels of risk and uncertainty and high transaction costs. To be specific, the institutional elements such as rule of law, regulatory quality and control of corruption are considered to reduce investment uncertainty, risk and costs in the PPI projects. Doh and Ramamurti (2003) also emphasizes the role of government in the successes and failures of infrastructure investments for investors and developers.

There have been a significant number of empirical studies examining the effects of institutional qualities on economic development in general (e.g., North, 1990; Rodrik et

al., 2002; Lee and Kim, 2009; Vaal and Ebben, 2011; Flachaire et al., 2014). The limited studies have, however, investigated the institutional impacts on private investment in infrastructure projects. Although some studies have targeted specific sector's investments (e.g., Bergara et al., 1998), few have analyzed the total PPI effects in relation to a wide variety of institutional variables. There are the following two studies in this context. Hammami et al. (2006) analyzes the determinants of public-private partnerships (PPPs) in infrastructure projects using the PPI database of the World Bank on the projects in developing countries for 1990-2003. They find that the market conditions and macroeconomic stability are important channels of determinants of PPIs, and also that the control of corruption and the rule of law contributes to attracting private investor to infrastructure projects. Banerjee et al. (2006) examines empirically how different institutional structures affect private investment in infrastructure in emerging market economies by utilizing the same PPI database for 1990-2000. They indicate that institutional factors such as property rights and bureaucratic quality as well as macroeconomic performances play a significant role in promoting private infrastructure investment, and also that countries with higher levels of corruption attract greater private participation in infrastructure. They interpret the corruption effect, for instance, such that countries with higher levels of corruption would be more aggressive in deregulating infrastructure and private companies would be attracted to such countries for opportunistic reasons. These two studies target the period until the early 2000s as their samples and produce a contrasting outcome on the corruption effect on the PPI.

This paper aims to revisit the issue of institutional role in the PPI and to reexamine empirically institutional impacts on the PPI in the recent period for 2002-2017 using the PPI database and the Worldwide Governance Indicators (WGI) of the World Bank. The study would contribute to the reviewed literature above as follows. First, this study enriches the evidence of the institutional effects on the PPI by updating the targeted sample from the period until the early 2000s to the one for the recent decades for 2002-2017. Second, this study widens the coverage of sample developing economies by using the WGI database as institutional variables. The previous studies depended on the International Country Risk Guide (ICRG) database for measuring institutional quality for the sample period until the early 2000s, but since 2002 the WGI database has become available every year as institutional variables. Against the 117 sample economies available in the PPI database for 2002-2017, all the 117 economies are also available as the sample in the WGI database, whereas only the 83 economies excluding the 34 ones containing Cambodia and Lao DPR were sampled in the ICRG database. Through

updating and widening samples, the evidence could be added on the critical issue of the corruption effect, on which the previous two studies had a contrasting outcome.

The rest of the paper is structured as follows. The next section represents empirics on the institutional impacts on the PPI: key variables and data, methodology, estimation outcomes and discussions. The last section summarizes and concludes.

2. Empirics

This section conducts empirical analyses of the impacts of the institutional variables on the PPI, describing key variables and data, methodology, estimation outcomes and discussions.

2.1 Key Variables and Data

This study adopts the variables common to the previous two studies, i.e., Hammami et al. (2006) and Banerjee et al. (2006), considering their data availability for the sample period from 2002 to 2017. For the dependent variables, both studies use two kinds of indicators: number of projects and total investment commitments in the PPI database of the World Bank. As for explanatory variables, Hammami et al. (2006) derives 12 hypotheses about possible determinants of the extent of the PPI, and adopts 17 variables (8 variables for institutional category and 9 variables for economic factors). Banerjee et al. (2006) uses 16 variables (7 institutional variables and 9 economic variables) under 6 proposed hypotheses.

This study chooses number of projects and total investment commitments in the PPI for dependent variables as in the previous studies, and finally selects 11 explanatory variables (6 institutional ones and 5 economic ones). The variables are listed with their measurement and data sources in Table 1, and their descriptive statistics are presented in Table 2. The details of each variable are described as follows.

Regarding the dependent PPI variables, i.e., number of projects (PPIN) and total investment commitments (PPIV), their data are retrieved from the PPI database of the World Bank as in the previous studies. The PPI database has data on over 6,400 infrastructure projects in the energy, telecommunications, transport, and water and sewerage sectors, and the projects include management or lease contracts, concessions, greenfield projects, and divestitures. The database covers 139 low- and middle-income countries, and in this study 117 countries out of them could be sampled totally for the sample period for 2002-2017. The total investment commitments (PPIV) in terms of

million US dollars are transformed in logarithm to avoid scaling issues. It is because, although the investment would be better expressed as a share of GDP, the share is negligible for all sample countries with very little variation, as Banerjee et al. (2006) suggests.

For the institutional variables as explanatory ones, the data comes from the WGI database of the World Bank. This study adopts all the indicators the WGI database provides: voice and accountability (VOA), political stability and absence of violence/terrorism (PSV), government effectiveness (GVE), regulatory quality (REQ), rule of law (ROL) and control of corruption (COR). Those indicators are almost corresponding to the institutional variables in the previous two studies using the ICRG database. Each of the WGI indicators takes the number ranging from approximately -2.5 (weak) to 2.5 (strong). The reasons why the WGI database is used here are as follows. First, the database has newly been developed since 1996 and the time-series data has been available every year from 2002 to the present. Second, what is more important is that the WGI database has wider coverage of sample developing economies than the ICRG database. Against the 117 sample economies available in the PPI database for 2002-2017, all the 117 economies are also available as the sample in the WGI database, whereas only the 83 economies excluding the 34 ones containing Cambodia and Lao DPR would be sampled in the ICRG database.

For the economic variables as explanatory ones, the study adopts five indicators: inflation (INF), GDP growth (GRW), GDP per capita (GDPPC), exchange rate (EXR) and government budget balance (GBL). The first four indicators represent macroeconomic stability and conditions, and the last one shows government constraints, as used in the previous studies. INF and GRW are expressed by year-on-year rate of changes in consumer prices and real GDP, respectively. GDPPC is shown by current US dollars and EXR is presented by the period average of national currency per US dollars. GBL is expressed by the general government net lending or borrowing as a percent of GDP. GDPPC and EXR are set in logarithm to avoid scaling issues. All the economic variables are lagged by one year as they may be endogenous to the model. The data sources of INF, GRW and GDPPC are the World Development Indicators, World Bank, and those of EXR and BBL are the International Financial Statistics and the World Economic Outlook Databases of the International Monetary Fund, respectively.

Then the study constructs the panel data with 117 countries for 2002-2017 for the subsequent estimation, based on the data availability of the PPI and WGI databases.

2.2 Methodologies

The study then turns to specifying the estimation equation in the following way.

$$y = \alpha + \beta * I + \gamma * E + \varepsilon \qquad (1)$$

where y, I, E are PPI variables (PPIN and PPIV), institutional variables (VOA, PSV, GVE, REQ, ROL and COR) and economic variables (INF, GRW, GDPPC, EXR and GBL), respectively. α, β, γ, ε are constant term, parameter of institutional and economic variables and error term, respectively.

There would be a threat of multicollinearity among the explanatory variables. Table 3 indicates that the bivariate correlations between institutional variables are more than 0.5 except the correlation between PSV and RGQ, whereas those between economic variables are less than 0.4. The variance inflation factor (VIF), a method of measuring the level of collinearity between the regressors in an equation, tells that ROL (11.934) is far beyond the standard level of collinearity and GVE (9.112), COR (7.870) and REQ (6.306) are in the risky zone inducing multicollinearity, while the other variables including all the economic ones range in the normal level. Thus the institutional variables, specifically, ROL, GVE, COR and REQ, would cause multicollinearity, and so these variables should be treated as independent regressors in the estimation equation (1). The subsequent estimation, therefore, uses four sets of the institutional variables: (GVE, VOA, PSV), (REQ, VOA, PSV), (ROL, VOA, PSV) and (COR, VOA, PSV), and also full-set of those variables as a reference.

Regarding the estimation methodologies, in the regression where the dependent variable is the number of projects (PPIN), i.e., integer values that represent the number of events that occur, the study employs a count data model. Since over-dispersion occurs due to a large number of zeros in the PPI database, this study adopts the negative binomial regression model as in Banerjee et al. (2006). As for the regression in which the dependent variable is the total investment commitments (PPIV), i.e., continuous nonnegative values, the study relies on the Tobit regression model, namely, the canonical censored regression model, as in Hammami et al. (2006).

2.3 Estimation Outcomes and Discussions

Table 4 represents the estimation outcomes on the number of projects (PPIN) with the negative binomial regression model and the total investment commitments (PPIV) with the Tobit regression model. The outcomes could be summarized as follows.

Regarding the institutional variables, the government governance indicators of government effectiveness (GVE), regulatory quality (REQ), rule of law (ROL) and control of corruption (COR) are identified to have positive effects on both the number of projects (PPIN) and the total investment commitments (PPIV) at the 99 percent significant level, when they are treated as independent regressors in the regressions from (1) to (4). It should be noted that there are contrasting results in ROL and COR in the reference regression (5) including all the institutional variables: the effects of ROL on PPIN and PPIV is insignificant and negative respectively, and those of COR are significantly negative. These results in the regression (5) could be attributed to the regressors' multicollinearity problem, since ROL and COR have high levels of VIF as examined in the previous section. Based on the regressions from (1) to (4) avoiding the multicollinearity, all the four governance indicators are considered to have positive effects on the PPI projects (thus the regressions from (1) to (4) are focused on hereafter). The estimation results on governance indicators from (1) to (4) are basically consistent with those of Hammami et al. (2006) and Banerjee et al. (2006). Those two studies, however, reveal different results of the corruption effects on the PPI: Banerjee et al. (2006) shows a negative effect of the corruption control on the PPI, whereas Hammami et al. (2006) represents its positive effect. Thus this study could enrich the evidence to support Hammami et al. (2006), by updating the sample time-horizon and by widening the coverage of sample economies.

As for the other institutional variables, the variable of the voice and accountability (VOA) shows mixed results according to the regressions, and so does not provide any clear messages on its PPI effects. The variable of the political stability and absence of violence/terrorism (PSV), on the other hand, has significantly negative effects on both PPIN and PPIV. The result seems to be against usual expectation that the political stability is a basic requirement for attracting the PPI projects. It is true that Hammami et al. (2006) argues the need for controlling political risks for the PPI, but at the same time they present the hypothesis that the PPI arrangements are likely to be positively correlated with "ethnic fractionalization". It means that the ethnic fractionalization represents the heterogeneity of preferences in the overall population; it often leads to political tensions; and the political endeavors to satisfy the conflicting demands produce more PPI projects. The PSV adverse effect on PPI in this study might reflect the channel of this ethnic fractionalization.

Concerning the impacts of the economic variables on PPI, the regressions of the total investment commitments (PPIV) do not have clear results compared with those of the

number of projects (PPIN). It might be probably because the values of investment commitments themselves depend on the sector, type and status of the PPI projects. Focusing on the PPIN, most of the estimated coefficients follow the usual expectation. The macroeconomic stability is identified as an important factor to boost the PPI projects: high inflation (INF) and currency depreciation (EXR) have negative effects on PPIN, and high GDP growth (GRW) and GDP per capita (GDPPC) have positive effects on PPIN. The government constraints also push up the PPI projects as shown in the negative effect of GBL on PPIN.

The emphasis of the empirical study here is summarized as follow. The institutional role in promoting the PPI projects are clearly identified in terms of government governance indicators such as government effectiveness, regulatory quality, rule of law and control of corruption. In particular, the control of corruption, which is the controversial issue in the previous studies, is confirmed to be one of the important factors to boost the PPI projects, when the regressors' multicollinearity problem is avoided. The macroeconomic stability in terms of prices, currency value and economic growth is also a significant contributor for the PPI projects.

3. Concluding Remarks

This paper aims to revisit the issue of institutional role in the PPI and to reexamine empirically institutional impacts on the PPI in the recent period for 2002-2017 using the PPI and WGI database of the World Bank. The study contributes to enriching the evidence of the institutional effects on the PPI by updating the sample time-horizon and by widening the coverage of sample economies. By doing so, the evidence could be added on the critical issue of the corruption effect, on which the previous studies had a contrasting outcome.

The main findings of this study are summarized as follow. The institutional role in promoting the PPI projects are clearly identified in terms of government governance indicators such as government effectiveness, regulatory quality, rule of law and control of corruption. In particular, the control of corruption, which is the controversial issue in the previous studies, is confirmed to be one of the important factors to boost the PPI projects, by avoiding the regressors' multicollinearity. The macroeconomic stability in terms of prices, currency value and economic growth is also a significant contributor for the PPI projects.

References

McKinsey Global Institute (2016) *Bridging Global Infrastructure Gaps*, McKinsey Global Institute: Washington, D.C.

Banerjee, S.G., J. M. Oetzel and R. Ranganathan (2006) "Private Provision of Infrastructure in Emerging Markets: Do Institutions Matter?" *Development Policy Review* 24(2), 175-202.

Bergara, M.E., W.J. Henisz and P.T. Spiller (1998) "Political Institutions and Electric Utility Investment: A Cross-Nation Analysis" *California Management Review* 40(2), 18-35.

Doh, J. and R. Ramamurti (2003) "Reassessing Risks in Developing Country Infrastructure" *Long Range Planning* 36(4), 337-53.

Flachaire, E., C. Garcia-Penalosa and M. Konte (2014) "Political versus Economic Institutions in the Growth Process" *Journal of Comparative Economics* 42(1), 212-229.

Hammami, M., J.F. Ruhashyankiko and E.B. Yehoue (2006) "Determinants of Public-Private Partnerships in Infrastructure" *IMF Working Paper* WP/06/99.

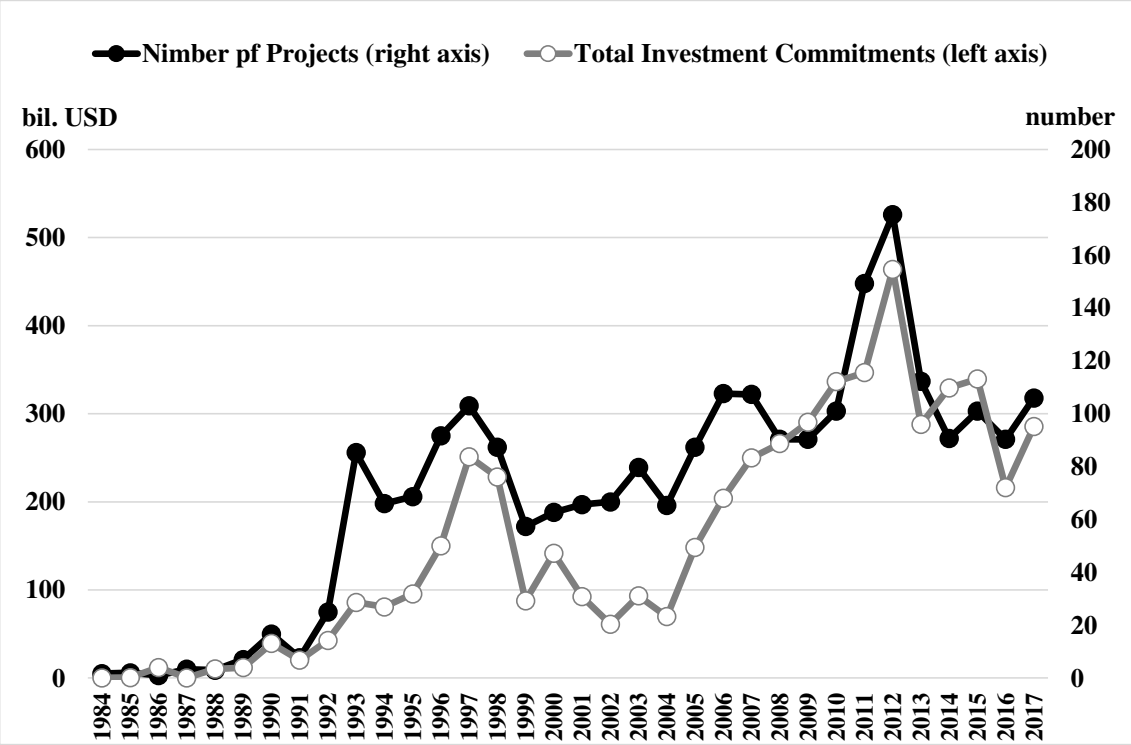
Lee, K. and B.Y. Kim (2009) "Both Institutions and Policies Matter but Differently for Different Income Groups of Countries: Determinants of Long-Run Economic Growth Revisited" *World Development* 37(3), 533-549.

North, D.N. (1990) *Institutions, Institutional Change and Economic Performance*, Cambridge University Press: New York.

Rodrik, D., A. Subramanian and F. Trebbi (2002) "Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development" *NBER Working Paper* 9305.

Vaal, A. and W. Ebben (2011) "Institutions and the Relation between Corruption and Economic Growth" *Review of Development Economics* 15(1), 108-123.

Figure 1 Trend in Private Participation in Infrastructure



Sources: Private Participation in Infrastructure Database, The World Bank

Table 1 List of Variables

Variables	Description	Data Siources
Dependent Variables		
PPIN	Number of Projects of Pivate Participation of Infrastructure (PPI)	PPI Database, World Bank
PPIV	Total Investment Commitments of PPI [million USD, log term]	
Explanatory Variables: Institution		
VOA	Voice and Accountability [from approximately -2.5 (weak) to 2.5 (strong)]	Worldwide Governance Indicators, World Bank
PSV	Political Stability and Absence of Violence/Terrorism [ditto]	
GVE	Government Effectiveness [ditto]	
RGQ	Regulatory Quality [ditto]	
ROL	Rule of Law [ditto]	
COR	Control of Corruption[ditto]	
Explanatory Variables: Economic Conditions		
INF	Inflation, consumer prices [annual %, lagged]	World Development Indicators, World Bank
GRW	GDP growth [annual %, lagged]	
GDPPC	GDP per capita [current USD, log term, lagged]	
EXR	National Currency per USD [period average, log term, lagged]	International Financial Statistics, IMF
GBL	General government net lending/borrowing [percent of GDP, lagged]	World Economic Outlook Databases, IMF

Sources: Author's description

Table 2 Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max
Dependent Variables					
PPIN	1,872	2.59	9.90	0	127
PPIV	1,872	2.28	3.07	0	10.94
Explanatory Variables: Institution					
VOA	1,872	-0.43	0.75	-2.31	1.22
PSV	1,861	-0.45	0.87	-3.31	1.38
GVE	1,865	-0.49	0.59	-2.44	1.26
RGQ	1,864	-0.48	0.64	-2.64	1.24
ROL	1,872	-0.56	0.59	-2.60	1.07
COR	1,872	-0.53	0.56	-1.86	1.56
Explanatory Variables: Economic Conditions					
INF	1,762	7.13	10.30	-18.10	254.94
GRW	1,819	4.66	4.94	-33.10	64.06
GDPPC	1,830	7.62	1.03	4.71	9.68
EXR	1,795	3.72	2.69	-2.89	22.62
GBL	1,807	-2.19	6.19	-35.39	125.13

Sources: Author's estimation

Table 3 Correlation Matrix

[Institutional Variables]

	VOA	PSV	GVE	RGQ	ROL	COR
VOA	1					
PSV	0.500	1				
GVE	0.578	0.512	1			
RGQ	0.671	0.430	0.818	1		
ROL	0.686	0.662	0.842	0.772	1	
COR	0.642	0.646	0.784	0.644	0.850	1
VIF	3.027	2.437	9.112	6.306	11.934	7.870

[Economic variables]

	INF	EXR	GRW	GBL	GDPPC
INF	1				
EXR	0.018	1			
GRW	0.029	0.056	1		
GBL	0.017	-0.040	0.058	1	
GDPPC	-0.148	-0.365	-0.171	0.010	1
VIF	1.568	1.928	1.740	1.099	1.449

Sources: Author's estimation

Table 4 Estimation Outcomes

[Number of Projects (PPIN) with Negative Binomial Regression Model]

PPIN	(1)	(2)	(3)	(4)	(5)
GVE	2.170 ***				2.500 ***
	(15.109)				(10.239)
RGQ		1.828 ***			0.521 ***
		(11.279)			(2.647)
ROL			1.778 ***		0.054
			(9.279)		(0.189)
COR				1.060 ***	-1.300 ***
				(5.216)	(-5.182)
VOA	-0.132	-0.324 ***	-0.395 ***	-0.174 *	-0.017
	(-1.541)	(-3.732)	(-4.055)	(-1.852)	(-0.166)
PSV	-1.014 ***	-0.936 ***	-1.077 ***	-0.958 ***	-0.849 ***
	(-11.425)	(-10.091)	(-10.496)	(-9.047)	(-8.984)
INF	-0.007	-0.004	-0.018 **	-0.030 ***	-0.005
	(-0.795)	(-0.493)	(-1.984)	(-3.236)	(-0.596)
EXR	-0.041 *	-0.063 ***	-0.100 ***	-0.096 ***	-0.055 **
	(-1.933)	(-2.907)	(-4.698)	(-4.187)	(-2.559)
GRW	0.044 ***	0.069 ***	0.049 ***	0.064 ***	0.050 ***
	(3.125)	(4.904)	(3.275)	(4.241)	(3.576)
GBL	-0.030 **	-0.061 ***	-0.025 *	-0.059 ***	-0.032 **
	(-2.405)	(-4.515)	(-1.811)	(-4.144)	(-2.398)
GDPPC	0.110 ***	0.079 ***	0.151 ***	0.122 ***	0.082 ***
	(7.707)	(5.315)	(9.377)	(7.788)	(5.296)
Observations	1,587	1,587	1,587	1,587	1587
Mean dependent var.	2.910	2.910	2.910	2.910	2.910
S.E. of regression	10.283	15.239	10.374	17.370	10.586

[Total Investment Commitments (PPIV) with Tobit Regression Model]

PPIV	(1)	(2)	(3)	(4)	(5)
GVE	5.120 ***				4.667 ***
	(13.201)				(7.067)
RGQ		5.691 ***			3.644 ***
		(13.854)			(6.710)
ROL			3.662 ***		-1.213 *
			(7.842)		(-1.668)
COR				1.977 ***	-2.345 ***
				(4.238)	(-3.718)
VOA	0.208	-0.628 **	0.407	0.941 ***	0.029
	(0.717)	(-2.017)	(1.266)	(2.870)	(0.090)
PSV	-2.874 ***	-2.469 ***	-3.015 ***	-2.538 ***	-2.180 ***
	(-12.082)	(-10.735)	(-11.171)	(-9.450)	(-8.552)
INF	-0.023	0.004	-0.047 **	-0.066 ***	-0.000
	(-1.063)	(0.191)	(-2.032)	(-2.842)	(-0.003)
EXR	0.097	0.076	-0.024	-0.048	0.095
	(1.549)	(1.225)	(-0.374)	(-0.721)	(1.545)
GRW	0.051	0.065 *	0.035	0.033	0.070 **
	(1.443)	(1.822)	(0.959)	(0.918)	(2.006)
GBL	-0.034	-0.036	-0.034	-0.066 **	-0.038
	(-1.084)	(-1.139)	(-1.075)	(-2.022)	(-1.182)
GDPPC	0.043	0.001	0.083 *	0.043	-0.032
	(1.011)	(0.038)	(1.855)	(0.944)	(-0.735)
Observations	1,587	1,587	1,587	1,587	1587
Mean dependent var.	2.510	2.510	2.510	2.510	2.510
S.E. of regression	2.850	2.859	2.991	3.048	2.797

Note: ***, **, * denote rejection of null hypothesis at the 99%, 95% and 90% level of significance, respectively.
Sources: Author's estimation