International Research Journal of Finance and Economics
ISSN 1450-2887 Issue 164 November, 2017
http://www.internationalresearchjournaloffinanceandeconomics.com

Linkage between Public (State Sector) Investment, Private Investment and Economic Growth: Evidence from Vietnam

Nguyen Thi Canh
University of Economics and Law-Vietnam National University-Ho Chi Minh City (VNU-HCM)
E-mail: canhnt@uel.edu.vn

Nguyen Anh Phong
University of Economics and Law-Vietnam National University- Ho Chi Minh City
E-mail: phongna@uel.edu.vn
(This research paper is funding by VNU-HCM budget with research project No B2016-34-01)

Abstract

This study is to assess the impact of public (state sector) investment on private investment and economic growth in Vietnam based on data from 22 economic industries over a 27-year period (1990-2016) by applying PVAR model combined with GMM. The results show that public (state sector) investment (including public investment and state-owned enterprise investment for production and business activities) has a positive impact economic growth in most economic industries in the short and medium term. Public (state-sector) investment has increased the private capital stock in the short term, but crowds out private capital stock in the medium term, it also crowds out domestic private and FDI investments in the short term, incentives them in the mid-term.

Keywords: Public Investment, State Sector Investment, Private Investment, Economic Growth
JEL Classification: O00

1. Introduction

Vietnam has achieved satisfactory results after implementing innovative economic policies for30 years which records a stable and higher growth rate than that of the nations in the Southeast Asia region for years. Vietnam economy is now integrating into the global economy, improving fiscal policy (Budget revenue and expenditure suits the economy scale and overspending rate is in allowed restriction) which creates trust for international investors and sponsor organizations. Since 2007, Vietnam became an official member of World Trade Organization (WTO); and since early 2016, Vietnam has been a member of ASEAN Economic Community (AEC), Vietnam has been step by step cutting tariffs as integrated commitment. Tax reduction means a part of budget income through tax will decrease, and a sharp drop in crude oil price also leads to decreased budget income. However, Vietnam Government needs to maintain public expenses for social- economic and infrastructure development, which is far too weak. In the context of high budget pressures, the need to save government expenses is set. However, in order to achieve economic growth and improve the competitiveness of the economy to attract private domestic investment and foreign direct investment (FDI), it is necessary to improve the investment and business environment. To improve the investment and business environment, the role of Government is to provide public goods and services through investment in technical infrastructure (e.g., roads, bridges, ports, industrial parks, and so on) and social infrastructure (e.g., hospital, school, and so on). It is therefore necessary to increase public investment by the government, and public investment must ensure efficiency by attracting private investment and economic growth.

There are two opposite trends in public investment research. As for the first trend, many studies in developing countries have evidence that public investment affects private investment and economic growth (Syed Adnan Haider Ali Shah Bukhari et al. 2007; Pooloo Zainah . 2009; Thanapat Reungsri. 2010; Sheikh Touhidul Haque. 2013; etc.). as for the second trend which has the opposite result to the first one, the results of studies in developed countries indicate that public investment crowd out public investment and has little or no impact on economic growth; moreover, it even has opposite effect on economic growth (Vedder and Gallaway (1998)). However, some studies in developed countries such as Christian Dreger and Hans- Eggert Reimers (2014) acknowledged that in the short run public investment has no impact on economic growth but in the long run is impacted.

Within the scope of this research, we would like to consider whether public investment in Vietnam has a positive effect, i.e. public investment has an impact on attracting private investment and economic growth or not. The questions to be answered in this study are: What is the role of public investment in Vietnam today? What is the impact of public investment on attracting private investment and economic growth?

In answering the above questions, the study will assess the impact of public investment on attracting private investment and economic growth and testing hypotheses on whether public investment is crowding out or crowding in the private investment in Vietnam.

2. Literature Review

2.1. Theoretical Literature

The most simple and famous growth model applied is Harrod-Domar which was introduced in 1940s, named after its originators, Roy Harrod – British and Evsey – American. The model focuses on ICOR ratio or capital-outcome ratio, showing the relationship between investment and growth in gross product. While the low ICOR ratio infers the lack of investment, the high one infers the situation of capital wasting.

The theory that explains the relationship between inputs and growth in a national product is called the production function. The production function is one of the key concepts of mainstream neoclassical theories, used to define marginal product and to distinguish allocated efficiency, the defining focus of economics. Cobb–Douglas production function (1928) represent the technological relationship between the amounts of two or more inputs, particularly physical capital (K) and labor (L), and the amount of output (Y) that can be produced by those inputs. Robest Solow (1956) tried to explain the origin of growth by a different kind of production function that allows analysis of the different causes or origins of growth called the Solow model. The main assumptions of the Solow model relate to the characteristics of the production function and the evolution of the three inputs of product (capital, labor and knowledge) over time.

Public investment which affects strongly to economic growth is also reflected by aggregate supply and demand. Public investment directly impacts on aggregate demand as a government expenditure and aggregate supply as a production function (capital factor). Public investment has spillover effect and indirectly impacts to aggregate demand by stimulating private investment and to aggregate supply through attracting private investment.

2.2. Previous Empirical Studies.

Investigation about effect of public investment on private investment has had series of studies done in many countries and has the opposite results. Studies showing the positive effects of public investment on private investment appear to be frequency and often occur in developing countries or emerging economies. The study on the effect of public investment on private investment in developing economies was done by Lutfi Erden and Randall G. Holcombe, (2005, 2006) with applying several pooled specifications of a standard investment model and panel data for period (1980 – 1997)has a result indicating that public investment crowds in private investment. Toshyya Hanato, (2010) has a study investigating the effects of public investment on private investment based on Japanese empirical data. Estimating the error correction model, the author affirmed that the crowding-in effect of public investment on private investment. Altin Gjini and Agim Kukeli (2012) has a study in crowding – out effect of public investment on private investment in transition economies in Eastern Europe. The result of this study showed that there was no crowding-out effect of public investment on private investment. The study of Victoria Oluwatoyin Foye (2014) is t**he impact of public capital spending on private investment in Nigeria showed that public investment is motivation of private investment growth.** Christian Dreger and Han – Eggert Reimers (2016) have a study to answer a question "Does public investment stimulate private investment in the euro area" and indicated that the lack of public investment may have restricted private investment and thus GDP growth in the euro area. In addition to the above-mentioned studies that have resulted in the positive effects of public investment on private investment (public investment stimulates private investment); there are also some studies that show the negative effects of public investment (public investment crowds out private investment). The study on the impact of public investment on private investment in Brazil for the period (1947 – 1990) was done by Bruno de Oliveira Cruz and Joanílio R. Teixeira (1999), indicated that private investment is crowded out by public investment in short – term, but in the long term these two variables complement each other. **Erden and Randall G. Holcombe, (2005) indicated that public investment has positive affect private investment in developing economies, whereas, public investment has a negative affect private investment in developed countries. Study of** Altin Gjini and Agim Kukeli (2012) showed that there is a crowd-out effect of public investment on private investment in Western countries, but it does not in Eastern European Countries.

A comprehensive study of the effects of public investment on private investment and economic growth has also been carried out in different countries and groups of countries, and results are not quite the same. William E.Cullison (1993) applied VAR model to evaluate linkage between public investment and economic growth. The results indicated that Government consumptions for Education and Labor training have clear effects on economic Growth in future. Edward Hsieh and Kon S. Lai,(1994)used endogenous growth model by Barro (1990) to examine the relationship between government consumption and economic growth for the Group-of-Seven countries (G7). The empirical results suggest that the relationship between government spending and growth can vary significantly over time as well as across the major industrialized countries. Most importantly, there is no clear evidence that government spending can increase GDP per capita GDP in G7.In Mohsin S. Khan's (1996)study on government investment and economic growth in the Developing World, the empirical results indicated that t**he private investment has a much stronger impact than public sector investment. There is a difference between public investment and private investment in areas. For Africa and the Middle East, both types of investment exercised a similar impact, while in Latin America public investment appeared to have had, on average, very limited impact and private investment with a pronounced positive effect. In Asia, public investment was statistically significant, but had an effect on growth only about half that of private investment.**Ramirez and Nazmi's (1997 and 2003)studies on public investment and economic growth in Latin America with using OLS and data for the period (1983-1993)showed that the openness of economy, human capital and government consumption/ public health significantly affect private investment. Research results also indicated that both private investment and public investment contribute to economic growth. Ejaz Ghani and Musleh-ud Din, (2006) have studied the impact of public investment on economic growth in Pakistan with using the vector autoregressive approach (VAR). The VAR consists of four variables including public investment, private investment, public consumption and GDP with data from1973 to 2004. The result showed that economic growth is largely driven by private investment and that no strong inference can be made about the effects of public investment and public consumption on economic growth. The results also showed the presence of long run causality from public investment, private investment, and public consumption to economic growth.Syed et al.(2007)examined the casual connection between public investment and economic growth in the Three Little Dragons (Korea, Singapore, and Taiwan) using a variety of econometric techniques with Heterogeneous Dynamic Panel Data in the period (1971 – 2000). The authors also used four variables model that includes public investment, public consumption, private investment and growth rate of GDP. The results indicated that both public and private investment and public consumption have a long-term dynamic impact on economic growth and the pair-wise analysis showed bidirectional causality between public investment and economic growth in all the countries. Rohan Swaby, (2007),investigated the relationship between public investment and growth in Jamaica, with using VECM. The Granger causality result suggested that public investment does not cause GDP; however, GDP causes public investment. The VECM showed that in the long-run domestic private investment, FDI, and the REER all have a positive statistically significant direct impact on the level of GDP. Public investment has the effect of crowding – out net private investment. **Andros Gregoriou andSugata Ghosh (2008),have a study on t**he impact of government expenditure on growth for 15 developing countries. Using GMM techniques, the authors showed that countries with substantial government expenditure have strong growth effects.

Pooloo Zainah (2009),investigated the role of public investment in promoting economic growth in Mauritius, used dynamic econometric framework, and Vector Autoregressive (VAR) model. The link between public capital, as measured by transport and communication infrastructure and economic performance has been analyzed in a multivariate dynamic framework. Results from this analysis revealed that both transport and communication infrastructure are important elements promote the Mauritian economy.Kongphet Phetsavong and Masaru Ichihashi (2012),have a study on **t**he impact of public and private investment on economic growth in developing Asian Countries, The author analyzes the factors affecting economic growth and the interrelationship of public investment, FDI, and private domestic investment using a panel data covering the period 1984 – 2009. The study found that both public investment and private domestic investment positively affect economic growth. Therefore, any increasing in public investment more than 4.9% - 8%, the public investment will reduce the positive effect of FDI on economic growth. Wolassa L.Kumo (2012) conducted pairwise Granger causality tests between infrastructure investment and economic growth in South Africa for the period 1960-2009 using bivariate vector auto-regression (VAR) model with and without a structural break. The author found that there is a strong causality between infrastructure investment and GDP growth that run in both directions implying that infrastructure investment drives the long term economic growth in South Africa while improved growth feeds back into more public infrastructure investments**.**Sheikh Touhidul Haque (2013)investigated the effect of public and private investment on economic growth in Bangladesh, using the new neo-classical growth model of Cobb- Douglas production function utilizing the error correction model (ECM). The findings of the study concluded that there exist a short-run and long-run relationship between public and private investment and economic growth in Bangladesh.

In Vietnam, there have been some studies on the impact of public investment on economic growth but mainly on qualitative or theoretical descriptions and not much empirical research. Recently there have been a few empirical studies on public investment and economic growth in Vietnam. To Trung Thanh (2011) used the error correcting vector model (VECM) to estimate responses to public, private investment and GDP variables for the period 1986-2010. The result showed that both of private investment and public investment positively influence output, and be statistically significant, but private investment is stronger. Tran Nguyen Ngoc Anh and Le Hoang Phong (2014) used autoregressive distributed lag model (ARDL) to examine the effects of public investment on Vietnam economic growth for the period 1988 – 2012. The result indicated that the effect of public investment on economic growth in short term is not statistically significant, but it promotes long - run growth. However, these empirical studies in Vietnam are limited in number of variables and data sources.

Our research will inherit international research and overcome the limitations of some researches in Vietnam, including (1) replacing some variables with Vietnamese characteristics (2) analyzing the impact of public investment by industry with panel data.

3. Research Method, Model and Data

In this study, the authors use research variables to assess the interactive relationship between public investment and private investment and economic growth, along with other macro variables, according to studies done by Mohsin S. Khan and Manmohan S. Kumar (1997), Ejaz Ghani and Musleh-ud Din (2006), Kongphet Phetsavong and Masaru Ichihashi (2012) or Pooloo Zainah (2009).

Unlike previous studies, they were using the VAR method as studied by William E. Cullison (1993), Edward Hsieh and Kon S. Lai (1994), Ejaz Ghani and Musleh-ud Din (2006), Pooloo Zainah (2009) or study by Wolassa L. Kumum (2012). Our study used the PVAR method for panel data on 22 economic industries from 1990 to 2016.

Panel VARs are designed to capture both static and dynamic interdependencies across countries or regions using some set of restrictions, treat the linkages across units, and can account for cross sectional heterogeneities (Canova and Cicarelli, 2013).According to Abrigo and Love (2015),estimation and inference of homogeneous panel VAR models in a generalized method of moments (GMM) framework, by using standard Stata datasets.

Under the subdivision of the General Statistics Office of Vietnam, the whole economy is classified into 22 primary industries (see appendix). The total set of data table in our study including a sample of 594 observations is suitable for applying PVAR.

The difference in this study compared to previous studies is that previous studies analyzed a country's series data or panel data for a group of countries, while our study analyzed panel table data by economic industries/sectors. According to figures published by the General Statistics Office of Vietnam, investment capital data are broken down into three categories: the State sector investment, the private sector investment, and foreign sector investment. State sector investment includes public investment in socio-economic infrastructure construction and state-owned enterprise investment for production and business activities. The investment capital of each kind is calculated on average for one year. In addition to investment capital for one year, it is possible to add capital stock of private sectors, includes domestic private capital stock and foreign capital stock. Data of capital stock can be obtained from IMF and WB source, which is calculated in US dollars. Because data are from two sources of IMF/WB and General Statistics Office of Vietnam, we transferred data from the General Statistics Office of Vietnam in the local currency (Vietnam Dong) to the data in US dollars. In addition to the investment and GDP variables, in the research model, there were a number of other macro variables, such as real interest rates, public debt and the openness of the economy. The variables used in this study are described in the following table 1.

Table 1: Description of the variables used in the model

Variable name	Notation	Data Source	Unit
Public (state sector) investment for i economic industry at year t	I_{it}	GSO; Converted at the annual average exchange rate	Billion USD
GDP of i economic industry in the year t	Y_{it}	GSO; Converted at the annual average exchange rate	Billion USD
Domestic private investment in i economic industry at the year t	PEI_{it}	GSO; Converted at the annual average exchange rate	Billion USD
Foreign investment in i economic industry at the year t	FDI_{it}	GSO; Converted at the annual average exchange rate	Billion USD
Real interest fixed for i economic	RR_{it}	WB	%

Variable name	Notation	Data Source	Unit
industry at the year t			
% of public debt to GDP fixed for i economic industry at the year t	$Debt_{it}$	GSO; Converted public debt and GDP into USD at the annual average exchange rate and calculated ratio	%
Economic Openness fixed for i economic industry at the year t	$Open_{it}$	GSO; total of export and import to GDP	%
Private capital stock fixed for i economic industry at the year t	$PRCS_{it}$	IMF	Billion USD

Research model with PVAR method (a panel VAR framework) for assessing the impact of public investment on private investment and economic growth is a set of the following equations (with optimal expectation of lag and difference of order 1):

$$I_{it} = \beta_0 + \beta_1 I_{it-1} + \beta_2 D.Y_{it-1} + \beta_3 D.PEI_{it-1} + \beta_4 D.FDI_{it-1} + \beta_5 RR_{it-1} + \beta_6 Debt_{it-1} + \beta_7 Open_{it-1} + \beta_8 PRCS_{it-1} + \varepsilon_{it} \quad (1)$$

$$D.Y_{it} = \beta_0 + \beta_1 I_{it-1} + \beta_2 D.Y_{it-1} + \beta_3 D.PEI_{it-1} + \beta_4 D.FDI_{it-1} + \beta_5 RR_{it-1} + \beta_6 Debt_{it-1} + \beta_7 Open_{it-1} + \beta_8 PRCS_{it-1} + \varepsilon_{it} \quad (2)$$

$$D.PEI_{it} = \beta_0 + \beta_1 I_{it-1} + \beta_2 D.Y_{it-1} + \beta_3 D.PEI_{it-1} + \beta_4 D.FDI_{it-1} + \beta_5 RR_{it-1} + \beta_6 Debt_{it-1} + \beta_7 Open_{it-1} + \beta_8 PRCS_{it-1} + \varepsilon_{it} \quad (3)$$

$$D.FDI_{it} = \beta_0 + \beta_1 I_{it-1} + \beta_2 Y_{it-1} + \beta_3 D.PEI_{it-1} + \beta_4 D.FDI_{it-1} + \beta_5 RR_{it-1} + \beta_6 Debt_{it-1} + \beta_7 Open_{it-1} + \beta_8 PRCS_{it-1} + \varepsilon_{it} \quad (4)$$

Where:
β is Coefficient of marginal impact between variables
D.() is the year-to-year difference of order 1
ε is the contingent error

4. Research Results

Table 2: Descriptive statistics of the variables

Variable	Obs	Mean	Std. Dev.	Min	Max
I	594	.4781269	.7500281	.0008	4.3344
y	594	3.256035	5.670092	.0114	34.8746
pei	594	.3985968	.6217143	.0003	3.7325
fdi	594	.2553069	.864636	0	9.7906
rr	594	-2.896667	17.80065	-62.6	12.58
debt	594	94.07333	105.8785	11.5	450.6
open	594	110.4626	40.23563	45.31	170.07
prcs	594	226.2593	155.4563	44.18	543.75

Source: Author's calculations from Stata14

Table 2 describes the statistical data from research data showing that variables I, Y, PEI, and FDI are normal, while groups of other macro variables such as RR, Debt, Open, and PRCS have some abnormalities. The real interest rate (RR) has an average value of -2.89%, the min value is -62.6% and the max value is 12.58%, or the debt to GDP ratio in average is 94.07%, the min value is 11.5%. % and the max value 450.6%. These abnormal results stemmed from the shock of the start of the opening economy (from 1990 to 1995). At this stage, the macro-economic policy was not good, the inflation rate hiked so that the real interest rate with negative figure was too high. At the same time, at this stage, Vietnam was a low-income country while government debt was mainly the debt owed by the former Soviet Union and the Russian-dollar Rupee exchange rate has not changed over a long period, this led to a high public debt / GDP ratio. After this period, Vietnam reached an agreement with the Russian Federation to change the - rupee -dollar exchange rate, to restructure its debt, and to get a debt reduction. Thus, the debt-to-debt ratio declined significantly after 1995.

In addition, table 2 describing the statistics of the variables shows that the standard deviation is greater than the mean value, so that most variables exhibit varying variance. To overcome this phenomenon, the author applied a combination of the PVAR method integrated with the GMM according to Abrigo and Love (2015).

By using integrated GMM with PVAR, to ensure that data is stationary, the author applies fisher-type to test stationary of variables according to Abrigo and Love (2015).Test results are shown in Table 3.

Table 3: Test results of the stationary of the variables

Variable	P-value	Stationary/Non-stationary
I_{it}	0.000	stationary
$D.Y_{it}$	0.000	stationary
$D.PEI_{it}$	0.000	stationary
$D.FDI_{it}$	0.000	stationary
RR_{it}	0.000	stationary
$Debt_{it}$	0.000	stationary
$Open_{it}$	0.000	stationary
$PRCS_{it}$	0.000	stationary

Source: Author's calculations from Stata14

The results of Table 3 indicates that Y, PEI and FDI variables are stationary at the difference of order 1, while the I, RR, Debt, Open and PRCS variables are stationary, ensuring that PVAR integration with GMM is appropriate

The seeking result of lag length using in the model shows that the optimal lag is 1 because at this level the MBIC, MAIC and MQIC values are min (Table 4).

Table 4: The result of optimal lag length selection

lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	.9952323	379.175	2.18e-14	-798.8534	-4.824956	-317.4402
2	.9889668	199.5081	.0000536	-585.8442	-56.49186	-264.902
3	.9998756	93.82652	.0089344	-298.8496	-34.17348	-138.3786

Source: Author's calculations from Stata14

Co-integration Test applying Westerlund (2007); this allows for complete check of heterogeneous characteristics of long run parts of error correction model. Notation ‘a’ refers to the estimate of the error correction, while't' refers to the estimate the standard error of 'a'; Gt and Ga are group mean tests, while Pt and Pa are panel mean tests.

The results of Granger-causality Test of variables are statistically significant but for the long run Co-integration Test, they are non-significant, indicating that almost all variables have interaction effects in short and medium term (excepting for those variables that are not statistically significant such as RR and Debt to I or impact of RR on FDI), but they have not interaction effects in the long terms (table 5). This result may be due to the fact that every five years of the development planning cycle, the Vietnamese government has adjusted its economic industry structure. Therefore, the variables have only co-integration in the short and medium term, without co-integration in the long run. So this result is appropriate for assessing the interaction effect between variables using in the PVAR model in short and medium term.

The results also show that it is appropriate to evaluate the interaction effect between variables by the PVAR model

Table 5: The Result of Granger-Causality and Long run Co-integration Test

Equation	Granger Test			Long run Co-integration Test	
	Excuded	**chi2**	**Prob>chi2**	**Statistic**	**Prob>chi2**
I_{it}	$D.Y_{it}$	6.39	0.011(**)	Gt	0.685
	$D.PEI_{it}$	1057.75	0.000(*)	Ga	1.000
	$D.FDI_{it}$	3683.56	0.000(*)	Pt	0.736
	RR_{it}	1.03	**0.31**	Pa	1.000
	$Debt_{it}$	0.02	**0.88**		
	$Open_{it}$	3.22	0.07(**)		
	$PRCS_{it}$	308.06	0.00(*)		
	ALL	5203.71	0.00(*)		
$D.Y_{it}$	I_{it}	154.77	0.00(*)	Gt	0.987
	$D.PEI_{it}$	1996.97	0.00(*)	Ga	1.000
	$D.FDI_{it}$	6825.54	0.00(*)	Pt	0.997
	RR_{it}	6.86	0.09(***)	Pa	1.000
	$Debt_{it}$	19.34	0.00(*)		
	$Open_{it}$	21.97	0.00(*)		
	$PRCS_{it}$	122.02	0.00(*)		
	ALL	7604.05	0.00(*)		
$D.PEI_{it}$	$D.Y_{it}$	57.21	0.00(*)	Gt	0.996
	I_{it}	936.62	0.00(*)	Ga	1.000
	$D.FDI_{it}$	280.74	0.00(*)	Pt	1.000
	RR_{it}	0.41	**0.52**	Pa	1.000
	$Debt_{it}$	0.05	**0.82**		
	$Open_{it}$	13.07	0.00(*)		
	$PRCS_{it}$	105.85	0.00(*)		
	ALL	1381.32	0.00(*)		
$D.FDI_{it}$	$D.Y_{it}$	125.72	0.00(*)	Gt	0.758
	I_{it}	1809.91	0.00(*)	Ga	1.000
	$D.PEI_{it}$	1803.03	0.00(*)	Pt	1.000
	RR_{it}	2.32	**0.12**	Pa	1.000
	$Debt_{it}$	3.25	0.07(***)		
	$Open_{it}$	7.91	0.00(*)		
	$PRCS_{it}$	161.72	0.00(*)		
	ALL	3502.71	0.00(*)		

Source: Author's calculations from Stata14;
(*), (**),(***) Statistics those are significant at 1% level, 5% level, and 10% level

The PVAR results (table 6) show that almost the variables are statistically significant, exception of RR and Debt variables in the model (1) and model (3), suggesting that real interest rate and short

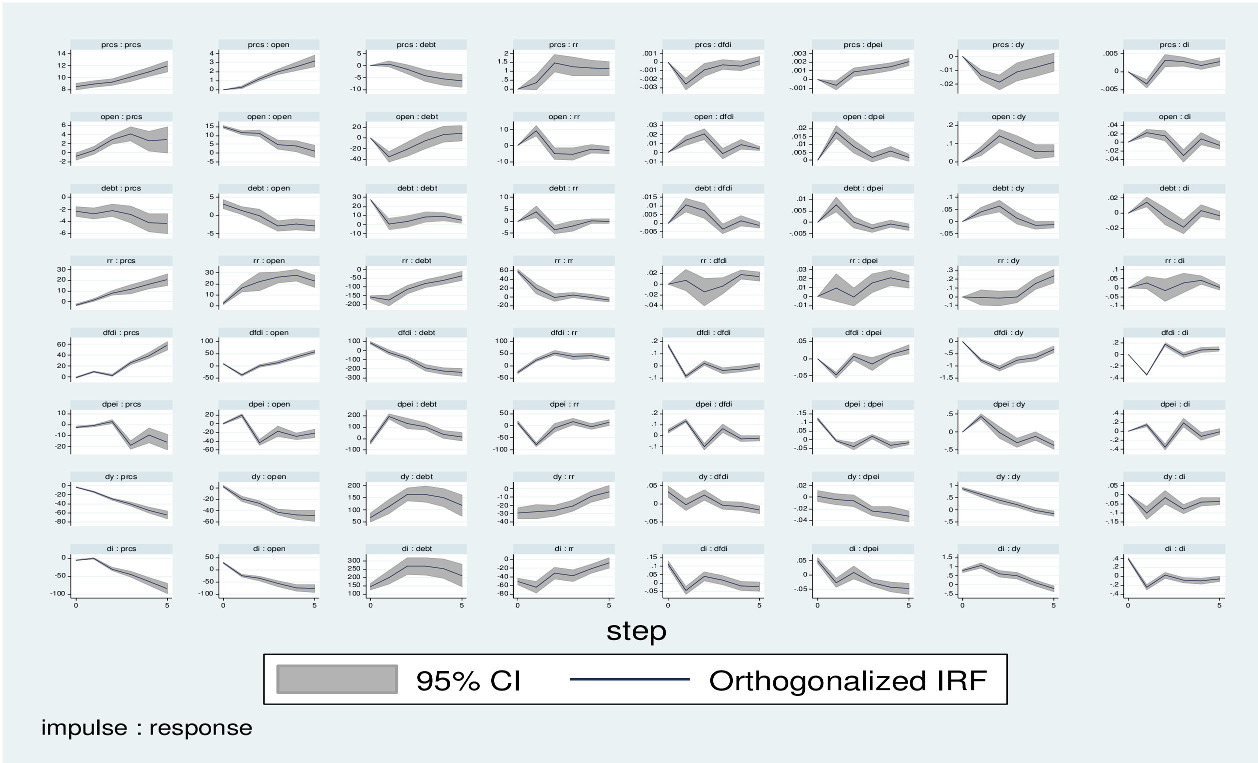
term debt do not affect state sector investment and domestic private investment. In addition, the real interest rate variable does not affect the FDI sector investment model (4).
To see causal effects in the short and medium term, we can see the figure of impulse response function.

Table 6: Estimation results of model using PVAR combined with GMM

Model		**Variables**	**Coef**	**Std.Err**	**P>|Z|**
(1)	**I_{it}**	I_{it-1}	0.11	0.02	0.00$^{(*)}$
		$D.Y_{it-1}$	-0.01	0.001	0.01$^{(*)}$
		$D.PEI_{it-1}$	1.01	0.01	0.000$^{(*)}$
		$D.FDI_{it-1}$	-1.41	0.03	0.000$^{(*)}$
		RR_{it-1}	0.000	0.001	**0.11**
		$Debt_{it-1}$	0.000	0.001	**0.12**
		$Open_{it-1}$	0.001	0.000	0.07$^{(**)}$
		$PRCS_{it-1}$	0.001	0.000	0.000$^{(*)}$
(2)	**$D.Y_{it}$**	$D.Y_{it-1}$	0.17	0.02	0.000$^{(*)}$
		I_{it-1}	0.41	0.03	0.000$^{(*)}$
		$D.PEI_{it-1}$	1.11	0.11	0.000$^{(*)}$
		$D.FDI_{it-1}$	-1.12	0.01	0.000$^{(*)}$
		RR_{it-1}	0.004	0.000	0.000$^{(*)}$
		$Debt_{it-1}$	0.001	0.000	0.000$^{(*)}$
		$Open_{it-1}$	0.002	0.000	0.000$^{(*)}$
		$PRCS_{it-1}$	-0.002	0.000	0.000$^{(*)}$
(3)	**$D.PEI_{it}$**	$D.Y_{it-1}$	0.02	0.000	0.000$^{(*)}$
		I_{it-1}	-0.11	0.007	0.000(*)
		$D.PEI_{it-1}$	-1.11	0.004	0.000(*)
		$D.FDI_{it-1}$	-0.12	0.003	0.000$^{(*)}$
		RR_{it-1}	0.000	0.000	**0.13**
		$Debt_{it-1}$	0.000	0.000	**0.15**
		$Open_{it-1}$	0.001	0.000	0.000$^{(*)}$
		$PRCS_{it-1}$	0000	0.000	0.000(*)
(4)	**$D.FDI_{it}$**	$D.Y_{it-1}$	0.017	0.001	0.000$^{(*)}$
		I_{it-1}	-0.23	0.002	0.000$^{(*)}$
		$D.PEI_{it-1}$	0.72	0.017	0.000$^{(*)}$
		$D.FDI_{it-1}$	-1.13	0.01	0.000$^{(*)}$
		RR_{it-1}	0.001	0.000	**0.12**
		$Debt_{it-1}$	0.001	0.000	0.07$^{(**)}$
		$Open_{it-1}$	0.001	0.000	0.000$^{(*)}$
		$PRCS_{it-1}$	0.000	0.000	0.000(*)

Source: Author's calculations from Stata14
(*), (**),(***) Statistics those are significant at 1% level, 5% level, and 10% level
D.() is difference of order 1 of variables.

Figure 1: Impulse Response Functions (IRF)



Source: Author's calculations from Stata14

The results from the impulse response function (Figure 1) show the effect of state sector investment on private investment, economic growth and on other variables for the following conclusions:

- State sector investment (including public investment and SOE investments) have the effect of stimulating economic growth in the short and medium term. This result is similar to the impulse response function graph of the public debt to GDP, whereby public debt also causes economic growth in the short or medium term.
- Domestic private investment has a similar effect to state sector investment, which stimulates economic growth in the short and medium term. In contrast, the FDI investment does not create momentum for economic growth in the short term, but in the medium term, FDI investment stimulates to increase GDP growth quite clearly.
- The impact of openness of the economy and public debt only increases GDP in the short run term, while in the medium term these two factors have the effect of gradually decreasing GDP growth over time.
- Real interest rate has the effect of stimulating GDP growth in the short run term, while in the medium term this factor has the effect of decreasing GDP growth over time.
- State sector investment has the effect of increasing public debt even in the short and medium term. This is very true of Vietnam's reality, as state sector investment has increased as public debt is rising.
- State sector investment has the effect of crowding out the FDI investment and domestic private investment in the short term; it has the effect of boosting private and FDI investment in the medium term, but by decreasing the effect on the private investment.
- State sector investment has increased the amount of private investment capital stock (including both FDI and private investment capital stock)in the short run term, while in the medium term

state sector investment has the effect of diminishing private investment capital stock. This means state sector investment crowds out private investment capital stock.

- State sector investment has the effect of reducing the economy's openness in the short and medium term

5. Conclusions and Policy Implications for Public Investment and State Sector Investment in General in Vietnam

The study used a quantitative method to assess the impact of public investment on private investment and economic growth based on data from 22 economic industries /sectors over a 27-year period (1990-2016) by applying PVAR model combined with GMM. The findings show that public investment affects private investment as well as has a spillover effect on GDP across most industries/sectors with varying effects cyclically and over time. In addition, private and state investments also have an impact on GDP cyclically or threshold effects (an inverted U-shape). The research also indicates that real interest rates (RRs), private capital stock(PRCs), economy openness (Open), and public debt (Debt), all have an impact on economic growth as shown in an inverted - U shape in medium term. Because in Vietnam the government not only performs the role of providing public goods and services and investing in infrastructure to create favorable business environment to attract domestic private and FDI investments, but also directly involves in production and business activities through state-owned enterprises (SOEs).Through the history of development, Vietnam has shifted from a centrally planned economy to a market economy. In this process although the private sector has developed over the years, the state sector remains dominant.

1) In terms of the impact on economic growth, public (state sector) investment has the positive impact on economic growth in most economic industries/sectors in the short and medium term.
2) In terms of the impact on domestic private and FDI investments, public or state-sector investment has increased the private capital stock in the short term, but crowds out private capital stock in the medium term. It also crowds out domestic private and FDI investments in the short term, incentives them in mid-term;
3) In terms of impact on other variables, public (state sector) investment has the effect of increasing public debt; it reduces the openness of the economy in the short and medium term.

In general, our results are relatively consistent with previous studies, such as Barro's (1990) study or study in Asian developing countries by Kongphet Phetsavong and Masaru Ichihashi (2012). According to this, public investment is often the investment in infrastructure that has the effect of attracting private investment and promoting economic growth. However, public investment is increasing public debt. This implies that government funding for public expenditure from state budget, usually made by tax increase or borrowing. It will negatively affect the private sector and economic growth. Therefore, public investment must be closely monitored to ensure transparency and efficiency. On the other hand, the impact factors have a threshold, which suggests that the government adjusts its policy of public investment, debt financing, and interest rate policy and investment environment in general to limit the impact in the down cycle.

The following part will give some implications and some more specific policy recommendations including:

First, it is clear that public investment is “bait” for private sector investment and a major driver of growth. However, through the analysis, public investment has a short cycle, therefore, to make public investment stable and become the leading factor, the government needs to have a long-term strategic investment plan that minimizes uncertainty (i.e., regulate to increase / decrease instability);

Second, public investment policy needs to be open and transparent. The lack of information in public investment has led to only temporary stimulus of private investment in the short term, in the medium term, there is a crowding-out private investment. In the long run, all information is clear, so public investment is likely to make the private sector investment increase and become more stable. These results also impact economic growth in a similar tendency;

Third, private domestic investments only have the effect of stimulating economic growth in the short run. In the medium term it is necessary to determine the reduction threshold and hence to have a policy of increasing investment in the growth phase to help stimulate growth in the next period;

Fourth, the study also found that it was necessary to determine the thresholds (maximum or minimum) for variables affecting GDP growth such as private capital stock (PRCS), real interest rate (RR) openness of economy (Open), and public debt (Debt). The results of the determining impact thresholds of variables can provide timely response policies consistent with the threshold in the period of increased or decreased GDP;

Fifth, because public state sector investment including public investment for infrastructure and state owner enterprise investment for production and business activities it is necessary to continue to restructure the state economic sector/ SOEs. Accordingly, reducing government intervention in the production business sector, promoting equitization, divesting state-owned enterprises from equitized SOEs, for increasing investment in infrastructure to reduce public debt, to create an investment environment that attracts domestic private investment and FDI capital, ultimately boosting economic growth.

References

[1] Abrigo and Love, 2015, Estimation of Panel Vector Auto regression in Stata: a Package of Programs. University of Hawaii working

[2] Altin Gjini and Agim Kukeli. (2012), paper “Crowding-Out Effect of Public Investment on Private Investment: An Empirical Investigation”. *Journal of Business & Economics Research.*

[3] Aschauer, D. (1989). “Is Public Expenditure Productive”, *Federal Reserve Bank of Chicago*, IL 69690, USA.

[4] Bruno de Oliveira Cruz, Joanílio R. Teixeira. (1999). “The impact of public investment on private investment in Brazil 1947-1990”, *Cepal review* 67. 75 – 84

[5] Bukhari, S and Ali, L and Saddaqat, M. (2007). *“Public Investment and Economic Growth in the Three Little Dragons: Evidence from Heterogeneous Dynamic Panel Data”. International Journal of Business and Information*.

[6] Canova F, Ciccarelli M (2013): Panel vector autoregressive models: A survey, ECB Working Paper 1507

[7] Christian Dreger, Hans-Eggert Reimers (2014), “On the Relationship between Public and Private Investment in the Euro Area”, Discussion Papers, DIW Berlin, 2014

[8] Christian Dreger, Hans-Eggert Reimers (2016), “Does public investment stimulate private investment? Evidence for the euro area, Economic Modeling 58 (2016) 154–158

[9] Dreger, C and Reimers, H. (2014). “On the relationship between public and private investment in the euro area”. *Discussion Papers.*

[10] Edward Hsieh and Kons Lai, N. (1994). “Government spending and economic growth the G-7 experience”. *Review of Applied Economics*, 26, 535-542.

[11] Erden, L and Holcombe, R. (2005). “The effects of public investment on private investment in developing economies”, Public Finance Review, 575 – 60.

[12] Erden, L and Holcombe, R. (2006). “The linkage between public and private investment: a co-integration analysis of a panel of developing countries”. *Eastern Economic Journal*, Vol. 32, No. 3, Summer 2006

[13] Foye, V. (2014). “The impact of public capital spending on private investment in Nigeria”. *Journal of international academic research for multidisciplinary*, Impact Factor 1.393, ISSN: 2320-5083, Volume 2, Issue 2.

[14] Ghani, E and Din, M. (2006). "The Impact of Public Investment on Economic Growth in Pakistan". *The Pakistan Development Review 45*: 1 pp. 87–98.

[15] Greene, William H. (2008). *Econometric Analysis*, 6th Edition, Upper Saddle River, NJ: Prentice-Hall.

[16] Gregoriou, A and Ghosh, S. "The Impact of Government Expenditure on Growth: Empirical Evidence from a Heterogeneous Panel", *Economics and Finance, Brunel University.*

[17] Haque, S. (2013). "Effect of Public and Private Investment on Economic Growth in Bangladesh: An econometric Analysis". *Research Study Series No –FDRS.*

[18] Khan, M and Kumar, M. (1997). "Public and private investment and the growth process in developing countries", *oxford bulletin of economics and statistics*, 59, 1 (1997) 0305-9049.

[19] Kneller, R, Bleaney, M and Gemmell, N. (1999). "Fiscal policy and growth: evidence from OECD", *Journal of Public Economics* 74, 171–190

[20] Kollamparambil, U and Nicolaou, M. (2011). "Nature and association of public and private investment: Public policy implications for South Africa", *Journal of Economics and International Finance* Vol. 3(2), pp. 98-108

[21] Kumo, W. (2012). "Infrastructure Investment and Economic Growth in South Africa: A Granger Causality Analysis", *Working Paper Series N° 160 African Development Bank, Tunis, Tunisia.*

[22] Mohsin s. Khan, "Government Investment and Economic Growth in the Developing World". *The Pakistan Development Review* 419—439.

[23] Pesaran, M.H. and Shin, Y. (1999). "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis." *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, Strom, S. (ed.) Cambridge University Press.

[24] Pesaran, M.H., Shin, Y. and Smith, R. (2001). "Bounds Testing Approaches to the Analysis of Level Relationships." *Journal of Applied Econometrics*, 16, 289–326.

[25] Phetsavong, K and Ichihashi, M. (2012). "The Impact of Public and Private Investment on Economic Growth: Evidence from Developing Asian Countries", *IDEC Discussion paper, Hiroshima University*

[26] Ramirez, MD and Nazmi, N. (2003). "Public Investment and Economic Growth in Latin America: An Empirical Test". *Review of Development Economics,* 7(1), 115–126.

[27] Rohan Swaby. (2007). "Public Investment and Growth in Jamaica". *Fiscal and Economic Programme Monitoring Dept. - Bank of Jamaica*.

[28] Toshiya Hatano. (2010). "Crowding-in Effect of Public Investment on Private Investment", Policy Research Institute, Ministry of Finance, Japan, Public Policy Review.

[29] William E. Cullison. (1993). "Public Investment and Economic Growth", *Federal Reserve Bank of Richmond Economic Quarterly* Volume 79/4

[30] Zainah, P. (2009). "The Role of Public Investment in Promoting Economic Growth: A case study of Mauritius". *SADRN/TIPS project.*

Vietnamese articles (in Vietnamese)

[1] To Trung Thanh "Public investment "crowds out" private investment? A look from experimental model of VECM", *Magazine of Finance-Tạp chí tài chính*, Vol.6 (560) 2011

[2] Tran Ngoc Anh Thu and Le Hoang Phong (2014), "Impact of public investment on economic growth in Vietnam: An experimental look of ARDL model", *Development and Integration-Tạp chí Kinh tế và Hội nhập*, Vol.19, 3-10.

[3] Christian Dreger, Hans-Eggert Reimers (2016), "Does public investment stimulate private investment? Evidence for the euro area, Economic Modelling 58 (2016) 154–158

APPENDIX: List of Economic Industries/ Activities are classified by GSO-Vietnam

Code	Kind of economic industry/activity
001	Agriculture,
002	Forestry
003	Fishery
004	Mining and quarrying
005	Manufacturing
006	Electricity, gas and hot water supply
007	Water supply and waste disposal
008	Construction
009	Trade, repair of motor vehicles and household goods
010	Transport, storage
011	Hotels and restaurants
012	Communications
013	Finance, banking and insurance
014	Real estate activities
015	Professional activities, science and technology activities
016	Administrative activities and assistant services
017	Public administration, defense; compulsory security and socio-political organizations
018	Training and education
019	Health and social work activities
020	Culture, sport and entertainment
021	Other services activities
022	Activities of households as employers; undifferentiated goods and services producing activities of households for own use