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Private and Public Investment in Malaysia: A Panel Time-Series Analysis

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ABSTRACT: Public capital hypothesis explains that a positive relationship exists between private and public investment. This paper examines the validity of the hypothesis by using a panel time series analysis on four sectors of the Malaysian economy (agriculture, industry and trade, transportation and communication, and construction). Panel co-integration analysis is used to prove the relationship between private domestic investment and public investment by using panel data for the period of 1976–2006. Two interaction variables, public investment and gross domestic product and investment and privatization policy were included as independent variables to take into account the influence of gross domestic product and privatization policy on the effect of public investment on private investment. Results of the study indicate that public investment has positive effect on private investment in all the three sectors except agricultural sector, suggesting that government expenditure encourage more private investment if focus is given towards productive expenditure.

Keywords: Public capital hypothesis, Panel time-series, Malaysia
JEL Classification: H50

1. Introduction

Public investment is argued as one of the important business stimulus to private investment. Public and private investment may be linked by a complementarity relationship if public capital exerts positive stimulus on the private sector. Aschauer (1989a) claims that the positive influence of public investment towards private investment can be explained by the public capital hypothesis. According to this hypothesis, an increase in public investment results in an increase in private investment as the availability of economic and social infrastructure may create conducive condition for private decision to invest by offering essential services to the production system both in the short-run and the long-run. However, this hypothesis still remains a controversy as there is no consensus and convergence of opinions especially in terms of empirical evidence. Hence, this paper provides evidence on the validity of the hypothesis by using a panel time series analysis approach in the context of Malaysia. The contribution of this paper lies in the fact that the application of panel data approach has never been widely used in this kind of study in Malaysia, particularly in public and private investment analysis.

2. Macro facts of capital expenditures in Malaysia

The total and composition of public and private capital expenditures have significantly changed due to impressive economic development during the last three decades. The changes of capital expenditure in both sectors are necessary to expand productive capacity so as to cope with expected increase in demand and modernization of Malaysian economy. In particular, Figure 1 shows the trend of public capital expenditure for agricultural, industrial, transportation and communication, and construction for the period 1976 – 2005. During this period, public capital expenditure for the transportation and communication sectors have experienced continuous increasing trend with slight fluctuation. Public capital expenditure for this sector exceeded other sectors for almost all the years beginning 1990 and it has continuously dominated other sectors until 2005. This is related to huge government allocation to develop new and expand core public infrastructure such as harbor, highway, road and airport (Kuala Lumpur International Airport) that are important for development of Malaysian economy. This situation reflects the interest and priority of the Malaysian government to the development of national productive capacity which is in line with the needs and aims of current development activities particularly for the expansion of new residential and industrial areas.

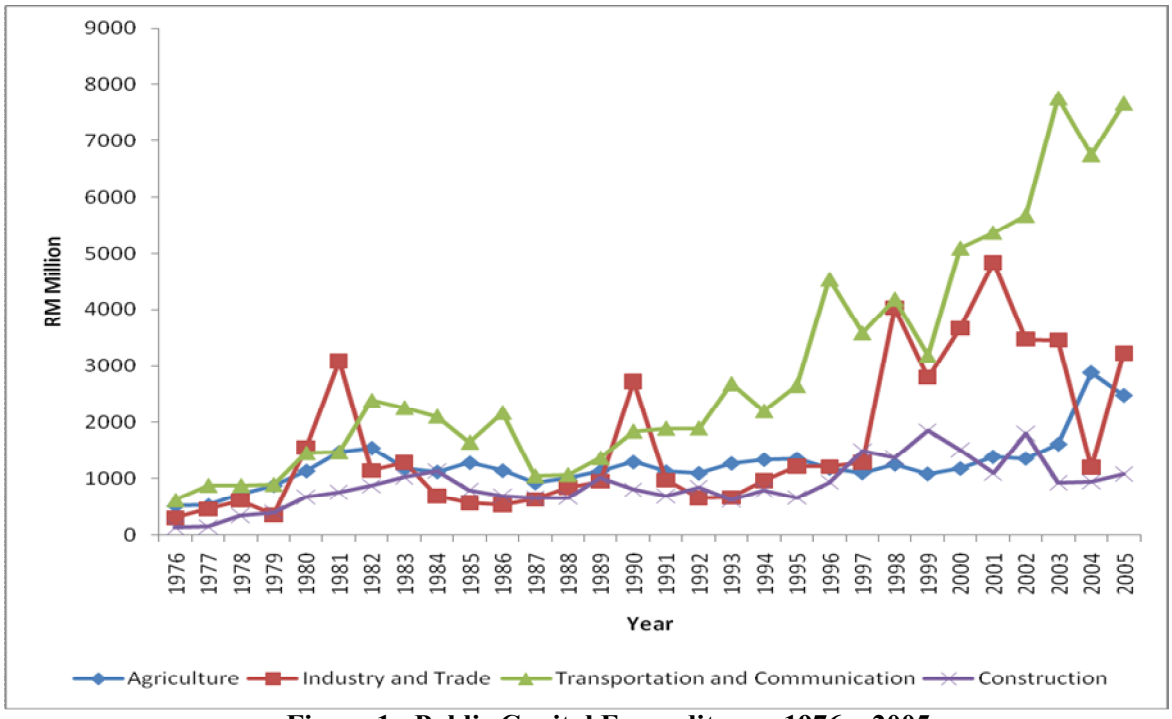

Figure 1. Public Capital Expenditures, 1976 – 2005

Meanwhile, private capital expenditure represents the expenditure for purchasing fixed assets residential, non-residential, other construction and land; planting and replanting of major perennial crops such as rubber and palm oil; purchasing new transportation and the expansion of plant capacity such as outlay on new plant, machinery and equipment; and conducting exploration activities. The trend of private capital expenditures is shown by Figure 2. The figure shows increasing trend particularly after the 1980s. In the 1970s, private capital increased consistently. Beginning in 1987, private capital expenditure for industrial and trade and construction considerably increased compare to other sectors.

The trend also shows that private capital expenditure of industrial and trade had dominated other sectors. In general, private capital expenditure that contributes to fixed asset investment increased every year. The pattern of private capital expenditure has changed due to the transformation of the Malaysian economic structure. For instance, the growth of fixed asset capital investment of the agricultural sector is less than manufacturing sector. This scenario reflects the private sector's response that is consistent with government policies which focus on the manufacturing sector as one of the main economic activities. Furthermore, in consonance with the government effort to further transform its economy, private capital expenditure is expected to rise further.

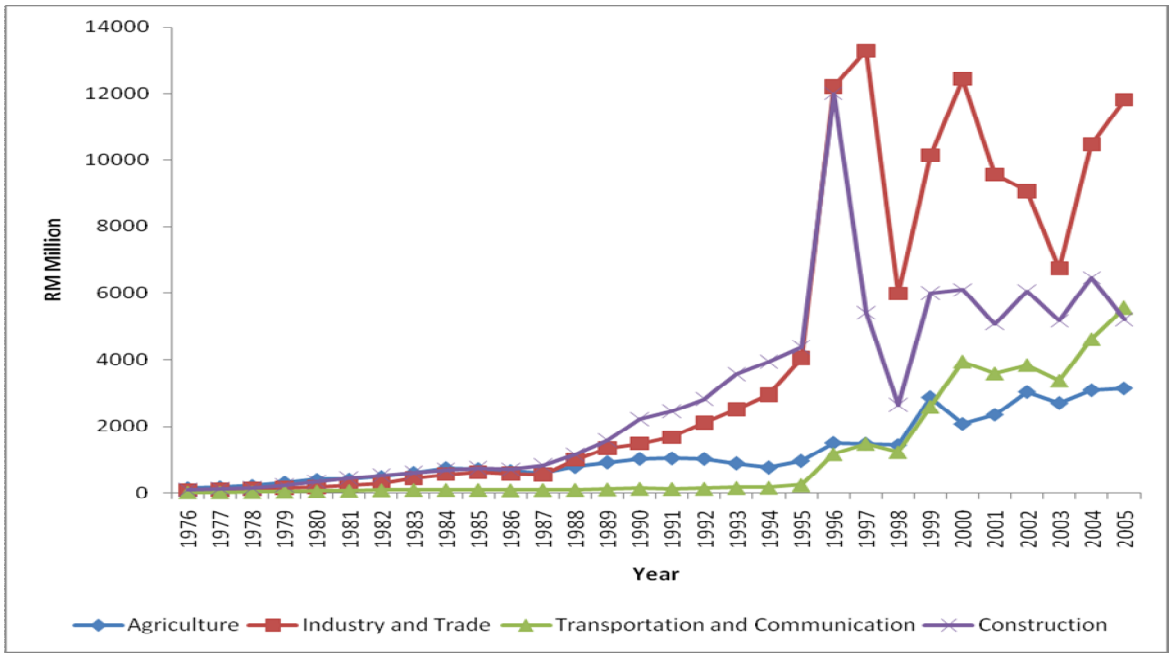

Figure 2. Private Capital Expenditure, 1976 – 2005

3. Literature Review

Recently, studies related to panel analysis have developed rapidly, starting with conventional panel analysis and evolving into non-stationary panel analysis. This development is closely related with the strength of panel analysis. Panel analysis has several advantage compared with time series analysis. The advantages of panel data analysis is discussed extensively by Baltagi (2005) and Hsioa (1996). For instance, Baltagi (2005) has listed a few major advantages of using panel data. Among these advantages are panel analysis allows for heterogeneity in individuals, firms, sectors, regions, and countries. The heterogeneity aspect is usually ignored in analysis using aggregate time series data. Aretis & Demetriades (1997) and Aretis *et al.* (2001) have shown that analyses using time series and cross section methods produce different results. In analyses to identify the determinants of growth, their results from cross section analysis show that capitalization of stock market is an important determinant of investment and growth compared to private credit.

Even though the analytical approach using panel data has many advantages compared to analysis using time series and cross section data, its usage in analyzing and explaining the public capital hypothesis has been limited compared to analysis of public capital hypothesis using time series approach. This statement is supported by Erden & Holcombe (2006). Proving the public capital hypothesis by using panel analysis has been undertaken by several researchers whether using panel of countries, states, economic sectors, or industries. Among the earliest studies using panel data relating to public capital hypothesis is by Evans & Karras (1994) who used panel data series for the OECD countries. Their findings showed that public capital brings negative effect on private capital.

Studies which used panel data for countries are Greene & Villanueva (1991), Ahmed & Miller (2000), Ghura & Goodwin (2000), Bende-Nabende & Slater (2003) and Erden & Holcombe (2005) for developing countries; Ramirez (2000) for Latin American countries, Blejer & Khan (1984); Oshikoya (1994) for African countries and Odedukun (1997) for a panel consisting of 48 developing countries. All these studies found that public investment is a stimulus for private investment as the results show that public infrastructure investment has a positive effect on private sector investment, while non-infrastructure investment has an opposite effect. The study by Erden & Holcombe (2005) aimed to look at the effect of public investment in developing countries. Balanced panel consisting of 19 developing countries including Malaysia has been used in analyses using four methods which are pooled OLS, fixed effect, random effect, and two stage least squares (2SLS). Data analysis for the 1980 – 1997 period show that public investment is a complement to private investment. This study found that on average, an increase of 10 percent in public investment has increased private investment

by two percent. On the other hand, Bende-Nabende & Slater (2003) for instance, used co-integration panel method to study private capital formation in the ASEAN countries for the period of 1965 – 1999. This empirical study intended to evaluate factors which are stimuli to private investment. The effect of public investment is significant but relate negatively with private investment.

Meanwhile, the study by Zugasti *et al*. (2001) and Martinez-Lopez (2006) used panel for sectors and industries to prove the validity of PCH. The study of Zugasti *et al.* (2001) aim to look at the effect of public infrastructure on the performance of private businesses in Spain at the industry level. The study sample consist of 14 industries chosen from six selected sectors which are manufacturing, construction, hotels and restaurants, transportation, communication, and financial services. By using a trans-log function and using the maximum likelihood method for analysis, the results of their panel analysis show that the effect of public infrastructure are different across industry, where the value of estimated parameter lies in the range of -84.16 – 8.60. The value of parameters show that public infrastructure provide a high benefit for chemical industry and the lowest for non-metallic mineral and synthetic mineral. This study confirmed that the effect of public capital on private investment differs, depending on sectors.

4. Methodology

Panel co-integration analysis is used to prove the relationship between domestic private investment and public investment by using a balanced panel with four units of cross sections (j) which represents four selected sectors. The selected sectors are agricultural sector (1), trade and industry sector (2), transportation and communication (3), and construction sector (4). The panel period (t) is for 30 years for the period of 1976 – 2006.

Data for all variables are at the industry-level. The sources of data are Central Bank of Malaysia, International Financial Statistics (IFS) and other official government reports.

The model constructed for panel estimation shown by equation 1 is based on the modification of models developed from the previous studies. In contrast to other models, this model incorporates the effects of privatization that is represented by dummy variable and interaction variables.

$$RPS_{jt} = \lambda_0 + \lambda_1 RPA_{jt} + \lambda_2 RGDP_{jt} + \lambda_3 NKD_{jt} + \lambda_4 RDF_{jt} + \lambda_5 DUM_{jt} + \lambda_6 RPA*GDP_{jt} + \lambda_7 RPA*DUM_{jt} + \varepsilon_{jt} \quad (1)$$

where;

PS_{jt}	=	Real domestic private capital expenditure for sector *j* at year *t*,
RPA_{jt}	=	Real public expenditure for sector *j* at year *t*,
$RGDP_{jt}$	=	Real gross national product for sector *j* at year *t*,
NKD_{jt}	=	Domestic credit ratio for sector *j* at year *t,*
RDF_{jt}	=	Real fiscal deficit for sector *j* at year *t*,
$RPA*GDP_{jt}$	=	Interaction variable between real public capital expenditure and *GDP* for sector *j* at year *t*,
$RPA*DUM_{jt}$	=	Interaction variable between real public capital expenditure and *DUM* for sector *j* at year *t*,
ε_{jt}	=	Error terms for sector *j* at year *t* and
λ_i	=	Coefficient (i = 0, 1, ... , 7).

The domestic credit ratio is defined as credit for each sector/*GDP*. The dummy variable is included to capture the change in domestic private investment in each sector due to the implementation of privatisation policy. All variable other than the domestic credit ratio are expressed in real values. The real value of each variable is calculated based on the consumer price index (CPI).

Panel analysis in this study involved three main steps which are panel unit-root test, panel cointegration test, and panel estimation by using the panel data set from the four selected economic sectors. Panel unit-root test was carried out on all variables in equation [1] before panel cointegration analysis and panel estimation were carried out to avoid the incidence of spurrious regression when panel data are used. Panel unit-root test was used because the main problem of using unit root using ADF is its low power of the test. The use of panel unit-root test can overcome this problem because

according to Banerjee, Marcellino and Osbat (2001), this test have more power and can provide a reliable prove even though cross section cointegration is bias when using panel test.

Panel unit root tests have become popular in empirical studies after the pioneering work by Levin and Lin (1992,1993) and Quah (1994), even though earlier tests have been introduced by Abuaf and Jorion (1990) to test purchasing power parity. Subsequently, various panel unit root tests were done by McCoskey and Kao (1998), Harris and Tzavalis (1999), Kao (1999), Pedroni (1999), Maddala and Wu (1999), Breitung (2000), Hadri (2000), Choi (2001), Levin, Lin and Chu (2002) and Im, Pesaran and Shin (2003).[1] Kao, Maddala and Wu, Hadri, Levin, Lin dan Chu (LLC) and Im, Pesaran and Shin (IPS) are the main group who continue to contribute in this field.

Based on several arguments explained in previous studies, this study used IPS test as the main panel unit root test because of its dominant usage specifically in international finance and macroeconomy compared to other tests.[2] Panel unit root test was carried out using autoregressive model of variable Y_t shown by equation 2.

$$\Delta Y_{it} = \mu_i + \beta_i t + \delta_i Y_{i,t-1} + \sum_{j=1}^{P} \theta_{ij} \Delta Y_{i,t-j} + \alpha X'_{i,t} + \varepsilon_{it\,jt} \tag{2}$$

where $Y_{i.t}$ represent all variables in the study, μ_i is the fixed effects coefficient, β_i is the specific time effects coefficient, t is the deterministic trend and δ_i is the heterogenous coefficient for cross section unit i. The error terms for the panel are normally and independently distributed, $\varepsilon_{it} \sim \mathrm{IN}(0,\Sigma)$ that is contemporaneous variance-covariance for cross section i at year t. Next, p_i is the order for the ADF regression and the value chosen must assure that the residuals do not relate in the analysis period.

Panel unit root test is carried out by testing the null hypothesis that every series in the panel contains unit root, that is $\mathrm{H_o} : \delta_i = 0$ for all i. Because the IPS test allows for heterogeneity among the panel units, the alternative hypothesis is shown by equation 3.

$$\mathrm{H_1} : \begin{cases} \delta_i < 0 \text{ for } i = 1,2,...,N \\ \delta_i = 0 \text{ for } i = N_1 + 1,...,N \end{cases} \tag{3}$$

This hypothesis allows for a part of the (but not all) individual series have unit root.

The IPS test uses $\bar{t}$ –statistic which is average statistic for every individual ADF obtained by carrying out regression analysis of equation 2 . The $\bar{t}$ –statistic is defined by equation 4.

$$\bar{t}_{N.T} = \frac{1}{N} \sum_{i=1}^{N} t_{\delta_{iT}}(p_i) \tag{4}$$

where $t_{\delta_{iT}}(p_i)$ is the invidual ADF adalah ADF t –statistic for testing the null hypothesis $\mathrm{H_o} : \delta_i = 0$ for all i based on the ADF regression with lat p_i.[3] Further, the IPS test transform the $\bar{t}$ –statistic to $Z_{\bar{t}}$ –statistic, which is shown by equation 5.

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[1] See Banerjee (1999) for the purpose of comparing all panel root test methods.

[2] For example, see the study by Chou and Chao (2001) relating to the effectiveness of currency devaluation in the Asian economic crisis.

[3] IPS (1997) explains that this statistic has certain characteristics. If it is assumed that there is no correlation between sectors for errors and T is the same for all sectors, normalized statistics centre on normal distribution, which is, $\sqrt{N}\left(\frac{\bar{t}_{N,T} - E[\bar{t}_{N.\backslash T}]}{\sqrt{\mathrm{var}[\bar{t}_{N,T}]}}\right) \Rightarrow N(0,1)$, where the focus in distribution $E[\bar{t}_{N,T}] = \mu$ and $\mathrm{var}[\bar{t}_{N,T}] = \sigma^2$ are arranged according to the Monte-Carlo simulation.

$$Z_i = \sqrt{N}\,\frac{\left(\bar{t}_{N,T} - E\left(\bar{t}_{N,T}\right)\right)}{\sqrt{Var\left(\bar{t}_{NT}\right)}} \sim N(0,1) \tag{5}$$

where the mean is $E\left(\bar{t}_{N,T}\right) = \left(1/N\right)\sum_{i=1}^{N} E\left(t_{iT}\left(p_i\right)\right)$ and the variance is $Var\left(\bar{t}_{N,T}\right) = 1\Big/ N\sum_{i=1}^{N} \mathrm{var}\left[t_{iT}\left(p_i\right)\right]$. Both the mean and variance are asymptotes for individual ADF–statistics where both are the product of a simulation process and have been tabled in Im et al. (2003). The $Z_{\bar{t}}$ –statistic is normally distributed when N and $T \to \infty$ and $N/T \to k$ where k is a positive constant. The results of the $Z_{\bar{t}}$ –statistics test are compared with the critical value for the IPS test shown in Im et al. (2003).

Panel cointegration test was carried out to identify whether there exist a long run relationship between domestic private investment and public investment and other variables. The method suggested by Pedroni (1995,1997,1999) was used to run the panel cointegration test on the model shown by equation [1]. Pedroni (1999) suggested two types of statistical tests, namely panel statistics and group statistics to determine the significance of panel cointegration test. Panel statistic test is based on the within-dimension-approach. This test involved four statistics which are panel *v*–statistics, panel ρ-statistics, panel PP–statistics and panel ADF–statistics (panel statistics test). All these statistics group autoregressive coefficient across different panel units for unit root test on the estimated residual. Group statistics test, on the other hand, are based on between-dimension-approach. This test involved three statistics namely group ρ-statistics, group PP–statistics and group ADF–statistics (group-mean statistics). All these statistics are obtained from the estimators which are the average value of each individual estimated.[4] The hypotheses of panel co-integration test using the Pedroni method are represented by equations 6, 7, and 8.

$$H_0 : \rho_i = 1 \quad \forall i \tag{6}$$

$$H_1 : \rho_i = \rho < 1 \quad \forall i \tag{7}$$

$$H_1 : \rho_i < 1 \quad \forall i \tag{8}$$

Equation 6 is the null hypothesis for both panel statistics and group average statistics tests. Equations 7 and 8 each represents the alternative hypothesis for panel statistics test and group average statistics test. Equation 7 assumes that ρ value is the general value for all panel unit whereas equation 8 allows for heterogeneity across the panel units.

With the assumption that panel cointegration exists, panel estimation was carried out to identify the long run relationship between the domestic private investment variable and public investment and other variables in equation 1. The FMOLS method, first suggested by Phillips dan Hansen (1990) to overcome the problem of asymptotic bias and nuisance parameter dependency relating to the estimated cointegration vector in single equation, was used for estimation purposes. Pedroni (1996, 2000, 2001) has suggested two types of FMOLS namely pooled panel FMOLS and group-mean FMOLS. This study has used group-mean FMOLS because this estimation method allows for more flexible alternative hypothesis based on the existence of heterogeneity of cointegration vector and it is less problematic in terms of small sample size disturbance compared to FMOLS pooled panel.

$$\hat{\beta}^{*}_{GFM} = \frac{1}{N}\sum_{i}\left[\frac{\sum_{t=1}^{T}\left(SR_{i,t} - \overline{SR_i}\right)IR^{*}_{i,t} - T\hat{\gamma}_i}{\sum_{t=1}^{T}\left(SR_{i,t} - \overline{SR_i}\right)^2}\right] \tag{9}$$

[4] The formula for all statistics tests are shown by Table 1 in Pedroni (1999).

where,

$$IR_{i,t}^{*} = \left(IR_{i,t} - \overline{IR_i}\right) - \frac{\hat{\Omega}_{21,i}}{\hat{\Omega}_{22,i}} \Delta SR_{i,t}$$

$$\hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}_{21,i}^{0} - \frac{\hat{\Omega}_{21,i}}{\hat{\Omega}_{22,i}} \left(\hat{\Gamma}_{22,i} + \hat{\Omega}_{22,i}^{0}\right)$$

Here, $\hat{\Omega}_i = \hat{\Omega}_i^0 + \hat{\Gamma}_i + \hat{\Gamma}_i^{'}$ is the estimated long run covariance matrix for stationary vector, $\hat{\Omega}_{21i}^{0}$ is the long run covariance between the stationary error term and autoregressive error unit root.

FMOLS estimator is constructed by correcting the endogeneity problem and serial correlation on OLS estimator. The estimator is shown by equation 10.

$$\hat{\beta}_{FM}^{*} = \left[\sum_{i=1}^{n}\sum_{t=1}^{T}\left(X_{it} - \overline{X}_i\right)\left(X_{it} - \overline{X}_i\right)'\right]^{-1}\left[\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\left(X_{it} - \overline{X}_i\right)\hat{Y}_{it}^{+} - T\hat{\Delta}_{\varepsilon\mu}^{+}\right)\right] \qquad (10)$$

where $\Delta_{\varepsilon\mu}^{+}$ is the serial correlation correction term and Y_{it}^{+} is the endogeneity correction.[5] The FMOLS group average hypothesis allows for the null hypothesis $H_0: \beta_i = \beta_0$ and alternative hypothesis, $H_1: \beta_i \neq \beta_0$ for all *i*. This means that homogeneity is not required across panel unit under the alternative hypothesis.

5. Results and discussions

The results of the panel unit root tests using the IPS test at the level and first difference are shown in Table 1.

Table 1. Panel Unit Root Test

Variable	Level		First Difference	
	Range	W–stat	Range	W–stat
Intercept				
RPS	0 – 6	2.938	0 – 6	-8.706*
RPA	0 – 1	0.071	0	-12.723*
RGDP	0 – 1	4.235	0	-6.032*
NKD	0 – 4	1.330	0 – 3	-6.051*
RDF	0	1.201	0	-6.292*
*RPA*GDP*	0 – 3	0.687	0 – 6	-7.855*
*RPA*DUM*	0 – 1	1.105	0	-13.021*
Intercept and trend				
RPS	0 – 6	-0.589	1 – 6	-7.519*
RPA	0 – 2	0.636	0 – 1	-8.086*
RGDP	0 – 1	0.809	0	-6.082*
NKD	0 – 1	-0.893	0 – 3	-5.036*
RDF	0	2.069	0	-5.110*
*RPA*GDP*	0 – 6	-0.184	0 – 6	-5.433*
*RPA*DUM*	0	-2.057	0 – 6	-10.018*

Note: * Significant at the five percent confidence level

[5] Cripolti & Maarconi (2005) provide detailed review relating to the methods for the derivation of the FMOLS estimator.

For the series in level, the IPS test results show that the null hypothesis could not be rejected at the five percent confidence level. Therefore, all variables in the series are not stationary. After first differencing the series, the null hypothesis of unit root can be rejected. This confirms that all variables are stationary in first difference. The results verify that all variables are integrated of order one, i.e. I(1). Based on the panel unit root test, it clearly shows that co-integration analysis is needed to get the long run equilibrium equation. The panel co-integration results using the Pedroni (1997) method are shown in Table 2.

Table 2. Pedroni Residual Cointegration Test

Statistics	**Statistics Value**
Alternative hypothesis : general AR coefficient (internal-dimension)	
Statistics – *v* Panel	1.127
Statistics – ρ Panel	-0.384
Statistics – PP Panel	-5.345*
Statistics – ADF Panel	-5.240*
Alternative hypothesis : general AR coefficent (inter-dimension)	
Statistics – group ρ	0.197
Statistics – group PP	-6.194*
Statistics – group ADF	-6.523*

Note: * significant to reject H_O at the 5 percent confidence level.

With the exception of the panel *v*–statistics, panel ρ, and group ρ, all the PP and ADF statistics show that the statistics values are higher than the critical value which is -1.64. This shows that the null hypothesis that there is no co-integration between domestic private investment and public investment in every sector can be rejected: In general, all specifications form long run co-integration vector.

The panel long run estimation results were obtained by estimating the investment equation by using the FMOLS group-mean method shown in Table 3. These results do not include the constant value as panel data analysis normally eliminates the individual effect by rejecting the individual mean. The results in Table 3 show that the *RPA* individual variable gives significant effect on *RPS* for all sectors under study.

Meanwhile, both interaction variables *RPA*GDP* and *RPA*DUM* does not have significant effect on *RPS*. This means that no matter what kinds of economic growth and privatization policy is in place, the individual *RPA* on *RPS* is the main influence which determines the change in *RPS* for each selected sector. Therefore, the overall effect of the change in *RPS* on the selected economic sectors is only determined by one channel which is the change in individual *RPA* variables, and not through the *RPA* interaction variables, *RPA*GDP* and *RPA*DUM*.

With the exception of the agricultural sector, the *RPA* variables for the trade and industry, construction, and the transportation and communication sector give a highly significant positive effect on the *RPS*. This indicates that there exists a complementary relationship between public and private capital expenditure for the latter three sectors which corresponds with the expected relationship. An increase in public capital expenditure in the three sectors will result in an increase in private capital expenditure in these sectors. As shown in Table 3, an increase of RM1 million in *RPA* will result in an increase of RM0.44 million in *RPA* for the trade and industry sector, RM0.50 million for the transportation and communication sector, and RM1.90 million for the construction sector. In this context, according to Aschauer (1989a), public capital expenditure in each sector will result in an increase in the rate of return of private capital and consequently will encourage private capital expenditure in these sectors.

Table 3. FMOLS Individual Panel Estimation Results

Dependent Variable: RPS

Independent Variable	Agricultural Sector	Industrial & Trade Sector	Transportation and Communication Sector	Construction Sector	Group
RPA	-0.14	0.44	0.50	1.90	0.30
	(-2.31)*	(2.01)*	(7.47)*	(4.41)*	(26.19)*
RKDNK	0.06	0.14	0.08	0.90	-0.50
	(2.66)*	(6.19)*	(36.34)*	7.19*	(0.37)
NKD	4615.38	5754.48	908.37	611.78	2972.50
	(9.85)*	(3.13)*	(3.48)*	(3.18)*	(9.82)*
RDF	-0.00	0.10	-0.04	0.00	0.02
	(-0.06)	(1.27)	(-3.63)*	(0.02)	(-1.20)
DUM	-0.01	-0.00	0.00	-0.00	-0.00
	(-0.56)	(-0.32)	(3.56)*	(-0.11)	(1.29)
*RPA*KDNK*	0.27	0.39	0.14	-1.13	-0.08
	(0.49)	(0.31)	(0.81)	(-0.62)	(0.50
*RPA*DUM*	-66.32	-1720	-71.11	-49.62	-477.22
	(-0.46)	(-1.66)	(-0.91)	(-0.12)	(-1.58)

Note: Statistic-*t* in parenthesis
(*) Significant at the five percent confidence level.

Based on the significant positive effect of *RPA* on *RPS* for all the three sectors, the biggest change in domestic private investment is shown in the construction sector followed by the services sector. These results verify that the construction sector is regarded as having a higher degree of interdependence compared to the industry and trade sector and services sector. This sector gets higher benefits compared to the other sectors. Even though using the VAR approach, Pereira and Roca-Sagales (2001) have shown the same scenario as proven by the results of this study. However, their results showed that the positive effect of public capital is the highest in transportation and communication sector followed by manufacturing sector. On the other hand, construction sector receive the minimum positive effect. This scenario is consistent with Aschauer (1989b) who explained that public expenditure which is a complement to private sector production input is expected to have a large impact on the output of the private sector.

Meanwhile, the *RPA* variables provide the opposite significant effect on *RPS* in the agricultural sector with the smallest coefficient magnitude. The same relationship was also shown by Pereira dan Roca-Sagales (2001). Our result provides evidence that public capital expenditure for the agricultural sector has a negative effect on the development of private capital expenditure in this sector. The result of this study is consistent with the statement by Ramirez (2000) who noted that a negative relationship probably exists for agricultural sector as this sector receives high government subsidy and investment activities are partly carried out by inefficient state-owned enterprises. In addition to Ramirez's statement, this situation is also because of agro-climatic factors which worsen agricultural investment asymmetry. For example, agricultural land is only suitable for certain crops. Moreover, other forms of investment such as tractors and agricultural equipment can only be used solely for agricultural sector and they are regarded as having limited alternative use. In addition, human and social capital in agriculture cannot be well adapted in other sectors and the adjustment process of agricultural input for use in other sectors involves high costs. Due to this problem, FAO for example, explains that there is a decline in investment in education and training in developing countries which becomes a hindrance towards the growth of the agricultural sector (Beal, 1978). This situation is one of the root causes of the existence of substitute relationship between public and private capital expenditure where an increase in public capital expenditure will reduce private capital expenditure.

The effect of privatization policy on private capital expenditure is not comprehensive in all economic sectors. The effect of privatization policy is significant for the services sector by looking at the *DUM* coefficient which is very significant for this sector. However, the effect of an increase in the *RPS* for this sector is too small with the implementation of privatization policy. On the other hand, economic growth has a comprehensive effect on private capital expenditure because the results show a positive significant effect between the *RGDP* and *RPS* for all four selected sectors at five percent confidence level. This situation shows that a high economic growth will increase domestic private investment in all sectors with the highest increase shown in the construction sector. An increase of RM1 million in *RGDP* will increase *RPS* by RM0.90 in the construction sector, compared to RM0.14 million, RM0.90 million and RM0.06 million for the industry and trade sector, construction sector, and agricultural sector, respectively. In general, the results of this study confirm that high economic growth is very important in influencing domestic private investment. Meanwhile, control variables such as *NKD* and *RDF* only give significant effect on the *RPS* for the services sector at the five percent confidence level.

6. Conclusion

Results of the study indicate that public investment, particularly investment in industrial and trade, transportation and communication, and construction sectors has positive effect on private investment in all the four sectors. Public investment in construction sector has contributed the largest effect on domestic private investment followed by services sector. One percent increase in public investment in construction sector cause a 1.9 percent increase in domestic private investment. Our results are consistent with the public capital hypothesis and other studies such as by Barth dan Cordes (1980) and Blejer and Khan (1984). Barth dan Cordes (1980) suggested that capital financed by the public sector must be a catalyst to the private sector investment and output. Policy and incentives designed by the government geared towards a change in the economic structure result in a change in the government expenditure composition. The government expenditure encourage more private investment if focus is given towards productive expenditure. A productive and large scale government expenditure will have an impact on an increase in private investment activities. Blejer and Khan (1984) have explained that public and private investment are related with one another even though there exist an uncertainty on whether public investment increases or decreases private investment.

Consequently, the level and composition of government expenditure must be harmonized with the policy framework of an adjustment program, specifically for programs that influence domestic private investment. Government expenditure analysis must be undertaken as part of the economic sector performance analysis. Specifically, the analysis will be able to evaluate and identify the disparity and imbalance in allocation between and within sectors. Private investors will associate their investment decisions with the expenditure allocation by sectors. Sectors which receive a high allocation normally will be the focal point of current economic change framework.

Finally, the step to reorientate public investment is very important in influencing the development of economic sectors. Consistent with the change in focus of economic sectors or sector shift, public investments in sectors which are very sensitive to domestic private investment change are very important. Sector shift may cause a fluctuation in aggregate demand and consequently cause a shift in investment.

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