



PUBLIC AND PRIVATE CAPITAL FORMATION AND ECONOMIC GROWTH IN MALAYSIA, 1961-1995

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ABSTRACT

This paper analyzes the productivity of public and private capital formation in a developing economy, Malaysia, using annual data from 1961 to 1995. The analysis is based on neoclassical growth regression, where the transition to the steady-state level of income per capita is modeled using an error correction framework. The results suggest that the public investment has been unproductive over the periods under consideration. Consistent with existing empirical studies, the private investment rate and the export performance of the country are positively related to economic growth. Our results call for a reduction in the public capital formation. However, for this recommendation to be more convincing, we believe that further analyses are much needed to examine which types of public capital are unproductive.

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Key words: Cointegration, Economic growth, Public capital

1. INTRODUCTION

The contributions of the public sector to the growth process of a country continue to be a subject of heated debate among development economists. Arguably, public expenditure can have an adverse effect on growth through the “crowding-out” of efficient and potentially profitable private investments. Conversely, the public expenditure in the forms of investments in infrastructure, education and research and development may also exert a positive effect on growth through the enhancement of private capital productivity. It also promotes growth indirectly by increasing the economy’s aggregate demand, and subsequently, influencing the private sector’s future profits and sales

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expectations. Still, public capital can be unproductive if they are excessive. Given these various and contradicting channels of influences, the net effects of the public capital formation on growth obviously depend on which influence dominates; this is the issue that needs to be verified empirically.

The results of the empirical research in this area are not yet settled. Fitting aggregate growth regression for the United States using annual data from 1949 to 1985, Aschauer (1989a) found that public capital was significantly productive. Indeed, he noted that the productivity of public capital exceeded that of private capital during this period. Likewise, he also documented highly positive and significant contributions of public net investments to the growth rates using a pooled data set of the Group of Seven (G-7) industrial countries over the period 1966-1985 (Aschauer, 1989b). Munnell (1990) further substantiated the findings of high contributions of public capital. Employing cross-national data, Barro (1989, 1990), and Khan and Kumar (1997) also found some evidence for a positive relationship between public investments and output growth.

It is argued, however, that the reported correlation may not imply causality that suggests the changes in the growth rates when public policies change (Hulten and Peterson, 1984 and Levine and Zervos, 1993). Additionally, Tatom (1991) criticized such findings as Aschauer (1989a) and Munnell (1990) as being spurious as they did not account for stochastic trends in the data. In his analysis, he subjected the data to standard unit root tests and found them to be non-stationary. Using the first differences of the variables to estimate the production function, Tatom (1991) found that the strong positive association between private output and public capital disappeared. Estimating VAR models using both levels and first differences of the variables, MacMillan and Smyth (1994) also indicated negligible impacts of public capital on output. However, Munnell (1992) contended that using only the first differences of the variables may lead to mis-specification bias since first differencing filters out the long-run information in the data. Having examined the literature, she argued that future research should give particular attention to the integration and cointegration properties of the variables. Most recently, Batina (1998) re-examined the issue using annual observations from 1948 to 1993 for the case of the United States.¹ Employing both integration and cointegration tests, Batina (1998) concluded that public capital seemed positively related to output, labor and private capital in the long-run. His results also suggested that innovations in public capital could have long-lasting effects. Furthermore, the public capital responded positively to innovations in output, labor and private capital.

Devarajan, Swaroop and Zou (1996) raised the possibility that the public expenditures such as capital investments that were generally viewed as productive might be unproductive. They derived conditions that related a change in the composition of the expenditure to a steady-state growth rate of the economy. Distinguishing between productive and unproductive expenditures, they showed that the effects on growth of the shift in their

respective shares in the expenditures depended not only on the productivity of the two expenditures but also on their initial shares. Thus, the increase in productive public expenditure might be unproductive if its initial share is already excessive. This implication was supported by data from 43 developing countries over 20 years. Namely, the relationship between capital expenditure and growth per capita was found to be negative while that between current expenditure and growth was positive. These results led them to conclude that the governments of developing countries tended to “over-invest” in public capital.

The present paper extends and complements existing studies, which focus mainly on developed economies, by evaluating the role of public capital formation for the case of a developing economy, namely Malaysia. Over the past decades, the growth rates of the Malaysian economy have been impressively high. Since the inception of the New Economic Policy (NEP) in 1970, the Malaysian government has been directly and actively involved in the economic process. The active participation of the government is generally argued by some as a leading cause of the Malaysian success. Still, it is also generally believed that non-financial public enterprises established to carry out the government’s economic activities are highly inefficient. The privatization program that started in early 1980s to relieve the government’s financial burdens and to give the private sector a greater role in the nation’s development notwithstanding, the government involvement continues at a high scale as reflected by the persistently high public investment ratios (as percentage of GDP). Thus, Malaysia seems to provide an interesting setting for evaluating the role of public capital expenditure.

The structure of the paper is as follows. In the next section, we outline some background information of the Malaysian economy. Then, section 3 describes the empirical methodology. Section 4 reports the estimation results. Lastly, section 5 contains our concluding remarks.

2. BACKGROUND

Since independence in 1957, the growth performance of the Malaysian economy has been very impressive. The average annual growth rate of real income (real income per capita) was 6.4 percent (3.7 percent) over the years 1961-1995.² During this period of high economic performance, the government’s roles in the economy may be characterized by various phases of involvement.³ After independence, Malaysia inherited a *laissez faire* type economic system, which gave the private sector a leading role in the nation’s development process. The government largely played supplementary roles to the private sector by directing public expenditures toward providing basic and necessary infrastructure. During this early period, the government also implemented policies to diversify the economic base of the country, which mainly depended

on rubber and tin production. Economic stability came at the forefront of the government's economic agenda, as it was highly important for the economy to grow without interruptions. The economic performance during 1961-1970 is considered as a success, recording the average growth of 4.8 percent (2.4 percent) of real income (real income per capita). The public investment rate during this decade was 6.5 percent while the private investment rate was 9 percent (see Table 1). At the same time, however, the economy faced the challenge of unequal income distribution and racial imbalances.

TABLE 1
Mean Values of Key Economic Variables

Variable	1961-95	1961-70	1971-80	1981-90	1991-95
ΔY	6.43	4.85	9.05	4.60	8.01
Δy	3.75	2.37	6.29	2.00	4.95
S_p	15.58	9.00	15.43	17.17	25.88
S_G	10.02	6.54	8.29	13.36	13.73
n	2.68	2.48	2.77	2.60	3.05

Note: ΔY = growth rate of real gross domestic product; Δy = growth rate of real income per capita; S_p = private investment ratio; S_G = public investment ratio; n = population growth.

The increasing racial imbalances in the country that resulted in racial riots in 1969 prompted the government to intervene. The New Economic Policy (NEP) was introduced in 1970 to address the imbalances and, at the same time, to eradicate poverty. As the government made clear, the mechanisms to achieve these two objectives of the NEP would be through high economic growth. The NEP also marked the beginning of active government involvement in the economy. One main aspect of this involvement of the government was the establishment of public enterprises, the number of which increased drastically during this period, to carry out the government's economic activities. In the late 1960s, the number of public enterprises was only 55. Then, it increased sharply to 253 during 1971-1975 and 294 during 1976-1980. The highest number was recorded during 1981-1985 where it stood at 354 (see Salleh, 1994, Table 7). The biggest number of these enterprises was in the manufacturing and services industries. Subsequently, the ratio of the public capital formation to GDP increased to 8.3 percent during 1971-1980. A more pronounced increase was observed, however, in private investment rate. It went up by more than 6

percent to 15.4 percent during the same period.

The average growth rate of real income (real income per capita) increased to 9.1 percent (6.3 percent) during 1971-1980. However, the slowdown of the global economy in the early 1980s that culminated in negative growth for Malaysia in 1985/1986 witnessed a reduction of the real GDP growth (GDP growth per capita) to only 4.6 percent (2.0 percent) during 1981-1990. This slowdown of the economy also worsened the overall deficits of the country, which was mainly due to the deficits of the public enterprises. The economic slowdown of early 1980s, the poor performance of the public enterprises and the rise in the deficits and debt service obligation gave rise to the realization that the government may not be able to sustain high growth through its active participation. As a result, the government embarked on a privatization program in 1983 to relieve the financial and administrative burden of the government as well as to give greater roles to the private sector in the nation's development process. The government privatization efforts notwithstanding, the ratio of public capital formation to GDP increased to 13.4 percent during 1981-1990. The number of public enterprises, however, reduced sharply to 98 in 1986. Again, private investment continued an upward trend to have an average rate of 17.2 percent during the decade.

The recovery that took place onwards has brought the economy to the high growth track again. Since 1987, the economy has performed exceptionally well, recording an average growth of real income of over 8 percent. During 1991-1995, the public investment ratio stayed high at 13.7 percent. The rate is reassuring since it shows the continuing active participation of the public sector in the economy during the privatization era. Meanwhile, private investment rate was 25.9% during the same period, an increase of more than 8% from the previous decade.

3. EMPIRICAL METHODOLOGY

Existing empirical studies on the contributions of public and private investments to economic growth are essentially based on the production function framework. Several alternative specifications have been used. Assuming a generalized Cobb-Douglas production function, for instance, Aschauer (1989a) related the productivity of private capital to the private labor – capital ratio and the flow of government services. Similarly, extending the neoclassical growth model to include the public sector capital stock as an additional input of the production, Khan and Kumar (1997) derived an equation of the growth of per capita income along the line suggested by Mankiw, Romer and Weil (1992). The equation specified the growth rate of income per capita to depend on both private investment rate and public investment rate. Lastly, the standard growth regressions normally employed in cross-national analyses such as Levine and

Renelt (1992) relate the growth rates of real income to the determinants of growth including investment ratios. Recently, an error correction model is used to evaluate the dynamic interactions between the variables (see, for instance, Munnell, 1992; and Batina, 1998).

In the present analysis, we adopt a time series approach to evaluate the role public and private capital formation may play in the growth dynamics of the Malaysian economy. Our empirical analysis starts with an equation for the steady-state level of real output per capita (y^*)

$$(1) \quad \ln y_t^* = a + gt + b \ln S_{p_t} + c \ln S_{G_t} + d \ln(n),$$

where S_p is private investment rate, S_G is public investment rate, n is population growth rate, and t is a time trend representing technological progress. The equation is derivable from the standard neoclassical growth theory assuming Hicks-neutral technology (see also Mankiw, Romer and Weil, 1992; and Khan and Kumar, 1997). Normally, within this framework, public capital is incorporated as an additional input to the economy's production process. Alternatively, we may also view the public capital formation as a determinant of the technological progress or the productivity component of the production function. Within this specification, we contend that the growth process of the economy will adjust to this steady-state level in the long-run. Thus, equation (1) may be equivalently viewed as the long-run equation for real output per capita.

Following along a similar line as Cellini (1997), we employ an error correction mechanism to represent the transition of income per capita to its steady state.

Thus, we have,

$$(2) \quad \Delta \ln y_t = K + \lambda(\ln y^* - \ln y)_{t-1}$$

where λ represents the speed of adjustment to the steady state, and $0 < \lambda < 1$. Let K denote the short-run effects of the variables in the model on economic growth. Replacing (1) in (2), we obtain the following error correction model for output growth:

$$(3) \quad \Delta \ln y_t = (k + \lambda a) + \sum_{i=1}^{n1} \phi_i \Delta \ln y_{t-i} + \sum_{i=0}^{n2} \varphi_i \Delta \ln S_{P,t-i} \\ + \sum_{i=0}^{n3} \gamma_i \Delta \ln S_{G,t-i} + \sum_{i=0}^{n4} \pi_i \Delta \ln(n)_{t-i} + \lambda gt + \lambda b \ln S_{P,t-1} \\ + \lambda c \ln S_{G,t-1} + \lambda d \ln(n)_{t-1} - \lambda \ln y_{t-1} + v_t$$

Note that, in the above equation, the growth rate of income per capita responds not only to the changes in other variables but also to the lagged

levels of the variables which form the steady-state equation. The latter allows the real output to correct for any deviations from the long-run steady-state level. Thus, the approach taken is appealing in that, while it is theoretically based on the well-known growth theory, it econometrically combines the short-run dynamics and long-run adjustments of the growth process. Moreover, all key parameters in (1) and (2), except the constant terms, can be recovered. However, due to the non-linearity of the parameters, calculation of individual standard errors is not straightforward and is not attempted here.

Several points related to model (3) need to be noted. First, we can estimate regression (3) and avoid a “spurious” regression problem as long as the non-stationary variables appearing in (3) are cointegrated (Phillips, 1986; and Sims, Stock and Watson, 1990). Moreover, the presence of cointegration among the variables justifies the use of the error-correction model such as (3), which is based on the Granger’s representation theorem. Accordingly, we perform *a priori* tests to evaluate the cointegration properties of the variables. For the former, we employ the standard augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. To check for cointegration between integrated series, we use the maximum likelihood approach of Johansen (1988) and Johansen and Juselius (1990).⁴ It should be noted that the empirical implementation of (3) requires cointegration tests of only the variables that are found to be non-stationary. Indeed, estimating (3) is appropriate when a subset of the variables in levels are stationary (Mehra, 1993).⁵

Second, we employ a general-to-specific procedure to determine the lag lengths of the first-differenced terms, representing the short-run effects of the variables on the income growth. In particular, we start with a maximum lag length of 3 for each variable. Then, the number of lag is reduced sequentially if it turns out that the last lag is insignificant. Otherwise, it is retained as the final lag length for the variable under consideration.

Third, we also examine the sensitivity of the results to the inclusion of the export share in the regression. Various empirical studies have documented findings that the economic growth in Malaysia is export-driven (see, for instance, Doraisami, 1996; Ghatak, Milner and Utkulu, 1997; and Islam, 1998). Thus, it may be interesting to see whether the inclusion of a trade variable will affect the results of our analysis. Lastly, in our estimation of regression (3) with and without the export share variable, we note that the regressions fail the Chow test for structural stability. In particular, the Chow test suggests a structural break in 1977. To alleviate this problem, we also include a dummy variable in the final regression. The dummy variable equals 1 for post-1977 period and 0 otherwise.⁶

4. ESTIMATION RESULTS

4.1 INTEGRATION AND COINTEGRATION TESTS

As we have noted in the previous section, the first step in our empirical analysis is to establish the temporal properties of the data series. Namely, *a priori* tests of integration and cointegration tests need to be implemented.

Table 2 reports the ADF and PP tests for a unit root in the series.⁷ We implement the tests with and without a time trend. With the exception of the population growth rate, the results from the table indicate non-rejection of the unit root null hypothesis for all variables in levels. However, the PP tests suggest that these variables are stationary in first differences. The ADF tests further substantiate this result for the case of real income per capita (y), private investment ratio (S_p), and public investment ratio (S_g). Thus, our results indicate that the population growth is $I(0)$ variable while the remaining variables are $I(1)$. The finding of stationarity in the population growth rate, which appears in (1), motivates the estimation of the model as specified in (3).

However, before we can proceed to the estimation of model (3), we need to run cointegration tests for the integrated variables appearing in (3). The results of the JJ cointegration tests are reported in Table 3. Looking at the table, we find evidence for the presence of a long-run relationship (i.e., cointegration) between (1) real income, private investment ratio, and public investment ratio, and (2) real income, private investment ratio, public investment ratio, and export ratio (as percentage of GDP). For the former, the null hypothesis for zero cointegrating vector is rejected at the 10 percent level by the trace test, and at the 5 percent level by the maximal eigenvalue test. For the latter, it is rejected at the 10 percent significance level by the trace test. Accordingly, we proceed to the next step, taking the presence of cointegration in the integrated series.

4.2 RESULTS OF GROWTH REGRESSIONS

The results we obtained provide a basis for us to proceed and estimate growth regression (3). The results from the estimation are presented in Table 4 through Table 6. Table 4 provides the results for the basic model (without the export share variable). Meanwhile, Table 5 incorporates the export ratio into the analysis. Lastly, Table 6 summarizes the implied parameters of (1) computed from the results from Table 4 and Table 5. In Tables 4 and 5, we also present various diagnostic statistics to evaluate the appropriateness of the models. These include Breusch-Pagan-Godfrey heteroskedasticity test (Het), Jarque-Bera normality test (JB), Ramsey's specification test (RESET), Ljung-Box-Pierce serial correlation test (BP), and Engle's conditional heteroskedasticity test (ARCH).

TABLE 2
Integration Tests

Variable	ADF Tests			PP Tests		
	No Trend	Trend		No Trend	Trend	
(A) Levels						
y	-0.1872	-1.8853		-0.1169	-2.5843	
s_p	-0.3987	-1.9982		-0.5305	-2.2393	
S_G	-1.5010	-2.0888		-1.6292	-2.3328	
Ex	0.6967	-1.8170		0.5862	-1.8610	
n	-3.0241*	-3.7555*		-7.7536*	-8.1166*	
(B) First Differences						
y	-3.4775*	-3.4153*		-5.3222*	-5.2475*	
S_p	-2.9282*	-2.9007		-4.7308*	-4.7069*	
S_G	-4.7275*	-4.6457*		-4.7538*	-4.6739*	
Ex	-1.9862	-2.7456		-4.8978*	-5.3559*	

Note: * denotes significance at least at the 10 percent significance level.

TABLE 3
Cointegration Tests

Null Hypothesis	Trace	Eigenvalue	90% Critical Values	
			Trace	Eigenvalue
(A) y, S_p, S_G				
$r = 0$	28.870	21.524	28.4	19.0
$r \leq 1$	7.283	7.200	15.6	12.8
$r \leq 2$	0.083	0.083	6.7	6.7
(B) y, S_p, S_G, Ex				
$r = 0$	46.086	21.711	45.2	24.9
$r \leq 1$	24.375	13.795	28.4	19.0
$r \leq 2$	10.580	7.454	15.6	12.8
$r \leq 3$	3.126	3.126	6.7	6.7

Note: r is the number of cointegrating vectors. Critical values for the test statistics are from Johansen and Juselius (1990).

Panel A in Table 4 (Model A) gives the estimation results of the basic model (3) using the OLS method. The model seems to explain the Malaysian growth rate reasonably well, having an R^2 equal to 0.44. Moreover, it passes all diagnostic tests. From the regression, we find that only the lagged income growth and the public investment ratio have short-run impacts on the income growth. Interestingly, the contemporaneous change in the public investment ratio exerts a negative influence on the growth rate while the once-lagged change in the ratio has a positive impact. The sum of the coefficients, however, is negative.⁸ It needs to be noted that, although the performance of the model is reasonably good, it is far from being satisfactory on two counts. First, the coefficient representing the speed of adjustment to the steady state (λ) appears insignificant at conventional levels, although it has the expected sign. And second, we also run a sequential Chow test to evaluate the structural stability of the model. We find evidence of a structural break in 1977. In particular, the Chow test statistics is the maximum at the point where it equals 5.25 and is significant at the 1 percent level.

Accordingly, we construct a dummy variable to represent the break in 1977 ($D77$), where it equals 1 for post-1977 periods and 0 otherwise. The growth regression is then re-estimated with the break dummy variable included. The results of this estimation using the OLS method are provided in Panel B of Table 4 (Model B). There seems to be a significant improvement in the goodness of fit of the model, having an R^2 of 0.55. Again, the regression passes all diagnostic tests. Consistent with Model A, the coefficients of the changes in the public investment ratio indicate negative contemporaneous effect and positive lagged effect on growth. Note that the break dummy coefficient is negative and significant at the 1 percent level, indicating a level drop in the real income per capita growth in 1977. More importantly, the speed of the adjustment coefficient is signed as expected and significant at the 1 percent level. Additionally, the coefficient of the once-lagged private investment ratio is significant at better than 10 percent level. These results are further substantiated by our estimation of the model using the instrumental variable estimation method (IV), presented in Panel C (Model C), which we implement to evaluate the robustness of the results to alternative estimation methods. The IV method also accounts for the simultaneity bias that may possibly be present in the model.

To assess the long-run relationship between the variables as given in (1), we compute the implied long-run coefficients from the regressions in Table 4. These are presented in the rows with corresponding headings, i.e., Model A – C, in Table 6. These three models uniformly suggest the positive long-run relationship between the private investment ratio and real income per capita. The public investment ratio, however, is negatively related to the real income in the long-run.⁹ For the population growth, only the OLS results (Model A and

TABLE 4
Basic Regression Results

(A) OLS Estimation (Model A)			
$\Delta lny_t =$	0.8969 (1.071)	+ 0.0126t (1.768)***	+ 0.4694 Δlny_{t-1} (2.121)**
	+ 0.1520 ΔlnS_{Gt-1} (1.925)***	- 0.3120 lny_{t-1} (1.446)	+ 0.0565 lnS_{Pt-1} (0.734)
	- 0.0050 lnn_{t-1} (0.083)		- 0.2251 ΔlnS_{Gt} (2.385)**
	$R^2 = 0.4422$	Het(8) = 8.184	RESET = 0.135
	BP(1) = 0.20	BP(2) = 1.21	ARCH(1) = 1.29
(B) OLS Estimation with Break Dummy (Model B)			
$\Delta lny_t =$	2.7552 (2.534)**	+ 0.0213t (2.886)*	- 0.1394 $D77_t$ (2.405)**
	- 0.1840 ΔlnS_{Gt} (2.094)**	+ 0.1312 ΔlnS_{Gt-1} (1.806)***	- 0.7853 lny_{t-1} (2.820)**
	- 0.0467 lnS_{Gt-1} (0.683)	- 0.0102 lnn_{t-1} (0.183)	+ 0.1756 lnS_{Pt-1} (2.044)***
	$R^2 = 0.5543$	Het(9) = 7.327	RESET = 0.234
	BP(1) = 0.00	BP(2) = 2.24	ARCH(1) = 1.96
			ARCH(2) = 3.25

TABLE 4 (Continued)

(C) IV Estimation with Break Dummy (Model C)			
$\Delta \ln y_t =$	2.7098 (1.806) ***	+ 0.0209t (2.143) **	- 0.1406D77 _t (2.192) **
			+ 0.7192 $\Delta \ln y_{t-1}$ (2.932) *
	- 0.2008 $\Delta \ln S_{Gt}$ (1.317)	+ 0.1733 $\Delta \ln S_{Gt-1}$ (1.929) ***	- 0.7651 $\ln y_{t-1}$ (2.019) ***
			+ 0.1580 $\ln S_{Pt-1}$ (1.794) ***
	- 0.0512 $\ln S_{Gt-1}$ (0.495)	- 0.0079 $\ln m_{t-1}$ (0.136)	
	$R^2 = 0.5953$	Het(9) = 7.880	J-B(2) = 0.587
	BP(1) = 0.01	BP(2) = 1.72	ARCH(1) = 1.66
			RESET = 0.642
			ARCH(2) = 2.44

Note: The numbers in parentheses are absolute values of *t*-statistics. *, ** and *** denote significance at the 1 percent, 5 percent and 10 percent levels, respectively.

TABLE 5
Regression Results - Including Export Ratio

(A) OLS Estimation (Model D)	
$\Delta my_t =$	
1.7809 (1.669)	+ 0.0071t (0.871)
- 0.5471 Δmy_{t-2} (2.862) *	- 0.2544 $\Delta \ln S_{Gt}$ (3.217) *
+ 0.2279 $\ln S_{Pt-1}$ (2.848) *	+ 0.2347 $\Delta \ln S_{Gt-1}$ (3.372) *
	- 0.1719D77 _t (3.373) *
	+ 0.5317 Δmy_{t-1} (2.568) **
	- 0.4822 my_{t-1} (1.774) ***
	+ 0.0992 $\ln Ex_{t-1}$ (1.342)
$R^2 = 0.7144$	J-B(2) = 1.842
BP(1) = 1.55	ARCH(1) = 0.002
(B) IV Estimation (Model E)	
$\Delta my_t =$	
1.6343 (1.178)	+ 0.0074t (0.832)
- 0.5414 Δmy_{t-2} (2.670) **	- 0.2518 $\Delta \ln S_{Gt}$ (2.733) **
+ 0.2171 $\ln S_{Pt-1}$ (2.411) **	+ 0.2382 $\Delta \ln S_{Gt-1}$ (3.032) *
	- 0.1654D77 _t (2.786) **
	+ 0.5198 Δmy_{t-1} (2.284) **
	- 0.4554 my_{t-1} (1.362)
	+ 0.0798 $\ln Ex_{t-1}$ (0.807)
$R^2 = 0.7141$	J-B(2) = 1.442
BP(1) = 1.34	ARCH(1) = 0.003
	RESET = 3.590***
	ARCH(2) = 0.244

Note: The numbers in parentheses are absolute values of *t*-statistics. *, ** and *** denote significance at the 1 percent, 5 percent and 10 percent levels, respectively.

TABLE 6
Long-run Coefficient Estimates

$$\ln y_t^* = a + gt + b \ln S_{pt} + c \ln S_{gt} + d \ln(n_t) + e \ln(Ex)_t$$

Models	<i>G</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>E</i>
A	0.0404	0.1811	-0.1651	-0.0160	-
B	0.0272	0.2236	-0.0595	-0.0130	-
C	0.0273	0.2065	-0.0669	0.0103	-
D	0.0147	0.4726	-0.3409	-0.0056	0.2057
E	0.0162	0.4767	-0.3720	-0.0558	0.1752

Note: These values are computed from Models A - E in Table 4 and Table 5.

Model B) indicate a negative relationship as hypothesized by the growth theory. Thus, up until this point, our results are not favorable to the view that the public capital formation is productive.

Several existing empirical analyses of the Malaysian economic growth document evidence that the growth process in Malaysia is export-driven. If this is the case, the results we obtained may be biased due to the omission of this important variable. Accordingly, we incorporate the export share (as a percentage of GDP) in our analysis and re-estimate the growth regressions to further evaluate the robustness of our results. Like the previous analyses, we find a structural break in 1977 for the model and, accordingly, we incorporate the break dummy variable in the regression in the same manner as we have done above. The OLS and IV estimation results of this extended model are given in Table 5 and their implied long-run coefficients are given in Table 6 (i.e., Model D and Model E respectively).

Note that the inclusion of the export share in the regression increases the explanatory power of the regressions substantially. Similar to the previous regressions, the regressions pass all diagnostic tests at least at the 5 percent significance level. Qualitatively, the results indicate no marked differences from those in Table 4. In particular, only the lagged dependent variable and the public investment ratio enter as short-run determinants of economic growth. Then, the signs and significance of the coefficients of the changes in the public investment ratio are reassured in this extended model. It might be noted that the speed of adjustment coefficient is significant only when we use the OLS method. However, with the inclusion of the export share, the estimated speed of adjustment reduces substantially. In addition to confirming the significance of the once-lagged private investment ratio, the regressions also show that the coefficient of the once-lagged public investment ratio (i.e., in level) is also significant at better than the 10 percent level.

Lastly, the computed long-run coefficients reported in Table 6 reconfirm the positive relationship between private investment ratio and economic growth and the negative relationship between public investment ratio and growth in the long-run. The estimated coefficients, however, are higher. The long-run coefficient of the population growth is negative as expected in both regressions. Lastly, we note that the export share is positively related to economic growth in the long-run, the results that are consistent with the documented findings of several existing studies.

In a nutshell, our analysis provides evidence for the negative effect of the public capital formation on economic growth in both the short-run and the long-run. By contrast, the private capital formation seems productive. These conclusions are robust to estimation methods and to the extension of the model to include the export share in the model.

5. CONCLUDING REMARKS

This paper analyzes the productivity of public and private capital formation in a developing economy, Malaysia. The analysis is based on the neoclassical growth regression, where the transition to the steady-state level of income per capita is modeled using an error correction framework. Using annual data from 1961 to 1995, we document evidence for the negative relationship between the public capital formation and the growth rate of income per capita. This means that the public investment has been unproductive over the past decades. Consistent with existing empirical studies, the private investment rate and the export performance of the country are positively related to economic growth.

The finding of the negative relationship between the public capital and growth may stem from the widely noted inefficiency of the non-financial public enterprises. From early 1970s to early 1980s, development spending by the public enterprises increased sharply. In 1970, the ratio of non-financial public enterprises' development expenditure to general government development expenditure was only 0.09. Then, it increased to 0.20 in 1980 and to 0.90 in 1985. The increase in the ratio over the years is due to the increase in the development expenditure by the public enterprises and, at the same time, the reduction in the expenditure by the general government (see Salleh, 1994, Table 1).

Equally likely, the public capital may have been unproductive because the government "over-invests" in the public capital. Indeed, over the period under consideration, we note the shift in the public consumption and public investment shares. During 1961-1970, the public investment ratio (as a percentage of GDP) was only 6.5 percent while the public consumption ratio (as a percentage of GDP) was 16 percent. However, during the last five years in our sample (i.e., 1991-1995), the public investment ratio increased to 13.7 percent while the public consumption ratio decreased to 13.3 percent. This shift in the shares in both types of public spending may provide some indication that the public investment may have been excessive. If this is the case, the policy implication is obvious. Namely, the government may need to reduce its public capital formation.

One last point that needs to be noted is that our evidence indicates only the negative productivity of public capital in the aggregate. However, it does not point out which types of public capital are more unproductive or more productive. In other words, the evidence provided here does not rule out the possibility that certain types of public capital formation may still be productive. The issue may be a potential avenue for future research and is important to the policy implication we noted above.

ENDNOTES

1. Batina (1998) also reviewed some existing studies that utilized integration and cointegration tests. The results of these studies, again, may be best described as mixed.
2. The data used in the present study is described in the Appendix.
3. Our discussion is based on Salleh (1994), who aptly divided the public sector's roles into three distinct phases.
4. These tests are now well known. Readers may refer to Dickey and Fuller (1979, 1981), Johansen (1988) and Johansen and Juselius (1990) for details.
5. A more common way for implementing the error-correction modeling is to follow a two-step approach. In the first step, a cointegrating regression is estimated, from which the residuals are saved. Then, in the second step, the lagged residuals are included in (3) in place of all variables in levels. The model is referred to as restricted error correction model. However, since we find the population growth rate to be stationary while other variables are non-stationary, we follow the approach taken by Mehra (1993) by estimating (3) directly after conducting *a priori* tests of integration and cointegration.
6. We also include dummy variables for the two oil price shocks (1973 and 1979). However, these variables turn out to be insignificant. Thus, we leave to the data to decide the date of the break in the output growth. Although the date chosen, i.e., 1977, does not correspond to any major event, it may be considered as the aftermath of the oil price shocks as well as it coincides with the acceleration of the government's intervention.
7. The tests are implemented using SHAZAM econometrics package. The lag length of the first-differenced terms in the ADF tests is set by SHAZAM.
8. In evaluating the dynamic or short-run impacts of the independent variables on the dependent variable, attention should be placed more on the sum of the coefficients. In the framework, nothing much can be said regarding individual coefficients as they may reflect the complex nature of the interactions.
9. This interpretation is based only on the computed value of the long-run coefficients and on the finding that the public investment rate forms a long-run relationship with other variables in the model, as evidenced by the cointegration test.

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APPENDIX

The analysis employs annual data from 1961 to 1995. The main sources of the data are the *International Financial Statistics Yearbook* (IFS_Y) and the Bank Negara’s *Quarterly Bulletin* (QB). We use real gross domestic product (GDP) as a measure of real income. Since the GDP deflator figures are not available in the early years, we deflate the gross domestic product (IFS_Y, line 99b) using the consumer price index (IFS_Y, line 64). To arrive at real income per capita (y), we divide the real gross domestic product with mid-year estimates of population (IFS_Y, line 99z). The private investment rate (S_p) is calculated as the ratio of the private gross capital formation (QB, Table VI.1) to the gross domestic product. Likewise, the public investment ratio (S_g) is represented by the ratio of the public gross capital formation (QB, Table VI.1) to the gross domestic product. The population growth rate (n) is based on the mid-year estimates of the population. Lastly, the export ratio is obtained by dividing exports (IFS_Y, line 90c) by the gross domestic product.