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THE DYNAMIC RELATIONSHIP BETWEEN PRIVATE DOMESTIC INVESTMENT, THE USER COST OF CAPITAL, AND ECONOMIC GROWTH IN MALAYSIA

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ABSTRACT

This study attempts to examine the dynamic relationship between private domestic investment (PDI), the user cost of capital, and economic growth in Malaysia over the period of 1970 to 2009. Johansen cointegration test suggests that PDI, the user cost of capital, and economic growth are cointegrated in Malaysia. Granger causality test reveals that there is a uni-directional causality running from PDI to economic growth and also from PDI to the user cost of capital in the long run. Moreover, there is a bi-directional causal relationship between economic growth and the user cost of capital in the long run. Meanwhile, there is a strong evidence of a bi-directional causality between PDI, economic growth, and the user cost of capital in the short run. For completeness, variance decomposition is also generated and the results suggest that PDI is more important than the user cost of capital in explaining the variation of economic growth. Finally, the impulse response function confirmed that a shock in the user cost capital exerts a negative effect on PDI and economic growth in Malaysia.

Keywords: Causality; Cointegration; Economic growth; Private domestic investment
JEL Classification Code: C22; E22; O16; O53

1. BACKGROUND

Most developing countries, including Malaysia, rely heavily on the influx of foreign capital to generate long-term economic growth. However, in the wake of the financial crisis, foreign capital may not be a sustainable source for long-term economic growth because it is easily retrieved from the recipient country which has been a lesson learned from the Asian financial crisis of 1997/98. Griffin and Enos (1970) narrated that the influx of foreign capital from developed to less developed countries is an attempt to exploit the recipient country's natural resources rather than assistance. Therefore, it is rational to conclude that the influx of foreign capital is not a reliable source for sustainable long-term economic growth. Owing to this weakness, an Economic Transformation Programme (ETP) has been launched in 2010 through the New Economic Model (NEM) by the Malaysian government to emphasize the role of PDI in stimulating Malaysia's economic growth. Specifically, the primary objective of the programme is to propel the private sector to step up and make a full contribution to upgrade Malaysia to the status of a 'developed' nation by 2020. Motivated by the aforementioned programme and also the vulnerability of relying on foreign capital, it is of utmost important to analyse the dynamic relationship between PDI and its determinants (i.e. the user cost of capital and economic growth) in Malaysia.

In the review of past literature, most empirical works for Malaysia focused on the effect of domestic and private investments on economic growth (e.g. Ibrahim, 2000; Lee and Tan, 2006; Merican, 2009; Baharumshah and Almasaied, 2009; Tan, Lean and Tang, 2010; Tan and Lean, 2010). A general finding that emerged from these studies is that both investments positively influence economic growth in Malaysia. However, the earlier studies on Malaysia used gross fixed capital formation (GFCF) as a proxy for domestic investment but a measurement problem naturally arises because the GFCF consists of the components of domestic and foreign direct investment (FDI). For this reason, the positive effect may not necessarily be a result of a local source (Ang, 2009, 2010). Therefore, the earlier studies failed to assess the ability of the local source to stimulate economic growth in Malaysia. Although Ang (2009, 2010) has clearly defined the composition of total investment in Malaysia and has empirically examined the area of PDI, one area that has not received much attention is the causality between PDI and its determinants in Malaysia. The important thing to remember is that time-series data provide both opportunities and challenges for addressing causality. Besides, it is of great importance for us that the investigating of the direction of causality has important implications on policy-making. For example, if the causal relationship runs from PDI to economic growth, future economic policy should focus more on PDI in order to stimulate economic growth in Malaysia. In this respect, the earlier findings reported by Ang (2009, 2010) may be not genuine given that the direction of causality is absent in the study.

Therefore, it is important to examine the dynamic relationship between PDI and its determinants (i.e. the user cost of capital and economic growth) in Malaysia. The objectives of this study can be achieved using the following econometric methods. First, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests will be used to check for the stationarity of each variable. Additionally, the Johansen cointegration test in a vector error-correction model (VECM) will be used to detect the potential long-run equilibrium relationship among the three variables. Third, the Granger causality test will be employed to examine the causal relationship between PDI, the user cost of capital, and economic growth. Finally, the variance decomposition and impulse response functions will be performed to examine the dynamic interrelationship between PDI, economic growth, and the user cost of capital in Malaysia. The empirical findings of this study are expected to provide some significant implications to policy-makers in modelling effective economic policies in generating PDI and long-term economic growth in Malaysia.

The rest of the paper proceeds as follows: in Section 2, we discuss the data and the methodologies used by this study. The empirical results of the analysis will be presented in Section 3. The conclusion summarises the principal results and the main implications for the effectiveness of government policy will be reported in Section 4.

2. DATA, MODEL, AND ECONOMETRIC TECHNIQUES

2.1 Data and model specification

The series comprise annual observations from the period of 1970 to 2009 in Malaysia. The variable of economic growth is measured by the real gross domestic product (GDP), PDI was derived from the extraction of FDI and public investment from the gross fixed capital formation (GFCF) in Malaysia, and the real user cost of capital is computed using an analytical expression similar to that of Hall and Jorgenson (1969) and can be formulated as $COC_t = P_t^K (i_t - \pi_t^e + \delta_t) / P_t$. Price of capital (P_t^K) is measured by the GFCF deflator, i_t is the average commercial bank lending rates, the expected rate of inflation (π_t^e) is constructed from the GDP deflator, the depreciation rate (δ_t) is assumed to be constant at a 5 per cent level, and P_t is the GDP deflator.

All data is extracted from the Economic Report of the Ministry of Finance, the Annual Report of the Central Bank of Malaysia, and the CEIC database. The GDP deflator (2005=100) is used to deflate the variables into the real term. In the first instance, all variables are transformed into the natural logarithmic form as the equation:

$$PDI_t = \beta_0 + \beta_1 GDP_t + \beta_2 COC_t + \varepsilon_t \qquad (1)$$

where PDI_t is the natural logarithm of real private domestic investment (PDI), and GDP_t is the natural logarithm of real GDP, COC_t is the real user cost of capital, and ε_t is white noise error terms. The β_1 and β_2 are expected to have positive and negative signs, respectively.

2.2 System-wise Johansen cointegration test

A system-wise Johansen cointegration test (Johansen, 1988; Johansen and Juselius, 1990) is used to analyse the presence of the long-run equilibrium relationship between PDI, the user cost of capital, and economic growth. According to Gonzalo (1994), the Johansen cointegration test performs better than alternative tests for cointegration such as the two-step Engle and Granger (1987) cointegration test. In addition, Pfaff (2008) documented that it does not require the same order of integration for testing the presence of cointegration (see also Enders, 1994). To implement the Johansen cointegration test, we estimate the following VECM system:

$$\Delta Z_t = \pi Z_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + u_t \qquad (2)$$

where Δ is the first difference operator. Z_t is a vector of endogenous variables $\left[PDI_t, GDP_t, COC_t\right]'$. π is a coefficient matrix which contains information about the long-run relationship between variables in the vector. If the variables are cointegrated, the cointegrating rank, *r*, is given as $\pi = \alpha\beta'$, where α is the matrix of parameters denoting the speed of convergence to the long-run equilibrium and β represents the matrix of parameters of the cointegrating vector. Johansen and Juselius (1990) developed two likelihood ratio (LR) test statistics for testing the numbers of cointegrating ranks in the system, namely the trace test $LR(\lambda_{\text{trace}})$ and maximum eigenvalues test $LR(\lambda_{\max})$ as given in equations (3) and (4), respectively.

$$LR(\lambda_{\text{trace}}) = -T\sum_{i=r+1}^{n}\ln(1-\lambda_i) \tag{3}$$

$$LR(\lambda_{\max}) = -T\ln(1-\lambda_{r+1}) \tag{4}$$

where λ is the eigenvalue and T is the number of observations. If the LR test statistic is greater than the critical value, this indicates the null hypothesis of no cointegration relationship can be rejected. On all accounts, the critical values for both tests are listed in MacKinnon, Haug and Michelis (1999).

2.3 Granger causality test

A Granger causality test is then employed to determine the direction of causality between the three variables in this study. However, if the variables are *I*(1) and cointegrated, the Granger causality test within the first difference vector autoregressive (VAR) model will be misleading (e.g. Engle and Granger, 1987). In such circumstances, the Granger causality should be tested through the VECM as follows:

$$\Delta PDI_t = \alpha_1 + \sum_{i=1}^{k}\vartheta_1\Delta PDI_{t-i} + \sum_{i=0}^{k}\kappa_{1i}\Delta GDP_{t-i} + \sum_{i=0}^{k}\delta_{1i}\Delta COC_{t-i} + \psi_1 EC_{t-1} + \varepsilon_{1t} \tag{5}$$

$$\Delta GDP_t = \alpha_2 + \sum_{i=1}^{k}\kappa_{2i}\Delta GDP_{t-i} + \sum_{i=0}^{k}\vartheta_{2i}\Delta PDI_{t-i} + \sum_{i=0}^{k}\delta_{2i}\Delta COC_{t-i} + \psi_2 EC_{t-1} + \varepsilon_{2t} \tag{6}$$

$$\Delta COC_t = \alpha_3 + \sum_{i=1}^{k}\delta_{3i}\Delta COC_{t-i} + \sum_{i=0}^{k}\vartheta_{3i}\Delta PDI_{t-i} + \sum_{i=0}^{k}\kappa_{3i}\Delta GDP_{t-i} + \psi_3 EC_{t-1} + \varepsilon_{3t} \tag{7}$$

The equations above consist of the short- and long-run elements, where Δ is the first difference operator and the residuals ε_{it} are assumed to be normally distributed and white noise. From the above equations, EC_{t-1} is the one period lagged error-correction term which derives from the cointegrating equation. However, in the absence of cointegration, this term will be excluded. The significance of the EC_{t-1} term represents the long-run causality. While the joint significance F-test on the lagged first difference explanatory variables represents the short-run causality.

3. EMPIRICAL FINDINGS AND DISCUSSION

3.1 Unit root, cointegration, and Granger causality

As a prelude to any time series analysis, regression results with time series data may fall into a spurious regression trap if the variables are non-stationary and/or non-cointegrated. For this reason, we conduct three unit root tests to scrutinise the order of integration for each variable under investigation. Among them are the ADF, the PP, and the Dickey-Fuller Generalised Least Square (DF-GLS) unit root tests proposed by Dickey and Fuller (1981), Phillips and Perron (1988), and Elliott, Rothenberg and Stock (1996), respectively. Table 1 reports the results of the ADF, PP, and DF-GLS unit root tests.

Table 1: The results of unit root tests

Variables	Tests statistic		
	ADF	PP	DF-GLS
PDI_t	–2.369 (2)	–2.774 (4)	–2.477 (2)
ΔPDI_t	–5.033 (3)***	–8.794 (4)***	–7.153 (1)***
GDP_t	–1.315 (0)	–1.479 (2)	–1.306 (0)
ΔGDP_t	–4.970 (0)***	–4.982 (1)***	–5.004 (0)***
COC_t	–5.699 (1)***	–5.265 (2)***	–1.438 (2)
ΔCOC_t	–6.514 (3)***	–11.297 (11)***	–6.816 (1)***

Note: The asterisks *** denotes the significance at the 1 per cent level. ADF is the augmented Dickey-Fuller test, PP is the Phillips-Perron test, and DF-GLS is the Dickey-Fuller Generalise Least Square test. ln denotes a natural logarithm and Δ is the first different operator. The figures in parentheses indicate the optimal lag length for ADF and DF-GLS tests, and bandwidth for PP test. The optimal lag length and bandwidth are selected by Akaike's information criterion (AIC) and Newey-West Bartlett kernel. The critical values are obtained from MacKinnon (1996).

At the 1 per cent significance level, both ADF and PP unit root tests cannot reject the null hypothesis of a unit root at levels for PDI and GDP, but they reject the null hypothesis of a unit root at the level for the user cost of capital. In addition, both unit root tests consistently exhibit that all variables are stationary after first differencing, implying that the order of integration for the variables are not uniformly $I(1)$ processed. Contrary to the ADF and PP results, the DF-GLS unit root test strongly suggests that all three variables belong to the $I(1)$ process. On the basis of a Monte Carlo experiment, Elliott, Rothenberg and Stock (1996) exhibited that the DF-GLS test has the best overall performance and dominates the standard unit root tests, particularly in a small sample. In addition, DeJong et al. (1992) and Harris (1992) narrated that the standard unit root tests have low power in a small sample. Given the sample size of this study is relatively small and the discrepancy of the standard unit root tests, the unit root results suggested by DF-GLS are more reliable and robust. Therefore, we conclude that all variables follow the integration of order one process. With these findings, we can proceed to examine the presence of a potential long-run equilibrium relationship with the Johansen cointegration test.

To implement the system-wise Johansen cointegration test, it is compulsory to determine the lag order for the VECM system because the cointegration results are very sensitive to the choice of lag order. Given that the system-wise Akaike's Information Criterion (AIC) has superior performance in a small sample (Lütkepohl, 2005) we employ it to determine the optimal lag order. Apart from that, the standard Johansen statistics for cointegration are also inappropriate for small sample analysis (Cheung and Lai, 1993). Therefore, cointegration inferences based on the standard Johansen statistics may be fragile. In order to correct the statistic for a small sample, we employ the small sample correcting procedure suggested by Reinsel and Ahn (1992). The Johansen cointegration results are tabulated in Table 2. Evidently, the results of the Johansen trace and maximum eigenvalues tests, based on both the adjusted-LR and unadjusted-LR statistics, point to the conclusion that there is one cointegrating rank, at the five per cent significance level. Hence, PDI, the user cost of capital and economic growth in Malaysia share a common trend in the long run.[1]

Table 2: The result of the Johansen cointegration test

Panel A: System-wise Johansen cointegration test					
Series: PDI_t, GDP_t, COC_t		Unadjusted-LR statistics	Adjusted-LR statistics	Critical values[#]	
Hypotheses					
H_0	H_1			1 per cent	5 per cent
$LR(\lambda_{\text{trace}})$					
$r=0$	$r\geq 1$	39.643***	33.696**	35.458	29.797
$r\leq 1$	$r\geq 2$	8.198	6.968	19.937	15.495
$r\leq 2$	$r\geq 3$	1.488	1.265	6.635	3.842
$LR(\lambda_{\max})$					
$r=0$	$r=1$	31.445***	26.728***	25.8612	21.1316
$r\leq 1$	$r=2$	6.709	5.703	18.5200	14.2646
$r\leq 2$	$r=3$	1.448	1.265	6.6349	3.8415

Note: *** and ** denote the significant level at the 1 and 5 per cent levels, respectively. # represents that the critical values were obtained from MacKinnon et al. (1999). The AIC statistic is used to select the optimal lag order. The selected lag order is two. The unadjusted-LR statistics are the standard Johansen statistics, while the adjusted-LR statistics are the corrected Johansen's statistics for a small sample suggested by Reinsel and Ahn (1992).

Table 3 presents the normalised cointegrating vector by PDI. The results exhibit that economic growth is positively related to PDI, while the user cost of capital has an inverse impact on PDI in Malaysia. These findings are consistent with Greene and Villanueva (1991), Cardoso (1993), Oshikoya (1994), Ndikumana (2000), Ghura and Goodwin (2000), and Ang (2009, 2010); studies that show an increase of output level encourages PDI whereas an increase in the user cost of capital discourages PDI.

Table 3: Normalised long-run coefficients

PDI_t	GDP_t	COC_t	*Constant*
1.000	1.418***	–4.913***	13.986

Note: The asterisk *** denotes the significant at the 1 per cent level.

[1] In interpreting our results the main limitations of this study borne in mind are the order of integration for variables are not strictly $I(1)$ process and the model may fall into the omitted of relevant variable bias. As a sensitivity check, we also perform the bounds testing approach for cointegration developed by Pesaran, Shin and Smith (2001). The computed F-statistics (6.889) for cointegration are greater than the 5 per cent upper bounds critical values (6.437) tabulated in Narayan (2005), thus rejecting the null hypothesis of no cointegrating relationship. This result corroborates with the Johansen cointegration test in Table 2. Therefore, we conclude that the variables are cointegrated and the cointegration results are robust. Since the variables are cointegrated, according to Perman (1991) the model is also correctly specified, stable, and the impact of omitted variable has been minimised and less worry. As a result, the findings of this study are at best indicative. To conserve space, the cointegration results for bounds test are not reported here, but are available upon request from the authors.

As the variables are cointegrated, we proceed to ascertain the direction of causality within the VECM framework. Table 4 shows the results of the causal relationship between PDI, the user cost of capital, and economic growth in the short- and long-run dynamics. Beginning with the results for long-run causality, the coefficients on the one period lagged error-correction term is statistically significant with the expected negative sign in the GDP and the user cost of capital VECM equations at the 10 and one per cent levels, respectively. However, EC_{t-1} is not significant in the PDI VECM equation. These imply that in the long run there is uni-directional causality running from PDI to economic growth and also from PDI to the user cost of capital. In addition, economic growth and the user cost of capital are bi-directional causality. In the short run, the χ^2 - statistics show that the sum of lagged explanatory variables are statistically significant in all VECM equations, at the five per cent level. These exhibit strong bi-directional Granger causality between PDI, the user cost of capital, and economic growth in Malaysia. The evidence of strong bi-directional Granger causality between PDI and economic growth fulfil the moderation of government policy to re-constitute the PDI to upgrade Malaysia to the status of a high income nation in year 2020.

Table 4: The results of Granger causality tests based on VECM

Dependent variable	χ^2 statistics [p-values]			EC_{t-1}
	$\sum \Delta PDI_t$	$\sum \Delta GDP_t$	$\sum \Delta COC_t$	[*t*-statistics]
ΔPDI_t	–	22.811*** [0.0000]	8.479** [0.0371]	–0.153 [–1.363]
ΔGDP_t	9.799** [0.0204]	–	10.455*** [0.0012]	–0.027* [–1.751]
ΔCOC_t	15.774*** [0.0004]	13.776*** [0.0080]	–	–0.970*** [–4.289]

Note: ***, ** and * denote the significant level at the 1, 5 and 10 per cent levels, respectively. The AIC statistic is uses to determine the optimal lag order combination.

3.2 *Variance decomposition and impulse response functions*

To this end, we have been restricted to the in-sample tests. In order to provide further insight to the dynamic relationship between PDI, the user cost of capital, and economic growth in Malaysia, we perform the variance decomposition and the impulse response functions. Variance decomposition indicates the information about the percentage of the movements in a variable due to its own shocks versus shocks to the other variables in the system, while the impulse response functions show the directions of response to a random shock of a variable in the system. Both are out-of-sample tests which are useful in discerning the degree of exogeneity of the variables and the dynamic responses of the variables beyond the sample period. The results for variance decomposition are reported in Table 5. Among three variables under consideration, PDI is relatively the most exogenous variable in the short run, while GDP is the relatively most exogenous in the long run. At the end of 12 years, the forecast error variance for GDP, PDI, and the user cost of capital are 89 per cent, 77.9 per cent, and 54.6 per cent, respectively. Nevertheless, over the first two years, on average, 90.8 per cent of the variation in the forecast error for PDI is explained by its own shocks, while 87 per cent and 80.1 per cent of the variation in the forecast error for GDP and the user cost of capital, respectively are explained by their own shocks. On an average 12-year period, 14.58 per cent of the forecast error variance in PDI can be explained by GDP and 8.1 per cent of the forecast error variance in GDP can be explained by PDI. While, the contribution of the user cost of capital to explaining the forecast error variance in the other two variables is relatively small.

Table 5: The results of variance decomposition analysis

Relative variance of PDI			
Year	PDI	GDP	User cost of capital
1	100.00	0.00	0.00
2	81.63	14.94	3.43
3	77.49	18.92	3.59
4	77.71	16.80	5.49
8	77.71	15.47	6.82
12	77.86	15.08	7.06
Relative variance of GDP			
Year	PDI	GDP	User cost of capital
1	15.27	84.73	0.00
2	9.49	89.34	1.17
3	7.66	89.14	3.20
4	7.49	88.78	3.73
8	7.14	89.00	3.86
12	7.03	89.00	3.97
Relative variance of the user cost of capital			
Year	PDI	GDP	User cost of capital
1	0.04	19.81	80.15
2	0.26	19.78	79.96
3	10.09	17.40	72.51
4	17.10	15.75	67.15
8	25.42	14.35	60.23
12	32.53	12.88	54.59

Note: Cholesky ordering: PDI, GDP, the user cost of capital.

Apart from the variance decomposition, it is also essential to analyse the direction of response to random shocks of a variance in the system. Figures 1 to 3 depict the results of impulse response function with respect to one-standard deviation shocks over a 12-year period. Beginning with Figure 1, the results show that a shock in GDP leads to an increase in PDI for the first two years, while it fluctuates at the positive level from year three to six, and levels out thereafter. A shock in the user cost of capital has a negative impact on PDI over the entire 12-year period. Figure 2 shows response of GDP to shocks in PDI, GDP, and the user cost of capital. A shock in PDI leads to an increase in GDP, while a shock in the user cost of capital has a negative impact on GDP for the first three years. However, both effects level out thereafter. Finally, Figure 3 reveals that a shock in GDP induces the user cost of capital to fall for the first three years, while increasing and stabilising thereafter. Meanwhile, a shock in PDI leads to a fall in the user cost of capital for the first three years, while it fluctuates at a negative level from year three to seven, and levels out thereafter.

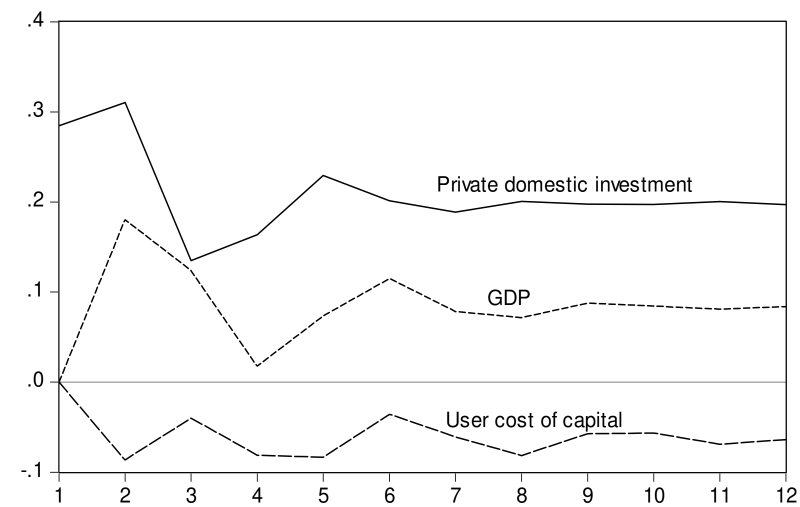

Figure 1: *The plots of impulse response of PDI to one-standard deviation shocks in PDI, GDP, and the user cost of capital*

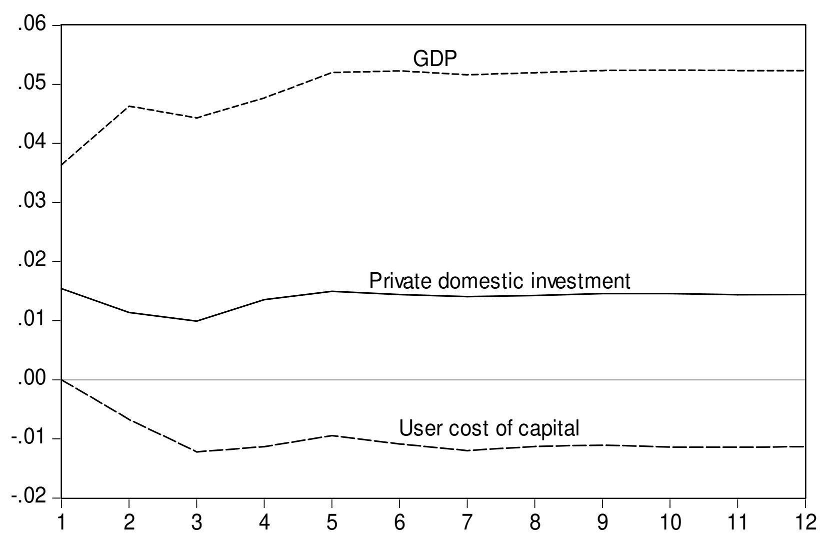

Figure 2: *The plots of impulse response of GDP to one-standard deviation shocks in PDI, GDP, and the user cost of capital*

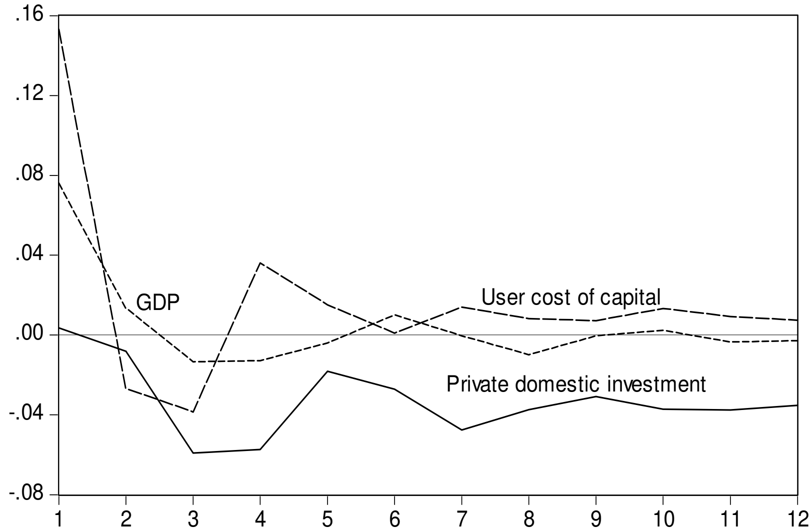

Figure 3: *The plots of impulse response of the user cost of capital to one-standard deviation shocks in the PDI, GDP, and user cost of capital*

As a summary for the overall results of impulse response function, shocks in each variable seem to persist over three to five years and dissipate thereafter, implying that the effect of policy intervention on PDI, GDP, and/or the user cost of capital in Malaysia is at most half a decade. This is in harmony with the policy period set for every Malaysian Plan.

4. CONCLUSION AND POLICY RECOMMENDATIONS

For the sake of brevity, this study assesses the dynamic relationship between PDI, the user cost of capital, and economic growth in Malaysia from 1970 to 2009. This study used various econometric techniques: cointegration, Granger causality, variance decomposition, and impulse response frameworks to achieve the objectives of this study. The key findings of this study can be summarised accordingly. Firstly, the system-wise Johansen cointegration test in association with the small sample correction procedure suggested by Reinsel and Ahn (1992) indicates that PDI is cointegrated with the user cost of capital, and economic growth. This implies that these variables are moving together in the long run, even though there might be deviations in the short run. The second key finding is that in the long run, economic growth has a positive effect on PDI while the user cost of capital is negatively affecting PDI in the long run. Third, the Granger causality results suggest that there is uni-directional causality running from PDI to the user cost of capital and from PDI to economic growth in the long run. In addition, there is a bi-directional causality between the user cost of capital and economic growth in the long run. Nevertheless, in the short run the three variables Granger-cause each other, implying that the variables are bi-directional causality. Finally, it is noteworthy to point out here that the variance decomposition indicates that on average most of the variations in PDI are explained by economic growth compared to the user cost of capital in Malaysia. Similarly, PDI is relatively more important that the user cost of capital in explaining the variations in economic growth. Therefore, PDI and economic growth are bi-directional causality in nature. In addition, the impulse response functions suggest that either shock to PDI or to economic growth has a positive effect on each other. While, a shock to the user cost of capital has a negative impact on PDI and economic growth in Malaysia. In this respect, the expansionary monetary policy that falls on the user cost of capital may effectively encourage PDI and then stimulate economic growth in Malaysia.

In terms of policy, the overall results of this study suggest that Malaysia should adopt the dual strategy in promoting more PDI and providing better domestic investment environments through proper economy management on macroeconomic and price stability. For example, tax rate, permits and licensing procedures should be reduced to encourage more entrepreneurs to participate in the private sector. Therefore, economic growth in Malaysia can be sustained through PDI accumulation. Evidently, our findings also suggest that monetary policy should be complemented with the above economic package in controlling the user cost of capital uncertainty. This is because the changes of the user cost of capital reflect market forces on the domestic investors. Furthermore, this is important for small and medium-sized enterprises (SME) in Malaysia as they rely heavily on financial supplements. Hence, learning about the changes of the user cost of capital is of utmost important in generating a conducive PDI environment. In doing so, PDI could be an effective invigorator for economic growth in Malaysia and this is also consistent with the ongoing ETP within the NEM.

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