Capital Formation in Thailand: Its Importance and Determinants

Jiranyakul, Komain

National Institute of Development Administration

September 2014

Capital Formation in Thailand: Its Importance and Determinants

Komain Jiranyakul, School of Development Economics, National Institute of Development Administration, Thailand. Email: komain_j@hotmail.com

Abstract:

Using the dataset that comprises annual data during 1979 and 2012 and obtained from various sources, this study examines the importance of capital formation to Thai economy and what driving forces influence capital formation. The results show that real GDP and capital formation are cointegrated, and capital formation imposes a positive impact on real GDP in the long run. It is found that stock market liquidity measured by stock market capitalization rather than foreign direct investment plays important role in capital accumulation process. These findings give some policy implications.

Keywords: Capital formation, economic growth, stock market capitalization, bounds testing.
JEL Classification: E22, O40

Introduction

The role of capital formation on economic growth has been widely addressed since the emergence of the Solow (1956) growth model. The change in capital stock is from the change in the savings rate that can stimulate growth. In agricultural sector, Herr (1964) finds that capital formation is important in terms of productivity and that taxation, a measure of government policy, affects farm investment. However, for many developing countries, industrial sector has been playing important role in the last two decades. This implies that capital formation has been generated from manufacturing firms. The issue that private investment or public investment is more important in stimulating growth has also been addressed. Khan and Reinhart (1990) formulate a simple growth model that separates the impacts of public sector and private sector investment and use it to estimate a cross-section dataset of 24 developing countries. Their results support the notion that private investment has a larger direct effect on growth than that of public investment.

Some empirical studies emphasize the role of macroeconomic variables. Greene and Villanueva (1991) examine the effects of policies and macroeconomic variables on the rate of private investment in developing countries and find that the rate of private investment is positively related to real GDP growth, level of per capita GDP and the rate of public investment, but negatively related to real interest rate, domestic inflation, the debt-service ratio, and the ratio of debt to GDP. Serven and Solimano (1993) examine the impact of macroeconomic variables on investment performance of 15 developing countries using panel data. Their main findings are: 1) output growth and public investment have significantly positive impact on private investment, and 2) foreign debt burden, macroeconomic instability and the deterioration in world

economic conditions impose significantly negative impact on private investment. Kim and Lau (1994) examine the sources of economic growth of four East Asian newly industrialized countries and five industrialized countries. They find that technical progress can be represented as purely capital-augmenting in all countries. However, the most important source of growth in East Asian newly industrialized countries is capital accumulation. The opposite view is addressed by Jun (2003) who finds evidence that investment efficiency in rural industrialization of small firms in non-state sector is the cause of high growth rate in China. One main finding by Qin et al. (2006) is that the growth of capital stock or investment does not exogenously drive output growth regularly either in the short run or in the long run. It is the output that drives investment demand. In addition, rapid investment growth results in rising capital-output ratio in China rather than output growth acceleration.

The role of stock market can be important in the growth process. Stock markets with high liquidity can enable listed firms to acquire more capital stocks compared to the lending by bank sector. However, this issue is still controversial. Arestis et al. (2001) find evidence that banking development plays more important role than stock market development on economic growth. On the contrary, Caporale et al. (2004) find evidence obtained from a sample of seven countries, which suggests that a well-developed stock markets foster economic growth in the long run by fuelling the engine of growth through faster capital accumulation, and by turning it through better resource allocation. Naceur and Ghanzouni (2007) find no significant relationship between banking and stock market development and economic growth in eleven Middle East and North African countries. Wolde-Rufael (2009) re-examines the relation between financial development and growth in Kenya and finds bidirectional causality between domestic bank credits and economic growth. Yu et al. (2012) find a causal linkages between financial development, stock market development and growth in cross-countries regressions for both regional and income groups.

For the role of foreign direct investment on capital accumulation, Al-Sadig (2013) examine the effect of foreign direct investment (FDI) inflows on private investment using panel data of 91 developing countries over the period 1970-2000. The results show that FDI inflows stimulate private domestic investment. For low-income countries, the positive impacts of FDI on private investment depend on the availability of human capital.

For Asian economies, Pradhan et al. (2014) employ principal-component analysis, panel cointegration, and Granger causality tests to apply to recent data of 35 countries. They find that banking sector and stock market maturity lead to economic growth via inflation and trade openness. Paul (2014) examines the determinants of investment or capital formation in Bangladesh and finds that lending rate, domestic credit, trade, foreign aid, economic openness and financial deepening impose the long-run impact on investment.

The main objective of the present study is to examine the importance of capital formation and its determinants using available time series data from 1979 to 2012. The next section describes data and methodology used. Section 3 presents the findings while the last section gives concluding remarks.

Data and Methodology

The dataset used in this study comprises annual data during 1979 and 2012 and obtained from various sources. Gross capital formation in billion US dollars at 1970 constant price is obtained from Ivan Kushnir's Research Center. Consumer price index (CPI) and the US dollar exchange rate are obtained from the Bank of Thailand. Real capital formation in billions of baht is obtained by multiplying the gross capital formation series with the US dollar exchange rate. Real GDP, imports, foreign direct investment expressed in billions of baht are also obtained from the Bank of Thailand. These series are deflated by CPI such that they are in real terms. The lending rate by banks is obtained from the bank of Thailand while stock market capitalization is retrieved from the Stock Exchange of Thailand website. Real market capitalization is obtained by deflating nominal capitalization with CPI. The share of imports in GDP is the ratio of real imports to real GDP. All series are transformed into logarithmic series. The sample size comprises 34 observations.

The present study adopts the asymptotic theory proposed by Pesaran et al. (2001) to test the existence of level relationship between a variable and its regressors when the degree of integration of each variable is not certainly known. This bounds testing procedure can provide unbiased long-run estimates and valid test statistics. For the importance of capital formation to real GDP, the long-run relationship is expressed as:

$$ly_t = a_0 + a_1 lcf_t + e_t \qquad (1)$$

Where *ly* is the log of real GDP, *lcf* is the log of real capital formation, and *e* is the error term. The model used to test for level relationship can be expressed as:

$$\Delta ly_t = \alpha_0 + \delta_1 ly_{t-1} + \delta_2 lcf_{t-1} + \sum_{i=1}^{p1} \beta_i \Delta ly_{t-i} + \sum_{j=0}^{p2} \gamma_j \Delta lcf_{t-j} + u_t \qquad (2)$$

where Δ denotes the first difference operator, δ_1 and δ_2 denote the coefficients of the lagged level, p_1 and p_2 denote the lag order of the first difference of variables. It should be noted that the lag orders of the first differences do not need to be the same. Without the lagged level of variables, the model in equation (2) will become the autoregressive distributed lag (ARDL) of order p_1 and p_2 or ARDL (p_1, p_2) model. The information criteria might not be suitable in selecting the optimal lag orders because of small sample size. Therefore, the grid search can be used to select the optimal lag orders such that the ARDL (p_1, p_2) model is free of serial correlation. This ARDL (p_1, p_2) model is tested against the model expressed in equation (2) to obtain the computed F-statistic to be compared with the upper bound and lower bound critical values provided by Pesaran et. al. (2001). If cointegration exists, the computed F-statistic will be larger than the upper bound critical value. If cointegration does not exist, the computed F-statistic will be smaller than the lower bound critical value. The computed F-statistic that takes the value between the upper bound and lower bound critical values will lead to an inconclusive result. In case the variables are cointegrated, the error correction mechanism (ECM) in the short-run dynamics can be expressed as:

$$\Delta ly_t = \alpha_0 + \sum_{i=1}^{p1} \beta_i \Delta ly_{t-i} + \sum_{j=0}^{p2} \gamma_j \Delta lcf_{t-j} + \lambda e_{t-1} + u_t \qquad (3)$$

where e_{t-1} is the error correction term, which is the lagged residual obtained from the estimate of equation (1). The coefficient λ is the speed of adjustment toward the long-run equilibrium relationship.

What driving forces or macroeconomic variables determine capital formation is tested by the following models:

Model 1: $$lcf_t = b_0 + b_1 ly_t + b_2 lfdi_t + b_3 lsm_t + b_4 lmc_t + e_t \qquad (4)$$

Model 2: $$lcf_t = b_0 + b_1 lfdi_t + b_2 lsm_t + b_3 lmc_t + e_t \qquad (5)$$

Model 3: $$lcf_t = b_0 + b_1 lfdi_t + b_2 lmc_t + e_t \qquad (6)$$

Model 4: $$lcf_t = b_0 + b_1 lsm_t + b_2 lmc_t + e_t \qquad (7)$$

where *lfdi* is the log of real foreign direct investment, *lsm* is the log of share of imports in GDP and *lmc* is the log of real stock market capitalization. These models are tested for cointegration and deriving the ECM equations in a similar manner of equations (1)-(3), but in a multivariate framework.[1]

Empirical Results

Even though testing for unit root of variables is not required in conducting the bounds testing for cointegration, the procedure is not suitable if any variable is integrated of order two, i.e., it is I(2) series. The PP tests proposed by Phillips and Perron (1988) are used to test for unit root of all variables of interest.[2] The results are reported in Table 1. The results of unit root tests show that three series are integrated of order one, I(1), and two series are integrated of order zero, I(0). All of the series do not appear to be integrated of order two, I(2). Therefore, the bounds testing is eligible for cointegration test.

How important capital formation (*lcf*) in determining real GDP (*ly*) is tested in a bivariate cointegration test. The ARDL (0,3) model is chosen and free of serial correlation with Chi-square stististic of 0.893 and the probability of accepting the null hypothesis that the residuals exhibit no serial correlation is 0.640. The results of long-run relationship with the 1997 financial dummy variable (*Dt*)[3] and short-run dynamics are shown in Table 2.

[1] See the results reported in the next section.

[2] According to Choi and Chung (1995), the PP tests seem to be powerful for low frequency data, specifically annual data.

[3] The dummy variable takes the value of zero before 1997 and of one thereafter.

Table 1 Results of PP tests for all variables, 1979-2012					
	Level of variables		First difference of variables		
Variables	Test A	Test B	Test A	Test B	Integration
Capital formation	-1.50 (0.52)	-0.64 (0.75)	-4.84 (0.01)	-4.89 (0.00)	I(1)
GDP	-.2.83 (0.06)	-0.87 (0.99)	-3.95 (0.01)	-5.27 (0.00)	I(1) or I(0)
FDI	-2.44 (0.14)	-3.05 (0.13)	-8.67 (0.00)	-8.20 (0.00)	I(1)
Share of imports in GDP	-0.41 (0.89)	-3.21 (0.10)	-5.72 (0.00)	-5.66 (0.00)	I(1) or I(0)
Stock market capitalization	-1.04 (0.73)	-1.61 (0.77)	-5.17 (0.00)	-5.16 (0.00)	I(1)
Note: Test A includes intercept only while Test B includes intercept and a linear trend. The number in parenthesis is the probability of accepting the null hypothesis of unit root. I(1) or I(0) indicates that at least one test shows the series is I(0).					

The result from bounds test shows that cointegration exists between *ly* and *lcf* because the computed F-statistic of 7.04 is larger than the upper bound critical value of 5.73 at the 5 percent level of significance. The diagnostic tests for the validity of ECM estimate show that it is free of serial correlation and heteroskedasticity. Also the residuals are normally distributed.

Table 2 Results of long-run and short-run dynamics estimates of the impact of capital formation on real GDP, 1979 to 2012	
Panel A. Long-run estimation with *ly* as dependent variable	
	Coefficient
lcf_t	0.609 (2.648)**
D_t	0.978 (5.644)***
Constant	6.323 (2.139)**
Adjusted R^2	0.816
Panel B. ECM estimation with Δly as dependent variable	
Δlcf_t	0.078 (1.063)
Δlcf_{t-1}	0.113 (1.554)
Δlcf_{t-2}	0.056 (0.760)
Δlcf_{t-3}	-0.090 (-1.210)
e_{t-1}	-0.099 (-2.865)***
Adjusted R^2	0.240
Diagnostic tests:	
Serieal correlation (LM)	1.973 (p=0.373)
Normality (Jarque Bera)	3.865 (p=0.145)
Heteroskedasticity (ARCH)	1.043 (p=0.307)
Note: The number in parenthesis is t-statistic. p is the probability of accepting the null hypotheses that there is no serial correlation, no heteroskedasticity, and residuals are normally distributed. *** and ** denote significance at the 1 and 5 percent level, respectively.	

In the long run, a one percent increase in real capital formation causes an increase in real GDP by 0.6 percent (Panel A of Table 2). This indicates that real capital formation is one of the main determinants of real GDP. The significantly positive coefficient of the 1997 financial crisis shows that the crisis imposes a positive impact for the contribution of capital formation to real GDP. It should be noted that there are various macroeconomic variables that can impose different impacts on capital formation (see Serven and Solimanu, 1993, among others). Therefore, the estimated equation illustrates the contribution of capital formation to real GDP.

The short-run dynamics result from error correction mechanism (ECM) estimate is illustrated in Panel B of Table 2. In the short run, the relationship between output growth and a change in capital formation is positive, but is not statistically significant. Furthermore, all coefficients of lagged *lcf* are insignificant. Therefore, a change in capital formation does not affect the growth rate in the short run. However, the estimated coefficient of the error correction term (e_{t-1}) is significantly negative and takes the absolute value of less than one. This indicates that any deviation from long-run equilibrium will be corrected.

The above results show that how capital formation is capable of generating real GDP for the country. There remain some questions such as: 1) what are factors affecting capital formation in the long run? and 2) what are important policy measures that foster these influential factors? Different forcing (independent) variables can be influential determinants of capital formation. Four models, expressed in equations (4) to (7), are estimated to obtain the existence of cointegration between capital formation and its forcing variables. The results are reported in Table 3.

Table 3. Results of bounds testing for cointegration with capital formation as dependent variable, 1979-2012

Model	Computed F-statistic	$\chi^2_{(2)}$
1. ARDL (1,1,1,1,1)	1.727	0.042 (p=0.979)
2. ARDL (1,0,1,1)	1.716	0.369 (p=0.982)
3. ARDL (2,1,1)	3.949	1.228 (p=0.541)
4. ARDL (2,1,1)	4.812	0.043 (p=0.979)

Note: The computed F-statistic is used to test the null hypothesis that the coefficients of lagged level of variables are equal to zero. The ARDL models must be free of serial correlation using the LM test with the Chi-square and its probability shown in parenthesis.

The criterion for choosing lag length in an ARDL model is the parsimonious model that is free of serial correlation. The Lagrangian Multiplier serial correlation test with the Chi-square statistic with the degree of freedom of two ($\chi^2_{(2)}$) rejects the null hypothesis that there is serial correlation in the residuals in each model. Table 3 summarizes the bounds critical value for unrestricted intercept and no trend for models with different regressors and their criteria.

Table 4 Bounds critical values		
	F-statistic	Critical bound
Four regressors	2.86 to 4.01	5 percent
	2.45 to 3.52	10 percent
Three regressors	3.23 to 4.35	5 percent
	2.72 to 3.77	10 percent
Two regressors	3.79 to 4.85	5 percent
	3.17 to 4.14	10 percent
Criteia: Above the upper bound critical value		Cointegration
Below the upper bound critical value		No cointegration
Between the lower and upper bounds critical value		Inconclusive result
Note: Adapted from Table CI (iii) Case III in Pesaran el al. (2001).		

The results in Table 3 indicate that no cointegration exists in Models 1 and 2 because the computed F-statistics are below the lower bound critical values at the 5 and 10 percent level of significance (Table 4). For Model 3, the result is inconclusive because the computed F-statistic is between the upper and lower bounds critical values at the 5 or 10 percent level of significance. Only Model 4 exhibits cointegration at the 10 percent level of significance because the computed F-statistic of 4.81 is larger than the upper bound critical value of 4.14.

Table 5 Results of long-run and short-run dynamics estimates of the impact of share of imports and stock market capitalization on capital formation, 1979 to 2012	
Panel A. Long-run estimation with *lcf* as dependent variable	
	Coefficient
lsm_t	0.030 (0.177)
lmc_t	0.219 (5.386)***
D_t	-0.083 (-0.764)
Constant	11.438 (10.644)***
Adjusted R^2	0.828
Panel B. ECM estimation with Δlcf as dependent variable	
Δlcf_{t-1}	0.337 (1.898)*
Δlcf_{t-2}	0.382 (2.823)***
Δlsm_t	0.581 (3.453)***
Δlsm_{t-1}	-0.008 (0.039)
Δlmc_t	0.019 (0.469)
Δlmc_{t-1}	0.036 (0.737)
e_{t-1}	-0.539 (-3.506)***
Adjusted R^2	0.693
Diagnostic tests:	
Serieal correlation (LM)	0.115 (p=0.994)
Normality (Jarque Bera)	3.829 (p=0.147)
Heteroskedasticity (ARCH)	1.132 (p=0.287)
Note: The number in parenthesis is t-statistic. p is the probability of accepting the null hypotheses that there is no serial correlation, no heteroskedasticity, and residuals are normally distributed. *** and * denote significance at the 1 and 10 percent level, respectively.	

The results of long-run equilibrium relationship and short-run dynamics are shown in Table 5. The long-run coefficient on the share of imports in real GDP is insignificantly positive, implying that capital formation does not depend on this variable in spite of the fact that there has been a substantial proportion of equipments and machinery in total imports. However, the positive impact of market capitalization is significant, implying that stock market plays a crucial role of capital formation in Thailand. A one percent increase in real market capitalization causes real capital formation to increase by 0.22 percent. Compared with other driving forces, such as real GDP and foreign direct investment, market capitalization can be considered the important driving force in the process of capital formation in the country.[4]

For the ECM estimate, diagnostic tests reveal that there are no serial correlation and heteroskedasticity in the residuals. The residuals are normally distributed. The highly significant coefficient of the error correction term (e_{t-1}) of -0.54 indicates that any deviation from long-run relationship will be corrected in a rapid speed. In addition, there is a positive short-run relationship between a change in the share of imports and a change in capital formation. It should be noted that the share of imports does not affect capital formation in the long run, but it does in the short-run.

The findings on the significant long-run impact of market capitalization and on the significant short-run impact of the share of imports on capital formation give some policy implications. Some measures that can foster the development of the stock market seem to be necessary in the future even though the stock market have been recently more developed. The bank borrowing rate might not directly effect capital formation, but might indirectly affect it. If fund mangers and investors can borrow at the lower rate, they can invest more in some blue ship stocks in energy and manufacturing sectors. This can lead to larger market capitalization in the future. Furthermore, the government can create investment climate for firms by ensuring macroeconomic stability so that firms can invest more in capital goods. As a result, higher long-run growth rate can be achieved in the near future.

Concluding Remarks

Many empirical studies investigate the role of capital formation or investment on output, but few studies emphasize the determinants of capital formation. The present study examines the impact of capital formation or investment on real GDP and its determinants. By employing the recent time series analysis techniques, the bounds testing shows that capital formation or investment imposes a positive long-run impact on real GDP. This result shows how important capital formation in determining real GDP in Thai economy. However, there is no short-run relationship between a change in capital formation and the growth rate because the coefficient is insignificantly positive. What the determinants of capital formation are is also investigated. It is found that stock market liquidity measured by stock market capitalization rather than foreign direct investment plays important role in capital accumulation process. Therefore, it is necessary that the government should create more favorable

[4] The bank lending rate as a driving force is also added to the model, but cointegration is not found. This implies that large enterprises in the country do not rely on bank lending. Therefore, financial deepening does not play any role in capital formation.

investment climate for firms by ensuring macroeconomic stability so that firms can invest more in capital goods if the main target is to enhance higher economic growth rate.

References

Al-Sadig, A., 2013. "The effect of foreign direct investment on private domestic investment: evidence from developing countries," Empirical Economics, 44(3), 1267-1275.

Arestis, P., Demetriades, P., and Luintel, K., 2001. "Financial development and economic growth: the role of stock markets," Journal of Money, Credit and Banking, 33(1), 16-41.

Caporale, G. M., Howells, P. G. A., and Soliman, A. M., 2004. "Stock market development and economic growth; the causal likage," Journal of Economic Development, 29(1), 33-50.

Choi, I., and Chung, B., 1995. "Sampling frequency and the power of tests for a unit root: a simulation study," Economics Letters, 2(3), 131-36.

Greene, J. and Villanueva, D., 1991. "Private investment in developing countries: an empirical analysis," IMF Staff Papers, 38(1), 33-58.

Herr, W. M., 1964. "Capital formation: its importance and determinants," Australian Journal of Agricultural Economics, 8(2), 97-111,

Jun, Z., 2003. "Investment, investment efficiency, and economic growth in China," Journal of Asian Economics, 14(5), 713-734.

Khan, M. and Reinhart, C., 1990. "Private investment and economic growth in developing countries," World Development, 18(1), 19-27.

Kim, J-I. and Lau, L., 1994. "The source of growth of East Asian newly industrialized countries," Journal of the Japanese and International Economics, 8(3), 235-271.

Naceur, S. B. and Ghanzouni, S., 2007. "Stock market, banks and economic growth: empirical evidence from the MENA region," Research in International Business and Finance, 21(2), 297-315.

Paul, B. P., 2014. "How to finance investment in Bangladesh: finding long-run factors in a bounds test method," International Journal of Finance and Banking, 1(2), 13-24.

Pesaran, M. H., Shin, Y, and Smith, R. J., 2001. "Bounds testing approaches to the analysis of level relationships," Journal of Applied Econometrics, 16(3), 289-326.

Phillips, P. C. B. and Perron, P., 1988. "Testing for a unit root in time series regression," Biometrika, 75(2), 335-346.

Pradhan, R. P., Arvin, M. B., Norman, N. R., and Hall, J. H., 2014. "The dynamics of banking sector and stock market maturity and the performance of Asian economies: time series evidence," Journal of Economic and Administrative Sciences, 30(1), 16-44.

Qin, D., Cagas, M. A., Quising, P. and He, X-H., 2006. "How much does investment drive economic growth in China?," Journal of Policy Modeling, 28(7), 751-774.

Serven, L. and Solimano, A., 1993. "Debt crisis, adjustment policies, and capital formation in developing countries: where do we stand?," World Development, 21(1), 127-140.

Solow, R. M., 1956. "A contribution to the theory of economic growth," Quarterly Journal of Economics, 70(1), 65-94.

Wolde-Rufael, Y., 2009. "Reexamining financial development and economic growth nexus in Kenya," Economic Modelling, 26(6), 1140-1146.

Yu, J., Hassan, M. K., and Sanchez, B., 2012. "A re-examination of financial development and economic growth," Applied Economics, 44(27), 3479-3489.