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Private Investment: Trends and Determinants in Thailand

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Abstract

This paper examines patterns and determinants of private investment in an attempt to understand why levels of private investment in South East Asia have not yet fully recovered, using Thailand as a case study. The private investment equation is estimated during the period 1960-2005. We find that it was capital fund shortages rather than existing spare capacity that hindered short-run investment recovery. While the health of financial institutions must be kept in check, policy attention should be geared more towards credit availability to ensure that prudent investors can access credit adequately and accelerate investment recovery. In the long run, policy emphasis should be on promoting a conducive investment climate.

Key words: investment-saving glut, investment determinants, Thailand

JEL: O11, O16, O53

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1. ISSUES

Private investment plays a vital role in the growth generating process in developing Asian economies. Even though investment typically represents a much smaller component of aggregate demand than does consumption, it determines the rate at which physical capital is accumulated. Hence, it plays an essential role in the expansion of the economy's production capacity and long-term economic growth. Private investment has become even more policy-relevant in recent years as after the 1997 financial crisis private investment in the crisis-affected countries has not yet fully recovered. Such a slow recovery process could hinder the efficiency of resource use and generate negative signals to foreign investors (Chhibber *et al.*, 1992).

The movements of private investment in crisis-affected Asian economies also become policy-relevant worldwide given recent concerns over persistent global payment imbalances, reflected in growing current account deficits, mainly in the US, and surpluses in Asian and oil-exporting economies. For East Asian economies, with the exception of China, instead of an increase in savings rates, there has been a private investment drought that induced these Asian countries to run successive current account surpluses.[1] Hence, examining factors hindering the recovery of private investment in these countries would also assist in redressing the global imbalances problem.

Given the nature of data availability, the existing empirical studies on the determinants of private investment, particularly for developing Asian economies, tend to be dominated by multi-country, cross-sectional, regression analysis.[2] The clear fundamental limitation of such analysis is that it is based on the implicit assumption of 'homogeneity' in the observed relationships across countries. This is a very restrictive assumption because there are considerable differences across countries in relation to various structural features and institutional aspects which have a direct bearing on private investment behaviour. In addition, there are also vast differences among countries with respect to the nature and quality of data available, which make any cross-country comparison a rather risky business (Chhibber et al. 1992; Athukorala & Sen, 2002).

This points to the need for an in-depth, time-profile analysis of private investment in an individual country in order to build a sound empirical foundation for informing the policy debate. Unfortunately, systematic single-country studies of this nature are few and far between.[3] Therefore, this paper aims to examine patterns and determinants of private investment, using Thailand as a case study. A single equation of private investment determinant is estimated where a comprehensive set of explanatory variables are well incorporated with a view to understanding the reasons behind private investment still not fully recovering..

Thailand is a suitable case study for the subject at hand for three reasons. Firstly, during the past three decades Thailand has exhibited a boom-and-bust cycle in private investment. After the recent 1997 crisis, private investment in Thailand has not fully recovered. Its share of GDP has not only been lower than the average level of the past three decades, but also relatively low compared with the other crisis-affected countries in the region. Hence, the analysis of patterns and determinants of private investment in Thailand would not only contribute to the ongoing debate in policy circles, but also shed light for other developing countries in designing policy to promote private investment.

Secondly, the incomplete recovery of private investment seems to involve several factors, such as real exchange rate depreciation, credit availability and excess capacity, some of which have theoretically ambiguous effects on investment. Their relative importance is also crucial in forming policy to speed up the investment recovery. Consequently, a systematic empirical analysis is required.

Finally, there has not been any systematic and up-to-date study of private investment in Thailand.[4] The most recent study was Mallikamas *et al*. (2003), in which private investment function in Thailand was estimated but whose results are subject to two serious limitations. The first limitation is that they ignored a number of key variables, i.e. public investment and various aspects of economic uncertainty. However, based on previous studies (i.e. Chhibber *et al.*, 1992; Athukorala & Sen, 2002)[5], these variables play a significant role in determining private investment in the context of developing countries Second, the proposed functional form for estimation is problematic. It is based mainly on the Tobin's *q* theory. However, the Tobin's *q* theory has met very limited empirical success in developing countries (Agènor, 2001). This is especially true for Thailand where total capital in the stock market was limited, accounting for only around 7% of the country's total capital stock during the period 2001-05.

The rest of the paper is structured as follows. Section II provides an analysis of patterns of private investment in the Thai economy in order to set the stage for the empirical analysis. The analytical framework and the model are presented in Section III. Time series properties of data and the econometric procedures used are described in Section IV and V, respectively. Section VI presents and discusses regression results. The final section summarizes key inferences.

2. PATTERNS OF PRIVATE INVESTMENT IN THAILAND

Thailand experienced a considerable expansion in private investment between 1986 and 1996 before the financial crisis starting in mid-1997 ended the boom. Before 1986, the share of private investment in GDP was less than 25% (Figure 1), while its average annual growth was 9%.[6] From then on, the private investment boom began and reached a peak in 1991. The share increased to 34% in 1991 and remained more or less at this level up to 1996. Its annual growth rate during this boom period averaged out at around 15%. The Asian financial crisis starting in mid-1997 affected private investment significantly and in 1999, the share of private investment in GDP dropped to 11%. This was the largest contraction in private investment over the past four decades. Even though private investment has resumed its positive growth rate since 2000, the share of private investment was still far lower than that during the boom period.

The pattern of total investment has shown to be resilient to that of private investment because public investment, as indicated by the gap between private and total investment, has remained more or less constant over the past four decades (Figure 1). It has mostly concentrated on public infrastructure rather than the business sector and sometimes, public investment was used as an instrument to counter business cycles, which may be observed by the decreased and increased shares of public investment during the periods 1988–89 and 1999–2002 (Jongwanich, 2007).

(Figure 1 about here)

A private investment slowdown tended to occur in all production sectors. Table 1 presents the share of total investment to GDP in nine sectors, namely agriculture, mining and quarrying, manufacturing, construction, ownership and dwellings, transportations and communications, wholesale and retail trade, banking, and other services. All of these significantly declined during the recent financial crisis and have shown a slow pace of recovery subsequently. The slow recovery of private investment in all sectors, rather than a specific individual sector, suggests that there would be common factors hindering such recovery.

(Table 1 about here)

Over and above the slow recovery of private investment from the financial crisis in 1997, its decomposition into new and replacement investment has raised more concerns regarding economic growth sustainability.[7] Figure 2 shows that the percentage share of replacement investment in the crisis aftermath period was somewhat close to that in the crisis period itself, but far higher than that during the boom period. It was new investment that enlarges a country’s production capacity and is more beneficial to long-term economic growth.

(Figure 2 about here)

3. THE ANALYTICAL FRAMEWORK AND THE MODEL

The determinants of private investment in this study are based on the framework of the neoclassical model (Jorgenson, 1967, 1971) with modifications, in which relevant structural features of developing countries are taken into consideration. The basic premise of the neoclassical investment model is that firms maximize utility of a consumption stream subject to a production function relating the flow of output to the flows of labour and capital services (Jorgenson, 1967, p.136). The firm supplies capital services to itself through the acquisition of investment goods. The demand for capital is therefore a derived demand. Under the Cobb-Douglas production function, the desired capital stock could be derived to positively relate to the planned output level (Y^e) and negatively relate to the expected cost of capital (C) as follows:

$$K_t^* = \alpha Y_t^e C_t^{-1} \tag{1}$$

where α is the distribution parameter

Cost of capital is composed of three components as expressed in equation (2). The first component is the interest rate, the opportunity cost that firms would receive if they sold capital goods and invested the proceeds. It is measured by the product of capital good prices $\left(Pk_t\right)$ and the nominal bank lending rate (*r*). The second component is depreciation of the capital goods, measured by δPk_t where δ is the rate of capital depreciation. The last component captures the capital gain/loss resulting from expected changes in price of capital goods, $\Delta Pk_t = \pi_t^e Pk_t$ where π_t^e is the rate of expected changes in price of capital goods. All of them are deflated by the general price (P) into real terms.

$$C_t = Pk_t \frac{r + \delta - \pi_t^e}{P} \tag{2}$$

Gross private investment (I) is defined as in equation (3);

$$I_{i,t} = \Delta K_{i,t} + \delta K_{i,t-1} \tag{3}$$

That is, gross private investment is composed of net and replacement components. The former is equal to changes in capital stock whilst the latter is taken to be proportional to the capital stock available at the previous period. It is noteworthy that in the short run where the actual stock of capital cannot reach the desired capital stock level, the private investment in equation (3) is rewritten as a function of lagged investment and adjustment coefficient as expressed in equation (4);

$$I_t = \left[1-(1-\delta)L\right]\beta K_t^* + (1-\beta)I_{t-1} \qquad (4)^8$$

where β denotes the adjustment coefficient, and L is lag operator, (e.g. $LK_{i,t}^* = K_{i,t-1}^*$).

In the long run where firms invest in order to reach the desired capital stock, the desired investment can be determined by a distributed lag of the changes in desired capital stock as follows:

$$I_t = \sum_{j=0}^{J} \beta_j \Delta K_{t-j}^* \qquad (5)$$

Substitute the desired capital stock from equation (1) to equation (5), private investment is a function of output, cost of capital, and adjustment coefficient;

$$I_t = \sum_{j=0}^{J} \beta_j \Delta \alpha Y_{t-j}^e C_{t-j}^{-1} \qquad (6)$$

As argued in previous studies β_j depends on economic and institutional factors. In the context of developing countries, these factors are as follows;

(1) Availability of Financing (PDC),

According to McKinnon (1973), Shaw (1973), Sundararajan & Thakur (1980), Blejer & Khan (1984), and Athukorala & Sen (2002), the availability of financing would be a key factor influencing investment behaviour independent of the cost of capital. Available bank credit to the private sector would perhaps tend to be quantitatively the most important variable in determining the amount of actual investment (Gertler, 1988; Hubbard, 1998) because equity markets have not been well developed and excess demand for credit typically exists. Thus, firms depend greatly on bank credit for both their working capital needs and the longer-term financing of capital accumulation. An increase in available credit to the private sector will in general encourage real private investment.

This view highlights that the inclusion of a credit constraint (PDC) as an explanatory variable in determining the adjustment of β_j is needed. This is especially relevant in Thailand where the presence of a credit crunch and its effect has been extant in the policy circle since the beginning of the crisis (Siamwalla, 2004). Nonetheless, whether it really constrains the recovery of private investment has not been studied systematically.

(2) Public Investment (GI),

It is a well-accepted proposition that in developing countries (desirable) private and public investment are related (Sundararajan & Thakur, 1980; Blejer & Khan, 1984; Athukorala & Sen, 2002). Nonetheless, its relationship can be either positive or negative, depending on the nature of public investment. When the public sector invests predominately in infrastructure, public and private investment can complement each other. Hence, the relationship between public and private investment would be positive. In addition, if there is some slackness in the economy (e.g. the onset of the crisis), an increase in public investment can encourage domestic demand expansion, inducing an expansion of private investment. On the other hand, with limited physical and financial resources, an increase in public investment can 'crowd out' private investment, thereby inducing a negative relationship.

(3) Economic Uncertainty (UC),

Economic uncertainty (*UC*) can also have an effect on the desired investment (Pindyck & Solimano, 1993; Price, 1995; Athukorala & Sen, 2002). An investment decision contains the property of irreversibility. Investment costs of setting up plants and installing equipment can be considered as sunk costs if capital, once installed, is industry specific and cannot be put to productive use in a different activity or if secondary markets are not efficient. The presence of a high degree of economic uncertainty can lead to an increase in opportunity costs — the cost of postponing or waiting for new information before deciding to invest — resulting in a reduction of (desirable) private investment. According to the previous studies, *UC* in developing countries can be measured in terms of the volatility of output growth (UC_{O}), inflation (UC_{Infla}), real exchange rate (UC_{RER}), and terms of trade (UC_{TOT}).

(4) Output Gap (*OUTG*),

Output gap (*OUTG*), the difference between actual and potential output, is used as an indicator of demand conditions in good markets. It can have a pervasive effect on private investment (Sundararajan & Thakur, 1980; Blejer & Khan, 1984). Its impact on investment is expected to be positive. When actual output is approaching its potential, this would indicate growing demand and encourage firms to expand their capacity in order to capture the increased demand. By contrast, when a country has excess capacity, i.e. there is a wider gap between actual and potential output, firms are likely to postpone their investment projects.

(5) Real Exchange Rate (*RER*).

The real exchange rate (*RER*) could also influence the desired investment level. Its impact can either promote or retard private investment. Its depreciation could lower the real income and wealth of the private sector, thereby lowering aggregate demand. A fall in domestic income and wealth could induce firms to revise their expectations of future demand and postpone their investment plan. In addition, RER depreciation could raise the real cost of imported capital goods and then adversely affect private investment. However, RER depreciation raises the price of tradable goods relative to the price of nontradable ones. Hence, this would help to stimulate investment in the tradable sector and if the positive impact on this sector outweighs the negative impact that could emerge in the nontradable sector, total investment could increase (Agènor, 2001).

On the basis of the argument discussed above, the adjustment coefficient β_j in equation (6) can be expressed as:

$$\beta_j = b_0 + \frac{1}{\Delta K_{t-j}}\left[b_1 PDC + b_2 GI + b_3 UC + b_4 OUTG + b_5 RER\right] \qquad (7)$$

For estimation purposes, the desired capital stock is approximated by the linear combination of the planned output and the real rental cost of capital, which is based on extrapolations of past value. With this assumption, substitute equation (7) into equation (6), the desired investment can be rewritten as

$$I_t^* = b_0 + \sum_{j=0}^{J}\theta_{1,j} g_{t-j}^{y} + \sum_{j=0}^{J}\theta_{2,j} g_{t-j}^{c} + \sum_{j=0}^{J}\theta_{3,j} PDC_{t-j} + \sum_{j=0}^{J}\theta_{4,j} GI_{t-j} + \sum_{j=0}^{J}\theta_{5,j} UC_{t-j} + \sum_{j=0}^{J}\theta_{6,j} OUTG_{t-j}$$

$$+\sum_{j=0}^{J}\theta_{7,j} RER_{t-j} \qquad (8)$$

By and large, the discussion so far implies the empirical model of private investment is as follows;

$$I = f\left(g^y,\ g^c,\ PDC,\ GI,\ UC, OUTG, RER\right) \qquad (9)$$

where *I* is the real private investment. The independent variables (with the expected signs are given in parentheses) are listed as follows,

g^y (+) = output growth

g^c (-) = growth of real cost of capital

PDC (+) = availability of financing

GI (+/-) = real public investment

UC (+/-) = economic uncertainty

OUTG (+) = output gap

RER (+/-) = real exchange rate

4. DATA AND VARIABLE CONSTRUCTION

Data series of investment, capital stock, and output were compiled from various issues of *National Income Account*, (National Economics and Social Development Board, Thailand). The data comprise annual readings during the period 1960–2005 at the constant price. Data related to private domestic credit, interest rates, world price, nominal exchange rates and terms of trade are compiled from *International Financial Statistics* (CD-ROM) (International Monetary Fund). In the selection and transformation of most of the data series, we have simply followed established practice in the field of research.

Total investment is measured by gross fixed capital formation (GFCF), which is further divided into private and public investment. The former covers both local and foreign owned enterprises[9], whereas the later is defined as GFCF net of private investment. Availability of financing (*PDC*) is measured by the ratio of private domestic credit to (nominal) GDP. Domestic lending rate is proxied by the MLR rate.

Even though capital markets have been increasingly important as an alternative source of funds, their use remained low and highly concentrated. The share of equity market capitalization to GDP increased from 53% in 1996 to 72% in 2005 while debt security to GDP also rose from 23% to 46% during the same period. The importance of capital markets is still far lower than that of the banking sector. The ratio of bank assets to GDP, although declining, remained higher than 100% in 2005. Compared to countries with well-developed financial markets, the ratio of both market capitalization and debt securities to GDP in Thailand was still low (Table 2). In addition, only large corporations could make use of capital markets. For example, more than 70% of total bond and long-term debt securities during 1999-2005 were issued by corporations whose assets exceed 50 billion baht, while corporations whose assets are lower than ten million baht account for only 6% (Suthiwart-narueput and Kritsophon, 2006). Thus, capital markets still play a limited role in being an alternative source of funds, especially for small and medium enterprises.

(Table 2 about here)

Price of capital goods (*Pk*) is proxied by the implicit price deflator of private investment. We cannot construct the price of capital from capital stock data because of the data limitations. Nevertheless, this would not create any major difference in our analysis because these two price deflators are highly correlated during the period 1983-2005. The general price level (*P*) is proxied by GDP deflator instead of consumer price index (CPI) to measure the price of all goods and services produced in the country. The latter measures the price of only the goods and services bought by the consumer, in which food accounted for almost 40%. This would be appropriate to reflect the cost of living. The depreciation rate (δ) is constructed by dividing the baht value of depreciation to that of capital stock.

The real exchange rate is generally defined as the ratio between world prices adjusted by exchange rate and domestic prices. World prices are the weighted average of the wholesale price indexes of major exporting countries to Thailand, using export shares during the period 2000-05 whereas domestic price is represented by the consumer price index. Export share is used on the basis of its superiority in representing a country's competitiveness than other possible weights, such as total trade share or import shares (Warr, 1986). This is the commonly used measure of real exchange rate.

The output gap (*OUTG*) is measured by the deviation of actual output (*Y*) from its estimated potential output ($\overline{Y}$). The potential output is measured by smoothing real GDP using Hodrick-Prescott's (HP) filter method (Hodrick & Prescott, 1997). While there are at least two alternatives to measure output gap, namely a linear time trend of (real) GDP and Kalman filter methods, the HP filter method is chosen, because of its better performance in terms of both explanatory and predictable power in determining private investment equations.

As mentioned above, there are four *UC*, namely volatility in output growth (UC_{O}), inflation (UC_{Infla}), real exchange rate (UC_{RER}), and terms of trade (UC_{TOT}). Three-year moving average standard deviations of change in these four variables are used to proxy the uncertainty. Nevertheless, by construction, most of them are highly collinear.[10] To redress the possibly multi-collinearity problem, our preferred alternative specification is to construct a composite variable (*UCT*) of these four variable, using the principal component procedure (PCP). In PCP, data patterns are analyzed in order to highlight their similarities and differences. Once the patterns of the data have been found, they can be compressed by reducing the number of dimensions to reveal the important information whilst simultaneously filtering out noise.

5. ECONOMETRIC PROCEDURES

In line with the standard practice in time-series econometrics, the time series properties of data were tested at the outset using the Augmented Dickey-Fuller (ADF) test. Test results are reported in Table 3. According to the results, the variables under consideration do not have the same order of integration; the output growth (g^y), the growth of cost of capital (g^c), the composite index of economic uncertainty (*UCT*), uncertainty of real exchange rates (UC_{RER}), uncertainty of inflation rates (UC_{Infla}), uncertainty of output growth (UC_O) and output gap (*OUTG*) are stationary ($I(0)$), while other variables are non-stationary ($I(1)$).The fashionable cointegration econometric procedures, such as the two-step residual-based procedure adopted by Engle & Granger (1987), and the system-based reduced rank regression approach due to Johansen (1991, 1995), that are appropriate for the variables in the system being of equal order of integration are not applicable in our case. We opted to use the 'general to specific' (unrestricted dynamic) modelling procedure (Hendry *et al*., 1984). The main advantage of this method is that it is not only able to be applied for the mixture of stationary and non-stationary data, but also for a small sample size study. In addition, recent Monte Carlo studies revealed that in the case of a finite sample, this method gives precise estimates and valid *t*-statistics, even in the presence of endogenous explanatory variables (Inder, 1993; Hendry, 1995; Pesaran *et al*., 2001).

(Table 3 about here)

The general to specific (GSM) procedure is to embed the relationship being investigated within a sufficiently complex dynamic specification, including lagged dependent and independent variables, so that a parsimonious specification of the model can be uncovered. Under this procedure, estimation begins with an autoregressive distribution lag (ARDL) specification of an appropriate lag order:

$$Y_t = \alpha + \sum_{i=1}^{m} A_i Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{m} B_{ij} X_{j,t-i} + \mu_t \qquad (10)$$

where α is a constant, Y_t is the endogenous variable, $X_{j,t}$ is the j^{th} explanatory variable and A_i and B_{ij} are the parameters.

Equation (10) can be rearranged by subtracting Y_{t-1} on both sides and turns the set of explanatory variables in terms of differences representing the short-run dynamics. The lagged levels of both dependent and explanatory variables are still left in the rearranged functional form on the right-hand-side in order to capture the long-run multiplier of the system.

$$\Delta Y_t = \alpha + \sum_{i=1}^{m-1} A_i^* \Delta Y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{m-1} B_{ij}^* \Delta X_{j,t-1} + C_0 Y_{t-m} + \sum_{j=1}^{k} C_1 X_{j,t-m} + \mu_t \qquad (11)$$

where $A_i^* = -\left[I - \sum_{i=1}^{m-1} A_i \right], B_{ij}^* = \left[\sum_{i=0}^{m-1} B_{ij} \right], C_0 = -\left[I - \sum_{i=1}^{m} A_i \right], C_1 = \left[\sum_{i=0}^{m} B_{ij} \right]$, the long-run multiplier of the system is given by $C_0^{-1} C_1$.

Equation (11) is known as the error correction mechanism (ECM) representation of the model. This is the particular formulation generally used as the 'maintained hypothesis' of the specification search. The estimation procedure involves first estimating the unrestricted equation (11), and then progressively simplifying it by restricting statistically insignificant coefficients to zero and reformulating the lag patterns, where appropriate, in terms of levels and differences to achieve orthogonality. As part of the specification search, it is necessary to check rigorously at every stage even the more general of models for possible misspecification. Such checks will involve both a visual examination of the residual from the fitted version of the model and the use of tests for serial correlation, heteroskedasticity and normality in the residual, and the appropriateness of the particular functional form used. In particular, any suggestion of autocorrelation in the residual should lead to a rethink about the form of the general model. Furthermore, the structural stability test is conducted by employing the cumulative sum of recursive residuals (CUSUM), the cumulative sum of squares of recursive residual (CUSUMSQ), and recursive coefficients and residuals. Above all, theoretical consistency must be borne in mind throughout the testing down procedure.

6. RESULTS

The final parsimonious estimate of the model, together with a set of commonly-used diagnostic statistics, and long-run elasticities computed from the steady-state solutions to the estimated equation are reported in Table 4. The equation reported here is based on the composite index of four economic uncertainty variables derived from the principle component.[11] The estimated private investment is statistically significant at the one-percent level in terms of the standard *F*-test and it performs well in terms of standard diagnostic tests for serial correlation (LM), functional form specification (RESET), normality (JBN), heteroskedasticity (ARCH), and whiteness of the regression residuals (DF). The Wu-Hausman test suggests no evidence of simultaneity for any of these variables. The cumulative sum of recursive residuals (CUSUM), the cumulative sum of squares of recursive residual (CUSUMSQ), and recursive coefficients and residuals suggest the stability of estimates.[12] According to the Chow tests for predictive failure, there is no structural break during the crisis. That is, the equation estimated for the pre-crisis period (1960–1996) has the statistical ability to forecast the dependent variable for the post-crisis periods, i.e. during the period 1997–99 (Chow 1) and 1997–2005 (Chow 2).

(Table 4 about here)

Private investment tends to positively respond to output growth (g^y) in both the short and long run. In the short run, an increase in output growth by one percentage point (e.g. 7% to 8%) leads to an increase in private investment by 2.3% in the first period and 1.2% in the following period.[13] In the long run, the impact of a percentage point increase in output growth promotes a growth rate of private investment by 26%. The relatively large impact of output growth on private investment is consistent with findings in previous studies, which are based on other developing countries (e.g. Sundarajan & Thakur (1980) on Korean and Indian experiences, Athukorala & Sen (2002) on Indian findings and Blejer & Khan (1984) on developing countries experiences).

In the short run, it was found that both estimated coefficients corresponding to the availability of financing (*PDC*) and output gap (*OUTG*) are significantly different from zero with theoretical suggested signs. An insignificance of real cost of capital (g^c) in the short run would be due to the impact of credit availability that is likely to overshadow the short-run effect of cost of capital, thereby preventing the role of the interest rate channel in determining private investment. However, in the long run, the real cost of capital is statistically significant and a one percentage point increase in this variable leads to a 1.5 percent reduction in private investment.

The presence of a high degree of economic uncertainty has a negative impact on private investment. A 1% increase in the uncertainty variable discourages private investment by 0.03% in the short run and 0.45% in the long run.[14] The statistical significance of the uncertainty variable supports the standpoint that the cost of setting up plants and installing equipment is sunk cost. Firms would prefer to postpone projects, awaiting new information before deciding to invest in the presence of a high degree of economic uncertainty, thereby resulting in a reduction of (desirable) private investment.

In the long run, public investment (*GI*) and real exchange rates (*RER*) are statistically significant. An increase in *GI* by 1% leads to an increase in private investment by 0.41%, reflecting the complementary nature of public and private investment in Thailand. Meanwhile, a 1% depreciation of *RER* (i.e. an increase in *RER*) leads to an increase in private investment in the long run by 5%. The positive and significant coefficient corresponding to *RER* would simply reflect the nature of an export-led growth economy in Thailand. The positive impact of *RER* depreciation on the tradable sector tends to outweigh the negative impact that could emerge in the nontradable sector and the overall economy. This finding would help us to gain more understanding as to why crisis-affected countries in East Asia have tried to maintain *RER* depreciation.

Note that the value of the lagged dependent variable (I(-1)) indicates the speed of adjustment of private investment to exogenous shocks. The coefficient corresponding to I(-1) is quite low (i.e. 0.10). This implies that it will take a long time to dissipate the shock in absence of policy action. According to the calculation, in Thailand, it takes approximately more than 20 years for private investment to fully adjust itself to a given shock.[15] The slow recovery reflects the irreversible nature of investment. The slow process is also found in Jongwanich (2007) where a Thai macro-econometric model is constructed. In particular, in Jongwanich (2007), private investment registers the lowest speed of adjustment, compared to other key macroeconomic variables such as consumption, exports, imports, etc. Such a slow recovery points to the demand for policy action to promote private investment.

In order to examine the key factors hindering private investment recovery, the time patterns of all estimated variables are examined together with their estimated coefficients. After the 1997-98 crisis, the availability of capital funds tends to be a key factor that hinders the recovery of private investment as PDC, which was negative during the crisis, still showed a downward trend with some years having negative values (Figure 3). With its statistically positive coefficient, the downward trend of PDC reflected its hindrance to the recovery of private investment. This was in contrast to other variables where their movements seemed to support private investment recovery, i.e. there was an upward trend of economic growth and output gap, while cost of capital, real exchange rates and economic uncertainty were kept at a relatively low level. In particular, the upward trend of *OUTG* with its value showed that production capacity tended to be fully utilised during 2000-05 so that concerns about the presence of excess capacity that would hinder the private investment recovery are limited.[16]

Some might urge that the low marginal productivity of investment measured by the ratio of capital income to capital stocks is a main cause of the investment decline. However, measuring the marginal productivity by such a ratio can not reflect accurately the impact of demand on investments (Caselli and Feyrer, 2007). Instead, it reflects the interaction outcome of demand for, and supply of, private investments. In our econometric analysis, demand side factors are better measured in terms of output growth and capacity utilization.

(Figure 3 about here)

7. CONCLUSION AND POLICY INFERENCES

The paper examines patterns and determinants of private investment in Thailand with a view to understand factors that have hindered its recovery in the post-crisis period. Private investment equations are estimated during the period 1960-2005. The empirical model is based on an extended version of neoclassical investment theory, in which relevant structural features of developing countries are taken into consideration.

The key finding is that private investment in Thailand has borne the brunt of aggregate demand contraction since the outbreak of the Asian financial crisis in 1997. More than 60% of the investment undertaken in the post-crisis period has been for replacement purposes, rather than for expanding production capacity, raising a concern for the country's long-term growth sustainability.

Our regression analysis suggests that in absence of policy action, private investment would take a long time to dissipate shocks such as the recent crisis. Among the short-run investment determinants (output growth, availability of capital funds, presence of spare capacity, RER and economic uncertainty), credit shortage was the most important constraint on investment recovery following the crisis. This would be largely due to the approach Thailand pursued in cleaning up the financial system.[17] In particular, compared to Malaysia and South Korea, Thailand tended to rely more on market forces (Athukorala, 2001). Hence, the process of restructuring/recapitalization of financial institutions in Thailand was slow and resulted in a credit market freeze. This in turn led to the sluggish investment recovery experienced during the post crisis period.

In the long run, private investment is mostly determined by business opportunities (output growth and RER) and investment costs. Through being highly concentrated on public infrastructure, government investment could have a positive impact on long-term investment in Thailand. Interestingly, the statistical significance of coefficients corresponding to economic uncertainty points to the role of governments in enhancing long-term private investment.

Two policy inferences can be drawn from this study. Firstly, while the health of financial institutions must be kept in check, the government should pay more attention towards the credit availability issue to ensure that potential and prudential investors can access credit adequately and help speed up the sluggish investment recovery. This is of importance for small and medium enterprises which rely heavily on bank financing. Secondly, long-term policy emphasis should be on promoting a conducive investment climate, especially concerning inflation and real exchange rate uncertainty. Even though changes in price levels and exchange rates to a certain extent reflect market forces acting on them, leaning against the wind of these changes could generate positive spillover in terms of generating a conducive investment climate and promoting long-term private investment.

NOTES

1. Such policy relevance is reflected in remarks by the Governor of the Fedearal Reserve Board, Ben S. Bernanke, *The Global Saving Glut and the US Current Account Deficit,* available at http://www.fedearlreserve.gov/boarddocs/speeches/2005/

2. See for example Sundarajan & Thakur (1980), Blejer & Khan (1984), Rama (1993), Oshikoya (1994), and Aizenman & Marion (1999).

3. See for example Chhibber *et al*. (1992) for seven developing countries (Chile, Colombia, Egypt, Indonesia, Morocco, Turkey and Zimbabwe) and Athukorala & Sen (2002) for India.

4. Nidhiprabha (1994) developed an investment function according to the neoclassical investment model during the period 1979-92. Nonetheless, the results are dated and subject to the inappropriate treatment of time series properties of data. The other two studies are Vines & Warr (2003) and Jongwanich (2007) whose investment functions are estimated as a part of the macro-econometric model. Only the later study, where the private investment function is determined in line with the investment function, is relevant for developing countries.

5. In Chhibber *et al*. (1992), investment function of seven developing countries are estimated separately (Chile, Colombia, Egypt, Indonesia, Morocco, Turkey and Zimbabwe) while Athukorala & Sen (2002) investigated systematically the pattern of private investment and estimated its determinants in India.

6. Caution is needed when considering the average annual growth during this period 1961-1985 because the annual growth rates in the 1960s can be affected by the low absolute value of investment.

7. To determine the new and replacement investment, the perpetual inventory method is applied. That is, total investment is a summation of changes in net private capital stock and depreciation. The former is regarded as new investment and the latter is replacement.

8. For the details of this derivation see also Blejer & Khan (1984).

9. The ideal data set would be one that distinguishes local and foreign owned enterprises because the effect of some investment determinants could have a different impact on each. In

particular, affiliates of multinational enterprises are unlikely to be affected by credit constraints. Unfortunately, the disaggregated data of private investment net of FDI are unavailable. Consequently, the findings in this study can be regarded as the lower bound of the effect of credit constraints on private investment.

10. The correlation-coefficient matrix among these four uncertainty variables (real exchange rate, inflation, terms of trade and growth) are as follows;

	RER	Inflation	Terms of trade
Inflation	0.52	1	
Terms of trade	0.34	0.82	1
Growth	0.70	0.64	0.32

11. The estimation results when four economic uncertainty variables (RER, inflation, terms of trade and output growth) are put separately are reported in Appendix I.

12. Test results are available by request to the authors.

13. $g^y = \left(\ln Y_t - \ln Y_{t-1}\right) = \ln\left(Y_t / Y_{t-1}\right) = \ln\left(1 + g_t^y\right) \approx g_t^y$ so $\partial \ln I_t / \partial \Delta Y_t = \frac{\left(\Delta I_t / I_t\right)}{\Delta g_t^y} = 25.66$. When the output grows from 4 to 5 per cent, $\Delta g_t = 0.05 - 0.04 = 0.01$.

14. Note that when four alternatives of economic uncertainty are included in the equation separately, only the coefficients corresponding to the uncertainty of real exchange rate (UC_{RER}) and inflation (UC_{Infla}) are found to be statistically significant (Appendix I). The insignificance of uncertainty variables measured by growth and terms of trade could result from the high correlation of these two variables with uncertainty measured by real exchange rate and inflation. See note 9 for more details.

15. The number of years to clear *X* percent of an exogenous shock through "automatic adjustment" alone can be computed from the formula $(1 - X) = (1 - |\hat{A}|)^T$, where $\hat{A}$ is the estimated coefficient of I_{t-1}, and *T* is the required number of years.

16. Note that the generated *OUTG* variable in this study is consistent with the time pattern of the capacity utilization index constructed by The Bank of Thailand. To compare these two series, we normalize them by their historical peak levels, i.e. we normalized the capacity utilization index of The Bank of Thailand by its 1995 level and the output gap by its 1996 level. Their correlation coefficient from 1995 to 2005 was almost 90%. Results are available by request to the authors.

17. See Siamwalla (2004) and Jongwanich (2007) for detailed discussion of a crisis-management policy package in Thailand.

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Table 1

The Share of Disaggregated Private Investment (% of GDP), 1986-2005

	1986-96	1997-99	2000-05	2001	2002	2003	2004	2005
Agriculture	1.2	1.1	0.8	0.7	0.9	0.9	0.9	1.1
Mining and Quarrying	0.5	0.2	0.2	0.2	0.2	0.2	0.3	0.3
Manufacturing	6.9	3.9	3.5	3.2	3.3	3.7	4	4.3
Construction	1.3	0.4	0.6	0.5	0.4	0.6	0.8	0.8
Ownership of Dwellings	8	2.6	3	2.5	3	3.2	3.6	3.7
Transportation and Communication	4.4	3.4	2.8	2.5	2.7	2.9	3	3.3
Wholesale and Retail Trade	3.6	1.7	1.8	1.5	1.5	1.7	2	2.1
Banking, Insurance and Real Estate	0.6	0.4	0.3	0.3	0.3	0.3	0.3	0.4
Services	3	1.6	1.6	1.5	1.5	1.6	1.7	1.7
Total	29.5	15.3	14.8	12.8	13.8	15.2	16.6	17.7

Source: National Economic and Social Development Board.

Table 2

Structure of Financial Market in Thailand in 1996 and 2005 (per cent of GDP)

	1996			2005		
	Market capitalization	Debt securities	Bank assets	Market capitalization	Debt securities	Bank assets
Thailand	53	23	156	72	46	116
Hong Kong	282	32	165	592	37	166
Japan	71	103	149	107	156	160
Singapore	165	20	114	220	59	120
USA	106	143	59	136	165	73

Source: Suthiwart-narueput and Kritsophon (2006)

Table 3
Augmented Dickey-Fuller Test for Unit Roots, 1960–2005

Variables	*t*-statistics for level Without time trend[a]	*t*-statistics for level With time trend[b]	*t*-statistics for first difference[a]
I	-1.76 (2)	-2.79 (1)	-4.24 (1)*
g^y	-3.61 (0)*	-3.79 (0)*	-6.56 (1)*
g^c	-7.39 (1)*	-7.29 (1)*	-5.10 (5)*
PDC	-1.32 (4)	-0.64 (4)	-6.23 (3)*
UC_{RER}	-4.08 (0)*	-4.83 (0)*	-8.48 (0)*
UC_{TOT}	-2.39 (0)	-2.71 (0)	-6.80 (0)*
UC_O	-3.54 (3)*	-3.53 (3)*	-7.14 (0)*
UC_{Infla}	-2.94(1)*	-3.49(1)**	-5.51(3)*
UCT	-3.52 (2)*	-3.46(1)**	-4.69 (3)*
$OUTG$	-3.71 (1)*	-3.64 (1)*	-4.55 (1)*
RER	-0.73 (4)	-4.14 (3)*	-4.39 (3)*
GI	-1.91 (1)	-4.15 (5)*	-4.23 (0)*

Notes: The t-statistic reported is the *t*-ratio on γ_1 in the below auxiliary regression, in which * and ** denote the rejection of the null hypothesis at 5 and 10 per cent level respectively.

a: $$\Delta X_t = \gamma_0 + \gamma_1 X_{t-1} + \sum_{i=1}^{p} \beta \Delta X_{t-i} + \mu_t \qquad \text{(Without time trend)}$$

b: $$\Delta X_t = \gamma_0 + \gamma_1 X_{t-1} + \sum_{i=1}^{p} \beta \Delta X_{t-i} + \gamma_3 T + \mu_t \qquad \text{(With time trend)}$$

where X is the variable under consideration, T is a time trend and μ is the disturbance term. The lag lengths (*p*) are determined by the Akaike Information Criterion (AIC) to ensure the residual whiteness. Numbers in parentheses indicate the order of augmentation selected on the basis of AIC. All variables are in logarithm formula. *ΔY*, *ΔC*, and *PDC* is measured in terms of ln(1+x).

Source: Author's estimates are based on data series discussed in the text.

Table 4
Determinants of Private Investment in Thailand: Regression Results

$$\Delta I = -1.26 + 2.33\Delta g^{y} + 1.22\Delta g^{y}(-1) + 0.08\Delta PDC - 0.03\Delta UCT + 0.99\Delta OUTG$$
$$(-2.77)^{*}\ (3.26)^{*}\ (2.82)^{*}\ (1.50)^{**}\ (-1.96)^{*}\ (1.40)^{**}$$
$$-0.10I(-1) + 2.35g^{y}(-1) - 0.14g^{c}(-1) + 0.46RER(-1) - 0.04UCT(-1) + 0.04GI(-1)$$
$$(-2.35)^{*}\ (2.56)^{*}\ (-1.22)^{***}\ (3.66)^{*}\ (-1.72)^{*}\ (1.16)^{***}$$

Long-run response of the investment rate with respect to explanatory variables

Output growth	25.7 (2.60)*
Growth of real cost of capital	-1.51 (-1.35)***
Real exchange rate	4.99 (2.07)*
Economic uncertainty	-0.45 (-1.46)**
Public investment	0.41 (1.40)**

Adjusted R^2 =0.92	*F*(13,29) = 39.44*	*RESET, F*(1,28)=1.79 (p=0.19)
LM1,F(1,28)=0.30 (p=0.59)	*LM2,F*(2,27)= 0.48 (p=0.62)	*JBN*, χ^2(2)=2.13 (p=0.34)
ARCH, F(1,41)=0.06 (p=0.81)	*DF*= - 6.99*	*Chow1, F*(3,20)=0.91 (p=0.46)
Chow2, F(9,20)=0.46 (p=0.88)		

Notes: The level of statistical significance denoted as: * = 5% , ** = 10%, and *** = 15%. All variables are measured in natural logarithms.

LM = Breusch-Godfrey serial correlation LM test
RESET = Ramsey test for functional form mis-specification
JBN = Jarque-Bera test of the normality of residuals
ARCH = Engle's autoregressive conditional heteroscedasticity test
DF = Dickey-Fuller test for residual stationarity (augmentation was not needed in terms of both the Akaike Information criterion and the Schwarz Bayesian criterion)
Chow1 = Chow test for predictive failure (the out-of-sample forecasting ability) conducted to test the ability of the equation estimated for the pre-recent crisis period (1960-1996) to forecast the dependent variable for the post crisis period (1997-99)
Chow2 = Chow test for predictive failure (the out-of-sample forecasting ability) conducted to test the ability of the equation estimated for the pre-recent crisis period (1960-1996) to forecast the dependent variable for the post crisis period (1997-2005)

[3]Two time dummy variables (i.e. D64 and D83) are introduced to capture the unusual jump (positive shocks) in private domestic credit. The corresponding coefficients are 0.16 and 0.13, respectively and statistically significant at the conventional level (e.g. 5 per cent).

Source: Author's estimates are based on data series discussed in the text.

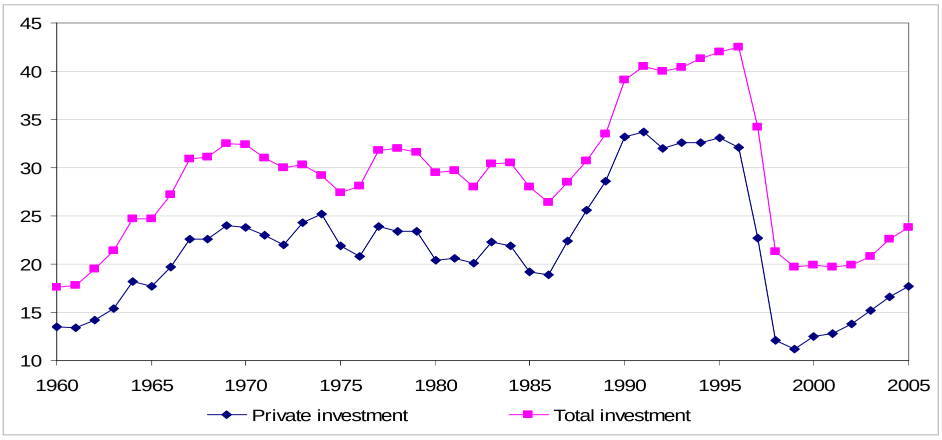

Figure 1: The Share of Gross Fixed Capital Formation to GDP in Thailand, 1960-2005
Source: The National Economic and Social Development Board.

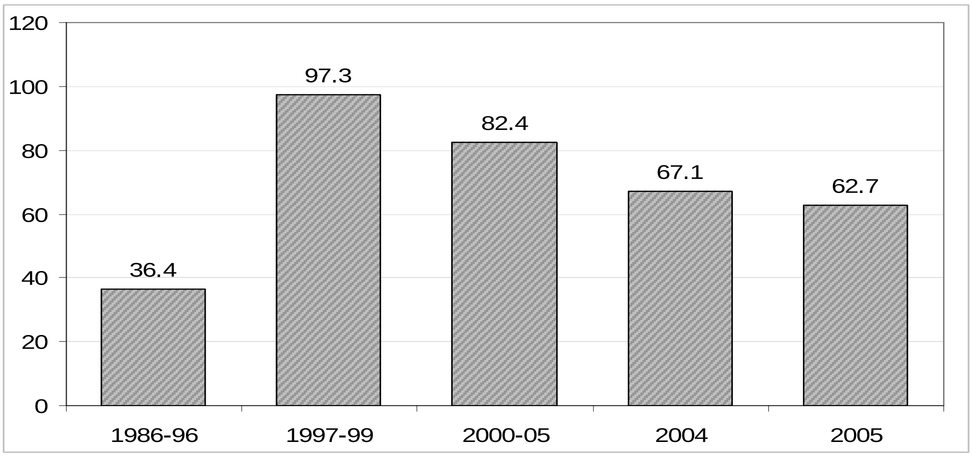

Figure 2: The Percentage Share of Replacement Investment to total Private Investment during 1986–2004
Source: The National Economic and Social Development Board.

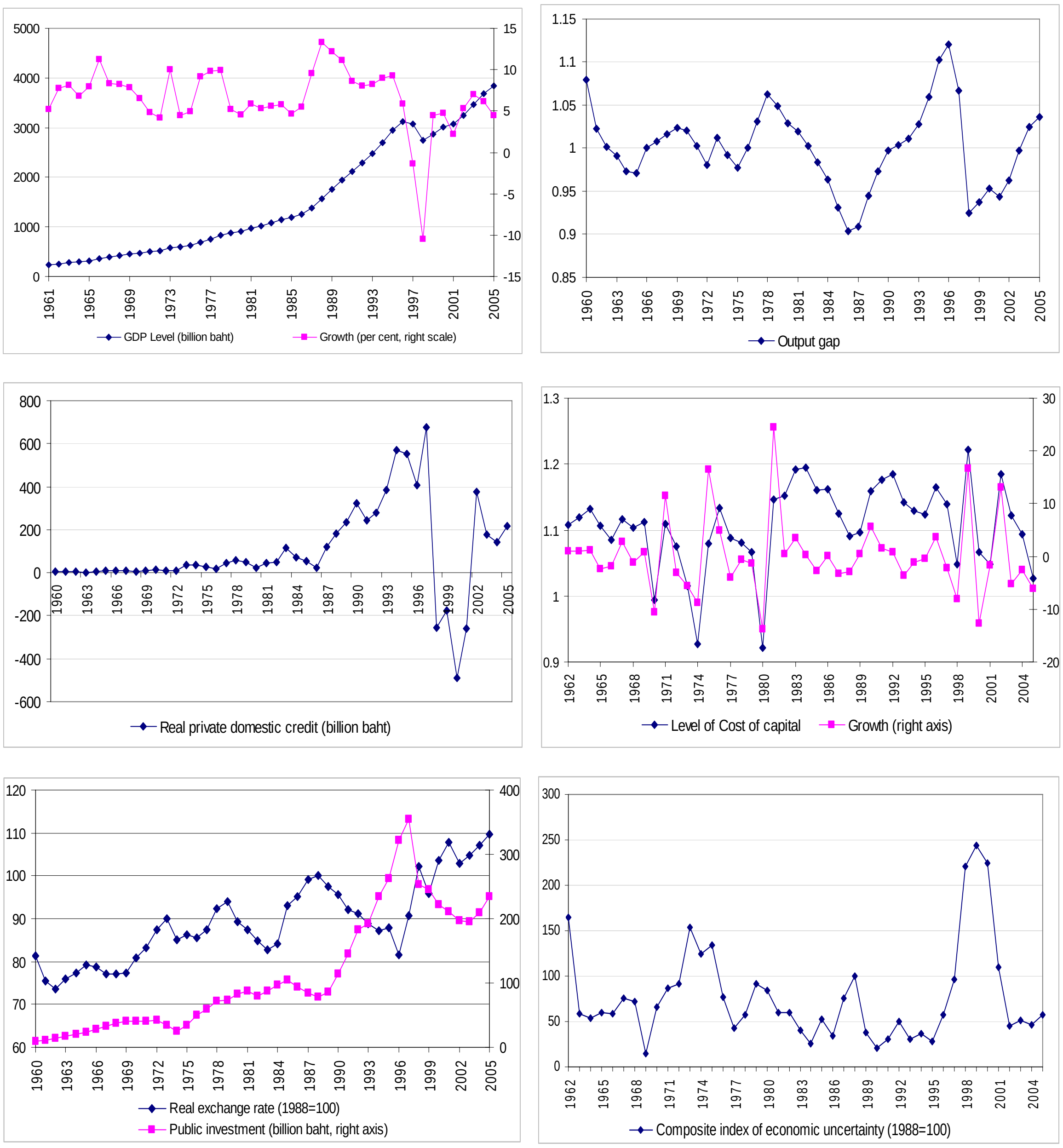

Figure 3: Time Patterns of Independent Variables, 1960-2005

Sources: The National Economic and Social Development Board, International Financial Statistics (IFS, CD ROM), IMF and author's calculation.

Appendix I

Sensitivity Analysis of Economic Uncertainty Variables on Determinants of Private Investment in Thailand: (Dependent variable = ΔI)

Variable	**Parameter (*t*-ratio)**			
Constant	**-0.59**	**-0.58**	**-0.61**	**-0.57**
	(-0.96)	(-0.85)	(-0.98)	(-0.84)
Δg^y	**2.43**	**2.38**	**2.39**	**2.42**
	(3.21)*	(3.00)*	(3.10)*	(3.11)*
Δg^y (-1)	**1.21**	**1.24**	**1.22**	**1.22**
	(2.76)*	(2.63)*	(2.74)*	(2.64)*
ΔPDC	**0.09**	**0.09**	**0.09**	**0.09**
	(1.51)**	(1.35)**	(1.54)**	(1.31)**
ΔUC_{RER}	**-0.015**	**-0.014**	**-0.014**	**-0.015**
	(-1.37)**	(-1.22)***	(-1.27)***	(-1.32)**
ΔUC_{INFLA}	**-0.02**	**-0.02**	**-0.02**	**-0.02**
	(-1.43)**	(-1.47)**	(-1.50)**	(-1.41)**
ΔUC_{OUTPUT}		**0.00096**		**0.0004**
		(0.13)		(0.097)
ΔUC_{TOT}		**0.00001**	**0.0001**	
		(0.53)	(0.54)	
$\Delta OUTG$	**1.03**	**1.05**	**1.05**	**1.04**
	(1.38)**	(1.36**	(1.38)**	(1.36)**
I(-1)	**-0.1**	**-0.1**	**-0.1**	**-0.1**
	(-2.58)*	(-2.35)*	(-2.49)*	(-2.45)*
g^y (-1)	**2.56**	**2.49**	**2.52**	**2.54**
	(2.70)*	(2.48)*	(2.62)*	(2.57)*
g^c (-1)	**-0.17**	**-0.15**	**-0.15**	**-0.17**
	(-1.41)**	(-1.10)***	(-1.11)***	(-1.38)**
RER(-1)	**0.29**	**0.29**	**0.30**	**0.29**
	(2.33)*	(2.03)*	(2.34)*	(2.02)*
UC_{INFLA}(-1)	**-0.03**	**-0.03**	**-0.03**	**-0.03**
	(-1.54)**	(-1.51)**	(-1.54)**	(-1.51)**
GI (-1)	**0.046**	**0.043**	**0.044**	**0.046**
	(1.01)***	(0.88)	(0.93)	(0.97)
D64	**0.15**	**0.15**	**0.15**	**0.15**
	(2.74)*	(2.69)*	(2.74)*	(2.69)*
D83	**0.15**	**0.16**	**0.16**	**0.15**
	(2.97)*	(2.91)*	(2.97)*	(2.90)*
N	42	42	42	42
$\bar{R}^2$	0.92	0.92	0.92	0.92
F-test	37.04*	30.38*	33.67*	33.30*
LM1, F-test	F (1, 27)=1.16	F (1, 25) = 1.90	F (1, 26) = 1.97	F (1, 26) = 1.11
	(p= 0.29)	(p= 0.18)	(p= 0.17)	(p= 0.30)
LM2, F-test	F (2, 26) =0.80	F (2, 24) = 1.61	F (2, 25) = 1.54	F (2, 25) = 0.81
	(p= 0.46)	(p= 0.22)	(p= 0.23)	(p= 0.46)
RESET,	F (1, 27)= 2.27	F (1, 25)= 3.17	F (1, 26)= 1.99	F (1, 26)= 3.54
	(p= 0.14)	(p= 0.09)	(p= 0.17)	(p= 0.07)
JBN, χ^2 (2)	1.069 (p= 0.59)	0.863 (p= 0.65)	0.872 (p= 0.65)	1.038 (p= 0.60)
ARCH,	F (1,27) = 0.39	F (1, 25) = 0.21	F (1, 26) = 0.20	F (1, 26) = 0.39
	(p= 0.53)	(p= 0.65)	(p= 0.66)	(p= 0.53)
DF	-7.36*	-7.86*	-7.86*	-7.35*

Notes: [1] The level of statistical significance denoted as: * = 5% , ** = 10%, and *** = 15%. All variables are measured in natural logarithms.

[2] Computed from the long-run (steady-state) solutions to the estimated model.

Test Statistics LM = Breusch-Godfrey serial correlation LM test
RESET = Ramsey test for functional form mis-specification
JBN = Jarque-Bera test of the normality of residuals
ARCH = Engle's autoregressive conditional heteroscedasticity test
DF = Dickey-Fuller test for residual stationarity (augmentation was not needed in terms of both the Akaike Information criterion and the Schwarz Bayesian criterion)
Two time-dummy variables (i.e. D64 and D83) aim to capture the unusual jump (positive shocks) in private domestic credit.