

**A Keynesian - Kaleckian Model of Investment Determination:  
A Panel Data Investigation.**

**By**

**Constantinos Alexiou<sup>1</sup>**

**Abstract**

The undertaken study assesses the empirical merits of the Post Keynesian doctrine as this is reflected by both the Keynesian as well as the Kaleckian theoretical approaches to investment determination. A GMM panel data methodology provides the econometric platform upon which the respective models have been tested. Annual time series data has been used, spanning from 1970 to 2005, for the G7 economies. The generated evidence confirms previous analyses in so far as capacity utilization and profits assume a key role in the determination of investment.

**Key words:** Keynes, Kalecki, Investment modelling, Panel data.

**JEL Classification :** E12; E13

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<sup>1</sup> Constantinos Alexiou, Assistant Professor, Department of Urban-Regional Planning and Development Engineering, Polytechnic School, Aristotle University, Thessaloniki, Greece; Tel. +302310700617, email: [calexio@plandevel.auth.gr](mailto:calexio@plandevel.auth.gr); [alexio07@otenet.gr](mailto:alexio07@otenet.gr).

## **1.0 Introduction**

The dominant assumption permeating the neo-classical and other orthodox economic theories is that investment is undertaken by well-informed profit maximizing agents. These agents apparently behave in a rather predetermined manner unfettered by any signs of uncertainty pervading the market environment within which they operate.

More specifically, according to the orthodox dogma uncertainty can be measured in terms of risk probability within the macroeconomic environment which is a reflection of the micro-behaviour of individuals and firms (Friedman 1953); Hahn, (1973, 1985). The resulting dogmatic interpretation of economic fluctuation can thus easily be formulated through technical mathematical expressions in a rather coherent and logical way.

In stark contrast, Post Keynesians challenge the neoclassical approach by seeing the real world characterized by more complicated axioms and therefore any conclusions based on the orthodox tradition might very well be invalidated. For Post Keynesians entrepreneurs are far from rational profit maximizing entities while uncertainty assumes a focal point that should be treated with caution.

This study purports to assess the relative empirical merits of the Post Keynesian school of thought as this is reflected by both the Keynesian as well Kaleckian theoretical frameworks of investment activity.

The rest of the study is organized as follows: Section 2 touches on the theoretical considerations of investment activity inherent in the Post Keynesian tradition. In section 3 by considering a string of factors envisaged to determine investment we formulate the model to be estimated in the subsequent subsections where the econometric methodology and the estimation results are presented. Finally, section 4 concludes.

## **2.0 Theoretical considerations.**

In his effort to explain the inability of the capitalist system to achieve full employment, Keynes (1936) by linking the micro-foundations of the neoclassical (Marshallian) theory i.e. the marginal efficiency of capital principle (MEC, hereafter). According to his analysis MEC in relation to business cycles refers to the volatile shifting of the MEC schedule due to uncertainty. The formation of uncertain long-term expectations precipitates volatile investment behaviour.

Despite the fact that Kalecki embraced the Keynesian conceptual framework of the role of investment in determining the flow of saving (or profits), he was rather critical of the MEC analysis 'rejecting the implied rising marginal cost curve of capital goods industries and recognising that higher capital goods prices only relate to *ex post* investment when the MEC is supposed to deal with *ex ante* decisions of investment' (Courvisanos, 1996a, p.160).

Within the neoclassical investment framework we distinguish between the user cost of capital and the *q* theory approaches<sup>1</sup>. Dornbusch and Fisher, (1984) and Sawyer (1982) argue that the cost of capital model is generally bound up with the way investment fluctuates in various economies<sup>2</sup>. In an attempt to explain aggregate investment using *q* theory analysis McKibbin and Siegloff (1988) generated evidence suggesting that only 10 percent of the predicted investment is explained by *q* theory while the rest 90 percent are explained by the profit theory in non-optimizing behaviour. The fact that numerous investment empirical studies have produced mixed results might well be ascribed to the oversimplifying assumptions of the rational behaviour of optimizing agents.

In the Post Keynesian tradition rational behaviour is the result of painstaking deliberations rather than the outcome of mathematical processes. Emphasis is placed on the impact of uncertainty in a “non-ergodic” world. Given the close ties between the Keynesian school of thought and the Post Keynesian doctrine many studies have attempted to assess the Keynesian belief in relation to the psychological factors and the ensuing profound impact of the latter on rational behaviour. Unfortunately, the underlying theoretical model implied by Keynes has proven to be rather complex.

Nevertheless different clusters of economists within the womb of Post Keynesianism have been formed in relation to the investor’s capacity to behave rationally. Amongst others Bateman (1990); Dow and Dow (1985); Gerrard (1992) Littleboy (1990); Meeks (1991); O’Donnell (1989) and Skidelsky (1992) share the belief that there is a continuity in the development of Keynes’s perception of rationality in his early works as expressed in the *Treatise on Probability* and his later beliefs as elucidated in *The General Theory*. On a different note, Mini (1990), Shackle (1972), and Winslow (1986) sustain that Keynes’s work presents the irrationality and destructiveness reflected by the subjectivism of economic behaviour.

According to Keynes’ (1936) and Schumpeter (1939) ‘animal spirits’ and ‘innovation’ should be internalized into firm’s behaviour<sup>3</sup>. In the same spirit, Courvisanos’ (1996a) in a rather articulate manner sustains that factors relating to firm’s behaviour should be vigorously analysed in a behavioural model incorporating microeconomic institutional elements.

In addition, alternative views on the interpretation of rational calculation and ‘animal spirits’ in the General Theory are expressed by a number of scholars who sustain that both are determined by sensible expectations and convention rather than irrational or rational ones (see for example, Crotty (1992), Davidson (1991a), Lawson (1981,

1985, 1995), Littleboy (1990), Minsky (1975, 1986), Robinson (1979). More specifically, Littleboy, (1990, p.34) argues that ‘conventional behaviour lies between two extremes, the fully rational and the fully irrational while Robinson (1979) looks upon Keynesian conventions as non-rational.

Recently, the inherent interaction of financial markets and investment has caused a wave of new research studies to emerge. Arguably, the bulk of the explorative research done on investment by the proponents of the mainstream tradition is based on the assumption that firm’s ability to obtain financing is contingent upon the profitability of the prospective investment project, i.e. the project is appraised at a cost of capital based on market interest rates.

Contrary to the conventional wisdom, novel theoretical frameworks have been proposed by academics in an attempt to capture the impact of an inherent feature of the financial world, namely ‘*finance constraints*’. According to the theoretical underpinnings of the ‘*finance constraints*’ concept, limited access to finance is an additional factor that will adversely affect investment (Fazzari, 1988; Fazzari and Petersen, 1993).

For a firm seeking sufficient external funds, (rather than internal ones), to finance an investment project might be rather costly for a number of reasons. The transactions costs involved when seeking external finance are rather substantial due in the main to the fact that financial intermediaries must cover their own costs and make profit on the deal (Fazzari, Hubbard and Petersen, 1988).

Further problems for firms in need of finance may arise from asymmetric information as well as the financial condition of the firm (Fazzari, 1993). Potentially, the ability of a firm to either internally or externally finance an investment project has significant ramifications in relation to the channels through which accelerator effects operate. In

particular, the underlying close association of fluctuations of internal finance, profits and business cycles suggest that periods of extensive recessions would increase the cost as well as the external credit that firms can obtain<sup>4</sup>. According to Fazzari (1993) ‘the impact of fiscal policy on the course of business cycle may be a much more important channel of influence for investment than effects that work through the cost of capital’ (p.19). It is therefore imperative that appropriate economic policies are in place to both effectively create and contain the business cycle.

On a slightly different note Courvisanos (1996b) developed a ‘susceptibility cycle model’ in an attempt to gain further insight into the patterns of investment behaviour<sup>5</sup>. According to his approach, the key Kaleckian variables - profits, increasing risk, and excess capacity – act as a catalyst in influencing the decision making process of investment activity. More specifically, as investment activity picks up tensions build up to such an extent that investment is susceptible to a collapse (Courvisanos 2007). High susceptibility is in effect identified with decreasing profit rates, increasing finance costs and dwindling utilization rates. Having thus reached the lower point of the downturn, firms will subsequently seek to expand investment, the prospect of which will to a large extent depend on the firm’s exposure to risk and uncertainty. Empirical evidence on the susceptibility cycles hypothesis can be found in Courvisanos (1996b) and Laramie *et al.* (2004).

### 2.1 Money and finance: A Post Keynesian perspective.

Apart from trying to merely interpret key Keynesian concepts Post Keynesians have taken a step further attempting to refine for instance Keynes’ analysis of the importance of money and finance in a world of uncertainty that conditions investment

decisions. Such an effort provides an alternative to Modigliani-Miller assumption according to which in a world of perfect capital markets, the cost of different forms of financing will be the same for all firms in a given risk category.

In contrast, within the Post Keynesian tradition money plays an instrumental role in an uncertain environment. In particular, money affects investment decisions in the following two ways: through interest rates as these are determined by the demand for money (liquidity preferences) and supply of money, as well as via the business or the finance motive (Davidson 1965). The latter in the Keynesian analysis is thought to serve as a component of transactions demand for money. According to this analysis, capitalists' command over money is conditioned not only by business confidence but by the willingness of banks to lend money as well i.e. the state of credit. In effect, any financial turbulence that precipitates economic austerity will cause financial institutions to curb their lending to potential entrepreneurs. What is even more interesting in their analysis is the notion that while business confidence or state of credit is sufficient to derail economic activity, getting out of the slump requires that both business confidence and state of credit recover substantially.

In a nutshell, Post Keynesians consider finance to be a very significant factor that affects investor's decisions and the supply and price of money to be endogenously determined. The implication of such a notion is that capitalist economies are characterized by inherent instability as uncertainty affecting one sector can spread so easily through the macro economy.

According to Harcourt and Sardoni (1995) imbalances between finance capital and industrial capital can be sources of uncertainty. Thereby, the endogenous determination of money supply in conjunction with the prospect of instability will

cause liquidity in the private sector to decrease deteriorating thus the environment within which investment opportunities can be exploited (Davidson (1978)).

## 2.2 Kalecki on profits.

It is widely held that Kalecki's main theoretical exposition was akin to that of Keynes. More specifically, Kalecki (1943) argued that profits is a significant variable that affect capital accumulation. He was swift to assert however that the underlying relationship is rather complex due in the main to the existing bidirectional feedback from capital accumulation to profits and vice versa. Profits will finance investment but actual investment expenditure will cause capital stock to increase (i.e. capital accumulation) creating thus expected profits to be reaped in the future. Robinson (1964) by elaborating on these ideas developed a conceptual framework on the basis of which the double-sided relationship does exist but this relationship is far from stable. She went on to argue that the underlying relationship changes all the time because of volatile animal spirits.

In an attempt to explicitly illustrate the way profits and savings are intertwined to investment decisions Kalecki (1943) devised a formula on the basis of which the rate of investment is increasing in gross corporate savings, decreasing in the rate of change of capital stock and increasing in the rate of change in profits. The mathematical expression of the above is envisaged as follows:

$$\Delta I = aS + \beta \frac{\Delta \Pi}{\Delta t} - \gamma \frac{\Delta K}{\Delta t} + dt \quad (1)$$

where  $\Delta I$  denotes rate of investment,  $S$  is gross savings,  $\Delta \Pi / \Delta t$  is the rate of change in profits,  $\Delta K / \Delta t$  is the rate of change in capital stock and  $dt$  is a deterministic trend.

The way equation (1) has been articulated reflects the belief that investment decisions are heavily constrained by finance. According to Kalecki (1937) the principle of increasing risk is inextricably linked to economic booms. More specifically, economic booms are accompanied by increasing investment activity, economic growth, and dwindling unemployment. At the same time however, financing fixed investment will eventually cause debt to build up rendering it thus unsustainable. In view of the latter, lenders will start increasing the risk premia they attach to their lending rates which in turn will chock off investment. It is for this reason why Kalecki (1937) held that firms would be exposed to less risk if they used their own corporate saving generated from the profit variable as source of financing their investments.

In the same line of argument, Mahdavi, Sohrabian and Kholdy (1994) argue that internal funds play a far more significant role than external funds. Internal funds have the ability to increase investment activity by regenerating more funds as well as serve as a cushion when economic conditions deteriorate. An increase in the debt to equity ratio will cause lender's and borrower's risk to increase which in turn will precipitate an increase in the discount rate and thus a dwindling demand price of capital. In a similar fashion the increased risk will cause the cost of borrowing to follow suit as well.

Minsky, (1986) by drawing on the Kaleckian principle of increasing risk, looks upon endogenous money as well as finance as being the major culprits for bubbles and crises. His contention stems from the fact that the banking system can boost investment through its ability to create money. He goes on to add that due to its inability to provide a sound reasoning of the role of endogenous money in capitalist economies, conventional theory is unable to explain financial crisis. By building on

Keynes' approach, Minsky (1986) regards the state of credit as well as the state of confidence as two factors that play an instrumental role in influencing financial investment decisions. From his perspective, particular attention should be paid to the way profits and investment are linked with one another i.e. the existence of a bidirectional relationship between the two variables. In particular, current investment which determines business' ability to finance their debts in the future will generate profits through augmenting capital stock. It should also be noted in passing that it is expectations of future profits that makes debt financing possible but these future profits will only materialize should investment continues in the foreseeable future. Effective demand is therefore a key component of the entire process.

### **3.0 Modelling investment activity**

Prior to devising models of real world investment activity it is imperative that we have a clear view as to the nature of uncertainty that we want to consider. In the neoclassical literature uncertainty is reclassified as risk, calculating afterwards the probability. As far as aggregate uncertainty is concerned however, the story is somewhat different as it is very difficult to incorporate into the fundamentals of micro-foundations of neoclassical theory.

Contrary to the conventional wisdom Keynesian and Post Keynesian theories have always treated uncertainty – in so far as this is communicated through financial and speculative channels - with caution as this can be a destabilizing factor for economic and particularly investment activity. The destabilizing effects of a volatile environment in conjunction with the state of confidence, can be pernicious to investment.

According to Keynes (1936, 1937) the MEC is a variable with the utmost importance in the determination of investment. Given the profound impact of expectation and the state of confidence on the MEC one can confidently deduct that both subjective as well as objective factors should be taken into account when modelling investment activity. If for instance, pessimism about prospective yields sets in then the propensity to save will increase and *vice versa*. As a result, the entire capitalist economic edifice will be far from self equilibrating irrespective of any neoclassical remedies to redress the balance.

In the sketch of the above arguments, Post Keynesian investment analysis focuses predominantly on the role of uncertainty, the attitude towards money, conventional behaviour, and the instrumental role of the availability of finance.

### *3.1 Econometric methodology*

In our attempt to craft a model that comprises elements of post Keynesian insights we have arrived at the following specification (*letters in italics denote natural logarithms*).

$$i_t = \alpha_0 + \alpha_1 \pi_{t-1} + \alpha_2 k_{t-1} + \alpha_3 y_{t-1} + \alpha_4 cu_{t-1} \quad (2)$$

where  $i$  is investment,  $\pi$  is profit,  $k$  is capital stock, and  $y$  is output. Cyclical factors are captured by capacity utilization  $cu$ , (proxied by actual/potential output).

Prior to estimating our model it is imperative that the series are checked for stationarity. In doing so both ADF and a panel unit root testing approach proposed by Im, Pesaran and Sin (2003), IPS thereafter, have been used.

The IPS test instead of pooling the data uses separate unit root tests for the N cross-section units. By modifying Levin and Lin's (1993) framework they consider a model, in which the coefficient of the lagged dependent variable is homogeneous

across all units of the panel, i.e.  $\Delta y_{i,t} = \alpha_i + \theta y_{i,t-1} + \sum_{z=1}^{p_i} \beta_{i,z} \Delta y_{i,t-z} + \varepsilon_{i,t}$ , they substituted

$\theta_i$  for  $\theta$  arriving thus at a model consisting individual effects and no time trend.

$$\Delta y_{i,t} = \alpha_i + \theta_i y_{i,t-1} + \sum_{z=1}^{p_i} \beta_{i,z} \Delta y_{i,t-z} + \varepsilon_{i,t} \quad (3)$$

The respective null and alternative hypotheses are envisaged as follows<sup>5</sup>:  $H_0: \theta_i = 0$  for all  $i = 1, \dots, N$ ;  $H_A: \theta_i < 0$  for all  $i = 1, \dots, N_1$  and  $\theta_i = 0$  for all  $i = N_1 + 1, \dots, N$ , with  $0 < N_1 \leq N$ . The IPS test is based on the ADF statistics averaged across groups<sup>6</sup>.

The IPS statistic is given as:  $\bar{z} = \sqrt{N}[\bar{t} - E(\bar{t})]/\sqrt{Var(\bar{t})}$ . By letting  $t_{iT}(p_i, \beta_i)$  with  $\beta_i = (\beta_{i,1}, \dots, \beta_{i,p_i})$  the test is expressed in the following manner:

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^N t_{iT}(p_i, \beta_i) \quad (4)$$

The critical values generated by Im, Pesaran and Sin (2003) are based on stochastic simulations. They also show that as the number of countries and the number of observations tends to infinity the t-bar statistic converges to a standard normal distribution.

For the empirical investigation a Generalized-Method-of-Moments (GMM) approach has been adopted. In spite of the growing concern of potential heterogeneity among the cross-sectional units when performing pooled data analysis, proponents of the homogeneous panel sustain that gains from pooling outweigh any costs. In contrast, a number of scholars, for example, Robertson and Symons (1992), Pesaran and Smith (1995), and Pesaran, Smith and Im (1996) dismiss pooling the data across heterogeneous units on the grounds that heterogeneous estimates can be combined to obtain homogeneous estimates. More specifically, Pesaran and Smith (1995) argue that the inherent parameter heterogeneity of panels makes the homogeneous assumption redundant and therefore the average from individual regressions should be

used instead. Maddala, Srivastava and Li (1994) and Maddala et al. (1997) on the other hand, are very much in favor of estimators that shrink the heterogeneous estimators towards the pooled homogeneous estimator. It is worth noting however, that the recent development of a number of heterogeneous estimators, relatively little is known as to how effective those are<sup>7</sup>.

Even though the scope of this study is far from elaborating on the very sophisticated theoretical arguments as to which is the most plausible estimator, two different approaches have been used to gauge the robustness of our results. We set off with the standard pooled estimators i.e. OLS, which ignores the country effects; the within estimator where heterogeneity between cross-section units or time periods is captured by individual or time specific intercepts and GLS, which assumes that country effects are random; we then proceed with the random coefficient (RC) regression estimator (i.e. a weighted average of the least squares estimates where the weights are inversely proportional to their variance-covariance matrices) proposed by Swamy (1970).

The data set used for the estimation of the model consists of  $N$  cross-sectional units, denoted  $i = 1, \dots, N$ , observed at each of  $T$  time periods, denoted  $t = 1, \dots, T$ . In this context, annual data for the group of the seven of the largest world economies (Canada, France, Germany, Italy, Japan, United Kingdom, and the United States) that span from 1972 to 2005 has been used. OECD, the Federal Reserve and the World Bank, were the main data providers.

The generalized regression model provides our basic framework:

$$y_{it} = \alpha_i + \beta_i' x_{it} + \varepsilon_{it} \quad (5)$$

$$\varepsilon_{it} \sim i.i.d. (0, \sigma_i^2).$$

where  $\alpha_i$  is a scalar, and  $\beta_i$  is a  $(k \times 1)$  vector of slope coefficients. The underlying assumptions are: Similar variances among banks, i.e.  $\sigma_i^2 = \sigma_\varepsilon^2 \quad \forall i$  and zero covariances among banks, i.e.  $Cov(\varepsilon_{it}, \varepsilon_{js}) = 0$  for  $i \neq j$ .

In our context, consider the following regression equation:

$$i_{it} = \alpha_i + \beta' x_{it} + \varepsilon_{it} \quad (6)$$

where  $i$  is gross investment,  $x$  denotes the set of explanatory variables.

Time dummies have also been used to account for period-specific effects, though these are omitted from the equations in the text.

### 3.2 Results

On the basis of the ADF and IPS unit root tests reported in Table 2 in appendix, the null hypothesis of unit root is rejected at various significance levels of the tests, i.e. 1%, 5% and 10%. All variables should therefore be treated as  $I(0)$  processes and therefore no need for further i.e. cointegration, investigation is needed.

During the econometric investigation several specifications were estimated. On the basis of the selection criteria (Schwarz (*S.I.C*) and Akaike (*A.I.C*) Information criteria) as well as the tests (*F-test*, *Hausman-test*) that were conducted to determine the most coherent model, the fixed effects (FE) model is preferred to both the pooled model as well as to the random effects one. What follows, is the presentation of the standard FE estimates, and the random coefficients estimates<sup>8</sup>.

**Table 1. Dependent variable:  $i$** 

<b>Fixed Effects model (<math>R^2 = 0.62</math>)</b>				
Variables	$\pi_{t-1}$	$k_{t-1}$	$y_{t-1}$	$cu_{t-1}$
Coefficients	0.362(2.87)*	0.241(3.67)*	0.253(4.77)*	0.343(2.01)*
<b>Random Coefficients model (<math>R^2 = 0.61</math>)</b>				
Variables	$\pi_{t-1}$	$k_{t-1}$	$y_{t-1}$	$cu_{t-1}$
Coefficients	0.371(2.93)*	0.247(3.59)*	0.211(4.71)*	0.352(1.91)**

Notes: (\*) and (\*\*) denote significant test at the 5% and 10% level of significance respectively; t-statistics are given in parentheses; Sargan test: [p-value = 0.64] (The null hypothesis is that the instruments are not correlated with the residuals); Fixed effects: AIC -2.43; SIC -2.49; Random effects AIC -2.40; SIC -2.97; F-test = 17.32; p-value: [0.00]; Hausman-test : 20.67, p-value: [0.00].

In view of the evidence yielded, both models appear to be well specified. More specifically the high  $R^2$  of all estimated models suggests that a relatively significant proportion of the variation in the dependent variable is well explained by variations in the independent ones. All variables are significant at the 5 per cent level bearing the expected signs apart from capacity utilization in the random coefficients model which is significant at the 10 percent significance level. In so far as the model is log linear the estimated coefficients approximate elasticities. Given the latter, the results can be interpreted as follows: a 1% increase in profit will cause gross investment to go up by about 0.36 percent. Similarly, a 1% increase in the capital stock and GDP will cause gross investment to go up by about 0.24 and 0.25 percent respectively. Finally, the variable reflecting the cyclical factors in the model (i.e. capacity utilization) appears to be playing an instrumental role in affecting positively investment activity. Such a finding even though appears to be akin to those obtained by Coen (1969), Eisner and Nadiri (1968), Bean (1981) stands at stark contrast to that obtained by Baddeley (2003).

#### **4.0 Conclusions**

Within the Post Keynesian tradition uncertainty, profits and finance are the key variables that affect investment decisions. The endogenous nature of money in conjunction with profits, render any capitalist economic system unstable prone to wide economic fluctuations.

The results obtained suggests that the models estimated in this study have merits i.e. confirming previous analyses on the importance of capital stock, GDP, capacity utilization and profits as key variables when modelling investment. It is therefore imperative, that policy makers, at least in the scrutinized economies, try and adopt policies geared towards boosting aggregate demand stimulating thus economic activity. Creating an environment conducive to capital growth and healthy entrepreneurial activity will ensure that the economies move out of periods of prolonged stagnation.

In view of the resulting inefficiency of the markets and the inadequate volume of investment activity, the government is thought to assume a key role in moderating uncertainty as well as in creating an environment conducive to boosting investment activity.

## NOTES

<sup>1</sup> For more on both approaches see Jorgenson (1963) and Tobin (1969).

<sup>2</sup> In a more recent study Alexiou (2009) reconsiders the theoretical underpinnings of the accelerator and Jorgenson's models by providing new empirical evidence on the economic ramifications that the underlying theories imply. On the basis of the initial estimation of the unrestricted models it transpired that the accelerator models outperformed the neoclassical ones.

<sup>3</sup> Both factors were thought to be exogenously affecting investment fluctuations (Samuelson, 1980).

<sup>4</sup> As investment spending rises, lenders are less willing to provide funds for marginal investment projects (Fazzari and Papadimitriou, (1992). As the cost of external finance goes up the supply price follows suit (Fazzari and Mott, 1986).

<sup>5</sup> According to the IPS test when individual effects and deterministic trends are included the null hypothesis of a unit root in all panels is occasionally strongly rejected.

<sup>6</sup> The results of the individual ADF unit root tests have been intentionally left out for economy of space.

<sup>7</sup> For an extensive analysis on applications of random coefficient models see Swamy and Tavlak, (1995).

<sup>8</sup> For economy of space we opted for presenting only the most plausible estimates. As a result the pooled and the random effects estimates have been left out intentionally. We do provide however the respective tests that took place during the model selection process.

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## APPENDIX

**Table 2.** Country by country (ADF tests) and IPS panel unit root tests

	$i$	$\pi$	$k$	$y$	$cu$
Canada	-3.275(0)	-4.932(0)	-3.621(0)	-3.226(1)	-4.872(0)
France	-3.654(1)	-5.637(0)	-3.461(1)	-3.381(0)	-3.981(0)
Germany	-4.733(1)	-3.782(1)	-3.289(1)	-3.542(0)	-4.231(1)
Italy	-3.871(1)	-3.682(0)	-4.121(0)	-2.987(0)	-3.621(1)
Japan	-4.218(0)	-4.211(0)	-3.311(1)	-3.391(1)	-3.912(1)
UK	-3.326(1)	-4.832(1)	-3.128(1)	-3.861(0)	-4.782(1)
USA	-3.247(1)	-5.345(1)	-3.451(1)	-4.274(1)	-4.467(1)
<i>Panel tests</i>	-2.216	-3.623	-1.972	-1.673	-2.871

Notes: Lags are given in parenthesis. For the ADF tests the critical values are -4.316, -3.572 and -3.223 for the 1%, 5% and 10% level of significance, respectively; For the panel test the critical values are -2.326, -1.645 and -1.282, respectively.

## DATA APPENDIX

### Definition of variables

$i$  : gross fixed capital formation  
 $\pi$  : profit rate  
 $k$  : capital stock  
 $y$  : Gross Domestic Product  
 $cu$  : capacity utilization (proxied by actual/potential output)