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THE END OF FINANCIAL REPRESSION? A CROSS-COUNTRY ANALYSIS OF INVESTMENT

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Abstract

We estimate a model of investment under financial restrains due to Demetriades and Devereux (2000), using total and private aggregate investment data from 38 high income and low income countries during 1972-2002. Our main findings for the overall sample are that (i) the US real interest rate is a robust determinant of total investment, suggesting that US monetary policy may have unintended global consequences; (ii) a term proxying domestic financial restraints is found to have an insignificant impact both on total and private investment. These findings are, however, somewhat less conclusive when we examine low income countries on their own, where financial restraints are found to have a negative and marginally significant effect on total investment.

Keywords: financial restraints, investment, dynamic panel data
JEL Classification: O16, G18, G28

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1 Introduction

In the early 1970s, McKinnon (1973) and Shaw (1973) put forward the idea that financial repression – i.e. government imposed controls on lending and deposit rates, capital controls, and directed credit - had a negative impact on investment and growth in developing countries by suppressing domestic saving and distorting the allocation of credit. While their views were vigorously challenged by a range of critics[1], their main policy recommendation, namely financial liberalisation gained momentum among policy makers in developing countries. As a result, the last forty years have witnessed a gradual removal of financial restraints worldwide with increased movement of capital around the globe.[2] Both these developments are likely to influence the behaviour of investment. Increased international capital flows combined with a decline in subsidised, albeit rationed, loans may result in a relaxation of borrowing constraints faced by firms that did not have access to cheap loans. At the same time, the price of credit for firms that enjoyed access to cheap domestic loans may rise, making their investment plans more sensitive to market interest rates and less sensitive to the quantity of -previously rationed- credit. In a world in which borrowing constraints matter less for all firms, the price of credit will matter more. In such a world, we would, therefore, expect to see that at the aggregate level financial restraints play little role in determining investment while the market price of credit plays a much greater role. This paper provides evidence which suggests that both these developments are already in place. Moreover, it also provides evidence which suggests that the relevant market price of credit is the one prevailing on world capital markets. Specifically, it shows that the US interest rate has a negative and significant effect on investment in 38 countries worldwide while domestic interest rates prevailing in those countries are generally not significant. This result, which implies that US monetary policy may have unintended global consequences, is robust to a variety of checks, including the inclusion of the US growth rate which should filter out the effects of US aggregate demand on other countries.

We utilise a theoretical model of investment which assumes that firms have access to

[1] See for example, Arestis and Demetriades (1999), Diaz-Alejandro (1985), Hellman, Murdock and Stiglitz (2000), Singh (1997), Stiglitz (1994), Taylor (1983), Van Wijnbergen (1983).

[2] Abiad and Mody (2005) document the gradual reduction of financial restraints around the world while Lane and Milessi-Ferretti (2005) document the increase in financial openness.

quantity-constrained domestic loans that are cheaper than those they can obtain from international capital markets.[3] This recognises the stylised fact that increased international capital flows have relaxed borrowing constraints for many firms while at the same time some firms may have continued to benefit from access to cheaper policy loans. Firms may borrow on the domestic market at a lower interest rate than the one prevailing on the world capital market but are quantity-constrained in that market because the domestic banking system is unable to satisfy the total demand for credit. Firms, however, may have access to finance on the world capital market, albeit at a higher lending rate.

We estimate the investment model using recently developed panel procedures that take into account the time-series properties of the data, namely panel cointegration and mean-group estimation methods. These techniques, which allow for parameter heterogeneity across countries, enable us to examine the long-run determinants of aggregate investment in 38 countries during the period 1972-2002. These procedures are more powerful than individual country cointegration tests and also allow generalised conclusions to be drawn for broad groups of countries. Moreover, they overcome the inconsistency problem present in conventional panel estimation that does not take into account the time series properties of the data and heterogeneous dynamics across countries (see Pesaran *et al.*,1995).[4]

The paper is organised as follows. The next section sets out the model of investment under financial restraints. Section 3 outines the three versions of the empirical model that we estimate and presents the econometric methodology. Section 4 presents and discusses the data and main empirical findings, including robustness checks. Finally, Section 5 summarises and concludes.

2 Investment under Financial Restraints

The dynamic investment equations estimated in this paper are based on the theoretical model put forward by Demetriades and Devereux (2000), henceforth D&D. Their approach

[3] The model is based on Demetriades and Devereux (2000).

[4] This problem is even more serious in dynamic panel data, when it is shown that the pooled estimators remain inconsistent even if both the time and cross-section dimensions are allowed to increase within bounds. In sharp contrast, the mean group estimator that we utilise provides quite precise estimates of the long-run effects in the presence of heterogeneity even for quite small panels (e.g. $N = T = 20$).

is preferable over empirical studies of investment which take an 'eclectic' view of investment, a euphemism for including variables suggested by alternative theories without a single underlying structural model. In contrast, D&D use a microeconomic model of a representative firm's investment decision under financial restraints as their starting point. The model suggests a structural relationship between the optimal capital stock and the 'modified' cost of capital, which is then used to derive a long-run theory consistent aggregate investment equation that takes into account the presence of financial restraints. The rest of this section provides a brief outline of the D&D approach.

The main assumption of D&D is that the official banking system is unable to satisfy the entire demand for investible funds because of the presence of an interest rate ceiling, which restricts the supply of funds à la McKinnon-Shaw (see also Fry, 1994). The model departs from the McKinnon–Shaw tradition, however, in that it assumes the existence of an 'alternative' financial market in which firms can borrow freely, albeit at an interest rate that is higher than the official lending rate. Their interpretation of the alternative market is that it is the world capital market although it could also be interpreted as the unofficial credit market also known as 'curb' market (see Taylor, 1983 and Van Wijnebergen, 1983). There are theoretical and empirical reasons for us also preferring the first interpretation to the second, not least the stylised facts relating to the increased international capital flows alluded to in the introduction. Thus, we assume that firms have access to two types of borrowing: domestic bank borrowing and international loans. Rationing of domestic loans to different firms is assumed to depend on the availability of collateral, which is related to the firm's capital stock.

The representative firm j is assumed to maximise the wealth of its shareholders, given by the present discounted value of dividends (D_{jt}). The nominal discount rate used in determining the present value is the one which one obtains in the world capital market, denoted i_t^*, since this is the rate at which shareholders are assumed to be able to borrow or lend as much as they wish.[5] Note that the firm takes both the domestic lending rate i and the world interest rate i^* as determined exogenously in the appropriate market. Moreover,

[5]The model assumes that there are two groups of investors in the country: sophisticated investors, who can lend and borrow in the world capital market and who own shares, and unsophisticated investors, who save only in the official banking sector.

the firm is assumed to be able to raise finance only through borrowing or retained earnings.

Formally, the optimimisation problem can be stated as:

$$\text{Max } V_{jt} = E_t \left\{ \sum_{s=t+1}^{\infty} \beta_s D_{js} \right\}, \tag{1}$$

where $\beta_s = \prod_{l=t+1}^{s} (1 + i^*_{l-1})^{-1}$, subject to the following constraints:

$$D_{jt} = q_t Y_j(K_{jt-1}) - p_t I_{jt} + B_{jt} - (1 + i_t)B_{jt-1} + A_{jt} - (1 + i^*_t)A_{jt-1}, \tag{2}$$

$$K_{jt} = (1 - \delta)K_{jt-1} + I_{jt}, \tag{3}$$

$$B_{jt} \leq x_{jt} p_t K_{jt}, \tag{4}$$

where E_t is the expectations operator, $q_t Y_j(K_{jt-1})$ represents current revenue, where q_t is the price of output in period t and Y is output, which in turn is a function of the capital stock at the beginning of the period, K_{jt-1},[6] $B_{jt} - B_{jt-1}$ and $A_{jt} - A_{jt-1}$ are new issues of one period debt from the domestic and international market, respectively, $p_t I_{jt}$ represents the value of current investment, where p_t is the current price of capital goods and I_{jt} is the quantity of investment made during period t, $i_t B_{jt-1}$ and $i^*_t A_{jt-1}$ are nominal interest payments to the official and alternative market, respectively,[7] and δ is the exponential rate of depreciation of capital assumed constant.

The first two constraints are standard in models of firm investment. The first constraint is the flow of funds identity for the firm and the second constraint is the equation of motion of the capital stock. The third constraint is specific to D&D: it constrains the supply of domestic bank loans from the official market to be a proportion, x_{jt}, of the value of the firm's capital stock. The capital stock, therefore, represents collateral—banks are willing to

[6] Stocks dated t refer to the end of period t, equivalent to the beginning of period $t + 1$.

[7] In both markets, the model assumes that the nominal interest rate is set at the time the borrowing takes place. Thus, for example, the interest rate applying to official borrowing at the beginning of period t (the end of period $t - 1$, denoted B_{jt-1}) is determined at the beginning of the period and hence denoted i_{t-1}.

lend more to large firms than to small firms.[8]

Rearranging the first-order conditions yelds

$$E_t[q_{t+1}Y_{K_{jt}}(K_{jt})] = i_t^* p_t + \delta E_t P_{t+1} - (E_t p_{t+1} - p_t) - \frac{p_t(i_t^* - i_t)}{(1+i_t^*)} x_{jt}. \quad (5)$$

This states that, in equilibrium, the expected marginal revenue product of capital is equal to a modified cost of capital. The modified cost of capital is a function of two interest rates: the interest rate on domestic bank loans and the interest rate prevailing in the world capital market. The greater the availability of domestic bank loans, the greater the weight attached to the former. For a given stock of bank lending available at a reduced rate, the cost of capital is lower and the demand for capital by each firm is higher relative to the case in which such cheaper finance was not available—as would be the case if, in the absence of restraints, the domestic market offered finance at the rate available in the world capital market.

Equation (5) holds for every firm in the economy. D&D show that the same argument can be applied to the economy as a whole providing that certain aggregation conditions are satisfied and that firm-specific shocks to the proportion of a firm's capital stock financed out of bank loans cancel out across firms. If so, the existence of finance at a lower rate than r_t^*, which is available in proportion to the size of the capital stock, means that the aggregate long run equilibrium capital stock will be higher than in the absence of such funds.[9]

In the long-run we expect equation (5) to hold. In the short-run, D&D assume that investment will be driven by the difference between these two variables, although adjustment of the actual capital level stock to the desired level would be gradual because of time lags in decision making, ordering, delivery and installation of new capital. This gradual adjustment is flexibly modelled by introducing lags in the main variables as follows:

$$\frac{I_{jt}}{K_{jt-1}} = b_{jo} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}\left[\frac{1+i_t^*}{1+\pi_{jt}^e} - 1\right] + b_{j4}D_{jt}\frac{(i_t^* - i_{jt})}{(1+i_t^*)(1+\pi_{jt}^e)}\frac{B_{jt}}{K_{jt-1}}. \quad (6)$$

[8] Note that firms cannot borrow from the official market to lend on the alternative market.

[9] See Figures 1 and 2 in D&D.

In this specification Y/K can be interpreted as a proxy for the marginal product of capital. The modified cost of capital is split into two components, the real interest rate in the world capital market and the term capturing financial restraints.

Since we expect investment to depend on the difference between the marginal product and the modified cost of capital, the theoretical model predicts that b_{j2} should be positive and b_{j3} negative. A positive b_{j4} would provide support to the hypothesis that the existence of an alternative market for credit outweighs the credit rationing effect described by McKinnon–Shaw. In such a case increasing the level of the interest rate ceiling in the domestic market would serve to increase the overall cost of capital which corresponds to Figure 1 in D&D. On the other hand, a negative b_{j4} would suggest that the existence of the alternative market is not sufficient to outweigh the McKinnon-Shaw effect i.e. on balance higher domestic interest will have a positive effect on investment. This case corresponds to Figure 2 in D&D, where the supply of domestic financial savings is elastic with respect to the domestic interest rate, so that an increase in the domestic interest rate has a relatively large effect on the domestic supply of investable funds.

3 Econometric Issues

There are three variables in Equation (6) that are not directly observed in the dataset: the capital stock, the world capital market interest rate and the financial restraints dummy. The construction of the first is based on the perpetual inventory method, given by expression (3).[10] The interest rate i^* used here is the US lending rate, which is a reasonable approximation to the cost of loans from the world market. Using a foreign interest rate for i^* necessitates, however, adapting the expression for the cost of capital in Equations (6.1-6.3) since in the theoretical model, both i^* and i are nominal interest rates denominated in domestic currency. However, each rate is effectively deflated by the domestic expected inflation rate so that the relevant interest rates to use in empirical work are the real *ex ante* interest rates, both denominated in domestic currency. This would require knowledge

[10] The initial capital stock for each country was constructed by using $K_0 = ((\sum_{t=1970}^{1974} I_t)/5)/\delta$, where δ is the depreciation rate, assumed to be 4%. The resulting capital-output ratios were within plausible limits.

of expected inflation rates in the US and the domestic economy and also expected rates of depreciation/appreciation of the US dollar *vis-à-vis* the domestic currency. Given these difficulties, we assume that purchasing power parity (PPP) holds so that expected movements in the exchange rate will be given by differences in expected inflation rates. The latter are measured by the current inflation rate prevailing in each country. The financial restraints dummy is based on the expected real interest rate differential $r^* - r$ in domestic currency, which is obtained by first deflating i^* and i by the respective inflation rates. In the theoretical model, the supply of bank loans becomes rationed only if r^* exceeds r. This suggests that an observation could be considered as being under condition of 'financial restraints' if $r^* - r > 0$ and this is the central case which we consider.[11]

We estimate three versions of Equation (6), exploiting the panel structure of the data as discussed in more details below.

Model 1, the 'benchmark' model, which corresponds to a world without financial restraints, is given by

$$\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + \varepsilon_{jt}. \tag{7.1}$$

Models 2-3 test the financial restraints hypothesis by including the term that modifies the cost of capital under financial restraints as follows

$$\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + b_{j4}\frac{(r_t^* - r_{jt})}{(1 + r_t^*)}\frac{B_{jt}}{K_{jt-1}} + \varepsilon_{jt}. \tag{7.2}$$

$$\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + \tilde{b}_{j4}D_{jt}\frac{(r_t^* - r_{jt})}{(1 + r_t^*)}\frac{B_{jt}}{K_{jt-1}} + \varepsilon_{jt}. \tag{7.3}$$

where the subscript j refers to country j and the error term is $IID(0, \sigma_j^2)$.

[11] However, it is possible that the domestic interest rate exceeds the US lending rate but that nevertheless firms in that country experience credit rationing. Alternatively, a country's domestic interest rate may be lower that the US lending rate and the country may not actually face financial restraints for various reasons. Hence, we experimented with alternative definitions of financial restraints, ranging from $r^* - r > -4$ to $r^* - r > +4$. In fact, the results were not sensitive to the change in the definition of financial restraints, and we therefore only report the results for the benchmark case where $r^* - r > 0$.

In Equation (7.2) it is assumed that all the countries are always operating under financial restraints whereas in Equation (7.3) the financial restraints proxy is interacted with D_{jt}, a dummy variable that equals 1 in the presence of financial restraints and 0 otherwise.

The analysis above is carried out separately for each country $j = 1, ..., N$, which provides some statistical advantages. In particular, if we are interested in whether the economic theory outlined in Section 2 is applicable across all countries, then the tests of unit roots, and of cointegration can exploit the panel structure to improve the statistical power of the tests. Furthermore, averaging the values of the long-run multipliers across countries provides a summary of these results in the form of the *mean group estimator* which, although involving loss of information through aggregation, also serves to show whether the behaviour patterns observed are confirmed across a broad range of countries.

To elaborate briefly, we have noted that the modelling framework described above will be particularly relevant when the variables under discussion are $I(1)$. In recent years, a large literature has emerged in which panel unit root tests have been developed, typically testing the null that all the series measured in each country have a unit root against the alternative that a fraction do not (the 'heterogeneous alternative'); see Breitung and Pesaran (2006) for a review. In this literature, tests based on simple averages of the test statistics obtained in the unit root tests applied to each of the individual country's series in turn, are found to perform well in the sense that they are relatively powerful in rejecting the null when the alternative is true. A good example is the IPS test of Im *et al.* (2003), based on the cross-country average of individual Dickey-Fuller statistics, which we carry out in the paper.

In testing for cointegration, we adopt the residuals-based approach. This is appropriate if we know that there exists at most a single cointegrating relationship among the variables and this feeds back to a specified endogenous variable. Pedroni (2004) and Kao (1999) suggest tests that are comparable to the IPS test but based on the residuals from a contemporaneous regression of the levels value of the (known) endogenous variable on the levels value of the exogenous $I(1)$ variables. Pesaran and Smith (1995) describes the single-equation framework in detail and raises the important issue of heterogeneity, recognising that, while there is rarely any strong justification for restricting system dynamics to be common across countries, there are occasions when the long-run relations might be common (e.g. where they relate to arbitrage or solvency conditions or common technologies). Estimates of the long-run effects can be obtained for each country. The mean group estimator obtained by averaging these statistics across countries will provide a measure of the long-run effects that is more reliable than that based on any single country and the variance of this mean group estimator can be calculated using the non-parametric procedure described in Pesaran *et al.* (1996).

It is worth emphasising that the issue of heterogeneity in the errors across cross-sectional units is key to obtaining valid estimates of the long-run coefficients. Pesaran and Smith (1995) show that in the static case, if the coefficients differ randomly, pooling, aggregating, averaging group estimates, and cross-section regressions all give unbiased estimates of coefficient means. However, in the dynamic case, pooling and aggregating give inconsistent and potentially highly misleading estimates of the coefficients, though the cross-section can provide consistent estimates of the long-run effects.

4 Empirical Findings

Our panel dataset contains 38 countries over the period 1970-2002. A detailed description of the countries involved, measurement of variables and data sources is given in the Appendix. The first two observations are kept for transformations and lags. The estimation periods are 1972-2002 for total investment and 1972-2000 for private investment.

Table 1 reports the results of the panel unit root test of Im *et al.* (2003), which is based on the average of augmented Dickey-Fuller (ADF) t statistics for individual countries. For both total and private investment, the panel unit root statistics support the null hypothesis of non-stationarity for all the variables.

Table 2 shows estimates of Pedroni (2004)'s panel ADF (unweighted and weighted) and Group ADF statistics, as well as estimates of Kao (1999)'s ADF statistics. Both Pedroni and Kao panel cointegration tests have the null hypothesis of no cointegration. Pedroni describes two alternative hypotheses: the homogenous alternative, which Pedroni terms the within-dimension test or panel statistics test (weighted and unweighted), and the heterogenous alternative, also refered to as the between-dimension or group panel statistics test. The Kao test follows the same basic approach as the Pedroni tests, but specifies cross-section specific intercepts and homogenous coefficients on the first-stage regressors. The Maddala and Wu (1999) test combines tests from individual cross-sections to obtain a test statistic for the full panel. The table reports the rank obtained according to the combined Fisher and Johansen's maximum eigenvalue test statistics. The results support the presence of a unique cointegrating relationship among the variables in the investment equation across all three specifications.

Our next step is to examine the long-run determinants of investment in the countries included in the panel. Tables 3 and 4 report mean-group estimates of long-run effects using total investment and private investment respectively for each of the three models described above. In each table, Panel A reports estimates for all countries, while Panel B and Panel C report estimates for high income and low income countries respectively.

For total investment (Table 3), the results for the overall sample and high income countries on their own show that the coefficient of the US real lending rate is negative and significant at the 5% level across all three specifications whereas the term proxying financial restraints is insignificant, regardless of whether it is interacted with the dummy variable. For low income countries on their own, however, the financial restraints proxy interacted with the dummy variable is negative and significant at the 10% level, suggesting that for these countries financial restraints continue to be relevant. The negative coefficient suggest that the McKinnon-Shaw effect -higher domestic interest rates leading to a higher supply of investable funds- dominates the world capital market effect, indicating that the supply of loan by the domestic banking system is relatively elastic (as in Figure 2 in D&D).

For private investment (Table 4), the results for the overall sample show that the coefficient on the US real lending rate is negative and significant at the 5% level in Model 1 and Model 3, and it is negative and significant at the 10% level in Model 2. For high income and low income countries on their own, it is negative and significant at the 10% level in Model 1 and Model 3. Furthermore, for high income countries on their own it is negative and significant at the 10% level for Model 2 and for low income countries on their own it is insignificant. Importantly, for private investment, the term proxying financial restraints is always found to be insignificant, regardless of whether it is interacted with the dummy variable and regardless of how the countries are categorised.

Finally, we check whether the results obtained with Model 1 are robust. More specifically, we examine whether the coefficient on the US real interest rate remains negative and significant following the inclusion of an interest rate differential term and a term capturing the impact of US aggregate demand on domestic investment, as shown in the equations below:

$$\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + b_{j4}(r_t^* - r_{jt}) + \varepsilon_{jt}. \tag{7.4}$$

$$\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + b_{j4}(r_t^* - r_{jt}) + b_{j5}\Delta \ln\left(\frac{Y_t}{N_t}\right)^* + \varepsilon_{jt}, \tag{7.5}$$

where $\Delta \ln\left(\frac{Y_t}{N_t}\right)^*$ is the growth rate of US real GDP per capita.

Table 5 reports the results of these checks.[12] For total investment, the finding that the US real lending rate is an important determinant of investment appears to be robust to the inclusion of both the interest rate differential term and the term capturing the impact of US aggregate demand on domestic investment both for the overall sample and for high income countries on their own, across the two specifications. For low income countries on their own, the estimate on the US lending rate remains negative but its statistical signicance drops to 10%. In contrast, the estimates on the two added terms are always insignificant, regardless of how the countries are categorised, which suggests that neither the domestic interest rate nor US aggregate demand are the driving factors behind total investment.

For private investment, the coefficient on the US lending rate is negative but only significant at the 10% level for the overall sample, and negative and insignificant for high income and low income countries on their own. It must be noted, however, that the estimates on the two added terms are again always insignificant, regardless of how the countries are categorised.

[12] The robustness analysis was also carried out using US real GDP per capita in levels. The results obtained were similar.

5 Conclusion

The last thirty, or so, years have witnessed a gradual elimination of financial restraints worldwide, starting with OECD countries, most of which became fully liberalised by the early 1990s. These trends were followed by developing countries around the globe, led by East Asian and Latin American countries (Abiad and Mody, 2005). Financial liberalisations have included the removal of lending rate ceilings - which in the McKinnon-Shaw paradigm were seen as a major deterrent on investment – and the gradual elimination of restrictions on international financial transactions. Against this background, it is perhaps not very surprising to find that aggregate investment in 38 countries is already more responsive to US interest rates than to domestic interest rates. Surprising or not, these findings not only indicate the end of the era of financial repression but may also have profound implications for policy makers worldwide. Specifically, our findings suggest that policy makers in both developed and developing economies may have less influence over the cost of capital in their own country than the Federal Reserve. The flip side of the same coin is that US monetary policy may have unintended global consequences. Specifically, it may impact directly on the cost of capital in other countries, over and above any indirect effects through US aggregate demand.

Besides their policy implications, our findings have suggestions for the direction of future research in relation to macro-econometric modelling. Specifically, they imply that studies of investment can no longer afford to ignore global factors such as the world interest rate.[13] We are, of course, not the first authors to point out the importance of global factors in macro-econometric modelling.[14] This paper's findings certainly add more weight to the view that global economic inter-dependencies need to be explicitly taken into account in macro-econometric models, highlighting further the dawn of a new era in macro-econometric modelling.

[13] Recent studies of investment in developing countries continue to be mainly concerned about the impact of domestic interest rate policy on investment, neglecting the possible influence of world capital market conditions e.g. Agrawal (2004).

[14] See, for example, Pesaran and Smith (2006), who provide a pioneering new perspective using a global VAR model in which the global variable is the foreign inflation rate.

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Appendix A: Description and Sources of Data

I is total or private fixed capital formation; K is total or private capital stock; Y is real GDP; $(Y/N)^*$ is US real GDP per capita; r^* is US real lending rate; r is domestic real lending rate; B is claims on private sector by deposit money banks and other financial institutions. The data is from the World Bank Development Indicators (2005). Data on private investment is from Everhart S.S and M.A. Sumlinski (2001). 'Trends in Private Investment in Developing Countries, Statistics for 1970-2000 and the Impact on Private Investment of Corruption and the Quality of Public Investment.' Discussion Paper No. 44, International Finance Corporation.

Appendix B: List of Countries

The lower income group comprises countries with real GDP per capita of less than US$3,500 in 1970. The countries are Algeria^{a,b}, Bolivia^{b}, Burkina Faso^{a}, Cameroon^{a}, Chile, Costa Rica, Cote d'Ivoire, Dominican Republic, Egypt, Ecuador^{a,b}, El Salvador, Gabon^{a}, Ghana^{a}, Guatemala, Haiti^{a}, Honduras^{a}, India, Kenya, Korea^{a,b}, Malawi, Morocco, Paraguay, Peru^{a,b}, Philippines, Rwanda^{a,b}, Sri Lanka^{a}, and Thailand.

The higher income group of countries comprises Argentina, Canada^{a}, Denmark^{a}, Japan^{a}, Mexico, Norway^{a}, Switzerland^{a}, Trinidad and Tobago, USA^{a}, Uruguay^{b}, and Venezuela.

Notes: a denotes data on private investment is not available. b denotes data on domestic lending rate is not available. USA is excluded from the regressions including an interest rate differential term since the latter would be equal to zero by construction.

Table 1: IPS (2003) panel unit root test

A: In levels	C	C/T
$\frac{I_{jt}^{TOT}}{K_{jt-1}^{TOT}}$	-1.4021	0.2817
$\frac{I_{jt}^{PVT}}{K_{jt-1}^{PVT}}$	$-1.7255^{\dagger}$	-0.3403
$\frac{F_{jt}}{K_{jt-1}^{TOT}}$	-1.1964	3.9064
$\frac{F_{jt}}{K_{jt-1}^{PVT}}$	-1.1178	3.1247
$\frac{B_{jt}(r_t^*-r_{jt})}{K_{jt-1}^{TOT}(1+r_t^*)}$	$-3.8688^{\dagger}$	-1.5740
$\frac{B_{jt}(r_t^*-r_{jt})}{K_{jt-1}^{PVT}(1+r_t^*)}$	$-3.5969^{\dagger}$	-1.4630
B: In first-differences	**C**	**C/T**
$\frac{I_{jt}^{TOT}}{K_{jt-1}^{TOT}}$	$-18.2272^{\dagger}$	$-16.9654^{\dagger}$
$\frac{I_{jt}^{PVT}}{K_{jt-1}^{PVT}}$	$-14.4386^{\dagger}$	$-13.7269^{\dagger}$
$\frac{F_{jt}}{K_{jt-1}^{TOT}}$	$-11.8974^{\dagger}$	$-10.6584^{\dagger}$
$\frac{F_{jt}}{K_{jt-1}^{PVT}}$	$-8.1555^{\dagger}$	$-7.9275^{\dagger}$
$\frac{B_{jt}(r_t^*-r_{jt})}{K_{jt-1}^{TOT}(1+r_t^*)}$	$-23.5567^{\dagger}$	$-27.6200^{\dagger}$
$\frac{B_{jt}(r_t^*-r_{jt})}{K_{jt-1}^{PVT}(1+r_t^*)}$	$-22.8738^{\dagger}$	$-25.1400^{\dagger}$

Notes: TOT means that the variable was constructed using total investment data. PVT means that the variable was constructed using private investment data. The (standardised) t_{IPS} has an asymptotic N(0,1) distribution under the unit root null hypothesis. †denotes rejection at the 5% level. The r_t^* series was tested using the standard unit root tests and found to be $I(1)$.

Table 2: Panel cointegration tests

	Model 1		Model 2		Model 3	
	TOT	PVT	TOT	PVT	TOT	PVT
	N=38	N=20	N=30	N=20	N=30	N=20
Pedroni (2004)						
-Panel ADF						
Within-u	-1.54††	-2.45†	-0.38	-2.45†	0.27	-1.61††
Within-w	-2.62†	-3.41†	-3.46†	-3.27†	-2.12†	-2.40†
-Group ADF						
Between	-3.00†	-3.43†	-2.49†	-2.76†	-1.69†	-2.43†
Kao (1999)						
-ADF	-4.15†	-1.59††	-3.79†	-1.60††	-3.79†	-1.60††
Maddala-Wu (1999)						
-Rank (r)	1	1	1	1	1	1

Notes: TOT means that the model includes variables constructed using total invetsment data. PVT means that the model includes variables constructed using private investment data. All the statistics have an asymptotic N(0,1) distribution under the null hypothesis. The tests are one-sided. The number of lags was selected automatically using the SIC and the maximum number of lags was automatically chosen based on the number of available observations. The results of both Pedroni and Kao tests were obtained assuming no deterministic trend. † and †† denote rejection of the null hypothesis at the 5% and 10% level respectively. The results of the Maddala-Wu test (combined Fisher and Johansen's maximum eigenvalue test statistics) were obtained under Eviews Model 3 with one lag in first-differences.

Table 3: Estimation results, using total investment

	Mean-groupe estimates (t-ratio) Model 1	Model 2	Model 3
A: All countries	N=38	N=30	N=30
b_0	-5.0326† (-4.08)	-2.3334 (-0.80)	-2.6298 (-1.06)
b_2	0.4233† (8.23)	0.3284† (3.68)	0.3477† (4.89)
b_3	-0.1903† (-2.83)	-0.1872† (-2.78)	-0.1985† (-2.52)
b_4	-	-0.4288 (-0.77)	-
$\tilde{b}_4$	-	-	-1.5255 (-1.26)
b_1	0.4946	0.4468	0.4512
B: High income	N=11	N=9	N=9
b_0	-2.8339†† (1.84)	-1.6492 (-1.02)	-1.4200 (-0.95)
b_2	0.3048† (6.79)	0.2858† (5.75)	0.2723† (5.71)
b_3	-0.1258† (-2.35)	-0.1246† (-2.40)	-0.1124† (-2.94)
b_4	-	0.3257 (1.41)	-
$\tilde{b}_4$	-	-	1.2066 (1.28)
b_1	0.5547	0.5230	0.3322
C: Low income	N=27	N=21	N=21
b_0	-5.9283† (-3.70)	-2.6266 (-0.64)	-3.1483 (-0.89)
b_2	0.4716† (6.90)	0.3467† (2.73)	0.3801† (3.82)
b_3	-0.2167† (-2.34)	-0.2140† (-2.28)	-0.2353† (-2.12)
b_4	-	-0.7523 (-0.96)	-
$\tilde{b}_4$	-	-	-2.6965†† (-1.66)
b_1	0.4701	0.4141	0.4201

Notes: Model 1: $\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + \varepsilon_{jt}$; Model 2: $\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + b_{j4}\frac{(r_t^*-r_{jt})}{(1+r_t^*)}\frac{B_{jt}}{K_{jt-1}} + \varepsilon_{jt}$; Model 3: $\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + \tilde{b}_{j4}D_{jt}\frac{(r_t^*-r_{jt})}{(1+r_t^*)}\frac{B_{jt}}{K_{jt-1}} + \varepsilon_{jt}$. Sample period: 1972-2002. † and †† denote significance at the 5% and 10% level respectively.

Table 4: Estimation results, using private investment

	Mean-groupe estimates (t-ratio)		
	Model 1	Model 2	Model 3
A: All countries	N=20	N=20	N=20
b_0	-9.1431† (-4.24)	-9.3247† (-3.94)	-9.0940† (-4.24)
b_2	0.0032† (8.98)	0.0033† (8.47)	0.0032† (8.88)
b_3	-0.1775† (-2.23)	-0.1714†† (-1.64)	-0.1734† (-2.13)
b_4	-	0.1833 (0.76)	-
$\tilde{b}_4$	-	-	0.4547 (0.73)
b_1	0.4435	0.4404	0.4498
B: High income	N=5	N=5	N=5
b_0	-5.7304† (-3.7354)	-5.6209† (-3.83)	-5.6267† (-3.57)
b_2	0.0028† (7.0207)	0.0029† (7.60)	0.0027† (6.95)
b_3	-0.1371†† (-1.8431)	-0.2274†† (-1.67)	-0.1448†† (-1.90)
b_4	-	0.8380 (0.94)	-
$\tilde{b}_4$	-	-	2.4117 (1.02)
b_1	0.4444	0.4438	0.4399
C: Low income	N=15	N=15	N=15
b_0	-10.2807† (-3.68)	-10.5593† (-3.43)	-10.2498† (-3.69)
b_2	0.0034† (7.34)	0.0034† (6.80)	0.0034† (7.28)
b_3	-0.1910†† (-1.83)	-0.1527 (-1.14)	-0.1830†† (-1.71)
b_4	-	-0.0348 (-0.27)	-
$\tilde{b}_4$	-	-	-0.1975 (-0.97)
b_1	0.4432	0.4393	0.4531

Notes: $\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + \varepsilon_{jt}$; Model 2: $\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + b_{j4}\frac{(r_t^*-r_{jt})}{(1+r_t^*)}\frac{B_{jt}}{K_{jt-1}} + \varepsilon_{jt}$; Model 3: $\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + \tilde{b}_{j4}D_{jt}\frac{(r_t^*-r_{jt})}{(1+r_t^*)}\frac{B_{jt}}{K_{jt-1}} + \varepsilon_{jt}$. Sample period: 1972-2000. † and †† denote significance at the 5% and 10% level respectively.

Table 5: Robustness checks

	Mean-groupe estimates (t-ratio)			
	Total Investment		Private Investment	
	Model 4	Model 5	Model 4	Model 5
A: All countries	N=30	N=30	N=20	N=20
b_0	-1.3477	-2.7801†	-9.3162†	-9.5178†
	(-0.36)	(-3.24)	(-3.85)	(-3.64)
b_2	0.3137†	0.2115†	0.0033†	0.0032†
	(3.17)	(5.77)	(8.11)	(7.93)
b_3	-0.2438†	-0.0500†	-0.1724††	-0.1739††
	(-2.16)	(-2.15)	(-1.90)	(-1.85)
b_4	-0.1015	0.0000	0.0285	0.0257
	(-0.92)	(0.12)	(0.93)	(0.85)
b_5	-	0.0044	-	0.0514
		(0.30)		(1.28)
b_1	0.4469	0.4617	0.4421	0.4365
B: High income	N=9	N=9	N=5	N=5
b_0	-1.5439	-1.8742	-5.2003†	-5.4299†
	(-0.97)	(-1.20)	(-3.17)	(-3.50)
b_2	0.2798†	0.2857†	0.0028†	0.0028†
	(5.67)	(5.72)	(7.01)	(2.17)
b_3	-0.1097†	-0.1067†	-0.1960	-0.1957
	(-2.11)	(-2.25)	(-1.60)	(-1.60)
b_4	0.0283	0.0229	0.0845	0.0849
	(1.56)	(1.41)	(0.85)	(0.86)
b_5	-	0.0697	-	-0.0770
		(1.62)		(1.00)
b_1	0.5191	0.5549	0.4420	0.4333
C: Low income	N=21	N=21	N=15	N=15
b_0	-1.2636	0.5096	-10.6882†	-10.8884†
	(-0.23)	(0.07)	(-3.41)	(-3.19)
b_2	0.3283†	0.2964††	0.0035†	0.0034†
	(2.33)	(1.68)	(6.61)	(6.47)
b_3	-0.3013††	-0.3505††	-0.1645	-0.1666
	(-1.89)	(-1.81)	(-1.42)	(-1.38)
b_4	-0.1572	-0.2103	0.0098	0.0059
	(-1.00)	(-0.99)	(0.38)	(0.24)
b_5	-	-0.1417	-	0.0428
		(-0.71)		(0.89)
b_1	0.4160	0.4218	0.4422	0.4376

Notes: Model 4: $\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + b_{j4}(r_t^* - r_{jt}) + \varepsilon_{jt}$; Model 5: $\frac{I_{jt}}{K_{jt-1}} = b_{j0} + b_{j1}\frac{I_{jt-1}}{K_{jt-2}} + b_{j2}\frac{Y_{jt}}{K_{jt-1}} + b_{j3}r_t^* + b_{j4}(r_t^* - r_{jt}) + b_{j5}\Delta\ln\left(\frac{Y_t}{N_t}\right)^* + \varepsilon_{jt}$. Sample periods: 1972-2002 (total investment) and 1972-2000 (private investment.). † and †† denote significance at the 5% and 10% level respectively.