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Examining Private Investment Heterogeneity

Evidence from a Dynamic Panel

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Abstract

We investigate domestic private investment behaviour in a panel of 24 low-income and middle-income countries spanning a period of 1981-2000. The paper rigorously addresses (i) the cross-country heterogeneity in private investment behaviour, and (ii) endogeneity. Indicators of financial sector development and other standard macroeconomic determinants of private investment appear significant in explaining private investment behaviour in our sample; however, the estimated parameters and adjustment dynamics exhibit important cross-country differences. The empirical findings of the paper have important implications namely that *first*, cross-country heterogeneity needs to be addressed while modelling the private investment behaviour, and *second*, at the policy level, the country-specific approach appears potentially more effective than the one-size-fits-all approach for boosting private investment.

Keywords: domestic private investment; public investment, dynamic heterogeneity; endogeneity; Generalised Method of Moments
JEL classification: E22, H54, O16, O23

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1 Introduction

Delving deeper into the determinants of domestic private investment behaviour in the case of developing countries is crucial for our understanding of how private investment is driven in these countries. This is a timely issue in view of the current public debate on the need to mobilise all sources of development finance, both external and domestic, to attain the Millennium Development Goals (MDGs) by 2015.[1]

There exists a vast literature, both theoretical and empirical, on the determinants of domestic private investment behaviour. The accelerator models of investment, originated mainly by Clark (1917) with further modifications by Chenery (1952) and Koyck (1954) assume that the desired capital stock at any point in time is a constant multiple of output at that time. In these models, investment is independent from the price of capital. This missing element in the accelerator model has been considered in depth by the 'neoclassical model of investment' developed mainly by Jorgenson (1971), Hall and Jorgenson (1967), Eisner and Nadiri (1968) and Bischoff (1971) among others.[2] Both the accelerator and the neoclassical models of investment behaviour are output-based models. In sharp contrast to these models, Tobin's Q-theory of investment attempts to explain investment behaviour in terms of portfolio balance (Tobin, 1969).[3]

In the early models of investment behaviour, financial variables do not play a direct role. However, since the 1980s a number of studies have emerged, most of them at the firm level, suggesting that the potential investors may face credit rationing due to asymmetric information in financial markets, thus demonstrating the importance of financial variables in determining private investment. Likewise, the 'hierarchy of finance' models emphasise the importance of a firm's internal cash flow. In sharp contrast to the neoclassical model, the 'hierarchy of finance' models suggest that a pool of firms is always resource constrained. Their investment expenditure is constrained by the availability of internally generated funds—see Fazzari and Athey (1987), Fazzari et al. (1988), Hoshi et al. (1991) and Bond and Meghir (1994), among others, regarding the role of financial variables under the asymmetric information assumption.

Stiglitz and Weiss (1981) and Greenwald et al. (1984), on the other hand, show that credit rationing and loan market equilibrium may co-exist when financial markets suffer from the problem of asymmetric information. Thus, asymmetric information may play a fundamental role in the functioning of capital markets whereby it is the availability of

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1 See UN Millennium Project (2005), Cheru and Bradford (2005) and Addison et al. (2005) among others for a recent discussion regarding the MDGs.

2 Nickell (1978) provides a detailed discussion.

3 When the market value of an additional unit of capital exceeds its replacement cost, a firm can raise its profit by investing. Within this context, it seems reasonable to assume that inefficient pricing in equity markets can affect investment. See also Abel and Blanchard (1986).

capital rather than its cost becomes crucial in the determination of private investment (Greenwald and Stiglitz 1990, and Calomiris and Hubbard 1990, also make this point).[4]

The other explanation for credit rationing in financial markets is associated with the 'financial repression' hypothesis of McKinnon (1973) and Shaw (1973) which mobilized a voluminous empirical literature in this area. The central message of this approach is the 'complementarity' between money and capital in developing countries—see Gibson and Tsakalotos (1994) for a comprehensive survey. A recent stream of theoretical and empirical analyses on the finance-growth nexus[5] has tried to illuminate the path through which financial variables affect growth via their impact on total factor productivity growth and investment—see among others, King and Levine (1993a,b); Benhabib and Spiegel (2000); and Beck et al. (2000).

Another strand of the literature pays particular attention to the role of uncertainty in domestic private investment. Different forms of uncertainty have been considered in the investment literature. They include uncertainty arising from investment irreversibility (see Bernanke 1983; Pindyck 1991; Bertola and Caballero 1994; Dixit 1992; Goldberg 1993; Dixit and Pindyck 1994; Chirinko 1996; Abel and Eberly 1999),[6] uncertainty related to economic instability (see Rodrik 1991; Kormendi and Meguire 1985; Cardoso 1993; Bleaney 1996; and more recently Beaudry et al. 2001; and Serven 2003),[7] and, finally uncertainty emanating from sociopolitical instability (see Pastor and Hilt 1993; Alesina and Perotti 1996; and more recently Campos and Nugent 2003). The possible 'crowding in' or 'crowding out' outcomes regarding the relationship between public and private investment have also received considerable attention in the private investment literature. Representative studies include Blejer and Khan (1984); Aschauer (1989); Pradhan et al. (1990); Greene and Villanueva (1991); and Taylor (1991).

Finally, yet another aspect of the private investment literature emphasises the role of external constraints such as debt stock and debt service in private investment in particular as far as developing countries are concerned. Indeed, the external debt position of a country may affect the level of private investment through a number of channels: high debt-service payments related to large external debt may reduce the available funds for investment since they divert foreign exchange away from the import of capital and intermediate goods. Furthermore, the debt burden imposes a sort of

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4 Likewise, Chirinko and Schaller (1995) show the role of liquidity constraints in private investment behaviour and Capasso and Mavrotas (2003) on how information asymmetries in the credit market affect average capital productivity and economic growth.

5 See Arestis and Demetriades (1997), Levine (1997), Rousseau (1998), Luintel and Khan (1999), Demirguc-Kunt and Levine (2001), and Wachtel (2004) among others for comprehensive surveys of this literature.

6 See also Zeira (1987) on how investment can be affected by 'structural uncertainty', i.e. uncertainty that arises when the firm does not fully know its own profit function, which relates profits to capital stock.

7 See also Fielding (1997) and Krishna et al. (2003) on uncertainty associated with the trade-investment nexus and Asteriou and Price (2005) for a recent empirical study on the interactions between uncertainty, investment and economic growth.

marginal tax by reducing expected return on investment; and finally, the debt burden affects the creditworthiness of the country by imposing restrictions to its access to future foreign credit to finance investment or trade—see *inter alia* Borensztein (1990), Sachs (1989), Greene and Villanueva (1991) and more recently Chirinko and Schaller (1995) and Acosta and Loza (2005).

Focus of paper

An important issue that has been overlooked in the empirical literature, particularly in those studies focusing on cross-country analysis of private investment behaviour, concerns the issue of cross-country heterogeneity. It is well-known that countries differ in terms of their levels of real and financial development, public investment, levels and history of inflation, real interest rates, real exchange rates and the magnitudes of the size and burden of national debt. Countries also differ in their risk profile, a key factor for private investment decisions. Given this cross-country diversity amongst the fundamentals that drive private investment, we argue that the key parameters of private investment function are likely to be heterogeneous and country specific. For example, the effect of the scale variable (i.e. real per capita income) may be positive on private investment but the magnitude of its effect may depend on other considerations such as the level of inflation, real interest rate, financial development and/or the level of per capita income itself. Real income may have a weaker effect on private investment in highly inflationary countries and *vice versa*. Similar arguments can apply vis-à-vis other determinants of private investment.

Hence, the aim of this paper is twofold. First, it models the private investment behaviour in a panel of 24 low-income and middle-income countries by explicitly allowing for the cross-country heterogeneity in the parameters of private investment function. Our empirical model (see equation 2 in Section 3) precisely captures such heterogeneity. Second, it addresses the issue of endogeneity in a rigorous way by employing, among others, the system GMM estimator. In so doing, the present paper makes a contribution vis-à-vis the extant empirical literature in this field. The paper also sheds further light on the crucial nexus between financial sector development and domestic private investment by explicitly modeling the effects of a series of financial sector development indicators on private investment.

The remainder of the paper is organized as follows. Section 2 deals with data issues and in Section 3 we discuss specification issues and the econometric methodology adopted in the paper. Empirical results are reported and discussed in Section 4. Section 5 concludes the paper.

2 Data

Our sample consists of 24 low-income and middle-income countries (see Table 1). Data frequency is annual for a period of 20 years (1981-2000). We have an unbalanced panel

of 468 observations. We assemble a broad array of data series for our sample countries whereby a fairly general empirical model of private investment, which incorporates most arguments put forward by competing economic theories, can be specified and estimated. The theoretical literature (see sections 1 and 3) postulates that the main determinants of private investment ($I^P_{i,t}$) are real per capita income ($Y^p_{i,t}$), growth rate of real per capita income ($\dot{Y}^p_{i,t}$), public (government) investment ($I^G_{i,t}$), levels of financial development ($FD_{i,t}$), real interest rate ($r_{i,t}$), real exchange rate ($rex_{i,t}$), variability of real exchange rate ($rexs^d{}_{i,t}$), inflation ($\pi_{i,t}$), debt stock ($B_{i,t}$) and debt servicing ($BS_{i,t}$).

Data on $I^P_{i,t}$, and $I^G_{i,t}$ are extracted from Everhart and Sumlinski (2001). Data on $B_{i,t}$ and $BS_{i,t}$ are extracted from the World Bank *Global Development Finance* database. We construct five indicators of financial development for each sample country. Four of them viz., LLY (ratio of liquid liability of the financial system to GDP), PRIVATE (ratio of claims on the non-financial private sector to total domestic credit excluding credit to money banks), PRIVY (claims on non-financial private sector to GDP), and BANK (ratio of deposit money bank domestic assets to deposit money bank domestic assets plus central bank assets) are constructed following King and Levine (1993). Besides, we also use credit flow to the private sector to GDP ratio (CREDIT) since it directly captures the effects of credit rationing on private investment. All the data series required for the construction of financial development indicators are obtained from the International Financial Statistics (IFS) published by the IMF. Likewise, data on real GDP, consumer price index (CPI), and nominal exchange rate (bilateral exchange rate with the US dollar) are also extracted from the IFS.

Heterogeneity in fundamentals

Table 1 presents some summary statistics of our dataset. They reveal important cross-country differences in various macroeconomic aggregates. The sample-wide average real (at 2000 prices) per capita income is USD2,496 dollars; however, the cross-country variation in per capita income is tremendous. Malawi and Ecuador appear at the bottom with a per capita income of USD132 and USD151 dollars whereas Barbados and Argentina appear at the top with per capita incomes of USD7,000 or above. India and Kenya have a per capita income of less than USD400 dollars. The growth rate is also pervasive across the sample of countries. The cross-country mean rate of growth of real per capita income over the sample period is 1.73 percent. However, three countries (Guatemala, Malawi and Philippines) record negative growth rates over the sample period. Nine countries (Argentina, Barbados, Brazil, Ecuador, El Salvador, Kenya, Mexico, Morocco and Uruguay) show a real per capita growth of less than one percent per annum. On the other hand, Belize, Grenada, Mauritius and Thailand record a real per capita income growth rate of above 4.0 percent. Indian and Chile show a similar real per capita income growth rate of 2.8 percent.

Table 1: Descriptive statistics

	GDP per capita	GDP per capita		LLY		Public Inv.		Private Inv.		Inflation		Credit Flow		REX		RIR		DSer/GDP		Dstock/GDP	
	Growth rate	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Argentina	0.04	7046	632	0.17	0.07	3.34	1.80	15.39	2.43	390	801	0.10	0.10	0.17	0.67	620	3107	4.06	2.03	43.0	15.0
Barbados	0.67	8516	566	0.50	0.09	3.81	1.63	13.69	3.85	5	4	0.03	0.02	0.60	0.37	1	4	4.09	1.70	32.2	10.6
Belize	5.19	1975	853	0.40	0.06	11.37	3.47	11.88	2.75	3	3	0.03	0.02	0.49	0.41	7	2	4.55	1.83	45.8	11.2
Brazil	0.59	3139	227	0.18	0.08	5.26	1.30	15.90	1.84	563	827	0.23	0.24	0.47	0.43	810	1766	4.61	2.69	34.6	8.6
Chile	2.82	3429	957	0.35	0.04	5.22	1.00	15.15	4.05	16	9	0.11	0.06	6.09	0.55	7	9	7.90	2.71	63.1	29.1
Colombia	0.96	1829	189	0.18	0.03	7.59	1.08	10.19	2.45	22	6	0.04	0.02	7.38	0.53	11	6	5.48	2.13	33.9	7.2
Costa Rica	1.05	3285	407	0.34	0.05	5.65	1.52	14.76	1.98	21	17	0.03	0.02	5.61	0.52	-4	17	7.22	4.20	70.9	40.0
Ecuador	0.80	151	296	0.18	0.04	7.22	2.15	11.96	2.16	39	21	0.01	0.05	9.51	0.58	-9	26	7.98	2.39	80.5	21.2
El Salvador	0.67	1777	202	0.07	0.04	3.90	1.34	10.83	2.83	14	8	0.00	0.01	2.31	0.37	0	7	3.38	0.98	34.5	6.2
Grenada	5.02	3038	1067	0.64	0.13	14.32	10.08	18.90	9.65	5	6	0.06	0.04	0.84	0.39	0	6	2.44	0.87	46.3	7.6
Guatemala	-0.11	1554	98	0.23	0.02	3.32	1.48	10.69	2.34	13	11	0.02	0.01	1.85	0.50	-2	9	2.53	0.97	26.1	7.1
India	2.83	333	63	0.41	0.04	8.66	1.36	12.56	2.36	9	3	0.04	0.01	3.39	0.56	7	3	1.89	0.77	22.3	6.1
Kenya	0.78	334	28	0.34	0.06	7.67	1.35	11.57	1.14	14	10	0.03	0.02	4.18	0.49	5	9	7.11	1.67	73.2	16.3
Malawi	-0.06	132	9	0.18	0.03	9.39	2.57	5.44	2.51	25	17	0.01	0.02	3.55	0.52	-7	11	4.91	1.72	102.9	33.6
Malaysia	3.48	2751	741	0.69	0.14	12.73	2.63	19.97	6.32	4	2	0.10	0.06	0.90	0.49	3	2	8.01	3.73	47.8	13.3
Mauritius	4.23	2535	713	0.57	0.14	7.77	1.77	16.75	3.52	9	8	0.06	0.03	3.01	0.49	3	4	5.39	1.65	43.1	6.9
Mexico	0.63	5137	298	0.24	0.05	5.29	2.80	14.38	2.20	43	37	0.05	0.04	2.34	0.48	-8	18	6.55	2.07	43.8	14.0
Morocco	0.88	1050	85	0.53	0.13	9.72	2.26	12.94	1.88	6	4	0.04	0.03	2.12	0.52	2	4	8.58	1.93	83.6	19.0
Pakistan	1.92	427	57	0.40	0.03	8.27	1.54	8.50	0.95	8	3	0.04	0.01	3.51	0.55	0	3	3.80	1.04	48.6	5.2
Philippines	-0.02	941	59	0.37	0.13	5.11	1.94	17.07	2.91	11	10	0.04	0.05	3.53	0.48	1	7	6.24	1.41	70.6	11.9
Thailand	4.26	1452	494	0.65	0.21	8.09	1.61	24.59	6.15	5	4	0.08	0.10	3.31	0.47	5	4	5.87	2.37	46.9	18.1
Tunisia	1.88	1568	214	0.45	0.04	13.03	2.60	14.24	2.80	7	4	0.06	0.03	-0.11	0.50	2	4	8.28	1.49	57.3	8.2
Turkey	2.15	2382	360	0.24	0.06	7.53	1.63	15.56	3.29	64	23	0.07	0.02	13.29	0.49	-8	24	5.42	1.91	40.6	8.6
Uruguay	0.98	5127	722	0.40	0.06	4.34	0.85	9.24	1.80	51	30	0.13	0.07	2.57	0.55	0	14	5.18	2.25	42.0	17.6
Mean	1.734	2496.31		0.36	0.07	7.441		13.840		56.116		0.06		3.372		60.299		5.477		51.402	

Similarly, cross-country heterogeneity is evident in private and public investment. The cross-country mean private investment is 13.84 percent of GDP whereas the country-specific proportion ranges from a minimum of 5.44 percent (Malawi) to a maximum of 24.59 percent (Thailand). The cross-country mean level of public investment is 7.44 percent. The lowest (less than 4.0 percent) public investment is recorded by countries like Guatemala, Argentina, Barbados and El Salvador whereas countries like Belize, Granada, Malaysia and Tunisia are associated with public investment of above 10 percent. The indicator of financial development (ratio of liquid liability of the financial system to GDP: LLY) also exhibits important cross-country differences. The mean value of LLY ranges from 0.7 percent (El Salvador) to 69 percent (Malaysia).[8] The credit flows to the private sector as a percentage of GDP diverge between a minimum of 1 percent (Ecuador and Malawai) to a maximum of 23 percent (Brazil). The average inflation also shows enormous cross-country variations. The highest inflation rate is recorded by Brazil (563 percent) and the lowest by Belize (3 percent). Cross-country heterogeneity is also apparent in real interest rate and real exchange rate movements and debt stocks and debt servicing (the latter two expressed as percentages of GDP). Thus, the panel of countries in our sample shows important divergence in their levels and growth of real income, levels of financial development, public investment, inflation, real interest rates, real exchange rates and in their magnitudes of national debt. Given this diversity, it is natural to expect cross-country heterogeneity in the parameters of private investment function—this is precisely the focus of this paper.

3 Specification and econometric issues

We aim to model empirically the private investment behaviour for our panel of countries focusing on two important issues of (i) cross-country heterogeneity in investment behavior, and (ii) endogeneity. We specify a general testable equation of private investment behaviour that incorporates most of the key arguments put forward by theoretical models. In this light, a typical dynamic (autoregressive) equation for private investment is:

$$I^{p}_{i,t} = \alpha_i + \gamma_t + \lambda I^{p}_{i,t-1} + \beta_1 y^{p}_{i,t-1} + \beta_2 \dot{y}^{p}_{i,t} + \beta_3 I^{g}_{i,t} + \beta_4 fd_{i,t-1} + \beta_5 \pi_{i,t} + \beta_6 r_{i,t} + \beta_7 rex_{i,t} + \beta_8 rexs^{d}{}_{i,t} + \beta_9 b_{i,t-1} + \beta_{10} bs_{i,t-1} + e_{i,t} \quad (1)$$

(i= 1,…,N; and t=1,…,T)

where ‘i’ and ‘t’ denote the cross-sectional and time series dimensions; α_i captures the time-invariant unobserved country-specific fixed effects (e.g., differences in the initial autonomous levels of investment) and γ_t captures the unobservable individual-invariant time effects (i.e. investment shocks that are common to all countries). In equation (1) the dependent variable ($I^{p}_{i,t}$) is the ratio of private investment to GDP; $y^{p}_{i,t-1}$ denotes the

[8] For the purpose of illustration we report only LLY. Other measures of financial development depict similar cross-country heterogeneity.

lagged real per capita income; $\dot{y}^{p}_{i,t}$ denotes real per capita income growth; $I^{g}_{i,t}$ is a ratio of public (government) investment to GDP; $fd_{i,t-1}$ denotes the lagged indicators of financial development; $\pi_{i,t}$, $r_{i,t}$, $rex_{i,t}$ and $rexs^{d}{}_{i,t}$ respectively denote inflation rate, real interest rate, real exchange rate and the standard deviation of real exchange rate. Finally, $b_{i,t-1}$ and $bs_{i,t-1}$ are lagged outstanding debt stock and debt service both expressed as a ratio to GDP. The autoregressive parameter, λ, measures the speed of adjustment while β_s measures the impact elasticity of $I^{p}_{i,t}$ with respect to all the right-hand side variables except for the lagged dependent variable.

Theoretically, $y^{p}_{i,t-1}$ and $\dot{y}^{p}_{i,t}$ are expected to exert a positive effect on $I^{p}_{i,t}$. This relationship is postulated by several variants of the flexible-accelerator model which assume a fixed relationship between the desired capital stock and the level of real output. Consequently, we expect β_1 and β_2 to be positive on *a priori* grounds. Government investment, on the one hand, may crowd-out private sector investment via increased deficits and a high interest rate—the well-known 'Ricardian Equivalence Theorem'. On the other hand, government investment, particularly in developing countries, may act as crowding-in catalyst through the provision of key infrastructures (e.g., transport, communication and irrigation projects). Thus, at the theoretical level, the effect of $I^{g}_{i,t}$ on $I^{p}_{i,t}$ is ambiguous. A $\beta_3 < 0$ would imply crowding-out; a $\beta_3 > 0$ means complementarity between $I^{g}_{i,t}$ and $I^{p}_{i,t}$; and $\beta_3 = 0$ entails one effect canceling the other. As discussed in section 1, a voluminous theoretical and empirical literature documents a positive effect of various indicators of financial development and credit flows on the productivity of physical capital and its accumulation rate. Hence, we expect $\beta_4 > 0$.

The irreversible nature of physical capital investment is well known (see for example, Pindyck, 1991). Physical capital, once installed, entails substantial costs for any alternative (different) usage. Consequently, investors are nervous about the social, political, and macroeconomic uncertainties, which may jeopardize their investment and production plans. A high and variable inflation rate as well as the volatility of real exchange rate is typically used to proxy macroeconomic uncertainty in the growth literature. Thus, *a priori*, we expect β_5 and β_8 should resume negative signs. In developing countries, the effect of real interest rate on private investment is potentially ambiguous. Under the neoclassical model, real interest rate is one of the key components of the user cost of capital; therefore, it should affect private investment negatively. However, models of financial repression (see among others, McKinnon, 1973; Shaw, 1973) emphasize a positive role of real interest rate on private sector investment in developing countries. They argue that a higher real interest rate increases the flow (supply) of bank credits which complements the private sector savings (which tend to be small and fragmented) and facilitates capital formation. Thus, $\beta_6 < 0$ would

imply the cost of capital effect whereas $\beta_6 > 0$ would support the 'complementarity' hypothesis; if $\beta_6 = 0$ then two opposing effects cancel one another.[9] A devaluation of exchange rate affects aggregate demand through expenditure-reducing (resulting from adverse real balance and real wealth effects) and expenditure-switching (emanating from relative price changes between domestic and foreign markets). On the demand side, expenditure-reducing effect will depress private investment whereas expenditure-switching may have the opposite effect. On the supply side, the sectoral relative price changes may stimulate private investment in the tradable goods sector at the cost of non-tradable goods sector. Thus, devaluation affects private investment through several channels. If devaluation does not lead to a proportionate price rise then it will have a positive effect on private investment. However, if devaluation leads to proportionate inflation then it is likely to depress private investment through other channels as well. Thus, the effect of real exchange rate on private investment is ambiguous; hence, $0 \leq \beta_7 \leq 0$. As discussed in section 1, accumulated external debt stock and debt servicing adversely affect private investment. A large debt stock may reduce the credibility of domestic economic policies and increase macroeconomic uncertainty. Likewise, a high debt servicing reduces resource availability for domestic investment. Both of these effects depress private investment; hence we expect β_9 and $\beta_{10} < 0$.

Specification (1) is standard in the literature. Yet, it merely allows for unobservable individual and time effects. All other parameters are assumed homogeneous across all countries in the panel. However, as pointed out above, the assumption of cross-country parameter homogeneity is quite strong and it is unlikely to hold. Hence, we model the cross-country heterogeneity in domestic private investment behaviour by estimating the following model:

$$\begin{aligned} I^p_{i,t} = {} & \alpha_i + \gamma_t + \lambda_0 I^p_{i,t-1} + \lambda_1 (y\bar{p}_i * I^p_{i,t-1}) + \lambda_2 (\bar{r}_i * I^p_{i,t-1}) + \lambda_3 (\bar{\pi}_i * I^p_{i,t-1}) + \lambda_4 (f\bar{d}_i * I^p_{i,t-1}) \\ & + \beta_k' X_{k,i,t} + \delta_k' (y\bar{p}_i * X_{k,i,t}) + \theta_k' (\bar{r} * X_{k,i,t}) + \varphi_k' (\bar{\pi}_i * X_{k,i,t}) + \phi_k' (f\bar{d}_i * X_{k,i,t}) + e_{i,t} \\ & \text{where } X_{k,i,t} = [y^p_{i,t-1}, \dot{y}^p_{i,t}, I^g_{i,t}, fd_{i,t-1}, \pi_{i,t}, r_{i,t}, rex_{i,t}, rexs^d{}_{i,t}, b_{i,t-1}, bs_{i,t-1}]'; \end{aligned} \tag{2}$$

$$\bar{W}_i = T_i^{-1} \sum_{t=1}^{T_i} W_{i,t} \; W_{i,t} \in (yp_{i,t}, r_{i,t}, \pi_{i,t}, fd_{i,t}) \text{; and (k= 1,…,10).}$$

Specification (2) is a dynamic heterogeneous panel model which allows slope parameters and the adjustment dynamics (λ_j) of private investment function to differ across countries.[10] Country-specific parameters are linearly related to the country-specific mean levels of per capita income, real interest rate, inflation and financial

[9] It should also be noted however that Keynesians have complained about the very weak cost of capital effect even for developed economies.

[10] See Pesaran et al. (2000: 53-82) for the theoretical development and empirical implementation of this approach. Specification (2) is not motivated by time-varying parameters; instead, it is assumed that the slope coefficients in each country are fixed over time but vary across countries linearly with $\bar{W}_i$.

development. At the estimation stage, (see Section 4) we use different measures of financial development.

Since all the potential determinants of private investment specified in equation (1) exhibit important differences across the sample of countries (see Section 2), conceptually, they all can be candidates for explaining the cross-country heterogeneity in productivity parameters. However, in our specification we allow diversity in only four key variables, namely, the mean values (levels) of real per capita income ($y\bar{p}_i$), real interest rate ($\bar{r}_i$) inflation ($\bar{\pi}_i$) and the indicators of financial development ($f\bar{d}_i$) to enter into the model. This is done with a view to keep the model tractable. If the mean values of all the potential determinants (ten in total) are to be allowed then our unrestricted model will have one hundred and ten parameters. However, concentrating on only four key macroeconomic variables leaves us with 50 unrestricted parameters and thus circumvents from over-parameterisation of the model.

Equation (2) nests static and some dynamic models. If $\lambda_j = \delta_k^{'} = \theta_k^{'} = \varphi_k^{'} = \phi_k^{'} = 0$ holds for j=(0,1,..,4); then the relationship is static. If $\lambda_j = 0 \cup \delta_k^{'} = \theta_k^{'} = \varphi_k^{'} = \phi_k^{'} \neq 0$ for j=1,..,4; then the relationship is heterogeneous in slope parameters but homogeneous in adjustment dynamics; if however $\lambda_j \neq 0 \cup \delta_k^{'} = \theta_k^{'} = \varphi_k^{'} = \phi_k^{'} \neq 0$, holds true then the relationship is heterogeneous in all parameters. From (2) the vector of the country-specific parameters can be obtained as:

$$\zeta_i = \zeta_1 + (\zeta_2 * y\bar{p}_i) + (\zeta_3 * \bar{r}_i) + (\zeta_4 * \bar{\pi}_i) + (\zeta_5 * f\bar{d}_i) \qquad (3)$$

where $\zeta = [\lambda_j, \beta_k, \delta_k, \theta_k, \varphi_k, \phi_k]'$.

Econometric issues

Three issues prominently feature in the estimation of equation (2). These are: (i) the potential endogeneity due to the joint determination of some of the right- and left-hand-side variables; (ii) inertia (a common phenomenon in annual macroeconomic time series which may cause bias and imprecision of the estimated parameters); and (iii) measurement errors. The system GMM estimator addresses these estimation issues and appears best suited for our purpose.

For a brief illustration of GMM, we rewrite equation (2) by suppressing the interaction terms for simplicity but without loss of its generality, as:

$$y_{i,t} = \alpha_i + \gamma_t + \lambda y_{i,t-1} + X_{i,t}\xi + v_{i,t} \qquad (4)$$

where y_{it} denotes $I_{i,t}^{p}$; $X_{k,i,t} = [y_{i,t-1}^{p}, \dot{y}_{i,t}^{p}, I_{i,t}^{g}, fd_{i,t-1}, \pi_{i,t}, r_{i,t}, rex_{i,t}, rexs^{d}{}_{i,t}, b_{i,t-1}, bs_{i,t-1}]$ and $\xi = \beta_k{}'$. If $E(v_{it}v_{is}) = 0$ holds for s≠t across all 'i', then the following moment conditions are valid (see Holtz-Eakin, Newey and Rosen 1988; and Arellano and Bond 1991):

$E(y_{i,t-s}\, \Delta v_{it}) = 0$ for s≥2; t= 3,…, T. (5)

Furthermore, if X_{it} are weakly exogenous then the following additional moment conditions are also valid:

$$E(X_{i,t-s}\,\Delta v_{i,t})=0 \quad \text{for } s\geq 2; \qquad t= 3,\ldots, T. \tag{6}$$

The difference GMM estimator exploits the above moment conditions and uses the lagged (two periods or more) levels of endogenous and weakly exogenous variables of the model as instruments to address endogeneity.[11] However, when data are persistent and the time-series dimension is moderately short, the difference estimator suffers from the problem of weak instruments. Internally generated instruments and the regressors tend to be poorly correlated. Consequently, estimates suffer from large finite sample biases and poor precision (see among others, Ahn and Schmidt, 1995 and Staiger and Stock, 1997). However, the system GMM estimator due to Arellano and Bover (1995) and Blundell and Bond (1998) considerably reduces the biases and imprecision associated with the difference GMM estimator.

The system GMM estimator estimates a system of equations in the first differences and levels. It pools (T-s) transformed (first difference) equations with an additional set of (T-s) level equations (note $s \geq 2$). The first difference specification uses the suitably lagged levels as instruments whereas the level equations utilize the suitably lagged first differences as instruments. The latter's validity is based on the following moment conditions:

$$E[(\alpha_{i,t} + v_{i,t})\,\Delta y_{i,t-s}] = 0 \text{ for } s=1 \tag{7}$$

$$E[(\alpha_{i,t} + v_{i,t})\,\Delta X_{i,t-s}] = 0 \text{ for } s = 1 \tag{8}$$

The validity of the set of instruments used as well as the absence of residual serial correlation are key to the consistency of GMM estimators. We perform Sargan's instruments validity test and the Difference-Sargan test to establish the validity of the instruments used. A second-order serial correlation test is performed to check residual serial correlation.

4 Empirical results

As a precursor, in Table 2 we report the results obtained from a typical first-order-autoregressive panel data model that allows for the fixed-effect and individual invariant time effects. This is an extensively used approach in the panel literature and it allows us to compare our results with those in the literature. Results in the first column show that the standard variables that economic theory postulates to affect private investment are indeed significant. The growth rate of per capita income positively and significantly explains private investment whereas the lagged level of per capita income appears

[11] The first difference specification gets rid of the fixed effects. However, other equally valid transformations include mean deviation and/or orthogonal deviations (see Arellano and Bond 1991). Equation (2) uses mean deviations.

positive but marginally fails significance at 10 per cent. Public investment appears significantly negative which supports the crowding-out hypothesis. Inflation, as expected, is negatively signed and significant. The coefficients of real interest rate and real exchange rate appear negatively signed but insignificant; consistent with the theoretical predictions that their effect may be ambiguous. The level of debt stock significantly reduces private investment for this panel of countries but debt service appears insignificant. The second and third columns augment the basic model (column 1) with measures of financial development. Only two measures of financial development, credit flows to private sector and BANK, appear significant. However, results in the last column show that credit flows dominate the BANK.[12] The significance of credit flows to private sector also indicates that private investment may be credit rationed in these economies. The results show significant fixed and time effects. Tests of the first and second order residual serial correlation reveal that residuals are serially uncorrelated. Overall, these results broadly echo the findings reported elsewhere in the literature.

However, results of the models reported in Table 2 do not capture cross-country heterogeneity; nor they address endogeneity. Table 3 reports the results obtained from our dynamic heterogeneous panel model specified in equation (2). We report results based on three different estimators, namely, the dynamic heterogeneous OLS, the single-equation GMM, and the system GMM in order to gauge the robustness of our results. In sharp contrast to the fixed-effect estimates of Table 2, regressors interacted with country-specific mean values appear highly significant in almost all cases. Thus, these results reject the homogeneity of slope coefficients and adjustment dynamics across all the sample countries. All the coefficients associated with the key determinants of private investment behaviour show significant cross-country variations. The parameters of private investment functions are country-specific and they systematically depend on the country-specific macroeconomic conditions such as the levels of real income, inflation, real interest rate, bank credit flows to the private sector and the levels of financial development. Our results also reveal that the cross-country adjustment dynamics of private investment depends on the levels of real income, real interest rate and the bank credit flows to the private sector. The signs of the estimated parameters suggest that relatively rich countries and countries with a developed financial system tend to show quicker adjustment of private investment behaviour. However, higher real interest rate appears to slow down the rate of adjustment. The latter may be due to the high adjustment cost.

[12] Other measures of financial development employed in the paper, i.e. LLY, PRIVATE and PRIVY, do not appear to be significant. Our results seem to indicate that it is the flow of credit to the private sector which is crucial for private sector investment. This finding is interesting because all countries in our sample are developing countries where capital markets play little role in raising equity capital.

Table 2: The fixed effects panel estimates

Specification: $$I^{p}_{i,t} = \alpha_i + \gamma_t + \lambda I^{p}_{i,t-1} + \beta_1 y^{p}_{i,t-1} + \beta_2 \dot{y}^{p}_{i,t} + \beta_3 I^{g}_{i,t} + \beta_4 fd_{i,t-1} + \beta_5 \pi_{i,t} + \beta_6 r_{i,t} + \beta_7 rex_{i,t} + \beta_8 rexs^{d}_{i,t} + \beta_9 b_{i,t-1} + \beta_{10} bs_{i,t-1} + e_{i,t}$$

	Estimator: OLS			
Constant	5.500**	6.622***	4.850**	6.138***
	(0.011)	(0.003)	(0.033)	(0.008)
$I^{p}_{i,t-1}$	0.695***	0.668***	0.691***	0.667***
	(0.000)	(0.000)	(0.000)	(0.000)
$y^{p}_{i,t-1}$	0.191	0.145	0.162	0.127
	(0.114)	(0.268)	(0.199)	(0.342)
$\dot{y}^{p}_{i,t}$	7.914*	8.176*	7.839*	8.114*
	(0.090)	(0.056)	(0.091)	(0.060)
$I^{g}_{i,t}$	-0.226***	-0.236***	-0.229***	-0.238***
	(0.000)	(0.000)	(0.000)	(0.000)
$\pi_{i,t}$	-0.001**	-0.002***	-0.0009***	-0.002***
	(0.012)	(0.000)	(0.001)	(0.000)
$r_{i,t}$	-0.027	0.0002**	0.038	0.002**
	(0.371)	(0.038)	(0.270)	(0.045)
$rex_{i,t}$	-0.301	-0.046	-0.120	0.067*
	(0.618)	(0.942)	(0.839)	(0.916)
$rexs^{d}_{i,t}$	-0.660	-1.204	-0.555	-1.111
	(0.720)	(0.512)	(0.770)	(0.552)
$b_{i,t-1}$	-0.025***	-0.023***	-0.023***	-0.022***
	(0.003)	(0.003)	(0.005)	(0.005)
$bs_{i,t-1}$	0.044	0.038	0.036	0.033
	(0.400)	(0.494)	(0.499)	(0.557)
$cr_{i,t-1}$	-	6.832***	-	6.561***
		(0.002)		(0.002)
$bn_{i,t-1}$	-	-	1.391*	0.940
			(0.101)	(0.285)
α_i	(0.000)***	(0.000)***	(0.000)***	(0.000)***
γ_t	(0.000)***	(0.000)***	(0.000)***	(0.000)***
R^2	0.873	0.877	0.874	0.877
σ	2.026	2.001	2.024	2.002
AR(1)	(0.421)	0.454	0.422	0.445
AR(2)	(0.230)	0.402	0.256	0.444
Observations	464	464	464	464

Note: (.) are p-values. AR(1) and AR(2) are first and second order LM tests of residual correlations. In this and subsequent tables 'cr' and 'bn' respectively denote the CREDIT and BANK measures of financial development.

It is interesting to note that countries with high levels of per capita income and high real interest rate tend to show a large marginal effect of real income (per capita) on private

investment. Thus, the real income effect on private investment appears heterogeneous across rich and poor countries. However, the income effect appears to dwindle when countries suffer from a high rate of inflation. Likewise, the marginal effect of real income growth on private investment increases with a higher level of per capita income but it lessens with higher inflation. Thus, our results suggest that the effects of the income and real income growth on private investment are closely linked to the levels of income, real interest rate and inflation of the country concerned and the relevant parameters are country specific.

Real interest rate is another important determinant of private investment. However, the effect of real interest rate on private investment is also country specific and depends on the level of real income (proxied by $y^{p}_{i,t-1}$) and financial development (proxied by credit flows to GDP ratio to the private sector). We find that the level of real interest appears to support the 'complementarity' hypothesis in developing countries because the coefficient of real interest rate ($\partial I^{p} / \partial r_{i,t}$) is significantly positive. Moreover, a higher real interest rate appears to increase private investment because $\partial I^{p} / \partial \overline{r}^{*}_{i} \, r_{i,t} > 0$. Interestingly, however, when these countries acquire higher level of income ($\overline{y}^{p}_{i}$) and higher financial development ($\overline{cf}_{i}$) the neoclassical effect becomes significant (the real interest rate resumes significantly negative coefficient when interacted with $\overline{y}^{p}_{i}$ and $\overline{cf}_{i}$). Thus, our results indicate that for the low-income countries the 'complementarity' hypothesis may apply but for the middle income countries the neoclassical prediction appears more consistent.

Public investment significantly reduces private investment and the extent of crowding out effect appears directly related with the country specific level of real income. Countries with higher real per capita income experience more crowding out and vice versa. We find that inflation significantly reduces private investment and a higher level of inflation magnifies this perverse effect; thus, the inflation effect is also country specific. Results show that debt stock affects private investment negatively and the magnitude of this effect appears to depend on the level of financial development. We find that the negative impact of debt stock on private investment increases with the level of financial development. This may indicate the information processing and signal extraction capacity of financial development. Surprisingly we do not find statistically significant effect of debt service to GDP ratio. Finally, financial development exerts significantly positive effect on private investment in sample countries. The effect of financial development on private investment is country-specific whereby the magnitude of the effect tends to increase when countries become more financially developed. The qualitative nature of our results is robust to all three estimators and the estimated models pass diagnostic checks. Tests for the first and second-order residual serial correlation suggest that residuals are well behaved. Sargan tests confirm the validity of the instruments in both GMM models. The fixed and time effects appear significant.

Table 3: The dynamic heterogeneous panel estimates

$$I_{i,t}^{p} = \alpha_i + \gamma_t + \lambda_0 I_{i,t-1}^{p} + \lambda_1 (\overline{yp}_i * I_{i,t-1}^{p}) + \lambda_2 (\overline{r}_i * I_{i,t-1}^{p}) + \lambda_3 (\overline{\pi}_i * I_{i,t-1}^{p}) + \lambda_4 (\overline{fd}_i * I_{i,t-1}^{p}) + \beta_k^{'} X_{k,i,t} + \delta_k^{'} (\overline{yp}_i * X_{k,i,t}) + \theta_k^{'} (\overline{r} * X_{k,i,t}) + \varphi_k^{'} (\overline{\pi}_i * X_{k,i,t}) + \phi_k^{'} (\overline{fd}_i * X_{k,i,t}) + e_{i,t}$$

	OLS	GMM-Single equation	System-GMM
Constant	5.446(0.777)	4.739 (0.801)	1.159 (0.967)
$r_{i,t}$	0.113(0.000)***	0.085 (0.005)**	0.064 (0.020)**
$rex_{i,t}$	6.823e-006(0.00)***	-	-
$\pi_{i,t}$	-0.002(0.001)***	-0.002(0.002)***	-0.003 (0.005)**
$\overline{yp}_i * I_{i,t-1}^{p}$	0.060(000)***	0.053(0.000)***	0.052(0.002)***
$\overline{r} * I_{i,t-1}^{p}$	-0.001(0.000)***	-0.001(0.000)***	-0.001(0.000)***
$\overline{cr}_i * I_{i,t-1}^{p}$	2.980(0.018)**	3.491(0.011)**	3.552(0.021)**
$\overline{yp}_i * y_{i,t-1}^{p}$	0.184(0.051)**	0.211(0.02)**	0.224(0.010)**
$\overline{r}_i * y_{i,t-1}^{p}$	0.011(0.085)*	0.014(0.034)**	0.014(0.036)**
$\overline{\pi}_i * y_{i,t-1}^{p}$	-0.020(0.058)*	-0.022(0.030)**	-0.024(0.013)**
$\overline{yp}_i * \dot{yp}_{i,t}$	2.044(0.000)***	2.199(0.003)***	2.246(0.004)***
$\overline{\pi}_i * \dot{yp}_{i,t}$	-0.048(0.063)*	-0.059(0.062)*	-0.048(0.057)*
$\overline{r}_i * r_{i,t}$	0.031(0.007)***	-	-
$\overline{cr}_i * r_{i,t}$	-0.165(0.001)***	-0.059(0.005)**	-0.045(0.021)**
$\overline{yp}_i * r_{i,t}$	-0.014(0.000)***	-0.009(0.005)**	-0.007(0.020)**
$\overline{yp} * I_{i,t}^{g}$	-0.032(0.000)***	-0.040(0.000)***	-0.043(0.000)***
$\overline{\pi} * \pi_{i,t-1}$	-0.008(0.000)	-0.008(0.000)***	-3.454(0.000)***
$\overline{bn}_i * b_{i,t-1}$	-0.030(0.029)**	-0.029(0.044)**	-0.030(0.036)**
$\overline{bn} * bn_{i,t-1}$	3.949(0.015)**	4.207(0.044)**	4.724(0.025)**
$\overline{cr} * cr_{i,t-1}$	53.386(0.000)***	54.628(0.001)***	54.562(0.000)***
α_i	(0.000)***	(0.000)***	(0.000)***
γ_t	(0.000)***	(0.000)***	(0.000)***
R^2	0.892***	-	-
σ	1.892	1.907	1.916
AR(1)	0.466	0.466	0.153

table continues…

AR(2)	0.872	0.872	0.520
Sargan	-	χ^2 [1532]=340.1	-
Diff-Sargan	-	-	χ^2 [153]=33.6
Observations	468	468	468

Note: Numbers in (.) indicate p-values.

Table 4: Country specific parameters system GMM (elasticities)

	λ_i	r_i	I_i^g	π_i	b_i	bn_i	cr_i	y_i^p	$\dot{yp}_i$
Argentina	0.209	-0.109	-0.083	-1.326	-0.058	0.148	0.038	0.616	1.137
Barbados	0.571	0.000	-0.108	-0.015	-0.063	0.271	0.003	0.140	1.468
Belize	0.506	0.005	-0.312	-0.007	-0.097	0.282	0.005	0.145	1.422
Brazil	0.417	-0.132	-0.115	-1.283	-0.030	0.064	0.178	0.751	0.986
Chile	0.801	0.001	-0.121	-0.139	0.000	0.000	0.042	0.102	1.156
Colombia	0.506	0.011	-0.241	-0.398	-0.005	0.001	0.007	0.128	1.551
Costa Rica	0.545	-0.001	-0.133	-0.257	-0.031	0.015	0.004	0.084	1.162
Ecuador	0.288	-0.022	-0.130	-1.058	-0.127	0.157	0.000	0.004	0.784
El Salvador	0.403	0.000	-0.116	-0.150	-0.058	0.162	0.000	0.123	1.490
Granada	0.621	0.000	-0.261	-0.010	-0.065	0.196	0.010	0.089	0.941
Guatemala	0.461	-0.003	-0.098	-0.133	-0.056	0.258	0.002	0.122	1.485
India	0.420	0.012	-0.172	-0.055	-0.003	0.001	0.005	0.094	1.004
Kenya	0.406	0.009	-0.166	-0.149	-0.142	0.227	0.004	0.089	1.068
Malawi	0.306	-0.037	-0.362	-0.911	-0.328	0.289	0.002	0.075	1.798
Malaysia	0.746	0.001	-0.217	-0.006	-0.068	0.215	0.025	0.087	0.882
Mauritius	0.611	0.001	-0.156	-0.042	-0.064	0.192	0.011	0.094	1.025
Mexico	0.627	-0.001	-0.135	-0.386	-0.077	0.233	0.009	0.082	1.248
Morocco	0.501	0.002	-0.225	-0.023	-0.137	0.183	0.007	0.112	1.186
Pakistan	0.442	0.001	-0.253	-0.069	-0.110	0.230	0.008	0.137	1.555
Philippines	0.500	0.001	-0.088	-0.064	-0.015	0.004	0.005	0.075	0.869
Thailand	0.658	0.002	-0.103	-0.010	-0.001	0.000	0.014	0.064	0.655
Tunisia	0.590	0.002	-0.290	-0.026	-0.107	0.261	0.013	0.107	1.138
Turkey	0.674	-0.003	-0.162	-1.311	-0.056	0.154	0.019	0.028	0.968
Uruguay	0.903	0.000	-0.172	-2.289	-0.083	0.188	0.099	0.075	1.812
Mean	0.523	-0.011	-0.176	-0.421	-0.074	0.155	0.021	0.143	1.200
SD	0.163	0.035	0.077	0.609	0.069	0.102	0.039	0.171	0.310

Note: Argentina, Brazil, Mexico and Turkey historically had very high rates of inflation, however, in recent years they have come down. Latin American countries in particular have significantly improved their inflation records in recent years. The reported inflation elasticities for Argentina, Brazil and Turkey are computed at the mean inflation rate of 50 percent; for Mexico it is 26 percent. Deletion of some major inflation outliers gives a mean inflation rate of these magnitudes for these countries. The use of unadjusted mean inflation rates produces huge negative point elasticity of inflation for these four countries. Note that we do not adjust inflation series in any of our estimations.

Source: Obtained from the estimates of Table 3.

Table 5: Country specific parameters (OLS elasticities)

	Lamda	r	l^g	π_i	b_i	bn_i	cr_i	y_i^p	$\dot{yp}_i$
Argentina	0.829	0.185	-0.060	-1.297	-0.055	0.119	0.036	0.005	0.310
Barbados	0.627	0.000	-0.078	-0.014	-0.059	0.217	0.003	0.103	0.511
Belize	0.546	0.118	-0.225	-0.006	-0.092	0.226	0.005	0.113	0.498
Brazil	1.149	0.173	-0.083	-1.255	-0.029	0.052	0.167	-0.004	0.259
Chile	0.803	0.101	-0.087	-0.135	0.000	0.000	0.040	0.068	0.380
Colombia	0.543	0.391	-0.174	-0.388	-0.004	0.001	0.006	0.078	0.487
Costa Rica	0.591	0.032	-0.096	-0.250	-0.030	0.012	0.004	0.041	0.370
Ecuador	0.327	0.186	-0.094	-1.034	-0.120	0.126	0.000	-0.053	0.183
El Salvador	0.461	0.000	-0.084	-0.146	-0.055	0.130	0.000	0.075	0.491
Granada	0.652	0.000	-0.188	-0.009	-0.062	0.157	0.009	0.065	0.327
Guatemala	0.508	0.015	-0.071	-0.129	-0.053	0.207	0.002	0.073	0.492
India	0.445	0.128	-0.124	-0.054	-0.003	0.001	0.005	0.067	0.335
Kenya	0.434	0.079	-0.119	-0.145	-0.134	0.182	0.004	0.054	0.343
Malawi	0.339	0.217	-0.261	-0.888	-0.310	0.232	0.002	-0.021	0.507
Malaysia	0.755	0.013	-0.157	-0.005	-0.065	0.172	0.023	0.066	0.308
Mauritius	0.640	0.015	-0.113	-0.041	-0.060	0.154	0.010	0.066	0.348
Mexico	0.669	0.147	-0.097	-0.377	-0.073	0.187	0.009	0.031	0.391
Morocco	0.533	0.011	-0.162	-0.022	-0.130	0.147	0.006	0.081	0.408
Pakistan	0.469	0.002	-0.183	-0.066	-0.105	0.184	0.008	0.091	0.524
Philippines	0.531	0.004	-0.064	-0.063	-0.014	0.003	0.005	0.048	0.289
Thailand	0.670	0.033	-0.074	-0.009	-0.001	0.000	0.013	0.048	0.226
Tunisia	0.615	0.011	-0.209	-0.025	-0.101	0.209	0.013	0.077	0.391
Turkey	0.696	0.126	-0.117	-1.282	-0.053	0.123	0.018	-0.031	0.251
Uruguay	0.897	-0.001	-0.124	-2.239	-0.078	0.150	0.093	-0.023	0.483
Mean	0.614	0.083	-0.127	-0.412	-0.070	0.125	0.020	0.047	0.380
SD	0.814	0.098	0.056	0.595	0.065	0.082	0.037	0.045	0.101

Source: Obtained from the estimates of Table 3.

Parameters in Table 3 are semi-elasticities hence interpretation of their magnitude is not straightforward. In Table 4 we report the country-specific parameters (elasticities) associated with each of the significant regressor reported in Table 3 under the System GMM approach (country-specific parameters associated with OLS elasticities are also reported in Table 5). These country specific parameters are calculated by using the methodology set out in equation (3). We also report the cross-sectional mean and standard deviation of the country specific parameters. Although our results are robust to different estimators, our focus on the system GMM estimator is due to its superiority over other estimators. Country-specific parameters show positive effect of real income and income growth for all countries in the sample. This is consistent with the priori expectation and findings elsewhere. What is revealing is the cross-country variations in the parameters of $y_{i,t}^p$ and $\dot{yp}_{i,t}$. The elasticity of private investment with respect to real per capita income ranges between a minimum of 0.004 (Ecuador) to a maximum of

0.751 (Brazil); the cross-country mean is 0.143. The elasticity of private investment with respect to real per capita income growth ranges between 0.784 (Ecuador) to 1.812 (Uruguay). Two indicators of financial development (CREDIT and BANK) positively affect private sector investment but the cross-country parameters are profoundly divergent. The point elasticity of BANK varies between 0.001 (e.g., India) to 0.289 (Malawi) whereas the point elasticity of CREDIT diverges between 0.001(El Salvador) to 0.178 (Brazil). The elasticity of private investment with respect to debt stock, inflation and public investment are uniformly negative for all countries however cross-country variations in parameters are apparent. The estimates of point elasticity vis-à-vis real interest rate are quite interesting. For eight countries we find a negative effect of real interest rate on private investment (consistent with neoclassical model) and for the rest the point elasticity is positive (consistent with the complementarity effect). The overall panel mean is -0.011. The country-specific parameters of lagged dependent variable also exhibit tremendous variation and hence a different speed of adjustment.

5 Concluding remarks

In this paper, we examined the domestic private investment behaviour of a panel of 24 low-income and middle-income countries spanning a period of 1981-2000. We rigorously address two important issues—(i) the cross-country heterogeneity in private investment behaviour, and (ii) endogeneity—that have remained largely overlooked by previous empirical studies of private investment behaviour.

Financial sector development (measured by various indicators) and other standard macroeconomic determinants of private investment appear significant in explaining private investment behaviour in our sample. However, the estimated parameters and adjustment dynamics exhibit important cross-country differences. More precisely, our empirical results clearly suggest that the parameters of private investment functions are country-specific and they systematically depend on the country-specific macroeconomic conditions such as the levels of real income, inflation, real interest rate, and the levels of financial development. Our findings also indicate that the effect of real income and income growth on private investment is closely linked to the levels of income, real interest rate and inflation of the country concerned; and hence these parameters are country specific. We also found that the level of real interest appears to support the ‘complementarity’ hypothesis in the case of developing countries provided they are characterized by low level of inflation. For high inflation countries, we find a negative point elasticity of real interest rate on private investment. Furthermore, our estimates seem to confirm the crowding-out relationship between public and private investment and that the extent of crowding-out effect appears directly related to the country specific level of real income - high income countries experience more crowding-out and vice versa. We find that inflation significantly reduces private investment but a higher level of inflation magnifies this effect. The inflation effect is also country specific. Our results show that the debt stock affects private investment negatively and the magnitude

of this effect appears to depend on the level of financial development that each country has acquired; this is consistent with the information gathering and processing capacity of a developed financial system. Surprisingly, however, we do not find a statistically significant effect of debt service to GDP ratio on private investment. Finally, we find that financial sector development has a significantly positive effect on private investment in our sample countries; and this effect is country-specific whereby the magnitude of the effect tends to be positively associated with the level of financial development. Our results are robust to a range of estimators used and the estimated models perform well vis-à-vis the key misspecification diagnostics.

Two important implications arise from our analysis. First, the cross-country heterogeneity is an acutely important facet of private investment behaviour and it must be addressed. Second, at the policy level, the country-specific approach appears potentially more effective than the one-size-fits-all approach for boosting private investment.

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