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Does Public Investment Crowd Out Private Investment? Evidence On Investment And Growth In Asia, 1971-2000

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Abstract

The paper looks at the growth and investment performance of six Asian countries - Bangladesh, India, Indonesia, Malaysia, Pakistan and Thailand. Having discussed the time series properties of the public and private investment series and the GDP growth rate, the paper goes on to use the concept of Granger-block causality in a three-variable VAR in the presence of possible unit roots. The analysis is based on the lag-augmented VAR concept developed by Toda and Yamamoto (1995). We find that no single relationship holds in all countries and that the relationship between public and private investment varies from country to country.

Keywords: Public investment, private investment, Granger-causality, Asia

JEL Classification: C32, E22, E62

1. Introduction

This paper is looking at the diverse growth experiences of a number of Asian countries over the last 25-30 years, particularly at the role of public and private investment in the growth process. Like various existing empirical studies of growth in developing countries, we examine the relative contribution of public investment in development and, in particular, its relation to private investment. Two possible effects are well known in the literature. Complementarity or crowding-in effect of public investment is said to occur by increased spending on infrastructure and more generally public services increasing the returns to private capital and/or reducing the costs of private investment. The other view regards public investment as a substitute for private investment, and posits that crowding-out takes place with public investment usurping scarce resources (public funds, credit, etc.) that would otherwise go to the private sector. As a result, public investment harms the private one via taxation, risk premia (if public investment is funded through excessive

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borrowing and indebtedness), or inflation. Yet a third view might question the empirical relevance of either of the above polar views.

The two opposite effects of public services (the one that augments the return to private investment due to public capital and services and the negative one due to higher taxation) have been synthesised in an elegant theoretical formulation by Barro (1990).[1] This analysis yields an optimal rate of expenditure on public services from the point of view of maximising social welfare. Based on this result, Miller and Tsoukis (2001) find that in the vast majority of countries world-wide, governments spending is at strongly sub-optimal levels. Not surprisingly, empirical support of both views exists. In the developing economies literature, Sundararajan and Thakur (1980) report no significant relationship between government and private investment. Tai and Wong (1982) report a positive, but insignificant, effect of government investment on private investment. Blejer and Khan (1984) disaggregated government investment into infrastructural and non-infrastructural government investment and reported a positive impact of infrastructural government investment and a negative impact of non-infrastructural investment on private investment. Pradhan et al. (1990) reported crowding-out for their study of the Indian economy. Shafiq (1992) also reports a positive impact of infrastructural government investment on private investment, a result confirmed by Greene and Villanueva (1991) when using public investment as ratio of GDP. In the case of Pakistan, Sakr (1993) reported a positive impact of both total government investment as well as infrastructural investment, with non-infrastructural investment being negatively correlated to private investment. Finally, in terms of contribution to economic growth, Khan and Reinhart (1990) demonstrate that private investment is more efficient than public investment, but qualify their result by noting that there might be significant indirect benefits of public investment. Similar results are obtained by Khan and Kumar (1997).

The aim of this paper is to shed light on crowding-in and -out by public of private investment using time-series since 1971 from a sample of six Asian countries - Bangladesh, India, Indonesia, Malaysia, Pakistan and Thailand. The choice of countries aims at juxtaposing and comparing the performance of central South Asia countries that have seen their living standards rise only very sluggishly in recent decades, with those of a sample drawn from the more dynamic South East Asian group. The ultimate objective is, naturally, to relate if possible the emerging patterns of public investment to diverging growth experiences. As a caveat, the theory of the second best reminds us that there is no golden rule for government action, which should depend on specific circumstances. This implies that, in examining empirical evidence on public and private investment, it should be kept in mind that the results (crowding-in or -out, etc.) possibly depend on factors specific to the country being studied - a point made by Kenny and Williams (2001, p.11).

More specifically, the paper aims to study the question through Granger causality methods. Crowding-in may obviously be identified with causality running from public to private investment, with a positive coefficient; crowding-out would be much the same except that sign should be reversed. Finally, pushed to its logical

[1] Barro's result has been extended such that public services are generated by flow spending and public capital, essentially with similar results (see e.g. Tsoukis and Miller, forthcoming).

conclusion, the sceptical view mentioned above would argue that government spending is relatively innocuous and simply caters for the needs of the private sector generated by private investment itself; therefore, causality in this case should run from private to public investment. Apart from bi-directional causality, we also bring the growth rate for each country into the picture, recognising that both public and private investment affect the growth rate, but the latter may also be an important determinant of the investment rates, if it creates the markets, opportunities or needs for them. Thus, the contribution of this paper is to examine the determinants and effects of public investment, particularly in relation to growth and private investment, in two, arguably quite different, groups of Asian countries.

2. An Investment and Growth Narrative of Selected Asian Countries[2]

Looking at the public and private investment rates of the six Asian counties summarised in Table 3.1, one trend stands out. Private investment as a percentage of GDP has increased on average from decade to decade in each of the six counties under consideration. That having been said, the private investment rates of the three South-East Asian counties have been much greater than the South Asian counties. Interestingly, with the exception of Malaysia which has seen government invest at rates of 12-13% of its GDP in the eighties and nineties, all the other countries seem to have invested between 7 and 9% of their GDP in the public sector. The real difference in the total investment rates has been due to the private sector, where Pakistan comes out at the bottom of the group both for the entire period and for its performance in the nineties. For both the entire period and for the nineties the cardinal sequence for both total investment rates and private investment rates are the same, ranging from Pakistan having invested the least to Thailand investing the most. For private investment rates, all countries average their highest rates in the nineties, with Pakistan investing at just over 9% of GDP, Bangladesh investing at 13% of GDP, India averaging over 14.5%, Indonesia averaging just over 18.5%, Malaysia averaging 22.8%, and Thailand leading the group with 27% of its GDP invested each year on average in the last decade.

In addition, the total investment rates have also increased, on average, from decade to decade in five of six countries, with Pakistan as the only (marginal) exception, but the extent of increase has been different. The averages for the nineties show that in aggregate, Pakistan has invested less as a percentage of its GDP than any of the other six countries. Looking at South Asia only, Pakistan's average total investment is just above 16.5 % of GDP in the nineties, which compares with 20% for Bangladesh and just over 22% for India. South East Asia has had much higher rates of investment. In the nineties, for example, Malaysia averaged over 35% of GDP, Thailand averaged approximately 36%, and Indonesia averaged over 26% of GDP in investment.

[2] Gupta(1992) undertakes a similar descriptive analysis in his pioneering work on the subject.

Figure 1 : Private and public investment ratios (IP/GDP & IG/GDP) and GDP growth rates in selected Asian countries

Not surprisingly the economic growth rates are also much higher with Malaysia growing at an average of 8.68% between 1991-96, Indonesia growing at an average of 7.13%, and Thailand averaging a growth rate of 8.38%. This compares with an average of 4.9% for Pakistan, 5.13% for India and 4.35 % for Bangladesh over the same time period. The last years of the same decade saw high negative growth rates for South-East Asia because of the financial crisis, and the average growth rate dropped over the entire period as a result. Over 1991-99 Malaysia averaged a real growth rate of 6.98% , Thailand averaged 4.71% , and Indonesia averaged 3.91%. Another interesting empirical regularity seems to be that over the entire period, public investment has been more stable, as measured by standard deviation, than private investment in all countries except Pakistan.

In Pakistan alone does private investment have a lower standard deviation than public investment. It has to be said however that this may be just a characteristic of the time period in question. Pakistan had a much more active private sector in the sixties which is excluded from this sample, and as can be seen from figure 3.1 the Pakistani private sector has had a small but consistent upward trend throughout the last 30 years. The private sector is moving slowly, but the trend is upwards.

The figures in Table 1 point to some other interesting facts. The eighties saw total public investment grow in all cases except Pakistan, where it stayed roughly at the same level as in the 70's (as % of GDP). In the nineties public investment saw significant contraction in all counties, ranging between 1.5-2% of GDP, except Thailand which saw a rise of over 1.5% of GDP. In all countries, private investment grew from decade to decade throughout the last thirty years but the extent of growth varied widely as indicated earlier. It may be the case that the relationship between

private and public investment is different across different time periods, and econometric estimation may only give us the average effect.

Table 1 : Trends in Investment and Growth in Selected Asian Countries

Country	Time Period	GDP Growth* (%)	IP/GDP (%)	IG/GDP (%)	(IG+IP)/GDP (%)
Pakistan	AVG 1971-80	4.81	5.96	9.33	15.29
	AVG 1981-90	6.19	7.78	9.17	16.95
	AVG 1991-2000	4.18	9.29	7.26	16.54
	AVG 1971-2000	**5.09**	**7.68**	**8.58**	**16.26**
	STDEV 1971-2000	**2.16**	**1.56**	**1.96**	**2.00**
Bangladesh	AVG 1971-80	5.92	5.03	4.45	9.48
	AVG 1981-90	4.01	11.41	8.10	19.51
	AVG 1991-2000	4.76	12.99	6.67	19.66
	AVG 1971-2000	**4.78**	**10.15**	**6.55**	**16.70**
	STDEV 1971-2000	**2.67**	**3.74**	**2.07**	**5.31**
India	AVG 71-80	3.06	9.00	7.27	16.27
	AVG 81-90	5.87	10.97	9.70	20.67
	AVG 91-2000	5.51	14.61	7.53	22.13
	AVG 71-2000	**4.76**	**11.42**	**8.19**	**19.61**
	STDEV 71-2000	**3.22**	**2.63**	**1.43**	**2.87**
Indonesia	AVG 1971-80	8.00			
	AVG 1981-90	5.51	16.05	9.58	25.63
	AVG 1991-2000	3.91	18.66	7.87	26.53
	AVG 1971-2000	**5.87**	**17.29**	**8.77**	**26.06**
	STDEV 1971-2000	**4.34**	**3.08**	**1.63**	**2.43**
Malaysia	AVG 1971-80	8.30	16.40	8.91	25.31
	AVG 1981-90	5.94	17.12	13.41	30.53
	AVG 1991-2000	6.98	22.87	12.17	35.03
	AVG 1971-2000	**7.08**	**18.80**	**11.50**	**30.29**
	STDEV 1971-2000	**4.12**	**5.63**	**2.98**	**6.94**
Thailand	AVG 1971-80	6.79	17.64	6.57	24.21
	AVG 1981-90	7.89	22.69	7.14	29.83
	AVG 1991-2000	4.71	27.06	8.96	36.03
	AVG 1971-2000	**6.59**	**22.46**	**7.56**	**30.02**
	STDEV 1971-2000	**4.44**	**6.11**	**1.72**	**6.49**

Source:- IFC DiscussionPaper No. 44. *The GDP growth rates are based on 1995 prices. These are obtained by multiplying the 1995 current-price GDP with the GDP volume index (1995=100), from the IMF's CD-ROM.

3. A Flexible Accelerator Model for Investment

Our modelling strategy for later use in empirical work is to develop a "flexible accelerator" formulation of investment. This model was chosen because it links investment to demand and output, rather than cost-of-capital measures that are the focus of neoclassical formulations of investment (such as those based on Tobin's Q). Ample empirical evidence now exists that that stresses the primacy of demand and sales variables rather than cost-of-capital arguments (see Chirinko, 1993). This evidence is even stronger for developing countries (Sakr, 1993; among others). A theoretically justifiable construction of the 'flexible accelerator model' for private investment has been successfully attempted by various authors, along a generally similar pattern (see Wai and Wong, 1982; Blejer and Khan, 1984; Mavrotas ,1997 among others). In this section a general model based on these papers is presented.

One of the basic assumptions of this model is that in period t, private sector's desired capital stock is proportional to its expected output.

$$K^*_t = a\, Y^e_t \qquad (1)$$

where K^*_t represents the desired capital stock and Y^e_t is expected output in year t.

Further, private investment, IP_t, is related to capital stock by the following equation where K_t is the private capital stock, and δ denotes the proportional rate of depreciation.

$$IP_t = (K_t - K_{t-1}) + \delta K_{t-1} \qquad (2)$$

Applying the lag operator, L, we can write:

$$IP_t = (1-(1-\delta L))\, K_t \qquad (3)$$

Considerations such as availability of public infra-structural support, time required for installing new capital and planning, availability of required manpower, etc., mean that firms can only partially adjust to the desired long term capital stock. This phenomenon is introduced into the model through equation (4), where IP^*_t represents desired private investment, and β is the coefficient of adjustment.

$$IP_t - IP_{t-1} = \beta(IP^*_t - IP_{t-1}) \qquad (4)$$

From the review of literature on private investment in developing economies, Public Investment (IG) appears to be prime candidate to be included as a possible determinant of the speed of adjustment βin the above equation. Other factors that are possible candidates could include interest rates, fiscal deficits, aid, and macroeconomic uncertainty (see e.g. Dixit and Pindyck, 1994); however, explicit treatment and incorporation of such variables would expand the VAR to unmanageable proportions and are therefore beyond the scope of the empirical work presented in this paper. Instead, only include private investment so as to focus on the crowding-out issue. So, we assume the speed of adjustment of private investment to be a simple function of public investment, IG:

$$\beta = b_1 IG_t \qquad (5)$$

b_1 is directly related to our discussion on crowding-in or –our: $b_1>0$ indicates crowding-in while a negative sign suggests the IG is detrimental to private investment. From equations (3), (4), and (5) we get:

$$IP_t - IP_{t-1} = b_0((1-(1-\delta L)K^*_t - IP_{t-1}) + b_1 IG_t \qquad (6)$$

From equation (1) and (6) we can then derive the following form:

$$IP_t = ab_0(1-(1-\delta L)Y^e_t + b_1 IG_t + (1-b_0)IP_{t-1} \qquad (7)$$

The first term of equation (7) reflects the accelerator component of the model, and is based on private sector output. Many authors use GDP as a proxy for private

sector output because of data problems in developing countries (e.g., Blejer and Khan, 1984; Sakr, 1993). While Blejer and Khan (1984) uses the expected change in GDP as the accelerator component, Sakr (1993) argues that actual change in GDP is as good a proxy for expected change as approximations obtained by using either the distributed lag model or the adaptive expectations model. Following on from these arguments the first term is replaced by a constant, INPT, to capture the autonomous effects (e.g., institutional and other factors mentioned above that remain constant over the sample period), and actual change in real GDP, to stand in for expected change in private sector output. Finally, a time trend is also added to capture deterministic trends if present. The resulting model can be specified as,

$$IP_t = INPT + \theta t + b_1 IG_t + b_2 \Delta GDP_t + b_3 IP_{t-1} , \quad (8)$$

where Δ stands for the difference operator.

4. Time Series Evidence on Investment and Growth Rates

The simple model of Section 3 relates the dynamics of private investment to public investment and GDP. While most of Macroeconomic theory customarily treats government investment as exogenous, the "General Theory of Everything" ought to help explain and endogenise this variable. Whilst Barro's (1990) model may be thought as going towards this direction, a standardised framework is as yet lacking; but the point remains that government investment ought to be treated as endogenous. Likewise, the GDP growth rate is also endogenous to the model. Various models would reinforce this suggestion but, again, would differ in the details. For instance, the Solow growth model would tie down both (private) investment and the rate of growth of output to the exogenous rates of population and technological growth in the long run, but would otherwise relate investment and output more closely for a (possibly considerable) transitory period. Endogenous growth theories would de-emphasise (but not eliminate) the role of private investment in creating output, and would give a more pronounced role to spending on public services (among which is public investment) as part of the explanation for the evidently growing Solow residual. The main point is once again the endogeneity of the GDP growth rate, as is that of the private investment rate. These three variables are directly related to the crowding-in/out question and seem to suggest themselves as a subset on which VAR analysis can be based so that all variables are treated initially as endogenous. In order to emphasise the interrelationship between the growth rate and the public investment rate (the theme of Barro's (1990) work), we also include these variables in a bi-variate VAR.

Hence, we base empirical work on two- and three-variable VARs, including the Private and Public Investment, IPY and IGY, respectively; and those together with the GDP growth rate, Δy. Although there are arguments for including other conditioning (exogenous) variables in the VAR, the length of the time series of 30 years requires a parsimonious specification so as to avoid over-parameterisation. The estimated VARs are then tested for Granger-Block Causality of the included variables. In both cases, a maximum lag of three periods is deemed sufficient to capture the dynamics of the system. Before estimation, we examine the statistical properties of the data. The methodology is the Dickey-Fuller (1979, 1981) one as

has been extended and standardised over the years. Enders (1995) summarises well the procedure that should be followed in the case of an unknown Data Generating Process (DGP), in which case one should start from the most general specification encompassing both drift and time trend, test for the appropriate parsimonious specification and use it for inference.

It is however generally agreed that like all other available unit root tests, the ADF test has very low power and often fails to distinguish between unit root and near unit root processes and between deterministic and stochastic trend, particularly in small samples like ours.[3] In view of this, it is often essential to consider all other information in addition to the formal tests when deciding about the nature of the series. In our case, we are concerned with three variables- public and private gross investment rates (as % of GDP) and GDP growth rates, for which a number of remarks are important. It should be remembered that for true unit root processes (i.e., not those appearing to be so because of finite samples), shocks are permanent, so that a unit root process will not be bounded as it grows by accumulating innovations over time. Both investment and growth rates (first differences of the capital stock and GDP, respectively, as a percentage over GDP) are bounded between 0 and 1, and hence cannot possibly be true unit root process. However, as both Jones (1995) and Patterson (2000) point out, this does not preclude the possibility that over a finite interval the process may be characterised by a unit root process. In other words, investment and growth rates, like interest rates, are among the variables for which the unit root test results and strong economic intuition are often in conflict with each other.

Second, it is also important to bear in mind that net investment rates (adjusted for depreciation), are bound to be different from gross investment rates used here. As Jones (1995) points out in his examination of OECD countries investment and growth data, net investment may show no persistence at all, while gross investment is more likely to exhibit evidence of non-stationarity (particularly in view of the low power of the tests). However, calculation of net investment is dependent on the assumption of a particular depreciation rate for capital which itself is controversial as pointed out by Scott (1992) and Jones (1995), therefore we use gross investment here. One should also keep in mind that endogenous growth theory predicts persistence in growth rates (a large root even if not a unit root), and it would be surprising to find such evidence for developing countries when similar evidence is not forthcoming even for developed nations[4]. In the balance, in seems wise to be extremely wary of evidence of non-stationarity for GDP growth and investment rates.

The GDP growth rates appear to be stationary in all but Thailand's case. When the auto-correlation function of Thailand's growth rate is examined (not shown here), it is seen to decay rapidly, and carries a value of only 0.44 on the first lag, which

is so far from the value of unity to practically rule out a unit root. So it would appear that the ADF test is misleading, and all growth rates can easily be considered I(0). The evidence on investment rates is mixed. Following the Enders (1995)

[3] See e.g. Enders (1995), Harris (1995), and Patterson (2000).

[4] See Jones (1995) for results for OECD countries.

procedure, alluded to above, indicates that only Pakistan and Malaysia have stationary gross investment rates with the most general application of (1). Even though the inclusion of the deterministic trend appears to be crucial to this result, that is fully consistent with the recommendation of the Enders (1995) procedure. Bangladesh, India, and Thailand all appear to have I(1) Gross Private and Public Investment rates. This evidence is harder to dismiss, especially in light of similar evidence for one-third of all OECD countries presented by Jones (1995). Indonesia is not examined because of an insufficiently long data series.

Table 2: ADF Unit Root Tests (Null: Unit Root Exists)

Country	**Specification**	**Δy**	**IPY**		**IGY**	
			Level	**Diff.**	**Level**	**Diff.**
Pakistan	Constant	-4.1** (0)	-1.49 (1)	-6.56** (1)	-1.17 (1)	-3.2** (0)
	Const. & Trend	-4.74** (0)	-3.91* (1)	-6.4** (1)	-4.3** (1)	-3.8** (0)
Ban'desh	Constant	-4.27** (2)	-1.54 (0)	-4.8** (0)	-2.92* (1)	-3.7** (0)
	Const. & Trend	-4.52** (2)	-2.2 (0)	-4.69** (0)	-2.73 (0)	-4.13** (1)
India	Constant	-5.8** (0)	-1.07 (0)	-6.58** (0)	-1.25 (0)	-4.62** (0)
	Const. & Trend	-6.20** (0)	0.23 (2)	-6.4** (0)	-2.9 (0)	-6.3** (1)
Malaysia	Constant	-4.1** (0)	-2.3 (2)	-3.6** (2)	-3.1** (1)	-3.4** (0)
	Const. & Trend	-4.1** (0)	-3.33* (2)	-3.5* (0)	-2.91* (1)	-3.5* (2)
Thailand	Constant	0.41 (0)	-1.6 (1)	-3.2** (0)	-2.7 (1)	-3.8** (0)
	Const. & Trend	0.41 (0)	-1.7 (1)	-3.3* (0)	-2.8 (1)	-3.7** (0)

Notes: Δy: GDP growth rate, IPY: private investment rate (IP/GDP), IGY: public investment rate (IG/GDP). Critical values: 10%= -2.6, 5%=-2.98 (constant included); 10%= -3.2, 5%=-3.59; (constant and trend included) - source: Dickey and Fuller (1979, 1981). SBC selected lag lengths are in brackets. ** and * indicate significance at 5% and 10%, respectively.

5. Estimating VARs in the Presence of Possible Unit Roots

The preceding analysis delivered a mixed bag of I(0) and I(1) variables: Neither the economic priors nor the empirical results are unanimous, nor necessarily consistent among themselves. Traditional estimation requires stationarity of data, and co-integration analysis requires that all variables be integrated of the same order. Clearly neither is appropriate in all cases. Fortunately, a procedure is available that bypasses these ambiguities. Toda and Yamamoto (1995) have proposed an increasingly used[5] method for estimating a VAR in the variable levels which may or may not be integrated of the same order, whether or not co-integration is present. They propose that the usual standard methods be applied to measure the true lag length of the VAR[6]; in our case we use the Schwarz Bayesian Criterion (SBC) . Having thus determined the true lag length *k*, we proceed to estimate the VAR of the order $k+d_{max}$, where d_{max} is the maximum suspected order of integration present in any variable included in the VAR. We can now proceed to use the standard asymptotic theory to test general restrictions on the coefficients of the first *k* lags. The coefficients on the last d_{max} lags are ignored.[7] This methodology is used to test for Granger block non-causality in the three-variable VAR, including both private and public investment as a ratio of GDP, and the GDP growth rate.

Based on the results presented in Table 2, the maximum possible order of any series is 1. The optimal lag of the VAR, *k*, is selected using SBC and the VAR is then estimated for *(k+1)* order. The restrictions are tested on the coefficients on the first *k* lags. In order to test for crowding-in/out in its strictest sense, Table 3 presents the results of causality tests based on the bi-variate VARs (IGY and IPY), using the Toda and Yamamoto (1995) methodology; while, to relate investment rates to growth, Table 4 presents those based on tri-variate VARs (IGY, IPY and Δy). In all cases, wherever there is statistically significant causation, a sign indicates whether the causal effect is an increase or decrease.

Table 3 : Summary of bi-variate Granger -Causality testing in the presence of possible unit roots in the series

Country	♦ From IGY to IPY		♦From IPY to IGY	
	F-test	**Causal**	**F-test**	**Causal**
Pakistan	6.03 [.008]	**Yes** (+)	0.28 [0.75]	No
Bangladesh	0.56 [0.46]	No	3.68 [0.06]	**Yes** (+)
India	0.39 [.536]	No	0.12 [0.72]	No
Malaysia	0.0003 [0.99]	No	1.18 [0.28]	No
Thailand	3.74 [.065]	**Yes** (+)	2.97 [0.09]	**Yes** (-)

Note: p-values are reported in parentheses. ♦ indicates the use of Toda and Yamamoto's (1995) methodology. The definitions of the variables are as they appear in Table 2.

[5] See Dolado and Lutkepohl (1996), Shan and Sun (1998), and Naka and Tufte (1997) and Abala-Bertrand and Mamatzakis (2001) for examples.

[6] See Urbain (1989) for discussion.

[7] Dolado and Lutkepohl (1996) proceed to use this method and use Wald Tests to test for restrictions.

As can be seen from Tables 3 and 4, only three of the five countries show evidence of any kind of causality, Pakistan and Thailand being the most important cases in point. Crowding-in of private by public investment appears to be the case in Pakistan, while on balance the evidence appears to show crowding-out in Thailand. In Bangladesh, public sector investment seems to follow, rather than lead, private sector investment which may actually indicate that public sector investment is undertaken in response to the needs or demand already built up by the private sector. India and Malaysia show no causality at all.

Table 4 : Summary of Granger Block-Causality testing in the presence of possible unit roots in the series

Country	Optimal Lags (SBC)	From IGY&IPY to Δy		From IGY&Δy to IPY		From IPY&Δy to IGY	
		F -test	Causation	F -test	Causation	F -test	Causation
Pakistan	2	1.7 [.187]	No	15.0 [.000]	**Yes** (+)	1.97 [.145]	No
Bangladesh	1	1.5 [.251]	No	0.809 [.861]	No	4.02 [.037]	**Yes** (+)
India	1	0.42 [0.66]	No	.18 [.829]	No	0.93 [.408]	No
Malaysia	1	0.48 [.622]	No	1.06 [.363]	No	0.73 [.493]	No
Thailand	1	1.77 [.196]	No	5.44 [.014]	**Yes** (-)	1.9 [.17]	No

Note: p-values in parentheses. Definitions of variables as in Table 2.

The lack of any results for India and Malaysia and the absence of any clear patterns of behaviour in the overall picture may reflect the need for additional conditioning variables, such as employment, interest rates, etc., which are suggested by various studies of flexible-accelerator model of investment outlined earlier. Likewise, empirical work on growth suggests that a number of other factors not captured here, such as institutional structures, the openness of the economies, export orientation, and general investment environment, among others, are reputed to distinguish the South Asian economies from the South East Asian economies in various studies, and may explain their superior investment and growth performance. While these additional conditioning variables may actually help explain growth or private investment, there are two main reasons why they were not included. First, given the sample size, the risk of over-parameterisation of the VAR precludes their addition. Second, theory is not precise as to how exactly these factors mediate among the 3 variables of interest and affect their interactions, which is the focus of this paper.

Another, possibly more important explanation for the lack of clear cut results is the sectoral heterogeneity concealed by aggregate public investment. The effects of infrastructural and non-infrastructural[8] components of public investment may plausibly be different, with the former usually assumed to crowd private investment

[8] Sakr (1993) defines non-infrastructural investment to consist of investment in the manufacturing and wholesale and retail trade sectors.

in and the latter likely to have the opposing crowding-out effect. If the two effects cancel each other out the average effect may appear non-existent. Work based on such disaggregation is on the agenda for the future. Similarly, one should always aim to enhance the data by both augmenting the relatively short sample of about 30 annual observations and increasing the sample of countries. Hopefully such work will shed sharper light on the issues and unravel more clear cut patterns of behaviour.

6. Conclusion

This paper analyses empirically public investment and its relations with private investment and the growth rate. The focus is mainly on the crowding-in/out issue of public investment and the relationship if investment (be it public or private) with growth, and the sample includes time series for 6 Asian countries (3 from South Asia and 3 from the Pacific region) for 1971-2000, so as to bring out any common or divergent patterns of behaviour between groups of countries with markedly different growth experiences. The analysis is motivated by a wealth of theoretical arguments, reviewed in the Introduction, that relate the 3 variables in a variety of ways. Empirical work proceeds with (2- and 3-variable) VAR estimation and Granger causality analysis, separately for each country. The empirical results show that such experiences are heterogeneous, as are their time series properties. Importantly, the evidence on crowding-in/out is mixed, with Pakistan appearing to be in the "in" category, while Thailand is "out". The Bangladeshi case seems to emphasise the endogeneity of public investment. India and Malaysia show no discernible patterns at all. Thus, there is not any single robust complementarity or substitutability between public and private investment and relation between these two and growth rates, which is either common to all countries in the sample, or different in a systematic way between sub-continents, so as to shed light on why countries with similar beginnings have had so remarkably different growth experiences in recent decades. Reasons for the failure of clear cut patterns to emerge were discussed in the previous Section, as were some extensions for future work. However tentative, though, the results in this paper serve to remind us about the complexity of interactions in the real world (which is concealed by the way in cross-section analyses) and to point out the importance of context-based analysis in the form of including other conditioning variables.

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