Private capital formation and macroeconomic policies in Sudan: application of a simple cointegrated vector autoregressive model

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Abstract

We investigate the impact of macroeconomic policies on private investment in Sudan employing annual data over the period 1969-1998. We focus on public investment, credit, devaluation, and interest rate policies. We blend cointegration, vector autoregressive and error correction techniques to estimate long- and short-run coefficients. The results suggest that public sector investment had a negative crowding out impact on private investment over the period of study. Devaluation policy also contributed to discouraging private sector capital expansion. Monetary policy in the form of restricting domestic credit appears to have had a significant impact on private investment. This is well indicated by the significant positive impact of banking sector credit on private investment, suggesting that a restrictive monetary policy may lead to shrinking private capital formation by tightening financial constraint on private firms. Increase in real interest rate has been deleterious to private investment, indicating that costs of funds did matter for private investors in Sudan.

Key words: Private investment; macroeconomic policy; cointegration; VAR; Sudan.
JEL classification: E22; O11; O23; O55.

1. Introduction

In developing countries the efficiency of state involvement in economic activities through its public enterprises has been of great concern. It has been generally agreed that the financial performance of public enterprises has been disappointing in most countries despite the huge financial resources dispersed to them. Moreover, it has been shown that returns on public investment are negligible, which has lent support for increasing the role of the private sector in the economy. The tendency to boost private sector participation has prominently shaped policy advice in regional and international financial institutions as well as the policy-making process in developing countries, giving rise to a wave of privatisation programmes and other policies designed to promote private sector development. The reconsideration of structural balance as to state/private sector ownership has been accompanied by much concern paid to the prospect of private sector capital expansion in a milieu of severe macroeconomic adjustments. In particular, and in view of ambitious growth targets that motivated macroeconomic policy-making in developing countries, the potential impacts of fiscal and monetary austerities on the private sector's ability to commit substantial capital outlays and various institutions to mobilise required savings have received special attention.

In Sudan, unsurprisingly, the policy orientation has been akin to that in other developing countries in manifesting an increasing recognition of the potential role the private sector could play in mobilising the country's formidable natural and human resources. Although the state sector has exercised an evidently dominant role in different production and distribution activities, the numerous development plans and strategies set out by successive Sudanese governments have emphasised the implications and importance of private capital formation for short-term stabilisation management and long-run growth and development. These concerns, however, do not seem to have been matched by an appropriate and consistent blend of policies to stimulate private sector investment. The reported performance of private investment has been less than satisfactory, and slightly less than the average for sub-Saharan Africa (SSA). The Sudanese private sector spent only around 10 percent of the country's national income over the period 1970-1998 (compared to around 11 percent average for SSA). While the 1980s and 1990s have witnessed a slight improvement, the 1970s marked a notably low performance with a private investment/GDP ratio of only 7percent (the corresponding average for SSA was around 13 percent). Not only has private investment been diluted over the 1970s and stagnant over the 1980s and 1990s, it has also been volatile. To use the 1990s as an example, in 1995 private investment as a percentage of GDP dropped by around 40 percent (from 15 percent to 9 percent), in 1996 it increased by nearly 33 percent (from 9 to 12 percent), and in 1998 it jumped by almost 67 percent to an unprecedented 20 percent of GDP.

This performance of private sector capital expenditure over the last three decades backdropped by successive attempts to sustain fiscal and external balances, by a pursuit of credit restraints to control galloping inflation, and by a continual devaluation of domestic currency to correct price distortions and accumulate foreign reserves. Moreover, the private sector in Sudan operated alongside a formidable public enterprise sector which dominated several economic activities and exerted severe competition over limited real and financial resources. It is hardly surprising then that public policies

which aim to downsize public sector and restructure economy should have important implications for private sector investment and development.

In view of the nature of macroeconomic management and the lack of research on its impact on private investment in Sudan, this study seeks to provide an empirical investigation of how macroeconomic policies have affected private sector capital formation over the period 1969-1998. This study extends the existing literature on private investment in developing countries in two directions. First, it applies methods that are scantly used to analyse impact of public policy on private investment. Second, it provides an empirical evidence for a country for which no research (or little research) has been conducted to understand the nature and dynamics of public policy and private investment. Section 2 of the study reviews private investment literature with special emphasis on the case of Less Developed Countries (LDCs). Section 3 presents empirical discussion where a simple cointegrated vector autoregressive (VAR) model is applied. Summary of results and policy implications make Section 4.

2. Literature review

Literature dealt with private investment behaviour in industrialised countries has distinguished a set of factors determining firm's investment decision. The firm may be concerned with demand conditions and changes in output when it expands its capital stock. This view - referred to as the accelerator principle in investment literature - states that increased demand for the firm's output would induce the firm to instantly increase its stock of fixed assets provided that it has been operating at full capacity (Clark, 1917; Manne, 1945; Tinbergen 1938). The assumptions of full capacity and instantaneous adjustment underlying the 'naïve' accelerator principle were modified, and a more realistic model termed the flexible accelerator model or capacity utilisation model was developed (Koyck, 1954; Goodwin, 1948; Ghenery, 1952). The neoclassical theory of investment – founded by Jorgenson (1963) – provided another explanation for investment expenditure in addition to changes in output. Inducement to invest may also be stimulated by favourable changes in relative prices where downward shifts in the real user cost of capital services imply that the firm has to restore equilibrium by cutting down the marginal productivity of capital stock (see Bischoff, 1971; Hall, 1977; Jorgenson, 1963).

The decision by the firm to invest is too complex to be determined only by output and relative prices as the accelerator-neoclassical framework suggests. Cash flow theories of investment – built on the assumption that external funds are more expensive than internal funds – argue that financial conditions internal to the firm in the form of liquidity constraints and profit availability determine investment outlay in a given firm (Eisner, 1963; Duesenberry, 1958; Grunfeld, 1960; Meyer and Glauber, 1964).[1] Not

[1] This branch of literature treated financial condition or profits variable differently, giving rise to two sets of theories. The first set emphasises the expectation influence of profits on the firm's investment decision. Firms expand their capital stock if they hold favourable expectations about future profitability. The second set - dubbed the liquidity theory of investment - asserts the impact of *actual* flows of profits on firms' decisions to boost capital stock. Firms may be directly induced to invest if they have generated sufficient undistributed profits. The liquidity theory of investment points to the necessity of "[converting profits] into a purer measure of the flow of free money…to improve the explanatory power of profits in investment models" [Meyer and Glauber, 1964, p.3]. Hence profits are no longer seen as a summary

only is firms investment decision internally determined, it is also responsive to financial factors external to the firm in the form of capital market's valuation of the firm's assets relative to replacement cost. Tobin (1969) and Brainard and Tobin (1968) introduced the infamous Tobin's *q* which transmits the impact of fluctuations in capital and financial markets on private sector investment. Tobin's *q* is the addition to the market value of the firm resulting from a unit increase in fixed capital, or the capital market valuation of the extra unit of the firm's fixed assets.

In a volatile, uncertain world the firm may not be interested in expected or actual values of the rate of returns, output, relative prices, or internally-generated funds. It may rather make investment decisions with a view to the degree of variability of investment determinants from perceived expected values. In models of investment under uncertainty firms are uncertain about such variables and hence maximise an expected utility or profits function whose arguments are probabilistically distributed rather than certainly given (see Abel, 1983; Bernanke, 1983; Dixit, 1989; Pindyck, 1988; Nickell, 1977; Hartman, 1972; Huizinga, 1993).[2] Moreover, the set of motives underlying entrepreneur decision to invest may have to be widened to incorporate alongside profit maximisation such motives as the desire to avert risk and maintain safe asset structure since the firm's attitudes towards risk may result in certain behaviours (see Meyer and Kuh, 1957, pp.9-10; Nickell, 1977, p.51). In general, literature on investment under uncertainty tries to explain how firms, given a set of motives, select their optimal capital stock and how the selected optimal capital stock is affected by variations in the degree of uncertainty about future prospects.[3] In this context of uncertainty, what matters to the firm is to 'keep its options open' though favourable conditions of investment atmosphere. When capital is irreversible or reversible but can not be sold when scrapped because of imperfect markets for used capital, the firm's option to delay investment until future uncertainty is resolved would exhibit a value that the firm has to consider when committing resources to expand its assets.

When the above theories of investment (which were basically developed for the case of industrialised countries) applied to developing countries in their original forms many theoretical and empirical problems arose, essentially related to peculiar characteristics of institutions, markets, and technologies in these countries. Investment literature dealt with LDCs hence sought to identify and quantify the relevant determinants of private investment as well as to bridge the gap between 'pure' investment theory and unique structural and institutional characteristics of developing economies (see Behrman, 1972; Fry, 1988; McKinnon, 1973; Rodric, 1989; Shaw, 1973; Sundararajan and Thakur, 1980; Taylor, 1983). Such theoretical and empirical query synthesised a

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conjecture of future circumstances. They are rather viewed as a mere proxy of fund flows into the firm from different activities.

[2] See Leahy and Whited, 1996, for a thorough discussion of models of investment under uncertainty.

[3] Similar to the neoclassical framework, optimal capital stock is determined by marginal conditions of maximisation. However, unlike the neoclassical framework with certainty, the firm maximises expected utility or profit function, resulting in a marginal condition for optimal capital where the expected marginal revenue product of capital is a function of random distribution of factor and output prices. It is the variance of the density function of probability distribution of each factor that determines the degree of uncertainty about that factor. These degrees of uncertainty about different factors may be assumed independent from each other by assuming an independent distribution of factors affecting expected marginal revenue function (for example Nickell, 1977) or assumed correlated by assuming joint distribution and analysing uncertainty in a multivariate context (for example Hartman, 1972).

framework which featured a new set of factors ignored or marginalised in conventional investment theories, while argued for the importance of conventional factors such as output, relative prices and interest rates.[4]

Banking sector credit and depth or size of financial intermediation came out as important factors and incorporated in investment equations to reflect information asymmetry and moral hazard which often taint capital markets in developing countries (Bhattacharya *et al*, 2004; Fazzari *et al*, 1988; King and Levine, 1993; Tybout, 1983; Wai and Wong, 1982). Within this context interest rates are 'screening device' to sort out 'good' borrowers from 'bad' ones, and are no longer a reflection of capital scarcity. This circumstantial confine of interest rates has brought about the contention that some fraction of borrowers are *credit rationed*, and that volume of credit is more relevant for investment equation (Stiglitz and Weiss, 1981, p. 409).[5,6] Another important factor introduced to investment equation is government or public sector investment. A voluminous empirical literature has investigated direct and indirect impacts of government capital expenditure on private investment, recognizing sizable government and public enterprise sector in LDCs (see Aschaur, 1989; Badawi, 2003; Blejer and Khan, 1984; Chhibber and van Wijnbergen, 1988; Galbis, 1979; Sundararajan and Thakur, 1980; von Furstenberg and Malkiel, 1977). While a crowding out effect appears plausible in a country marked by sizable state involvement in various economic activities, generalisation of such a result is troublesome. This is due to lack of clear cut empirical evidence, which appears to be mixed and country-specific.[7] In some countries

[4] The accelerator hypothesis received substantial empirical support in developing countries; output growth or increase in demand tends to be associated with high rates of private investment in most econometric models employed (for example, Fry; 1980; Harris *et al*, 1994; Ndikumana, 2000; Solimano, 1989; Wai and Wong, 1982). Some studies also asserted the effect of real user cost - the principal factor in neoclassical theory of investment - on corporate sector investment and in turn addressed the viability of government incentive schemes such as tax exemptions, capital subsidies, and investment tax credit (see Dailami, 1989; Dailami and Walton, 1989; Ermisch and Huff, 1999).

[5] In general, the effect of interest rates on investment has been studied mostly within the notion of financial liberalisation (Harris *et al*, 1994; Morisset, 1991; Rittenberg, 1991). When private sector investment is finance-constrained and real deposit rates are low or negative the increase in nominal rates entails higher real returns on deposits (provided that the rate of growth in nominal rates exceeds the inflation rate) and increases financial resources of the banking system. [However, increased real rate of return attracts resources to the financial system if (and only if) banks deposits are closer substitutes to unproductive cash assets and foreign assets than to capital goods (Morisset, 1991)]. The favourable impact of increased real returns would be transmitted to investment if banks could make free portfolio decisions and expand credits to efficient users. This scenario embodies a positive investment-interest rate relationship contrasting conventional negative relationship.

[6] Credit-rationed borrowers are characterised as having high default probability and negligible collateral, and, accordingly, variables such as likelihood of repayment, degree of leverage and collateral size have been suggested to be introduced to investment equation (see FitzGerald, 1999, p. 12; Hoff *et al*, 93,p.42).

[7] In their comparative study, Sundararajan and Thakur (1980), for example, provide conflicting scenarios for India and Korea. They report a negative long-run multiplier effect in the former and a positive multiplier in the latter (see tables (6) and (7), in p.850 and p. 851 respectively). This was explained by that the negative crowding out effect is larger than the positive crowding in effect in India, while the opposite is true in Korea. Further, the incremental capital-output ratio in the public sector is larger than in the private sector in India, while it is smaller in Korea. This in fact led to the increase in public sector output not being enough to compensate for the fall in private sector output in India, while in Korea the exact opposite takes place.

state capital infusions proved to be pivotal in alleviating supply bottlenecks and enhancing private sector expansion, thereby supporting complementarity hypothesis.[8]

In addition to testing substitutability, complementarity and credit rationing hypotheses, some investment literature recognised external constraints when dealt with investment behaviour in developing countries. In particular this literature examined potential impacts of capital and trade flows; increased trade and capital flows have been reported to have had a positive effect on private capital formation by increasing foreign exchange base and private sector's access to imported capital goods and foreign markets (see Bilsborrow, 1977; FitzGerald *et al*, 1994; Levine and Renelt, 1992). Numerous studies also linked investment to devaluation policy and its repercussions on private incentives and profitability in tradable goods sector (Buffie, 1986; Cahhibber and Shafik, 1990; Faini and de Melo, 1990; Krugman and Taylor, 1978; Lizondo and Montiel, 1989; Solimano, 1989). Extending the set of external constraints, the relationship between investment and country's indebtedness to international community was highlighted in many empirical investigations where it is shown how mounting debts and services 'overhang' private initiatives and thereby hamper productive expansion and prospects for future growth and prosperity (Dooley, 1986; Krugman, 1988; Iyoha, 2000; Sachs, 1990).

It is widely contended that investment is not only responsive to measured observable factors, it is also a determinate of macroeconomic and institutional settings in which investment and its determinants interact. Since macroeconomy and institutions are susceptible to recurrent socio-political and economic changes in developing countries, a considerable empirical literature sought to sketch an investment-uncertainty relationship (the so-called investment hysteresis in investment literature). Macroeconomic instability has received a prime attention, with a view asserting the unfavourable impact of macroeconomic instability on private investment (for example, Aryeetey, 1994; Pattillo, 1997; Schmidt-Hebbel and Muller, 1991).[9] However some literature did not come in contiguity with such intuitive perception, noting inadequate evidence.[10] Solimano (1989) explains such unexpected results by that "probably much of the variance in [selected proxies] may not correspond to changes in fundamentals and hence it should not be expected to be ['correctly'] correlated with [private] investment" [p.16]. In addition to macroeconomic instability, uncertainty induced by socio-political unrests has been given account and discrete variables such as changes in executive or government, number of assassinations, number of strikes and riots, and

[8] See Ermisch and Huff (1999) for the case of Singapore, Lee (1991) for Nigeria, Shafik (1990) for Egypt and Wai and Wong (1982) for Greece.

[9] Macroeconomic instability is approximated by variances of macroeconomic aggregates (variances in inflation, real exchange rate, real interest rate, and so forth) assuming that highly volatile macroeconomic environment increases the threshold of the marginal revenue product of capital, thereby leaving private investors in a state of inaction.

[10] For example, Sioum (2002) found that out of four proxies for macroeconomic instability only the volatility in terms of trade has a significant negative impact on private investment and Serven (1998) reported a *positive significant* relationship between volatility in real exchange rate and private investment. Fielding (2000) noted the contention that investment does not respond to its determinants within a certain range is not 'quite supported' [p.208]. In other words, he argues that the contention that firms' response to favourable changes is higher in a relatively more certain environment does not seem to have had enough support, pointing to possibility of a weak or positive investment-uncertainty relationship.

constitutional changes began to appear in empirical investment equations (for example, Bromley and Sjaastad, 1997; Stewart and Venieris, 1985). In essence, socio-political instability has been seen detrimental as it threatens property rights and tenure security and thereby affects business confidence in prevailing rules and regulations. Keefer and Knack (1995) go further and argue what is more important to private investors is not different manifestations of socio-political instability, but whether such instability has changed (or will change) institutional framework and arrangements. Indicators of socio-political instability may appear insignificant to private sector's investment decision when factors such as corruption and contract enforcement are accounted for.[11] Corruption in particular provided an explanation for low investment rates or 'investment collapse' in developing countries by imposing a 'tax' and increasing transaction costs (see Maoro, 1995; Murshed, 2002). In this regard, it has been argued *uncertainty* about the nature of corruption is as important to private investment as levels of corruption, and that "corruption regimes that are more predictable - in the sense that those seeking favours from government do obtain those favours - have less negative impact on investment than those that are less predictable" [Campos *et al*, 1999, p.1065].[12]

It appears from the above discussion that investment determinants are very much multidimensional. Although survey of relevant literature helps identify the most important factors that affect investment decision, it by no means provides an exhaustive list of investment determinants.[13] In the following section we estimate an investment equation whose variables are chosen in accordance with investment theory and empirical literature covered above.

3. Empirical investigation

3.1 VAR modelling and cointegration analysis

Most of literature outlined in section 2 above employed single investment equation framework to estimate determinants of private investment. This approach is troublesome in the sense that it does not account for nonstationarity and endogeneity problems often taint investment analysis. In this paper we rather employ a simple cointegrated VAR model combining cointegration analysis and vector autoregressive time series processes.[14] Use of cointegrated VAR model helps account for spurious correlations and exogeneity bias as it is designated for nonstationary time series, and requires no endo-exogenous division of variables (it assumes endogeneity of all

[11] This argument may explain the insignificance of some socio-political instability indicators employed in investment equations similar to those used by Serven (1998). [None of seven proxies of socio-political instability reported in Serven (1998) appeared to have had statistically significant negative impact on private investment.]

[12] Campos *et al* paper attempts to resolve perplexing paradox of why countries with high levels of corruption had high rates of private investment; the so-called 'East Asian puzzle'. China, Indonesia, Thailand and Vietnam reported large private investment/GDP ratios over 1981-1993 at high levels of corruption, and thereby posed a real challenge to the argument that corruption harms private investment (see Campos *et al*, 1999, p.1059-1060).

[13] These determinants may even include psychological factors such as entrepreneurs' reluctance to contract their plant size for no reason but maintenance of self-pride (Klein, 1948).

[14] This paper extends empirical discussion carried out in Badawi (2003) by including macroeconomic policies of credit, exchange rate, and interest rate.

variables). Further, vector error correction models (VECMs) embodied in cointegrated VAR technique distinguish clearly between long- and short-run impacts, providing a suitable tool for policy analysis.[15]

A simple autoregressive distributed lag investment equation may be written as follow

$$I_t = const + f_1 Y_t + f_2 PSI_t + f_3 CR_t + f_4 RE_t + f_5 r_t + f_6 I_{t-1} + u_t \ , \qquad (1)$$

where *I* is private investment, *Y* is real output, *PSI* is public sector investment, *CR* is banking sector real credit to private firms, *RE* is real exchange rate, *r* is real interest rate, and *It-1* is private investment lagged one period (all variables in natural logarithm except *r*). Under VAR system of equations, Eq. (1) is one of 6 equations where all variables are defined in terms of other variables (and their lagged values) and variable's own lagged value. This system of equations or unrestricted VAR model may be expressed as

$$Z_t = A_0 D_t + A_1 Z_{t-1} + A_2 Z_{t-2} + \cdots + A_k Z_{t-k} + \in_t , \qquad (2)$$

where *Z* is an *n.1* vector containing all *n* variables in the system, *D* is a vector holding deterministic terms (intercept, trend, dummies, and so forth), and $\in$ is an *n* dimensional vector of multivariate random errors with mean zero and covariance matrix $\sum$. The error correction representation of Eq. (2) takes this form

$$\Delta Z_t = A_0 D_t + \prod Z_{t-1} + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 Z_{t-2} + \cdots + \Gamma_{k-1} \Delta Z_{t-k+1} + V_t . \qquad (3)$$

Eq. (3) shows how long run impacts on elements of Z are incorporated in short term dynamics. Cointegration analysis is concerned with determining the maximum number of linearly independent relationships in the system; in technical language determining the rank of the long-run matrix $\prod$. Matrix $\prod$ is then decomposed into two matrices α and β. While matrix α holds long-run adjustment coefficients, matrix β contains long-run coefficients or elasticities. Hence, the essence of conducting cointegration analysis is to (i) test for presence of long-run stationary relationship(s) between variables (this is equivalent to testing the hypothesis that what exists is a mere spurious correlations between variables due to co-movements of trends), (ii) estimate long-run parameters βs (cointegration vectors), (iii) estimate long-run coefficients of adjustments αs (loading coefficients), and (iv) employ long-run information to estimate VECMs which describe short-term dynamics.

3.2 Cointegrated finite VAR and stationary long-run relationships

The VAR system of equations is estimated where matrix *Z* incorporates *I, Y, PSI, CR, RE,* and *r* over the period 1969-1998.[16] Un-restricted constant and restricted trend are

[15] Harris (1995) and Harvey (1990) provide detailed discussion of cointegrated VAR econometrics. Error correction models are thoroughly discussed in Banerjee *et al* (1993).

[16] See Appendix (A) for variables' definition and construction.

used in matrix D (the deterministic matrix).[17] Adopting a general-to-specific procedure starting with a slightly lengthy lag of 4, variables in the VAR system are finally lagged two periods (VAR(2)). The VECM (Eq. 3) which embodies short-term dynamics or reduced *I(0)* processes is assumed to depend on the rate of capacity utilisation, country's indebtedness, and uncertainty. Therefore, estimation of Eq. (3) is conditioned on these variables.[18] The statistical hypothesis under cointegration is H(p): rank($\prod$)$\leq$r, where r is the rank of the long-run matrix. To determine r the VAR model is estimated and results are reported in Table 1.[19] The results indicate that there are *two* cointegrating vectors in the system. The null hypothesis that there is no cointegrating vector in the system ($r \leq 0$) is rejected, and so is the null that there exists at most one cointegrating vector ($r \leq 1$). The trace statistics report respective magnitudes of 162.14 and 96.62, which are insignificant (greater than critical values) at 1% (see panel (a) of Table 1). The null of at most two cointegrating vectors ($r \leq 2$) is accepted. Unrestricted standardised estimates for two cointegrating vectors b*s* and respective adjustment coefficients a*s* are reported in panels (b) and (c) of Table 1.

Table (1): Cointegration Rank, Unrestricted Long-Run Elasticities and Loading Coefficients

(a) I(1) Cointegration analysis and testing for cointegration rank r*:*

$H_0 : r \leq$	Trace stat.	Eigenvalues	*p*-value
0	162.14	0.904	0.00
1	96.62	0.727	0.01
2	60.26	0.621	0.11
3	33.10	0.458	0.34
4	15.94	0.337	0.51
5	4.41	0.146	0.68

(b) Unrestricted standardised eigenvectors b'*:*

	I	*Y*	*PSI*	*CR*	*RE*	*r*	*Trend*
b_1'	1.0 (rest.)	-0.83 (-3.32)	0.13 (1.30)	-1.65 (-7.17)	0.65 (3.42)	0.112 (5.19)	0.0 (rest.)
b_2'	0.0 (rest.)	1.0 (rest.)	-0.37 (-12.33)	0.05 (0.63)	0.54 (7.71)	0.0463 (8.57)	-0.04 (-13.33)

(c) Unrestricted standardised adjustment coefficients a*:*

	a_1	a_2
I	-0.71 (-2.45)	-0.60 (-1.36)
Y	0.26 (1.86)	-0.49 (-2.33)
PSI	0.24 (0.65)	0.39 (0.68)
CR	-0.14 (0.82)	0.07 (0.27)
RE	-0.57 (-2.59)	-0.80 (-2.21)
r	-0.04 (-2.00)	0.10 (3.33)

t-values in parentheses.

[17] A *restricted* variable in cointegration analysis is the variable restricted to enter cointegrating space; that is to exert an impact on dependent variable in the long-run. Doornik and Hendry (2001), p.40, suggests to un-restrict constant and restrict the trend when data exhibit a non-stationary behaviour in order to allow for non-zero drift in nonstationary processes.

[18] Alternatively, these three variables could be directly introduced to the system. But this implies estimating more coefficients, which seem to be impractical with the relatively small sample size in hand.

[19] PcGive - based on Johansen (1988) - is used to carry out estimation and necessary tests.

3.3 Long-run weak exogeneity and restricted long-run cointegrating vectors and adjustment coefficients

Error correction terms (*(b′Zt-1)*) appear with the dominant long-run feedback effects in the investment and exchange rate equations as they report the largest magnitudes of adjustment coefficients; -0.71 and -0.60, and -0.57 and -0.75, respectively (Table 1). Adjustment coefficients (along with respective *t* values) in Table 1 infer some information about weak exogeneity. For example, *PSI* and *CR* exhibit long-run weak exogeneity to both cointegrating vectors of *I* and *Y* (implied by relatively small *t* values); *I* and *Y* seem to have no significant feedback effects on *PSI* and *CR*. Formal tests for long-run weak exogeneity tend to support that (Table 2). Tests for weak exogeneity of *PSI* and *CR* (by testing hypotheses αs=0) report favourable results. Associated likelihood ratios *Chi^2* report insignificant respective magnitudes of 1.13(0.57) and 0.63(0.73). Similar tests indicate that *RE* and *r* are *not* weakly exogenous; I and Y have a significant feedback effects on price variables in the system.

Table (2): Tests for Long-Run Weak Exogeneity
(H_0 : Variable is exogenous to investment vector)

	Chi^2	F-probability	Decision over H_0	Inference
Y	3.40	0.05	Rejection	Not exogenous
PSI	1.13	0.57	Acceptance	Exogenous
CR	0.63	0.73	Acceptance	Exogenous
RE	7.65	0.02	Rejection	Not exogenous
r	13.99	0.00	Rejection	Not exogenous

We utilise information about weak exogeneity of *PSI* and *CR* to re-estimate the VAR system, restricting αs on *PSI* and *CR* to equal zero and preserving the cointegration rank of 2. Results of restricted standardised as and bs are reported in Table 3. Comparing results of unrestricted and restricted models, neither magnitudes of restricted ßs have changed significantly nor have their respective signs. The only salient change to be reported is that *PSI* exerts a *significant* impact on private investment under restricted model, while this impact appears *insignificant* in unrestricted model (compare b_1' for *PSI* in Tables 1 and 3). This indicates that implications of *PSI* and *CR* exogeneity are of great importance for relationship between private investment and public sector investment. Other variables remain to be significant in explaining long-run private investment in both restricted and unrestricted VAR representations. Considering results of restricted cointegrated vector, all variables appear with expected signs, with *Y* and *CR* exerting significantly positive long-run impacts on private investment, whereas *PSI*, *RE* and *r* accounting for significantly negative long-run effects.

Table (3): Restricted Long-Run Elasticities and Loading Coefficients
$(a_{31} = a_{32} = a_{41} = a_{42} = 0)$

(a) Restricted standardised eigenvectors b':

	I	*Y*	*PSI*	*CR*	*RE*	*r*	*Trend*
b_1'	1.00	-0.90	0.19	-1.57	0.47	0.099	0.00
	(rest.)	(-3.75)	(2.11)	(-7.14)	(2.47)	(4.75)	(rest.)
b_2'	0.00	1.00	-0.37	0.03	0.55	0.0474	-0.04
	(rest.)	(rest.)	(-12.33)	(0.38)	(9.17)	(8.78)	(-13.33)

(b) Restricted standardised adjustment coefficients a:

	a_1	a_2
I	-0.90 (-3.60)	-0.81 (-2.19)
Y	0.18 (1.80)	-0.56 (-3.73)
PSI	0.00 (rest.)	0.00 (rest.)
CR	0.00 (rest.)	0.00 (rest.)
RE	-0.54 (-2.46)	-0.90 (-2.81)
r	-0.041 (-2.05)	0.09 (3.00)

t-values in parentheses

The long-run elasticity of investment with respect to real output is statistically significant and positive. With a magnitude of nearly 0.9 this elasticity is large compared to related results found for developing countries; for example, real output coefficient appears to be close to unity in Blejer and Khan (1984), equal to 0.46 in Fry (1980), between 0.01-0.08 in Ndikumana (2000), and nearly 0.002 in Sioum (2002).[20] Banking sector real credit to the private sector reports a positive long-run effect on private investment. This long-run elasticity is highly significant at 1 percent level of significance reporting a large t-statistic of around 7.14. Noting the magnitude of this elasticity (1.57), real credit seems to have exerted a larger impact on private investment in Sudan than in other developing countries, suggesting that credit rationing might have been more severe in Sudan in comparison to less developing countries' average. Blejer and Khan (1984), using various specifications for the investment equation for a panel of 61 developing countries, estimate a similar elasticity in the range 0.197-0.257 (table (1), p. 396). Ndikumana (2000), employing a sample of 30 Sub-Saharan African countries, estimates a more elastic investment demand to real credit with elasticity of 0.363 (table (4), p. 391). Public sector investment also reports a significant elasticity of – 0.19 supporting the crowding out hypothesis. This elasticity tends to be close to respective negative elasticities of 0.27 and 0.11 reported by Blejer and Khan (1984) and Sundararajan and Thakur (1980).[21]

Table 3 reveals another intriguing result. Persistent devaluation and depreciation of the domestic currency has impacted private investment negatively. This is indicated by the long-run elasticity of private investment with respect to real exchange rate which appears to be negative and statistically significant at 1 percent. Reporting a magnitude of - 0.47, this result seems to be consistent – qualitatively as well as quantitatively – with that reported by Solimano (1989) for the case of Chile over the 1980s. Solimano, estimated a system of simultaneous equations comprising private investment,

[20] See Blejer and Khan (1984), p. 394, Fry (1980), table (3), p. 322, Ndikumana (2000), table (4), p. 391, and Sioum (2002), table (3), p. 25.
[21] See Blejer and Khan (1984), table 1, p. 396, and Sundararajan and Thakur (1980), table 6, p. 850.

profitability and real output, and reported a highly significant coefficient of - 0.41 on natural log of real exchange variable (p.17). Real devaluation seems to have increased real user cost through the replacement or supply price of capital goods and thereby affected negatively profitability and investment. This seems to have dominated any long-run positive effects on investment through the increased market value of assets of firms in export and import substituting industries; real devaluation might not have had a negative long-run impact on private investment, if the size of the traded good sector in the economy had expanded and its dependence on imported capital goods diminished.

Results for the real rate of interest appear to be interesting in light of the considerable theoretical and empirical evidence advocating a positive relationship between investment and interest rate in LDCs (see discussion in Section 2). While many researchers made significant empirical contributions to establish such a positive relationship there seems to be no lack of an opposite position. With a highly significant negative long-run coefficient of nearly 0.10, Sudan seems to exhibit an interest rate-investment nexus similar to those at work in Indonesia and Chile. Chhibber and Shafik (1990) report a long-run coefficient of -2.3 for Indonesia, with a large t-statistics (-4.66) (see table 4, p.21). Solimano also reports a negative long-run coefficient for Chile, smaller in magnitude when compared to the one reported by Chhibber and Shafik but remains highly significant with -3.07 *t*-statistic (p.17).

3.4 Vector error correction model (VECM)

The cointegrating vectors b_1' and b_2' in Table 3 are investment and output equations respectively. The two cointegrating vectors are defined by

$$CIVa = I - 0.90 * Y + 0.19 * PSI - 1.57 * CR + 0.47 * RE + 0.0997 * r, \quad (4)$$

and

$$CIVb = (Y - 0.04 * t) - 0.37 * PSI + 0.03 * CR + 0.55 * RE + 0.0474 * r. \quad (5)$$

Equations 4 and 5 describe the two error correction terms that to enter short-term equations. They also embody restricted long-run stationary relationships. Short-term dynamics or the *I(0)* system comprises of six-equations of changes in *I, Y, PSI, CR, RE*, and *r* conditioned on the country's indebtedness (*INDBT*), capacity utilisation (*RCU*), and uncertainty (*INSTB*).[22] Also the two cointegrating vectors *CIVa* and *CIVb* lagged one period appear on the right-hand side of six equations. The system is estimated by unrestricted ordinary least squares and results are reported in Table 4.[23]

[22] *INSTB* as measured reflects war-induced spending impacts through squandered exc essive fiscal resources and resulting inflationary pressures.

[23] Since all variables in the *I(0)* system should be stationary, changes in indebtedness, capacity utilisation, and uncertainty should enter the system. Use of either level of or change in *INDBT* and *INSTB* in short-term system would not matter to stationarity as both variables are *I(0)* and so are their first differences, while change in *RCU* should enter the short-term system since *RCU* is *I(1)*. Hence, the conditioned system is estimated using change in *INDBT*, change in *RCU*, and change in *INSTB*.

Table (4): Short-Term Dynamics

Variables	*I*	*Y*	*PSI*	*CR*	*RE*	*r*
Const.	-3.795	2.142	-1.489	-0.917	2.393	-0.589
	(-1.1)	(1.57)	(-0.367)	(-0.424)	(0.882)	(-2.6)
DI_{t-1}	-0.078	0.023	0.068	-0.138	0.178	0.036
	(-0.302)	(2.3)	(0.224)	(-0.856)	(0.881)	(2.14)
DY_{t-1}	-0.062	0.239	-0.965	-0.051	-0.702	-0.035
	(-0.093)	(0.914)	(-1.24)	(-0.122)	(-1.35)	(-0.81)
$DPSI_{t-1}$	-0.405	-0.072	0.053	0.12	0.042	-0.011
	(-1.73)	(-1.78)	(0.193)	(0.818)	(0.231)	(-0.723)
DCR_{t-1}	0.314	0.264	0.486	0.459	-1.276	0.042
	(0.453)	(0.966)	(0.598)	(1.06)	(-2.35)	(0.933)
DRE_{t-1}	0.475	-0.025	-0.066	-0.052	0.544	-0.039
	(1.96)	(-0.199)	(-0.179)	(-0.265)	(2.21)	(-1.91)
Dr_{t-1}	-3.231	-1.804	-6.309	-2.521	10.85	-0.109
	(-0.632)	(-0.894)	(-1.05)	(-0.788)	(2.70)	(-0.323)
$CIVa_{t-1}$	-0.915	0.138	0.257	-0.101	-0.493	-0.043
	(-2.88)	(1.1)	(0.689)	(-0.51)	(-1.97)	(-2.07)
$CIVb_{t-1}$	-0.530	-0.248	0.699	0.041	-1.232	0.061
	(-0.924)	(-1.09)	(1.04)	(0.115)	(-2.74)	(1.63)
$DINDBT_{t-1}$	-0.109	-0.01	0.065	-0.052	0.093	0.002
	(-0.812)	(-0.19)	(0.414)	(-0.619)	(0.876)	(0.235)
$DRCU_{t-1}$	-0.653	-0.037	0.197	0.407	0.705	0.096
	(-0.862)	(-0.125)	(0.222)	(0.86)	(1.19)	(1.92)
$DINSTB_{t-1}$	-0.176	-1.078	-1.432	-0.078	0.431	0.038
	(-0.264)	(-1.80)	(-1.83)	(-0.187)	(0.823)	(0.875)
Serial correlation:	0.09	0.08	0.01	0.09	0.76	0.76
AR 1-2 F(1,15)	(0.72)	(0.78)	(0.98)	(0.76)	(0.40)	(0.40)
ARCH 1-1 test:	0.48	1.09	0.10	0.19	0.11	0.07
F(1,14)	(0.50)	(0.31)	(0.75)	(0.67)	(0.74)	(0.80)
Normality test:	0.92	1.98	1.22	0.75	1.20	0.31
$Chi^2(2)$	(0.63)	(0.37)	(0.54)	(0.69)	(0.55)	(0.86)
Heteroscedasticity:	16.62	23.43	22.60	25.99	22.13	23.83
$Chi^2(22)$	(0.78)	(0.38)	(0.43)	(0.25)	(0.45)	(0.36)
R^2	0.76	0.81	0.60	0.56	0.70	0.86
s	0.277	0.109	0.325	0.173	0.217	0.018

t values in parenthesises.

System statistics: log-likelihood =179.620872, -T/2log|Omega| = 418.002545,|Omega|=1.0792664e-013, log|Y'Y/T|= -22.941814, R^2(LR) = 0.999008, R^2(LM) = 0.552141, number of observations = 28, number of parameters = 72, F-test on regressors except unrestricted: F(66,64) = 2.57414 [0.0001] **.

Vector tests: AR 1-1F (36,24)= 0.87 (0.65). Normality Chi^2(12)= 12.95 (0.37). Hetero Chi^2 (462)= 469.86 (0.39).

In private investment equation lagged change in *RE* reports positive and significant coefficient at 5 percent level of significance. The favourable impact of devaluation in short term may be a result of a short-term transmission mechanism similar to the one described by Buffie (1986).[24] Lagged change in *PSI* also reports a significant (at 10 percent) but negative coefficient. Feedback of long-run relationship between private investment and right-hand side variables ($CIVa_{t-1}$) reports a significant impact at 1 percent on change in real investment. Lagged changes in *I*, *Y*, *CR*, and *r* however report insignificant coefficients. For the VAR system as a whole changes in *I*, *Y*, and *PSI* report insignificant overall impacts on the conditioned system. All other non-conditioning variables (lagged changes in *CR*, *RE*, *r*, and *CIVa-1*, *CIVb-1*) are significant at 10 percent and less for the system as a whole.[25]

All conditioning variables (*INDBT*, *RCU* and *INSTB*) report insignificant effects on private investment, although they all appear with theoretically justifiable negative signs. The insignificance of *INDBT* variable may be explained by the nature of long-term debt obligations. FitzGerald *et al* (1994) point that coefficients on debt services may appear 'correctly' negative but insignificant in countries largely dependent on debt from official sources at concessionl terms compared to those countries depending on private or diversified sources.[26] Since such type of borrowing is more or less stable and positive, the debt servicing burden may not exert a significant liquidity constraint on private investment. In Sudan, debt from official sources (excluding IMF purchases) constituted 85 percent of total outstanding long-term borrowing over the period 1975-1993, while interest payments on official debts amounted to around 70 percent of total interest payments. Official debts and debt services skewed notably towards concessionl loans which accounted for around 75 percent of total official debts, with interest payments on concessionl loans constituting nearly 68 percent of total services of debts from official sources.

[24] In the short run, given very low export and import elasticities, devaluation may be so contractionary that it induces downward pressure on consumer demand for domestic goods, and thereby stimulates export and investment expenditure (p.368). Two conditions need to be satisfied for such a scenario to take place. One is that domestic prices should fall sharply enough that the resultant favourable fall in the supply price of capital goods more than cancels the unfavourable decrease in the demand price of capital good or profitability. Fall in the demand price of capital good could be thought of as a fall in the value of firms' capital. Thus for devaluation to stimulate private investment Topin's *q* should increase; denominator (replacement or supply price of capital goods) should fall by more than numerator (demand price for capital goods) for q to increase. The other one is that the sum of export elasticity and the *product* of import elasticity and share of imported consumer goods in total imports is less than the share of imported consumer goods in imports. (In fact, this is a revertible statement of Buffie's condition, which describes an opposite case of falling investment due to contractionary devaluation; that is a devaluation that contracts aggregate demand). This condition, according to Buffie, is so strong that it could not be fulfilled without export elasticity less than 0.2. While this may not be the case in some countries (for example Chhibber and Shafik (1990), using an ECM, found that devaluation has dampened private investment in the short-run in Indonesia over the period 1973-1987), it remains an empirical question whether such a condition could be fulfilled in other countries. In Sudan, low short-term export elasticity is a likely outcome in view of tradable sector rigidities, supply irresponsiveness, and inflation-induced incentive erosions.

[25] See Table A.2 in Appendix (B), which reports tests for significance of variables to the system as a whole.

[26] See table (11.3), pp. 210-211.

The unexpected insignificant short-term effect of macroeconomic instability (*INSTB*) on private investment may be explained by the contention made by Solimano (1998) that insignificance of an uncertainty variable may reflect the variable's lack of correspondence to changes in fundamentals (see Section 2), though the uncertainty or macroeconomic instability variable is still significant to the VAR system as a whole. Insignificance of *RCU* is perhaps due to inappropriate approximation of prevailing capacity conditions by a mere fluctuation of output around its trend or it may reflect the notable colinearity of *RCU* and *r* in private investment equation. This colinearity is clearly indicated by a 0.91 correlation coefficient (see Table A.1 in Appendix (B)) and a significant parameter on *RCU* variable in the *Dr* Eq. (see Table 4).

For the VAR system as a whole change in conditioning variables *INDBT* and *RCU* tend to have no significant impact, while change in *INSTB* reports a significant effect at 5 percent on the system equations as a whole. Considering individual equations of the system, change in *INSTB* reports negative significant impacts in growth and public sector investment equations at 10 percent level of significance, while change in *RCU* reports a significant impact at 5 percent level of significance in interest rate equation (see Table 4) - the latter effect is noted above.

3.5 Summary of Results

Empirical discussion carried out in the preceding lines could be summarised as follows:

- *Real output or demand reports a significant direct long run effect on private investment over the period of study. The positive significant relationship between real output or demand and private investment provides evidence for the validity of the hypothesis that the accelerator principle does explain private sector investment.*
- *The expansion of government capital over the 1970s had a negative significant effect on private investment, while contraction in later periods had a positive significant effect. Although different categories of government investment may have had varying impacts, the long run overall effect has been negative, implying that the impact of the crowding out effect has been enough to outweigh the impact of the crowding in effect. The negative impact of state capital on private sector investment offers support to the crowding out hypothesis in developing countries. The slight increase in private investment in the early 1990s could be attributed to falling rates of public sector investment following privatisation programmes.*
- *Real banking sector credit to the private sector reports a long-run positive significant impact on private sector investment, indicating that private capital formation has been moving in the same direction as banking sector credit flows. The clear impact that banking sector credit exerts on private capital formation provides support for the rationing hypothesis.*
- *The real exchange rate appears to have a significantly positive short-term effect on private fixed investment, while it reports a negative long-run impact on private sector investment in fixed assets. Depreciation of the Sudanese currency has negatively impacted the formation of private capital over the period 1970-98 by possibly increasing the imported*

capital requirements of private investors. The deleterious impact of depreciation in the domestic currency on private sector investment may contribute to the debate on the appropriateness and relevance of devaluation policy, a debate that may be widened by adding a neoclassical dimension (as far as investment literature is concerned), considering the potential impacts of devaluation on the real user cost of capital, and thereby on investment and growth. This dimension may stand in conflict with the conventional view that devaluation has a favourable effect on growth and development through correcting distortions and generating incentives for the private sector (particularly in the tradable goods sector).

- *The real interest rate reports a negative and significant long-run impact on private investment over the period 1970-98, indicating that cost of funds does matter to private investors when they make decisions regarding expansion in fixed assets.*

4. Conclusion and policy implications

It is hardly potent to recognize the role the public sector has played in the Sudanese economy. During the first half of the 1980s, the public enterprise sector accounted for almost half the country's output, reporting the largest percentage in SSA (the average for SSA was 15 percent).[27] Moreover, the share of public enterprises in exports reported a staggering 65 percent over the 1980s, demonstrating state monopoly of cotton and gum Arabic trade. In view of such dominance public sector capital expansion should pose significant implications for private sector development. Further, and in light of the view that the public sector demonstrates an inherent inefficiency this formidable role of the state should raise concerns as to growth prospects. Those concerns about direct impact of public sector capital expansion on growth should also be addressed alongside private/public balance and its ensuing effect on growth and development. In Sudan, substitutability between public capital and private capital seems to have existed where public sector investments crowded out private investment, thereby jeopardising real growth.[28] As this study notes the expansion of government capital over the 1970s had a negative significant effect on private investment, while contraction in later periods had a positive significant effect. Although different categories of government investment may have had varying impacts, the long run overall effect has been negative, implying that the impact of the crowding out effect has been enough to outweigh the impact of the crowding in effect.

Much of the macroeconomic policy debate thus had to pay special attention to nature and extent of the relationship between the two types of investment. Although privatisation programme devised by the government in the early 1990s addressed by its very nature the implications of growing public sector for private ownership, it failed to recognize the nature of the relationship between public and private capitals. While many privatised corporations were transferred to non-profit and charitable state organisations (which later competed with private firms over limited markets), other privatised firms enjoyed enviable monopolistic status.

[27] See Swanson and Wolde-Semait, 1989.
[28] See Badawi (2003).

In as much as finding a macroeconomic atmosphere marked by a subtle, harmonious combination of capitals of the public and private sectors furnishes a potential ground for public policy, removing or alleviating financial constraints on private sector physical capital expansion does. Well established now in the literature of private investment in developing countries is the validity of the hypothesis that a positive relationship exists between private investments and banking sector credit; the current study has provided more supporting evidence to that strand of empirical literature. In the absence of well-developed capital markets, long-run private investment is likely to track credit flow originating in the banking sector; the so called 'rationing hypothesis'.

It is quite important to recognise as a platform for arguing for credit expansion to private sector the smallness of credit advances (as a percent of GDP) extended to private firms. Akin to other countries in the region of SSA, Sudan experienced a markedly low credit to GDP ratio; banking sector advances to the private sector fell from around 13 percent of GDP in 1980s to only 4 percent in 1990s. This dreadful performance seems quite alarming, especially when compared to the needs of a typical Sub-Saharan African country of *at least* 10 percent credit/GDP ratio in order to achieve private investment/GDP ratios of as high as 22 percent.[29] In light of such 'prerequisite' for a sustained, high long-run private investment/GDP ratio and the positive credit-investment nexus public policies which attempt to increase lending capacities of banks are not only crucial but also inevitable for private sector capital accumulation and economic growth.

Policy implications for the rationing hypothesis might seem simple by merely stating that more resources should be released to the private sector to reduce 'rationed demand' and thereby induce the required investment outburst. However, the relationship between the banking sector institutions and private sector capital expansion remains one of the most complicated issues in the policy-making process and design in developing countries. This is due to the fact that expanding banking sector loanable funds and their potential effect on domestic credit are at the heart of the concern of monetary policy as designed and implemented in developing countries. Mostly guided by the central objective of curbing inflation and lacking variety in monetary tools and instruments, monetary policy in developing countries, including Sudan, exercises tight measures in the process of constraining domestic credit by setting administered controls on the direction and terms of credit to the private sector. Moreover, expanding credit volumes to the private sector is well connected to financial and prudential reforms targeting the whole institutional and regulatory framework of the banking sector. The decline in credit to the private sector may reflect, to a large extent, inherent deficiencies in the Sudanese financial system; banks tend to accumulate most resources in excess reserves rather than lending to the private sector, basically due to structural problems of *inter alia* undercapitalisation, fragmentation, low profitability and non-performing assets.[30] The composition of advances to the private sector by heavily skewing towards *Murabaha*, which is a short-term finance modality suited by its very nature to trade finance, reflects another form of prolonged deficiencies.[31] This in particular discloses

[29] See Sioum, 2002, p. 37.
[30] See Kireyev, 2001, p.19.
[31] *Murabaha* is a debt instrument where the bank purchases the goods ordered by the client and assumes ownership bearing all risks associated before reselling the goods to the client (who may provide collateral) at an already known price. The resale price is the cost *plus* a profit margin or mark-up. Banks

the lack of the Sudanese financial system of well-diversified portfolio structure that asserts long-term financing modes which suit private sector long-term capital commitments.

Any policy recommendation of easing financial constraints on private sector development should therefore address a credit expansion proposal within a comprehensive framework that incorporates a complete set of monetary, institutional, and prudential objectives and which strikes at the same time an appropriate balance between inflation targets and expansion in bank advances to the private sector. This would pose numerous challenges to the central bank to adopt a proactive monetary stance which accommodates a favourable credit policy while observing liquidity and inflationary targets. Credit expansion may therefore need to be accompanied by indirect market-based instruments invoked basically to allow the monetary authority to manage banking sector liquidity (examples of these instruments are the recently invoked Central Bank and Government Musharaka Certificates (CMC and GMC)). Easing credit conditions in such a way will no longer be viewed as just "pumping … of additional liquidity ... [but rather, a way to] alleviate the obvious clots in credit extension and bank portfolio" [Kireyev, 2001, p.38].

Indirect market-based instruments may also provide a channel through which the government finances its fiscal deficits (through open market operations) without borrowing from the banking system and inducing a financial crowding out to the private sector in financial markets. The vigorous recourse of government to such instruments will indeed match the clauses of the recent fiscal adjustment programme of the IMF, which set a binding ceiling on government borrowing from the banking system. Development of market-based monetary tools and instruments are also intimately connected to the development of markets in which they are traded. By developing the stock market and inter-bank trading of monetary instruments, the government can obviously attract more players (banks and/or individuals) and widen the monetary base that such instruments make.

Policy prescription could be widened to include, in addition to targeting the *volume* of credit to the private sector, targeting the *terms* on which banking sector advances are extended to private investors. This is directly related to the cost of funds dilemma in the sense that governments in developing countries pursue measures with a view to make loans expensive in the process of restricting domestic credit. While the impact of the cost of funds (alternatively, user cost or interest rate) on private investment has been viewed by many as insignificant (or at least less significant than credit variable), a significantly negative relationship has not been uncommon. In the case of Sudan, a negative and significant long-run relationship has been found in the current study to have existed over the last three decades. This negative impact of real interest rate on private investment poses very important qualitative implications for financial sector efficiency and financial crowding out, though it may appear quantitatively negligible. It could be argued that the Sudanese banking sector failed to act as an appropriate intermediary to channel increased depository resources - if there were any - to the

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also extend credits in form of *Musharaka*. *Musharaka* is a profit-loss sharing instrument where the bank and the client provide jointly for capital. Returns on capital are to be distributed according to agreed ratios, and losses are shared. Between them *Murabaha* and *Musharaka* accounted for around 81 percent of banking credit to the private sector since the introduction of the Islamic modes of financing.

private sector, and that public sector capital requirements have siphoned considerable resources that could have been made available to the private sector. Under such circumstances an increase in the interest rate would coincide with an increase in the cost of funds and thereby discourage private investment. Such a position seems to be consistent with lines of reservations made by Morisset (1991) as to the efficacy of financial reforms in LDCs, particularly those related to an increasing interest rate.[32]

The adoption of administratively-set minimum *Murabaha* rate, which is always set at prohibitively high rates, has rendered bank credit to the private sector rather expensive, and has consequently shrunk private sector investment. Quite recently, the BOS has permitted commercial banks to set their own rates on *Murabaha* and *Musharaka* modes of finance in a step to liberalise financial transactions in the banking sector.[33] In the light of detrimental impact of increased cost of funds on private sector investment, such tendencies should be taken with a considerable caution. Liberalisation endeavours may imply efficiency gains by allocating scarce financial resources to efficient borrowers, thereby inducing productivity expansion. However, soaring interest rates and cost of funds may cause quantitative losses in form of shirking private investment. Therefore, a balanced policy action of price liberalisation should view an upward shift in the interest rates following liberalisation programme as embodying a risk of falling output due to decreasing rate of private investment rather than assuming an ultimate favourable impact on real output due to 'better investment quality' or efficiency gains.

The effect of devaluation found to be positive in the short-run but negative in the long-run. The long-run outcome of devaluation is country-specific since, "the structural characteristics of the economy matter a great deal [as a need arises for]…knowledge of the import shares, of the share of domestic output in aggregate investment, of export elasticity and of the individual import elasticities" [Buffie, 1986, p.376]. A possible scenario for an expansionary devaluation in the long-run is the positive effect of a permanent real devaluation of the market value of capital in the traded sector to dominate over the negative effect on replacement price of capital goods. This takes place as the relative size of the traded goods sector in the economy increases and import content of capital in that sector decreases. In Sudan, however, such a mechanism does not seem to have taken place in view of the deleterious long-run impact of devaluation on private investment. This may be due to policy failure to enable a steady expansion of the export sector by failing to remove supply bottlenecks. Further, the dependency of the traded goods sector on imported contents remained substantial due to undeveloped import substituting industries and their concentration on consumer goods production.

In view of the potential contractionary effect of real exchange rate, devaluation policy should be used in a broader, comprehensive policy framework to avoid shrinking private investment and growth. The government may follow a blend of contractionary public capital spending policy (or contractionary fiscal policy) and expansionary monetary policy consistent with contentions for government capital and credit (see above). Contraction in public capital spending should pay special and cautious attention to the nature of different categories of government capital and their implications for

[32] See footnote 5.

[33] In pursuing monetary tools the Bank of Sudan changes profit margins under *Murabaha* and client's share in capital provision under *Musharaka* in order to manipulate costs of funds and availability of loanable funds.

private sector investment, while cuts in recurrent expenditure should consider any potential plummeting in aggregate demand and output and their impacts on private investment through the accelerator effect (which was found to be positive and significant in this study).

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Appendix (A): definition and construction of variables

I and *PSI*: private and public sectors investments are gross fixed capital formation at 1987 constant prices. Private sector fixed capital formation is aggregate of corporate sector expenditures on construction and building, transport equipment, and machinery and equipment. Public sector capital expenditures are the sum of public enterprises and government (central and local) capital investments in the above categories of capital goods plus spending on land improvement and plantation development (for example, expenditures on irrigation and flood controls and land reclamation and clearing).

Y: real output is gross domestic product deflated by GDP deflator, base year 1987.

CR: banks credits to the private sector are categorised by sectors of destination (local trade, foreign trade, agriculture, manufacturing and others) in the Sudanese banking system's unified balance sheet. Since investments of some sectors (local and foreign trade) in fixed asset expansion are trivial banks credits are adjusted to reflect only financial resources directed to expansion of productive sectors such as agriculture and manufacturing. Tightening fixed capital expansion to bank credits to productive sectors disentangles potential effects of credit for commercial purposes. Hence an adjusted credit variable is $(1-y)\,CR_t$, where y is the proportion of bank credit directed to sectors where resource commitment to gross fixed capital formation is trivial. To determine y we use the average share of advances to these sectors in total bank advances; this share is nearly 13 percent of total banks' advances to the private sector.

RE: real exchange rate is computed as $RE_t = {E_t / GDPD_t} \big/ {1/XUV_t}$, where *E* is the average of official and market nominal rates, *GDPD* is gross domestic product deflator, and *XUV* is export unit value or export price in industrialised countries. The latter index stands as a proxy for the foreign price of Sudanese imports. Those imports were substantially originated in industrialised countries; around 45 percent of Sudan's imports over the period 1973-98 came from only seven industrialised countries; namely, France, Germany, Italy, Japan, Netherlands, United Kingdom, and the USA. An increase in the real exchange rate, *RE*, is equivalent to a real devaluation or depreciation of the Sudanese pound, while a decrease in the rate is equivalent to a real appreciation.

r: real interest rate is computed as $r_t = \left\{\left[{1+R_t} \big/ {1+\mathrm{E}_t(p_{t+1})}\right]-1\right\}$, where *Rt* is commercial banks nominal lending rate and $\mathrm{E}_t(p_{t+1})$ is expected rate of inflation, with both variables divided by 100. Thus a 10% expected rate of inflation, for example, is expressed as $\mathrm{E}_t(p_{t+1}) = 0.10$. Expected inflation is based on dynamic expectations about the inflation rate where expected inflation is a geometric distributed lag function of current and lagged values of rate of inflation; $\underset{t}{\mathrm{E}}(p_{t+1}) = \sum_{i=0}^{\infty} J^i p_{t-i}$, where $0< J <1$.

INDBT: indebtedness is measured by a conventional debt indicator; ratio of total debt service payments to export revenues.

RCU: since there is no data available for capacity utilisation rate, and likewise for private sector output, we use a general proxy, which relates total output, *Y*, to an estimated trend, *YT*. Assuming that private sector output co-moves with total output in the same direction, increases in *Y* relative to the long-run trend *YT* indicate an increasing rate of capacity utilisation in the private sector.

INSTB: macroeconomic instability is proxied by variance in the exchange rate. Uncertainty about the exchange rate and thereby about overall economic conditions is measured by fitting an autoregressive conditional heteroscedasticity (ARCH) model to real exchange data, following Huizinga (1993). Huizinga fit the same model (though to inflation series rather than to the real exchange rate) to measure uncertainty. The ARCH representation of the exchange rate reflects the fact that the particular measure is the conditional variance of the exchange rate rather than the unconditional one, in the sense that what is of concern here are the fluctuations of the variable around a predicted future path rather than fluctuations around an average.

Appendix (B): Tables

Table (A.1): Correlation Matrix

	I	*Y*	*PSI*	*CR*	*RE*	*r*	*INDBT*	*RCU*	*INSTB*
I	1.0								
Y	0.92	1.0							
PSI	-0.56	-0.66	1.0						
CR	-0.58	-0.73	0.87	1.0					
RE	0.65	0.54	-0.34	-0.31	1.0				
r	-0.80	-0.88	0.81	0.91	-0.51	1.0			
INDBT	-0.31	-0.29	0.32	0.29	-0.39	0.30	1.0		
RCU	0.19	0.26	0.30	0.19	-0.13	0.91	0.15	1.0	
INSTB	0.20	0.12	-0.19	-0.26	0.45	-0.32	-0.35	-0.25	1.0

Table (A.2): F-tests of Significance of Regressors for the VAR System of Table 4

Variables	F-statistics	F-probabilities
Const.	6.60439	0.004***
DI_{t-1}	1.11095	0.415
DY_{t-1}	1.07761	0.431
$DPSI_{t-1}$	1.11891	0.411
DCR_{t-1}	3.00868	0.050**
DRE_{t-1}	4.85868	0.012**
Dr_{t-1}	2.84977	0.063*
$CIVa_{t-1}$	7.11677	0.003***
$CIVb_{t-1}$	10.4251	0.001***
$DINDBT_{t-1}$	0.323005	0.911
$DRCU_{t-1}$	0.521897	0.781
$DINSTB_{t-1}$	3.28536	0.042**

***significant at 1%, **significant at 5%, and *significant at 10%.