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Savings, investment, foreign inflows and economic growth of the Indian economy 1950-2002

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Abstract
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SAVINGS, INVESTMENT, FOREIGN INFLOWS AND ECONOMIC GROWTH OF THE INDIAN ECONOMY*

1950 - 2002

R. Verma and E.J. Wilson

ABSTRACT

There is a large research literature on the roles of domestic savings and investment in promoting long run economic growth. This paper attempts to identify the major interdependencies between savings, investment, foreign capital flows and real output for India since independence. An endogenous growth model of an open economy, with government, is adapted to specify the complicated theoretical interrelationships between sectors of a growing economy.

The time series of real household, private corporate and public savings; private and public investment; foreign capital inflows and GDP are tested for stationary under structural change. Empirical estimation of the possible long run and short run relationships are conducted using Johansen's FIML cointegration techniques, which are appropriate for simultaneous systems. Granger causality techniques are then conducted to identify significant links between the sectors.

The estimates indicate that there are complicated relationships between the variables in aggregate and at the sectoral level. The evidence clearly shows that it is not only domestic savings which are driving the Indian economy. Private and public investment and foreign capital flows are as important. However their significant interdependencies do not lead to a strong collective influence on real GDP.

These findings have important implications for the formulation of appropriate policies relating to budget deficits, households, foreign inflows and financial sector reforms to promote economic growth.

Keywords: Savings, investment, foreign inflows and economic growth
JEL Classifications: F43, E21, E22, C22.

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1. Introduction

In recent years, there has been extensive empirical work on savings, investment and economic growth. The reasons for this are threefold. Firstly, the growing concern over the falling savings rates in the major OECD countries; secondly, the growing divergence in saving and investment rates between the developing countries; and thirdly, recent growth literature which emphasizes the role of investment in economic growth. Foreign capital inflows have also received considerable attention recently, which have beneficial effects in financing investment and economic growth. However they can be problematic in developing countries such as India because large inflows may create inflationary pressure, under fixed or pegged exchange rates.

The role of savings, investment and foreign inflows in promoting economic growth has received considerable attention in India especially after financial reforms were initiated in 1991. There have only been a few studies available on savings and investment behaviour in India. These are Krishnamurty (1987) *et. al.*, Laumas (1990), Pandit (1991), Ketkar and Ketkar (1992), and Athukorala and Sen (2002). Only Athukorala and Sen (2002) consider the post financial deregulation time period.

Since independence, there has been a consistent increase in savings and investment in India but not without some fluctuations, as can been seen from Figure 1. Foreign capital inflows have been low during much of the period under consideration, only tipping 10 percent after financial deregulation in 1991. The growth rate in real Gross Domestic Product (GDP) was consistently above 5 percent throughout the eighties and nineties except during the adjustment year of 1991-92. Table1 and Figure 1 show the growth rates of savings and investment have been considerably lower than the growth in GDP. Indeed, the growth gap has been widening in the last decade.

The Gross Domestic Savings (*GDS*) rate increased from about 10 percent of GDP in the early 1950s to 16 percent in the early 1970s and then to over 20 percent in the 1980s. Figure 2 shows the rate has increased to around 25 percent in the mid-1990s. Throughout the post-independence period, the household sector has accounted for the lion's share of total domestic savings rate (*vide*: Figure 3). Since the early eighties, there has been a decline in the public savings, reaching negative rates since 1998/99. The reason for the decline has been the deterioration in the fiscal position of the government administrative departments. There has been a rapid growth in private corporate savings over the past two decades.

Table 1

Savings, Investment, Foreign Capital Inflows and Real GDP

R's crore at constant prices

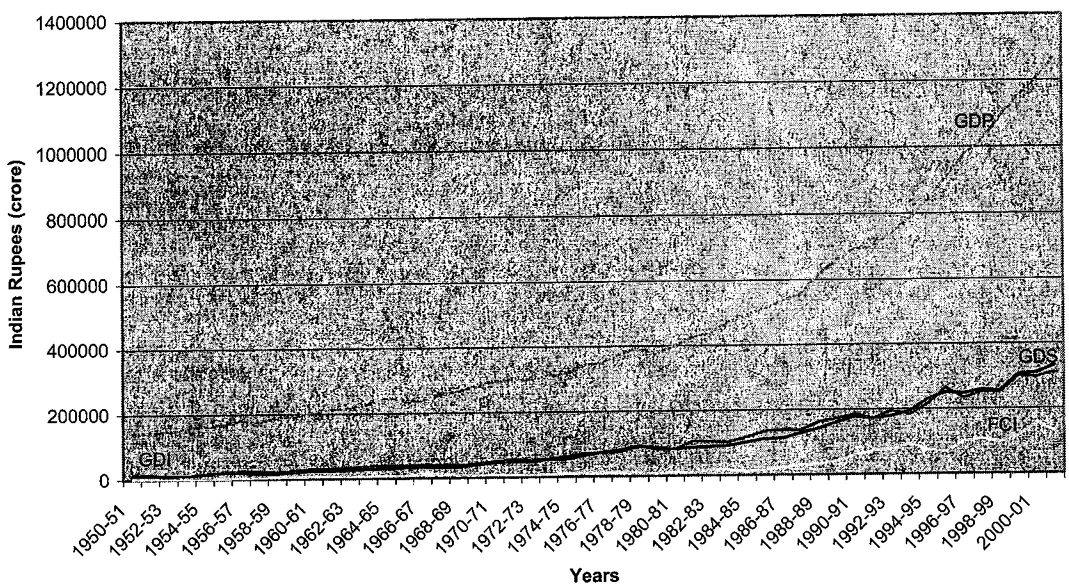
Years	*GDS*	*GDI*	*FCI*	*GDP*
1950/51	13570	14012	1236	140466
1960/61	25050	31133	6341	206103
1970/71	46601	50652	8368	296278
1980/81	83570	82745	13012	401128
1990/91	178370	185859	60007	692871
2000/01	309305	297895	155704	1198685

Source: CSO, India and Reserve Bank of India plus authors calculations.
Note: *GDS* denotes Gross Domestic Savings: *GDI* is Gross Domestic Capital Formation: *FCI* is Foreign Capital Inflows: *GDP is* Gross Domestic Product.

Figure 1

Savings, Investment, Foreign Capital Inflows and Real GDP

R's crore at constant prices

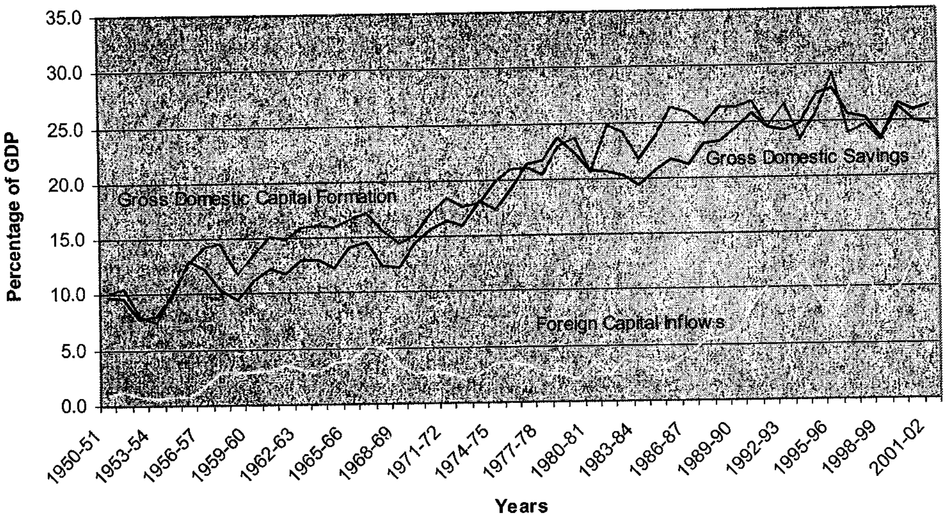


Source: CSO, India and Reserve Bank of India plus authors calculations.
Note: *GDS* denotes Gross Domestic Savings: *GDI* is Gross Domestic Capital Formation: *FCI* is Foreign Capital Inflows: *GDP is* Gross Domestic Product.

Figure 2

Savings, Investment & Foreign Capital Inflows

Percentage of GDP



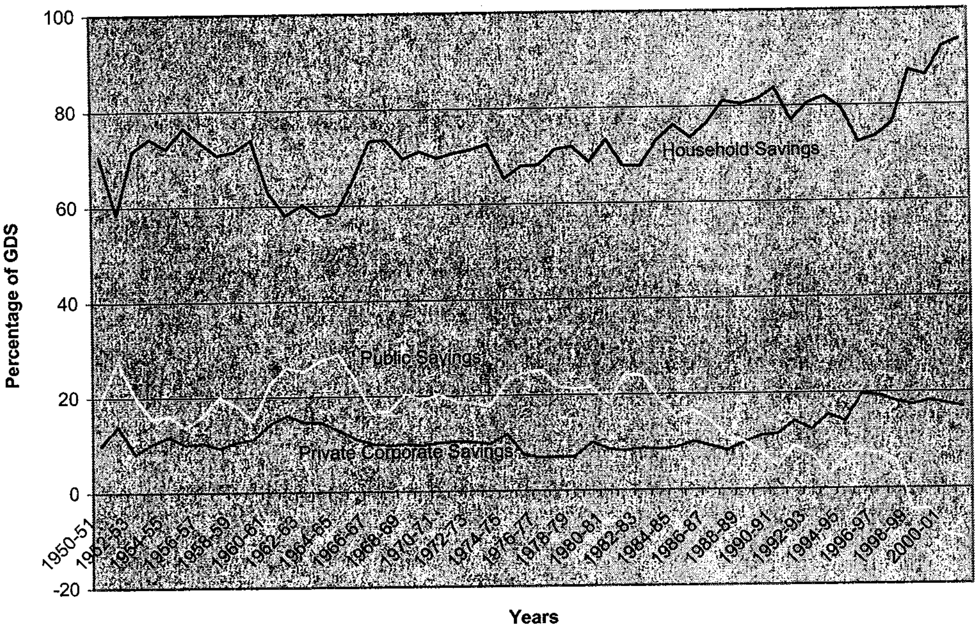
Source: Authors calculations.

Gross Domestic Capital Formation (*GDI*) rate increased from 10 percent of *GDP* in 1950/51 to around 18 percent in the early 1970s, and then to 26 percent by mid-1990 before dipping slightly to around 25 percent in the early years of 2000. As can be seen from Table 2 and Figure 4, the relative contribution of the private and public sectors to *GDI* has changed considerably in the period under consideration. The increase in overall investment rate was driven by the public investment from mid-1960s to the early 1980s. The public investment rate improved from 28 percent in the early 1950s to 45 percent in the early eighties. However, private investment was the one which contributed to total *GDI* since mid-1980 as public investment started to decline steadily. Private investment increased from 55 percent in the early 1980s to above 70 percent in the last couple of years.

Figure 3

Components of GDS

Percent



Source: Authors calculations.

Table 2

Components of Gross Domestic Capital Formation

Percent

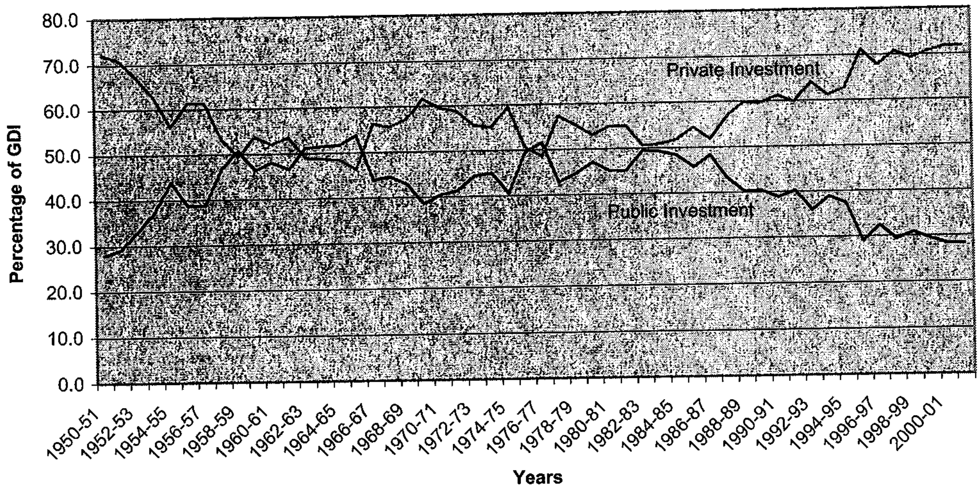
Years	Public Investment (*PUI*)	Private Investment (*PRI*)
1950/51	27.9	72.1
1960/61	48.0	52.0
1970/71	40.4	59.6
1980/81	45.1	54.9
1990/91	38.8	61.2
2000/01	28.3	71.7

Source: Author's calculations

Figure 4

Components of GDI

Percent



Source: Authors calculations.

Figure 1 shows that foreign capital inflows were less than 1 percent in the 1950/51, increasing to 3 percent in 1980/81 after a fall in the seventies and then an increase in 1990/91 to 8.7 percent, increasing to 10 percent in 2001/02. The easing of restrictions on private capital inflows has led to a significant increase in both foreign direct and portfolio investment since 1991-92. It is the surge in the private capital inflow that has led to a sharp increase in India's capital inflows. However, foreign investment has levelled off after 1997 due to various reasons, which include our weak infrastructure, rigid labour laws, cumbersome administrative procedures, to name a few. It could be said India gets very little foreign investment for its large economic and population size. India only receives one tenth of what China receives.

This paper intends to explore these important developments in savings, investment, foreign capital inflow and real GDP for India, taking particular care to identify their complex interrelationships. The paper is divided into four sections. Section 2 is devoted to formally modelling savings and investment in a small open economy with a government sector in a growth context. Section 3 deals with estimation procedures in a simultaneous setting and discusses the estimated results. The final section brings out policy implications of the important empirical findings.

2. The Model

In order to explore the possible relationships between private, government and overseas savings and investment, it is necessary to develop a generic growth model which includes overseas and government sectors. The private sector is specified to comprise households and corporate firms.

Households

A typical household supplies labour services (l) to firms, in exchange for the real wage rate (w), and owns real capital used in production (k), which has real return (rk). The household pays net taxes to the government (τ_h) and purchases consumption goods (c) from firms.[1] Total disposable income is therefore: $(wl+rk)-\tau_h$, which is consumed (c) and saved (s_h). Positive household savings are lent to the government in the form of government bonds purchases $(\dot{b}_g)$ with return on total borrowing (rb_g). We assume the household has negligible investment expenditure and does not borrow or lend overseas. The budget constraint for the representative household is given by:

$$c+\left(\dot{b}_g-rb_g\right)=\left(wl+rk\right)-\tau_h. \tag{1}$$

The household is assumed to select the time path of consumption and savings which maximises intertemporal utility:

$$U(c)=\int_0^{\infty}u\left[c(t)\right]e^{-\rho t}dt \tag{2}$$

where $u(c)$ is a concave instantaneous utility function.[2] The utility maximising growth in household consumption can be determined by substituting out the costate variable in the

1 Households may receive transfer payments from the government which are included in net taxes.

2 The utility function has the standard properties: $u(0)=0$, $u(c)>0$ and $u'(c)=\partial u(c)/\partial c<0$.

Hamiltonian maximisation: $H = u(c)e^{-\rho t} + \mu(\dot{b}_g)$ where: $\dot{b}_g = wl + rk - \tau_h + c + rb_g$, to give:[3]

$$\dot{c} = \theta(r - \rho). \tag{3}$$

The growth in consumption is therefore an inverse function of the rate of the fixed time preference (ρ) and a positive function of the real interest rate (r). Integrating (3) forward with respect to time gives the accumulated value of utility maximising consumption:[4]

$$c(t) = e^{\int_0^t \theta(r(s)-\rho)ds}. \tag{4}$$

We can now determine the optimal savings path from this result. Let: $y = wl + rk$ and specify household taxes as a proportion of household income: $\tau_h = \alpha_h y$. Substituting in (1) and collecting like terms gives:

$$s_h = \alpha' y - c \tag{5}$$

where: $\alpha' = 1 - \alpha_h$. Substituting (4) into (5) derives the time path of savings which maximise household intertemporal utility:

$$s_h(t) = \alpha' y(t) - e^{\int_0^t \theta(r(s)-\rho)ds}. \tag{6}$$

Government

The government budget constraint is:

$$g_i = (\tau_h + \tau_p) + (\dot{b}_g - rb_g). \tag{7}$$

where receipts comprise taxation received from households and firms: $(\tau_h + \tau_p)$ plus borrowings of net savings from households: $(\dot{b}_g - rb_g)$. Outlays are in the form of government purchases of capital goods from the firm (g_i).[5] We will now consider the behaviour of firms.

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3 The elasticity of marginal utility with respect to consumption term is specified here as: $\frac{-1}{\theta} = \frac{u''(c)}{u'(c)}$.

4 The initial value of consumption is standardised at unity, ie. $c_0 = 1$

Private Corporate Firms

The representative non-household, private sector corporate firm employs household labour and household owned capital to produce domestic real output. The sector is competitive with each firm's producing consumption and capital goods. The firm's production is given by the standard production function: $f(l, k; A)$ which explicitly includes the total factor productivity parameter (A).[6]

The firm therefore pays the household real wages for their labour services (wl) and distributed earnings in the form of the return to capital (rk). The firm is able to borrow capital from overseas $(\dot{b}_f)$ and pays interest to on the outstanding debt (rb_f). The typical firm also pays tax (τ_p) to the government, which in turn purchases capital goods (g_i). Households purchase consumer goods (c) from the firm, which also sells capital goods $(\dot{k})$ to other firms in the private corporate sector. Total cash inflows are therefore: $c+\dot{k}+g_i+\dot{b}_f$ and cash outflows are: $wl+rk+\tau_p+rb_f$. This gives the cash flow constraint:

$$c+\dot{k}+g_i+\dot{b}_f = wl+rk+\tau_p+rb_f. \tag{8}$$

Savings by firms, in the form of retained earnings (s_p), are:[7]

$$s_p = -\dot{b}_f = \dot{k}+c+g_i-wl-rk-\tau_p-rb_f. \tag{9}$$

The firm's savings differs from the cash flow constraint because they comprise savings in the form of capital formation $(\dot{k})$ plus income $(c+g_i)$, less payments $(wl+rk)$ to

5 Government expenditure will include consumption spending on goods and services, broadly defined to include public service wages. In order to keep the model tractable, for the purpose of this paper we will assume all government spending is for investment purposes.

6 The firm's production function is assumed to have the well behaved properties: $\forall x \in \{l, k; A\}$ $x(0)=x_0$, $f'_x>0$, $f''_x<0$, $\lim_{x\to 0^+} f'_x=\infty$ and $\lim_{x\to\infty} f'_x=0$ where $f'_x=\partial f/\partial x$, $f''_x=\partial^2 f/\partial x^2$.

7 In order to ensure model stability it is necessary to constrain government and overseas borrowing. We restrict total borrowings $(\dot{b}_g+\dot{b}_f)$ to be less than capital formation, $(\dot{k})$ in net present value terms. That is: $\int_t^\infty \left[\dot{b}_g(t)+\dot{b}_f(t)\right]e^{-\rho(s-t)}ds < \int_t^\infty \dot{k}(t)e^{-\rho(s-t)}ds.$

households, government (τ_p) and overseas (rb_f).[8] To the extent that firm's rely on overseas borrowings, then these are dissavings $(-\dot{b}_f)$. We can simplify by substituting: $y = wl + rk$ into (9), defining the company tax rate to be a fixed proportion of the firm's income: $\tau_p = \alpha_p y$, so that for: $\alpha = 1 + \alpha_p$:

$$s_p = \dot{k} + c + g_i - \alpha y - rb_f. \tag{10}$$

The representative competitive firm accumulates capital to maximise the intertemporal net present value of the retained earnings, $s_p(k)$:[9]

$$S_p(k) = \int_0^\infty s_p\left[k(t)\right]e^{-\rho t}dt \tag{11}$$

where the constant discount rate (ρ) is assumed to be the same for households. The Hamiltonian: $H = s_p(k)e^{-\rho t} + \mu\dot{k}$, subject to: $\dot{k} = s_p - c - g_i + \alpha y + rb_f$ can be used to maximise intertemporal retained earnings.[10] However it is convenient to define the costate variable (μ) as the net present value of Tobin's q at the current time period (t); that is, $\mu = \xi q e^{-\rho t}$. The Hamiltonian for this frictional system becomes:[11]

$$H = s_p(k)e^{-\rho t} + \xi q\dot{k}e^{-\rho t} \tag{12}$$

and the costate equation $\dot{\xi} = -H_k$ gives the result: $\dot{q} = rq - \alpha y'_k$, where: $y'_k = \partial y / \partial k$ denotes the marginal product of capital. This solves for q:

$$q(t) = \int_t^\infty (\alpha y'_k)e^{-\rho(s-t)}ds. \tag{13}$$

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8 Additional savings by the firm can be easily included in terms of the depreciation of capital (δk). This could simply be added to the profits distributed as earnings (rk) to households as the owners of the capital. In this sense (r) can be considered to include both effects, which will not be explicitly modelled here.

9 The firm may maximise total profits which comprise retained and distributed earnings $(\upsilon + rk)$. Given the return (r) to households is competitively determined, the firm will select the capital stock which maximises its retained earnings. The intertemporal maximisation is to determine the optimal stock of capital (k).

10 Household consumption and government expenditures, as well as the real wage and interest rates are all given to the competitive firm.

11 Capital formation in this system will involve costs of adjustment. We will not explicitly define these costs here and assume that investment $(\dot{k})$ is net of these costs, which are used up in production (*vide*: Wilson and Chaudhri (2000)).

Equation (13) clearly shows that Tobin's q is the sum of the weighted net present values of all future marginal products, $\alpha y_k'$. Since q represents the marginal valuation of capital (relative to its replacement cost) when frictions are present, then values of $q>1$ will encourage investment by firms according to the investment function:

$$\dot{k}=\phi(q-1) \quad \text{with} \quad \phi'>0. \tag{14}$$

When $q=1$, investment will be zero $(\dot{k}=0)$ and when $q<1$, there will be disinvestment $(\dot{k}<0)$. Using (13) to substitute for q in (14) gives the required result for capital formation as a function of the net present value of the marginal products of capital in production:

$$\dot{k}=\phi\left(\int_t^{\infty}\alpha y_k' e^{-\rho(s-t)}ds-1\right). \tag{15}$$

Foreign Capital

Rearrange (1), noting that household income comprises wage and profit receipts: $y=wl+rk$ and savings are lent to the government: $s_h=\dot{b}_g-rb_g$, to give:

$$y=c+s_h+\tau_h \tag{16}$$

for households. The constraint (9) for firms can also be manipulated to provide the relationship:

$$y=\dot{k}+c+g_i-\tau_p+\dot{b}_f-rb_f \tag{17}$$

Solving (16) and (17) and collecting terms gives the well known identity:

$$(\dot{k}-s_h)+(g_i-\tau)=(m+rb_f-x) \tag{18}$$

where: $\tau=\tau_h+\tau_p$ and the position of the balance of trade: $(x-m)$ is reflected in the foreign capital inflows: $-\dot{b}_f=m-x$.[12]

Examination of (18) clearly shows that if $(\dot{k}-s)$ does not change when there is an increase in the budget deficit caused by a reduction in taxes (τ), there will be a one-for-one

[12] An alternative derivation is to replace $(-\dot{b}_f)$ with (s_p) in (9) to give: $(\dot{k}-s)+(g_i-\tau)=(rb_f)$ where: $s=s_h+s_p$. The interpretation of this identity is the same as for (18).

increase in the current account deficit: $m + rb_f - x$. This is called the "twin deficits hypothesis". Alternatively, if the current account deficit does not change with a reduction in taxes, then there must be a one-for-one reduction in household savings (s_h). This represents the polar opposite case of the "Ricardian equivalence hypothesis" where the reduction in taxes, which increases household disposable income, does not increase consumption. Households prefer to increase savings to endow the future in order to pay the expected higher taxes.

Importantly, given India's budget deficit, relationship (18) clearly shows that this will be matched by current account deficit and/or an increase in domestic savings relative to capital formation. Since the current account has not been in deficit to the extent of the fiscal budget then there is a strong requirement for savings to increase in order to fund capital formation in India. This is consistent with the data in Table 1 and Figure 1 above. However these interrelationships are complicated. Equation (6) shows that household savings (s_h) are determined by households who maximise intertemporal utility. The private sector investment $(\dot{k})$ is a function (15) of competitive corporate firms optimising retained earnings. Foreign capital inflows $(\dot{b}_f)$ to corporate firms are determined by equation (9) and real output is given by the production function: $f(l, k; A)$. The government budget constraint (7) shows the government sector (dis)saving associated with autonomous government investment (g_i). Equation (10) specifies the savings (s_p) for corporate firms which are a function of their servicing existing overseas debt (rb_f), with consumption, private and government investment determined by the above relationships.

Table 3 summarises these key relationships which will be estimated in the next section. Our explorations will focus on whether domestic household, corporate and public savings act as constraints to private and public capital formation and economic growth in India.

Table 3

Summary of Important Relationships

	Variable	Specification	Equation
Savings			
Household	*HHS*	$s_h(t) = \alpha' y(t) - e^{\int_0^t \theta(r(s)-\rho)ds}$	(6)
Private Corporate	*PRS*	$s_p = \dot{k} + c + g_i - \alpha y - rb_f$	(10)
Government	*PUS*	$g_i - (\tau_h + \tau_p)$	(7)
Investment			
Private[1]	*PRI*	$\dot{k} = \phi\left(\int_t^\infty \alpha y_k' e^{-\rho(s-t)} ds - 1\right)$	(15)
Government	*PUI*	g_i	(7)
Foreign Capital Inflows	*FCI*	$\dot{b}_f$	(9)
Production	*GDP*	$f(k, l; A)$	(2)

Note: [1] Household and corporate.

3. Estimation of the Relationships

Annual data for the period of 1950/51 to 2001/02 were used for the estimations. The data for savings and investment were taken from Central Statistics Organization (CSO) National Accounts (various issues). Data for Foreign Capital Inflows (*FCI*) were taken from The Center of Monitoring Indian Economy. GDP figures were taken from the Reserve Bank of India. All the variables, except for GDP (which was already in constant prices) were converted into constant prices. All data is in Rupees for the new basis series 1993/94.

As explained in the model derivation, the economy is divided into four broad institutional sectors, namely the household sector, the private corporate sector, the public sector and the overseas sector. The household sector (treated as a residual) comprises, apart from individuals, all non-government non-corporate enterprises such as sole proprietorships and partnerships (owned and/or controlled by individuals) and non-profit institutions. The private corporate sector comprises all non-governmental financial/non-financial corporate enterprises and co-operative institutions. The public sector covers government administration, departmental enterprises, and non-departmental enterprises.

Gross Domestic Savings (*GDS*) is the sum of household (*HHS*), private corporate (*PRS*) and public savings (*PUS*). Gross Domestic Capital Formation (*GDI*) is the sum of private investment (*PRI*) and public investment (*PUI*). All variables were converted to Naperian logs.

Stationarity

The variables were tested using the augmented Dickey-Fuller tests and the results were mixed and inconclusive. It is well known that tests of stationarity in time series are biased towards not rejecting the null hypothesis of non-stationarity when structural change is present.[13] We therefore use the Innovational Outliner (IO) unit root test proposed by Perron & Vogelsang (1992). This procedure tests the variables for unit roots in the presence of a structural break, defined as a change in the mean, with an unknown time period break. Under the IO model, the change is supposed to effect the level of series (y_t) gradually, during a transition period. We suppose that the economy responds to a shock to the trend function (the change in the mean) in the same way as it reacts to any other shocks. Assuming at most one change, the test procedure is formulated as:

$$y_t = \gamma + \delta DU_t + \theta D(TB)_t + \lambda y_t - 1 + \sum_{i=1}^{K} c_i \Delta y_{t-i} + e_t \qquad (19)$$

where y_t stands for the time series variable being tested; DU_t is the dummy variable; TB_t is the time of the break (T_b), e_t is the error term and t is the time period. DU_t is equal to one if $t > T_b$ and zero otherwise. $D(TB)$ is equal to one if $t = T_b + 1$ and zero otherwise. Break time (TB) is unknown and therefore is determined through minimizing the Students-t statistic for testing $\delta = 0$. The number of lags (κ) is determined using the F-statistic to evaluate the significance of additional lags. The null hypothesis of a unit root, $I(1)$, is conducted by testing $\lambda = 1$, which also implies $\delta = 0$, when the above equation is estimated by ordinary least squares (OLS).

The empirical results show that all the variables are non-stationary in the presence of a structural break. The breaks, shown in Table 4, accord with important economic and political

13 *Vide* Perron (1989).

events. For example, prime minister Rajiv Gandhi introduced financial reforms in the 1986/87 budget and the years 1987-89 saw high levels of policy intervention in the Indian banking sector. Agricultural production was severely affected by a major drought in 1987 and significant financial and agricultural marketing deregulation took place in 1991.

Table 4

Unit Root Test – Innovational Outlier (IO) model

Variable	Break Period T_b	Lag Length κ	$\hat{\lambda}$	$\hat{\delta}$
HHS	1989	2	1.002	–0.007
PRS	1993	3	1.002	–0.007
PUS	1988	4	0.910	–1.361
GDS	1989	2	0.985	0.139
PRI	1990	2	1.005	0.006
PUI	1989	2	0.925	0.014
GDI	1989	2	0.972	0.015
FCI	1993	3	0.941	0.100
GDP	1989	3	1.022	0.002

Note: *HHS*: Household Savings; *PUS*: Public Savings; *PRS*: Private Savings; *GDS*: Gross Domestic Savings = *HHS* + *PUS* + *PRS*; *PRI*: Private Investment; *PUI*: Public Investment; *GDI*: Gross Domestic Capital Formation = *PRI* + *PUI*; *FCI*: Foreign Capital Inflows; *GDP*: Gross Domestic Product.

Cointegration Procedure

The estimation procedure needs to take into account both the simultaneity and possible non-stationary characteristics of the interdependent variables of interest. Unfortunately, the presence of intertemporal non-stationary effects complicates the system specification and estimation. An appropriate method is Johansen's vector autoregressive (VAR) approach which explicitly incorporates these temporal effects.[14] Define the VAR for the vector of variables, $\underline{y}_t$:

$$\underline{y}_t = \underline{\gamma} + \sum_{i=1}^{\kappa} \Phi_i \underline{y}_{t-i} + \sum_{j=0}^{l} \Psi_j \underline{x}_{t-j} + u_t \, , \qquad t = 1, 2, \ldots, n \qquad (20)$$

14 *Vide* Johansen (1991, 1995), Johansen and Julius (1992) and Pesaran and Pesaran (1997).

where vector $\underline{x}_t$ represents all other exogenous/deterministic $I(0)$ effects. The vector error correction (VECM) is:

$$\Delta \underline{y}_t = \underline{\gamma} + \sum_{i=1}^{K-1} \Gamma_i \Delta \underline{y}_{t-i} - \Pi \underline{y}_{t-1} + \sum_{j=0}^{l} \Psi_j \underline{x}_{t-j} + v_t \tag{21}$$

where: $\Pi = \sum_{i=1}^{K} \Phi_i - \mathbf{I}$, with $\mathbf{I}$ denoting the identity matrix. The rank (φ) of the Π matrix can be determined using Johansen's trace, eigenvalue and model selection criteria. Full information maximum likelihood methods can be used to estimate each of the (φ) vectors in the $\underline{\beta}$ matrix (with associated standard errors) using: $\Pi = \underline{\alpha}\underline{\beta}'$. The $\underline{\beta}$ matrix represents the long run steady state relationship between the variables: $\underline{\beta}'\underline{y}_t$. Whilst the variables: y_t are non-stationary in levels: $y_t \sim I(1)$ and stationary in first differences: $\Delta y_t \sim I(0)$ the long run cointegrating vector: $\underline{\beta}'\underline{y}_t \sim I(0)$ is stationary. The cointegrating vector can be identified by normalising the vector on each variable and estimating using full information maximum likelihood. That is, for the cointegrating vector:

$$\left\{\beta_1 y_1 + \beta_2 y_2 + \ldots + \beta_i y_i + \ldots + \beta_j y_j + \ldots + \beta_n y_n\right\} = u \sim \mathrm{N}\left(0, \sigma_u^2\right) \tag{22}$$

taking expectations of both sides and normalising for the variable: y_i gives:

$$y_i = -\frac{\beta_1}{\beta_i} y_1 - \frac{\beta_2}{\beta_i} y_2 - \ldots - \frac{\beta_j}{\beta_i} y_j - \ldots - \frac{\beta_n}{\beta_i} y_n. \tag{23}$$

consistent with (22). Since the variables are in Naperian log form: $y_i = \ln Y_i$, $i = 1, 2, \ldots, n$, the ratio of the coefficients represents the elasticity: ε_{ij} between the variables: y_i and y_j:[15] Maximum likelihood estimation then gives the elasticity estimate for each variable pair:

$$\hat{\varepsilon}_{ij} = -\hat{\beta}_j / \hat{\beta}_i \tag{24}$$

Finally, the matrix $\underline{\alpha}$ gives the error correction responses of the variables to short run deviations from the long run equilibrium relationship.

It is important to stress that the Johansen method allows estimation in a simultaneous setting, which is consistent with our model development in the previous section. Indeed this

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[15] $\varepsilon_{ij} = -\beta_i/\beta_j = -\partial \ln Y_i / \partial \ln Y_j = -(\partial Y_i/Y_i)/(\partial Y_j/Y_j)$.

approach is central to this paper because it allows exploration of the complicated interdependencies between the categories of savings, investment, foreign capital inflows and real GDP. It overcomes the difficulties associated with single equation procedures which are inconsistent with this analysis. Finally, we will now estimate the steady state cointegrating relationships to derive the long run equilibrium elasticities.

Cointegrating Relationships

To further account for these complicating factors, dummy variables were included in the stationary vector $\underline{x}_t$ in specification (20) to capture structural change effects. A structural dummy variable: d_{89} takes the value one for the period 1989 to 2001 and zero elsewhere to include the structural change effects on the *GDS*, *GDI* and *GDP* variables. Another dummy variable: d_{93} was included for *FCI*, taking values one for the years 1993 to 2001.[16]

The aggregate measures were firstly analysed to obtain an overview of the possible behaviour of the economy. The first step is to determine the optimum lag length: κ of the VAR model specified in (20) above. The Schwarz Bayesian criterion (SBC) shows the optimum lag is order one whilst the Akaike Information criterion (AIC) indicates two lags. However the likelihood ratio test agrees with the SBC criterion at the 5 percent level.

The first order cointegrating VAR with unrestricted intercept and no trend gives clear indication that the rank of the system is one. The estimated eigenvalues are {0.573, 0.234, 0.164, 0.008} and the maximum eigenvalue and rank tests accept the null hypothesis of $\varphi = 1$ at the 5 percent level of significance. The Schwarz Bayesian criterion (SBC) and Hann-Quinn criterion (HQC) agree with this whilst the Akaike Information criterion (AIC) shows a rank of three.[17] What this means is that only one vector is required to fully explain the long run relationships between all the variables. When the estimation is set to include unrestricted intercept and restricted trends, the measures indicate a rank of two. However the second eigenvalue is relatively low {0.606, 0.442, 0.164, 0.098, 0.000} and the first estimated cointegrated vector is very similar to that for the rank of one. The selection of a rank of one reduces the required number of identifying restrictions to one, rather than two. The simple normalisation is sufficient to identify the relationship and so we decide to remain with the rank of one. The estimated cointegrating vector: $\underline{\hat{\beta}}'\underline{y}$ is:

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[16] Whilst Table 4 shows possible structural breaks occurred between 1988 and 1993 it was decided to classify the variables into two groups with approximate periods 1989 and 1993.

$$\{1.319\ GDS - 2.086\ GDI + 0.325\ FCI + 0.703\ GDP\}$$

The maximum likelihood estimates of the long run elasticities from this vector, $\underline{\hat{\beta}}$ are presented in Table 5.

Table 5

Estimated Long Run Elasticities [1]

1951 to 2001

Unrestricted intercepts and no trends in the VAR.

Dependent Variable	Explanatory Variables			
	GDS	*GDI*	*FCI*	*GDP*
GDS	–	1.581	–0.246	–0.533
		(6.51)***	(–4.33)***	(–1.51)
GDI	0.632	–	0.156	0.337
	(6.51)***		(6.08)***	(0.17)
FCI	–4.060	6.420	–	–2.165
	(–4.33)***	(6.08)***		(–0.93)
GDP	–1.875	2.965	–0.462	–
	(–1.51)	(1.95)*	(–1.75)*	

Notes: [1] Figures in parenthesis below the estimated elasticities represent "*t*-ratios" of the parameter estimate divided by the estimated standard error.
*** Represents significant at the 1 percent level under the assumption of normality.
** Represents significant at the 5 percent level under the assumption of normality.
* Represents significant at the 10 percent level under the assumption of normality.

Clearly, *GDS* responses to changes in *GDI* are elastic with a long run elasticity of 1.58. *FCI* affects *GDS* inelastically and inversely with a measure of –0.25. *GDI* is, in turn, inelastically affected by *GDS* and *FCI.* Foreign capital inflows are significantly affected, negatively by *GDS* and positively by *GDI.* There is therefore a positive long run relationship between *GDI* and *GDS* as well as between *GDI* and *FCI.* However there is an inverse relationship between *GDS* and *FCI,* as expected. Note the important effect that *GDI* has on *GDP.* Whilst the estimate is only significant at the five percent level, the elasticity is large at

[17] The Schwarz Bayesian criterion (SBC) is the preferred model selection criterion because it is the most parsimonious and is consistent for large samples when the 'true' model is known.

2.97. The negative effects of *FCI* on *GDI* also carry through to negatively affect *GDP* at the ten percent level.

The estimated short run error correction mechanisms: $\hat{\alpha}$ for the cointegrating vector are summarise in Table 6 and detailed in Tables A1 and A2 in Appendix A. The dummy variables d_{89} and d_{93} were found to be significant in the error correction estimations for *GDI*, *FCI* and *PRI* (see Appendix A). The equilibrating corrections to disequilibrium for *GDI* are all significant at the one percent level. The estimates are relatively high for the *GDS* normalised cointegrating vector (–0.51) and a large –0.80 for the own *GDI* vector. The error corrections for *FCI* are greater than one for the *GDS* and *GDI* normalised cointegrating vectors. The estimates of –1.17 and –1.85 imply that *FCI* displays highly variable short run overshooting behaviour in disequilibrium with the *GDS* and particularly with the *FDI* normalised vectors. The positive *GDS* estimates represent unstable disequilibrium properties, although they are relatively small and significant at the five percent level.

Table 6

Estimated Short Run Error Correction Mechanisms [1]

1951 to 2001

Unrestricted intercepts and no trends in the VAR

(*ecm1*) Variable	**Cointegrating Vector Normalised on Variable:**			
	GDS	*GDI*	*FCI*	*GDP*
Δ*GDS*	0.252 (1.95)*	0.399 (1.95)*	0.062 (1.95)*	0.134 (1.95)*
Δ*GDI*	–0.505 (–3.86)***	–0.799 (–3.86)***	–0.124 (–3.86)***	–0.269 (–3.86)***
Δ*FCI*	–1.169 (–4.11)***	–1.849 (–4.11)***	–0.288 (–4.11)***	–0.624 (–4.11)***
Δ*GDP*	0.001 (0.04)	0.002 (0.04)	0.000 (0.04)	0.001 (0.04)

Note: Figures in parenthesis below the estimates are the *t*-statistics.
*** Significant at the 1 percent level: ** 5 percent level: * 10 percent level.

Let us now consider the sectoral relationships. The optimal lag of the VAR was determined to remain at one according to the model selection criteria. The first order cointegrating VAR with unrestricted intercept and no trend clearly has a rank of two according to the maximum eigenvalue and rank tests at the 5 percent level of significance. The estimated long run cointegrating vectors are:

$$\{0.632\, HHS + 0.062\, PRS + 0.020\, PUS - 0.148\, PUI - 1.501\, PRI + 0.072\, FCI + 1.369\, GDP\}$$

$$\{-1.040\, HHS - 0.795\, PRS + 0.003\, PUS + 0.304\, PUI + 0.606\, PRI - 0.047\, FCI + 1.59\, GDP\}$$

The long run elasticity estimates are included in Table 7. Consistent with the aggregate findings, *PRI* and *PUI* have significant effects on *HHS* and *PRS*. Indeed, *PRI* has elastic effects, with coefficients of 1.33 and 2.71 for *HHS I and* PRS respectively. However *HHS* and *PRS* have an inverse long term relationship. Importantly, both *HHS* and *PRS* significantly affect *PRI* and *PUI*. There is evidence of long run crowding out with the estimated elasticity of –2.03 whereby *PRI* changes in response to changes in *PUI*. There are no observed direct relationships between these sectors and *GDP*. This is consistent with Table 1 and Figure 1 which show that GDP has been growing very differently to savings and investment in India.

The short run error correction estimates, summarised in Table 8, clearly show that *FCI* demonstrates significant disequilibrium behaviour. In order to explore the possible short run relationships between these variables we conduct Granger causality tests in the next sub-section.

Table 7

Estimated Long Run Elasticities [1,2]

1951 to 2001: Unrestricted intercepts and no trends in the VAR

Dependent Variable	Explanatory Variables						
	HHS	*PRS*	*PUS*	*PRI*	*PUI*	*FCI* [3]	*GDP* [3]
HHS	–	–0.489 (–3.64)***	–0.012 (–1.49)	1.325 (11.32)***	0.269 (2.24)**	–0.074 (–1.20)	0.00
PRS	–2.046 (–3.64)***	–	–0.024 (–1.37)	2.710 (4.36)***	0.549 (2.11)**	–0.151 (–1.05)	0.00
PUS	–85.089 (–1.49)	–41.581 (–1.37)	–	112.700 (1.41)	22.845 (1.81)*	–6.259 (–1.27)	0.00
PRI	0.755 (11.32)***	0.369 (4.36)***	0.009 (1.41)	–	–2.03 (–2.01)**	0.0556 (1.13)	0.00
PUI	3.725 (2.24)**	1.820 (2.11)**	0.0438 (1.81)*	–4.933 (–2.01)**	–	0.274 (1.56)	0.00
FCI [3]	–13.594 (–1.20)	–6.643 (–1.05)	–0.160 (–1.27)	18.005 (1.13)	3.65 (1.56)	–	0.00
GDP [3]	0.810 (0.12)	0.576 (1.61)	0.00	–0.587 (–0.62)	–0.233 (–0.16)	0.041 (0.72)	–

Notes: [1] Figures in parenthesis below the estimated elasticities represent "*t*-ratios" of the parameter estimate divided by the estimated standard error.
[2] The rank is 2. Only the estimates for the first cointegrating vector are reported here.
[3] The system was identified by normalising and setting *GDP* and *FCI* to zero in the first and second cointegrating vectors, respectively. The *GDP* elasticities were calculated with a zero restriction on *PUS*.
*** Represents significant at the 1 percent level under the assumption of normality: ** 5 percent level: * 10 percent level.

Table 8

Estimated Short Run Error Corrections Mechanisms [1,2]

1951 to 2001: Unrestricted intercepts and no trends in the VAR

(*ecm1*) Variable	**Cointegrating Vector Normalised on Variable:**						
	HHS	*PRS*	*PUS*	*PRI*	*PUI*	*FCI* [3]	*GDP* [3]
Δ*HHS*	0.182 (1.51)	0.089 (1.51)	0.002 (1.51)	0.241 (1.51)	0.049 (1.51)	0.052 (3.88)***	–0.338 (-2.37)**
Δ*PRS*	0.387 (1.95)*	0.189 (1.95)*	0.005 (1.95)*	0.513 (1.95)*	0.104 (1.95)*	0.095 (4.30)***	–0.518 (–2.20)**
Δ*PUS*	0.873 (0.55)	0.426 (0.55)	0.010 (0.55)	1.156 (0.55)	0.234 (0.55)	0.005 (0.03)	0.000
Δ*PRI*	–0.924 (–9.27)***	–0.451 (–9.27)***	–0.011 (–9.27)***	–1.223 (–9.27)***	–0.248 (–9.27)***	–0.096 (–8.72)***	–0.421 (–3.57)***
Δ*PUI*	–0.222 (–1.55)	–0.108 (–1.55)	–0.003 (–1.55)	–0.294 (–1.55)	–0.060 (–1.55)	–0.022 (–1.39)	–0.115 (–0.68)
Δ*FCI* [3]	–0.141 (–0.52)	–0.069 (–0.52)	–0.002 (–0.52)	–0.186 (–0.52)	–0.038 (–0.52)	–0.070 (–2.31)**	0.638 (1.98)*
Δ*GDP* [3]		0.000	0.000	0.000	0.000	0.000	0.018 (0.42)

Notes: [1] Figures in parenthesis below the estimates are the *t*-statistics.

[2] The rank is 2. Only the results for the first cointegrating vector are reported in this table.

[3] The system was identified by normalising and setting *GDP* and *FCI* to zero in the first and second cointegrating vectors, respectively. The *GDP* (*ecm1*) was calculated with zero restrictions on *PRS* and *PUS*. The *FCI* normalized vector was identified with zero restrictions on *GDP* and *PUS*.

*** Significant at the 1 percent level: ** Significant at the 5 percent level: * Significant at the 10 percent level.

Granger Causality

The VAR in (20) is put into first differences to ensure stationarity and then partitioned into two sub-systems:

$$\begin{aligned} \Delta \underline{y}_{1,t} &= \underline{\gamma}_1 + \sum_{i=1}^{k} \Phi_{11,i} \Delta \underline{y}_{1,t-i} + \sum_{i=1}^{k} \Phi_{12,i} \Delta \underline{y}_{2,t-i} + \sum_{j=0}^{l} \Psi_{1,j} \underline{x}_{t-j} + \omega_{1,t} \\ \Delta \underline{y}_{2,t} &= \underline{\gamma} + \sum_{i=1}^{k} \Phi_{21,i} \Delta \underline{y}_{1,t-i} + \sum_{i=1}^{k} \Phi_{22,i} \Delta \underline{y}_{2,t-i} + \sum_{j=0}^{l} \Psi_{2,j} \underline{x}_{t-j} + \omega_{2,t} \end{aligned} \tag{25}$$

where: $\underline{y}_t = \left(\underline{y}_{1,t}, \underline{y}_{2,t}\right)$ for: $t = 1, 2, ..., n$. Block Granger causality tests the restriction: $\Phi_{12} = \mathbf{0}$ which, if rejected, means the of variables in $\underline{y}_2$ are said to collectively Granger cause the variables in $\underline{y}_1$. Similarly, the zero restriction test on Φ_{21} tests whether $\underline{y}_1$ Granger causes $\underline{y}_2$.

The results of the short run Granger causality tests are detailed in Tables 9 and 10 for the aggregate and sector measures respectively. The schematic in Figure 4 summarises the likelihood ratio Chi squared significant relationships for the aggregates. The heavy lines representing the one percent Granger causality run from *GDS* to *GDI*, then to *FCI* and back to *GDS*. There are two interesting (heavy dashed) feedbacks at the five percent level of significance from *GDI* to *GDS* and on to *FCI*. There is a weak (ten percent) link from *GDP* to *GDI*. Other explorations found significant short run block Granger causality from {*GDS*, *FCI*, *GDP*} to *GDI* with a Chi squared statistic of 29.69 which is significant at the one percent level. Other significant relationships exist from {*GDS*, *GDI*, *GDP*} to *FCI*, with a Chi squared statistic of 16.14, and {*GDI*, *FCI*, *GDP*} to *GDS* with a statistic of 16.20. These statistics are higher than those reported in Table 9 and show the cumulative strength of these associations although the links with GDP are weak at best.

Comparing these short run relationships with the long run elasticities shows a high degree of consistency. The strong short run links with feed backs between *GDS* and *GDI* agree with the findings of significant long run elasticities between the two variables. This also applies to the association between *GDS* and *FCI* and between *GDS* and *FCI*.

Figure 5 summarises the numerous short run Granger causing relationships found between the sectors. Due to the relatively large number of complex associations only the most significant Chi squared test statistics are included in the figure. Considering the heavy one percent lines, it becomes apparent that *HHS* is driving the system by Granger causing *PRS* and *PRI*, which in turn, causes *FCI* and then *PRS*. The five percent level of feedback, shown by the heavy dashed lines, runs in the opposite direction from *PRS* to *FCI*, then directly to *HHS* and indirectly via *FCI* and *PRI* to *HHS*. These sector relationships are consistent with the aggregate measures and show the additional weaker feed backs occurring. There is weak ten percent Granger causation running from *GDP* to *PUI*, consistent with the aggregate finding of *GDP* with *GDI*. Interestingly though, there is a one percent with Granger causation from *PUI* to *GDP* which washes out in the more broadly defined *GDI* measure. This is an important short run effect for policy formulation by the authorities. On the other hand, *PUS* appears to be the weakly determined by *HHS* and *PRS*. There are other weak relationships between many of the variables, which again shows the presence of the high degree of complex interrelationships.

There were also significant short run relationships between groups of these variables. Consistent with the aggregate findings, {*HHS*, *PRS*, *PUS*} were found to collectively Granger cause {*PRI*, *PUI*} with a one percent significant Chi squares statistic of 47.10. Dropping *PUS* gave a lower statistic of 32.31, which was still significant at the one percent level. {*HHS*} on its own caused {*PRI*, *PUI*} with a lower one percent significant statistic of 22.69. The feedback effects were weaker with a five percent statistic of 5.50 indicating {*PRI*, *PUI*} Granger causes {*HHS*}. Adding *PRS* to *HHS* found {*PRI*, *PUI*} causing {*HHS*, *PRS*} at only the ten percent level.

There is further consistency in these results when they are compared to the long run elasticity estimates. Table 7 showed the strong effects of *HHS* on *PRS* and the strong relationships between *HHS* and *PRI*.

Table 9

Estimated Short Run Granger Causality

Likelihood Ratio Chi-Squared Test [1]

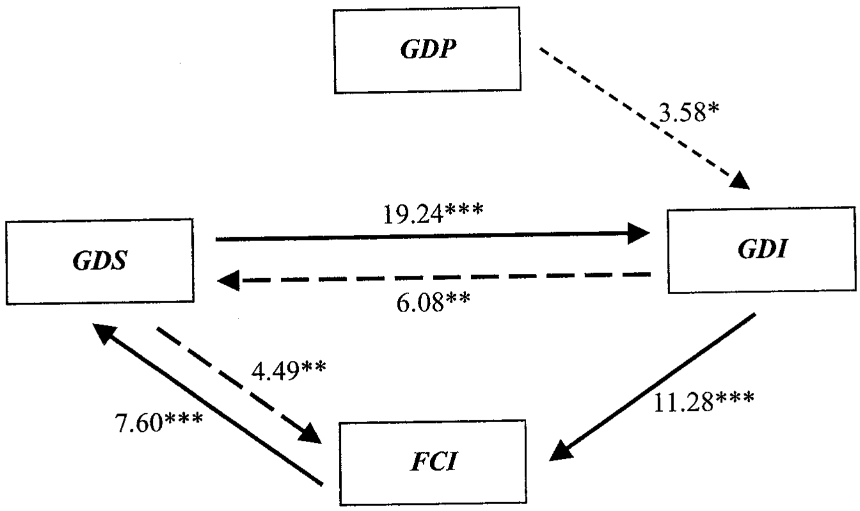
1951 to 2001

Granger Caused Variable	**Granger Causing Variable**			
	ΔGDS	ΔGDI	ΔFCI	ΔGDP
ΔGDS	–	6.076**	7.603***	0.859
ΔGDI	19.238***	–	2.074	3.576*
ΔFCI	4.489**	11.276***	–	1.689
ΔGDP	0.210	1.297	0.627	–

Notes: [1] The Chi-Squared test has 1 degree of freedom.
*** Significant at the 1 percent level: ** 5 percent level: * 10 percent level.

Figure 4

Short Run Granger Causality [1]



Key: *A* → *B* means that *A* Granger causes *B*.

Notes: [1] Figures with the arrows show the values of the χ^2 statistic.

*** Significant at the 1 percent level: ———

** Significant at the 5 percent level: — — —

* Significant at the 10 percent level: - - - - -

Table 10

Estimated Short Run Granger Causality

Likelihood Ratio Chi Squared Test [1]

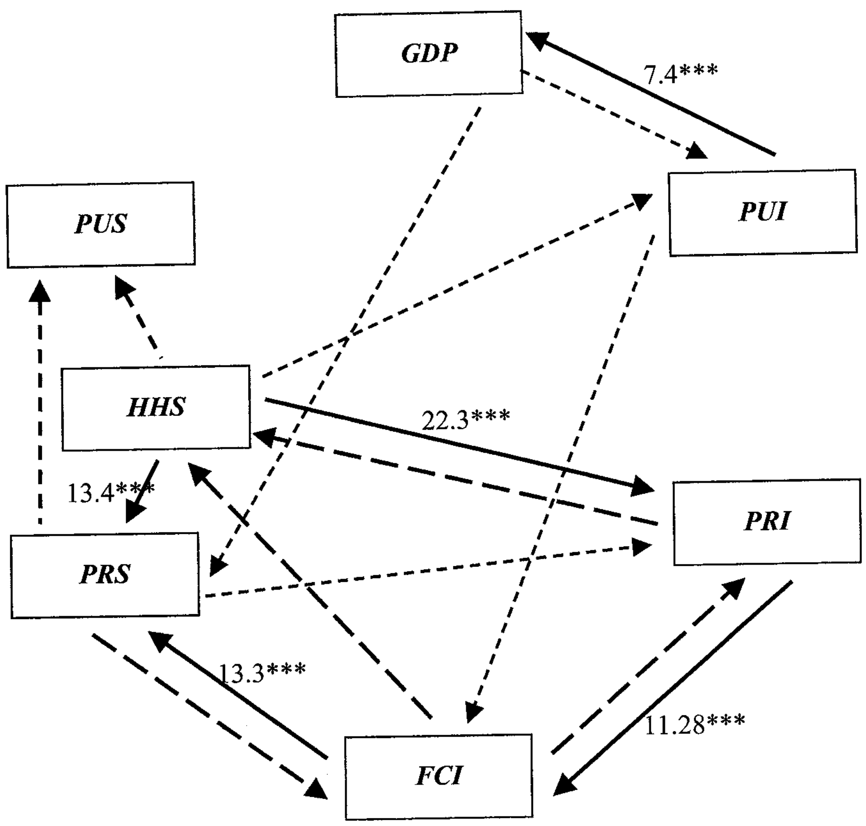
1951 to 2001

Granger Caused Variable	Granger Causing Variable						
	ΔHHS	ΔPRS	ΔPUS	ΔPRI	ΔPUI	ΔFCI	ΔGDP
ΔHHS	–	0.0304	0.9444	5.467**	0.123	3.991**	0.027
ΔPRS	13.449***	–	0.378	0.014	0.058	13.307***	3.638*
ΔPUS	2.946*	3.751*	–	0.515	0.384	0.289	2.089
ΔPRI	22.345***	3.155*	0.365	–	0.021	2.952**	0.871
ΔPUI	2.837*	1.839	0.670	1.758	–	0.212	6.122*
ΔFCI	1.909	4.906**	0.923	9.610***	3.527*	–	1.689
ΔGDP	0.009	0.012	0.326	0.054	7.391***	0.627	–

Notes: [1] The Chi-Squared test has 1 degree of freedom.
*** Significant at the 1 percent level: ** Significant at the 5 percent level: * Significant at the 10 percent level.

Figure 5

Short Run Granger Causality [1]



Key: *A* → *B* means that *A* Granger causes *B*.

Notes: [1] Figures with the arrows show the values of the χ^2 statistic.

*** Significant at the 1 percent level: ———

** Significant at the 5 percent level: — — —

* Significant at the 10 percent level: - - - - -

4. Conclusions and Policy Implications

This paper makes two contributions to the analysis of the interdependencies between savings, investment, foreign capital flows and economic growth in India. The first is the development of a basic endogenous growth model, with intertemporal household and private firm maximisation behaviour, and government and foreign sectors. This allows the identification of complex interdependencies between savings, investment, foreign capital flows and the growth in real output. The second contribution of our work is the econometric estimation of these relationships in a simultaneous autoregressive setting.

The FIML cointegration estimation clearly established the important long run links between household and private savings with private and public investment. The elasticities are significant and show strong interdependent influences. Public investment appears to crowd out private investment in the long run. No significant long run relationships were found between these individual sectors and foreign capital flows. However total gross domestic investment and savings had strong influences in the expected opposite directions on foreign capital flows. The sectors are also not directly linked to the growth in GDP (as expected according to Table 1 and Figure 1) although there is a weak aggregate relationship.

The short run error correction analysis showed that gross domestic investment and in particular, private investment, demonstrate strong and volatile equilibrating behaviour. There was evidence that this also occurs with foreign capital flows.

The tests of Granger causality reinforced these findings with some exceptions. Public investment affects short run GDP growth (measured as logs in first differences), possibly via the provision of infrastructure or development expenditure, which weakly feeds back into more public investment expenditure. Importantly, private and public savings do not directly affect economic growth. Household savings drive private investment, which in turn increases capital inflows to supplement investment, which promotes private corporate savings. The feedback to in the opposite direction increases private investment and private savings. Foreign capital inflow is an important component in these bi-directional relationships. Conversely public saving is weakly determined by household and private corporate saving. Unlike public investment, it appears to be a residual of the savings process.

In summary, there is strong evidence that it is not only domestic savings which are driving the Indian economy. Private and public investment and foreign capital flows are as important. However their strong interdependencies do not lead to a strong collective influence on real GDP.

Appendix A

Table A1
Estimated Error Corrections

1951 to 2001

Unrestricted intercepts and no trends in the VAR

(*ecm1*) for *GDS*	Explanatory Variables			
	Constant	*ecm1*(-1)	d_{89}	d_{93}
ΔGDS	–0.569	0.252	–0.067	–0.046
	(–1.76)*	(1.95)*	(–1.11)	(–0.70)
	$R^2 = 0.076$	$F_{3,47} = 1.29$	$DW\text{-}stat = 1.89$	$\chi^2 = 0.138$
ΔGDI	–1.200	–0.505	–0.141	0.112
	(–3.66)***	(–3.86)***	(–2.31)**	(–1.68)*
	$R^2 = 0.244$	$F_{3,47} = 5.05$	$DW\text{-}stat = 1.58$	$\chi^2 = 3.332$*
ΔFCI	3.014	–1.169	0.398	0.127
	(4.23)***	(–4.11)***	(3.00)***	(0.88)
	$R^2 = 0.279$	$F_{3,47} = 6.06$	$DW\text{-}stat = 2.06$	$\chi^2 = 0.106$
ΔGDP	0.035	0.001	0.006	0.014
	(0.36)	(0.04)	(0.34)	(0.70)
	$R^2 = 0.07$	$F_{3,47} = 1.22$	$DW\text{-}stat = 2.54$	$\chi^2 = 3.856$**

(*ecm1*) for *GDI*	Explanatory Variables			
	Constant	*ecm1*(-1)	d_{89}	d_{93}
ΔGDS	–0.569	0.399	–0.067	–0.046
	(–1.76)*	(1..95)*	(–1.11)	(–0.70)
	$R^2 = 0.076$	$F_{3,47} = 1.29$	$DW\text{-}stat = 1.89$	$\chi^2 = 0.138$
ΔGDI	–1.200	–0.799	–0.141	–0.112
	(–3.66)***	(3.86)***	(–2.31)**	(–1.68)*
	$R^2 = 0.244$	$F_{2,3} = 5.05$	$DW\text{-}stat = 1.58$	$\chi^2 = 3.332$*
ΔFCI	3.014	–1.849	0.398	0.127
	(4.23)***	(–4.11)***	(3.00)***	(0.88)
	$R^2 = 0.279$	$F_{3,47} = 6.06$	$DW\text{-}stat = 2.06$	$\chi^2 = 0.106$
ΔGDP	0.035	0.002	0.006	0.014
	(0.36)	(0.04)	(0.34)	(0.70)
	$R^2 = 0.07$	$F_{3,47} = 1.22$	$DW\text{-}stat = 2.54$	$\chi^2 = 3.856$**

Notes: *** Significant at the 1 percent level: ** 5 percent level: * 10 percent level.

Table A2
Estimated Error Corrections
1951 to 2001
Unrestricted intercepts and no trends in the VAR

(*ecm1*) for *FCI*	**Explanatory Variables** Constant	*ecm1*(-1)	d_{89}	d_{93}
ΔGDS	–0.569	0.062	–0.067	–0.046
	(–1.76)*	(1.95)*	(–1.11)	(–0.70)
	$R^2 = 0.076$	$F_{3,47} = 1.29$	$DW\text{-}stat = 1.89$	$\chi^2 = 0.138$
ΔGDI	–1.200	–0.124	–0.141	–0.112
	(–3.66)***	(–3.86)***	(–2.31)**	(–1.68)*
	$R^2 = 0.244$	$F_{3,47} = 5.05$	$DW\text{-}stat = 1.58$	$\chi^2 = 3.332$*
ΔFCI	3.014	–0.288	0.398	0.127
	(4.23)***	(–4.11)***	(2.30)***	(0.88)
	$R^2 = 0.279$	$F_{3,47} = 6.06$	$DW\text{-}stat = 2.06$	$\chi^2 = 0.107$
ΔGDP	0.035	0.000	0.006	0.014
	(0.36)	(0.04)	(0.34)	(0.70)
	$R^2 = 0.07$	$F_{3,47} = 1.22$	$DW\text{-}stat = 2.54$	$\chi^2 = 3.856$**
(*ecm1*) for *GDP*	**Explanatory Variables** Constant	*ecm1*(-1)	d_{89}	d_{93}
ΔGDS	–0.569	0.134	–0.067	–0.046
	(–1.76)*	(1.95)*	(–1.11)	(–0.70)
	$R^2 = 0.076$	$F_{3,47} = 1.29$	$DW\text{-}stat = 1.89$	$\chi^2 = 0.138$
ΔGDI	–1.200	–0.269	–0.141	–0.112
	(-3.66)***	(–3.86)***	(–2.31)**	(–1.68)*
	$R^2 = 0.244$	$F_{3,47} = 5.05$	$DW\text{-}stat = 1.58$	$\chi^2 = 3.332$*
ΔFCI	3.014	–0.624	0.398	0.127
	(4.23)***	(–4.11)***	(2.30)***	(0.88)
	$R^2 = 0.279$	$F_{3,47} = 6.06$	$DW\text{-}stat = 2.06$	$\chi^2 = 0.107$
ΔGDP	0.035	0.001	0.006	0.014
	(0.36)	(0.04)	(0.34)	(0.70)
	$R^2 = 0.072$	$F_{2,3} = 1.22$	$DW\text{-}stat = 2.54$	$\chi^2 = 3.856$**

Notes: *** Significant at the 1 percent level: ** 5 percent level: * 10 percent level.

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