

# The Relationship between Savings and Growth in South Africa: An Empirical Study

Aylit Tina Romm

*University of the Witwatersrand*

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THE CHALLENGE OF GROWTH AND POVERTY: THE SOUTH AFRICAN ECONOMY SINCE DEMOCRACY.



T I P S / D P R U F o r u m 2 0 0 3

# **The Relationship between Savings and Growth in South Africa: An Empirical Study**

By Aylit Tina Romm , Lecturer, University of the Witwatersrand

## **Abstract**

This paper uses the Johansen VECM estimation technique to examine the directions of association between savings and growth in South Africa over the period 1946- 1992. We examine the aggregate private saving rate and its interaction with investment and growth. The paper finds that the private saving rate has a direct as well as an indirect effect on growth. The indirect effect is through the private investment rate. In turn, we find that growth has a positive effect on the private saving rate. The extent of this effect is determined by liquidity constraints. Thus we have a virtuous cycle as growth enhances saving, which in turn further enhances growth.

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## Introduction

The title of this paper is "The relationship between saving and growth in South Africa: An empirical study".

Indeed, the empirical evidence to date has shown that there is a relationship between saving rates and growth. During 1984-94, 31 countries had average annual per capita GDP growth rates of 2.5% or higher. In these successful countries the median saving rate was 24%. By contrast, the median saving rate stood at 16% in the 59 countries in which per capita income grew at less than 1% a year<sup>1</sup>. Thus, while there appears to exist a correlation between growth and saving rates, the question is which way the direction of association runs.

Theory and evidence has shown that the direction of association can run both ways. On the one hand we have theoretical underpinnings for the direction of association running from saving to growth. Capital accumulation or physical investment is the proximate source of economic growth. Advocates of financial liberalisation (McKinnon (1973), Shaw, (1973)) have long argued for financial liberalisation on the basis that saving is complementary to investment in the development process, even with a money economy where saving can go either into the accumulation of money balances or the accumulation of physical capital.

The advocates of financial repression (Tobin 1965, 1967), however, argue that savings are not necessarily channelled into investment and that the development of a monetary sector could be damaging.

On the other hand, we have a theory for the direction of association running from growth to saving. The lifecycle theory of saving and consumption predicts that changes in an economy's rate of economic growth will affect its aggregate saving rate. In the simplest version of the model in which young people save for retirement and old people consume their previously accumulated assets, an increase in the rate of economic growth will increase the aggregate saving rate, because it increases the lifetime resources (and saving) of younger-age groups relative to older-age groups. When we take into account the possibility of the young borrowing against future income in order to finance current consumption, the degree to which growth affects the saving rate increases with the severity of

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<sup>1</sup> See Rodrik (2000)

liquidity constraints. When liquidity constraints are not binding at all, we might have the case where an increase in the growth rate actually decreases the saving rate.

Thus, what we have is theoretical backing for a potential two-way direction of association between saving and growth.

In this paper I use a time-series technique, namely the Johansen multivariate co integration technique, which accounts for possible endogeneity between the variables, in order to determine the direction of association between saving and growth for South Africa. Amongst other variables, investment is included, together with saving and growth, as a key endogenous variable in the VAR system. Including investment in the system allows me to look at how investment acts as the intermediate link between saving and growth. Using the Johansen vector error correction mechanism cointegration approach allows me to separate short-run dynamics from long run equilibrium relationships. This technique is especially useful in determining whether growth has an effect on the saving rate in steady state (i.e. in the long run), or, whether the effect growth has on the saving rate is merely a short-run phenomenon contributing to the dynamics of the system.

## **2. Theoretical background**

### **2.1 Financial Liberalisation versus Financial Repression**

This section presents a broad discussion on the debate between the financial liberalisation theorists and the financial repression theorists. These views are an extension of the Classical- Keynesian debate in which the Classical economists maintain that the direction of association runs from saving to investment while the Keynesians maintain that the direction of association runs from investment to saving. The implication of the Classical standpoint is that saving is a pre-requisite for investment and thus growth, while that of the Keynesians is that what is important for growth is not prior savings, but rather the prospect of profit and the elastic supply of credit to the private sector.

The advocates of financial repression argue that savings are not necessarily channelled into investment. Tobin (1965, 1967) argued that the development of a

monetary sector could be damaging. With the introduction of money balances, agents face the choice of allocating resources not used for consumption either to the purchase of physical capital, or to money balances. Since it is physical investment that is the source of economic growth, if money balances are not made available for investment, but rather held as a stock of purchasing power, the equilibrium growth path of an economy will occur at a lower level of per capita output than before.

Against this view, advocates of financial liberalisation (Levhari & Patinkin (1968), McKinnon (1973), Shaw (1973)) have long argued for financial liberalisation on the basis that saving is complementary to investment in the development process, even with a money economy where saving can go either into the accumulation of money balances or the accumulation of physical capital. Levhari & Patinkin (1968) argue money to be a productive factor of production. The production function can be written  $Y = F(K, L, M/P)$  so that production depends on working capital in the same way as it depends on fixed capital. If money were not productive there would be no point using it in production and the economy would revert to a barter system. Money, being a productive factor of production, allows the economy to realise a higher level of per capita output than in its absence.

McKinnon (1973) argues that money holdings and capital accumulation are complementary in the development process. Because of the lumpiness of investment expenditure and the reliance on self-finance, agents need to accumulate money balances before investment takes place. Positive (and high) real interest rates are necessary to encourage agents to accumulate money balances, and complementarity with capital accumulation will exist as long as the real interest rate does not exceed the real rate of return on investment. Shaw (1973), on the other hand, stresses the importance of financial liberalisation for financial deepening, and the effect of high interest rates on the encouragement to save and the discouragement to invest in low-yielding projects. The increased liabilities of the banking system resulting from higher real interest rates, enables the banking system to lend more resources for productive investment in a more efficient way.

The implication of financial liberalisation theory is that saving will drive the growth process, through its positive effect on the investment rate.

## 2.2 The Role of the Saving Rate in Growth Models

This section provides a review on the role the saving rate has played in various growth models.

An important distinction arises in growth models with regard to the effect of the saving rate. To illustrate this distinction, consider two sorts of growth models that have received wide attention in the literature: The Solow (1956)-Swan (1956) model and the Romer (1986) model. These two models specifically illustrate two alternative understandings of the role of saving rates in growth models. In one approach (illustrated here by the Solow-Swan model) the saving rate influences only steady-state and can impact on growth rates of output only temporarily. In the alternative approach (illustrated by the Romer 1986 model) the impact of the saving rate is not on steady-state output, but on the growth rate of output directly

The Solow (1956)-Swan (1956) model presents the case in which a rise in the saving rate affects the stock of capital and the *level* of per-capita income, but does not affect the *rate* of economic growth.

The Solow-Swan model has a linearly homogeneous production function of the form  $Y=F(K, L)$ , where  $Y$  is output,  $K$  is capital and  $L$  is labour. Specified in labour intensive form, the production function is written  $y=f(k)$ , where  $k$  is the capital-labour ratio ( $k=K/L$ ). The marginal product of capital is positive but decreasing i.e.  $f'(k) > 0, f''(k) < 0$ . The labour force grows at a constant rate  $g_L$ .

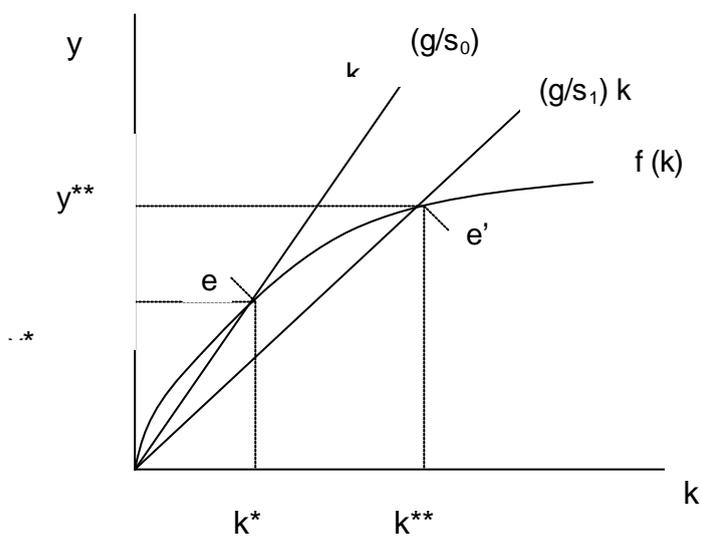
From the model it can be deduced that steady state or equilibrium occurs where:

$$f(k) = (g_L/s) k \quad (1)$$

Where 's' denotes the saving rate.

While  $f(k)$  specifies actual output per capita produced for any capital- output ratio,  $k$ ,  $(g_L/s) k$  specifies the output needed to maintain the corresponding capital-labour ratio.

An increase in the saving rate will increase the steady-state per capita capital stock and per capita output. The following diagram illustrates the situation.



**Figure 1.** The effect of a change in the saving rate

When the saving rate is  $s_0$  equilibrium is at  $e$ . An increase in the saving rate to  $s_1$  will shift the equilibrium to  $e'$ . Thus we see that an increase in the saving rate increases per capita output and per capita capital stock in steady-state.

A higher savings rate will generate more investment per unit of output than it did before- which in turn will lead to an expansion of capital per worker. The process, however, comes to a halt since for a given growth rate of labour, an increasing proportion of investment will be devoted to maintaining this higher capital-labour ratio. The saving rate thus influences the level of per capita capital stock and thus per capita output towards which the economy gravitates in equilibrium, rather than the rate at which either magnitude changes.

In sum according to the Solow-Swan model a change in the saving rate changes the economy's balanced growth path and hence per capita output in steady state, but it does not affect the growth rate of output per worker on the balanced growth path.

Only an exogenous technological change will result in a further increase in  $Y/L$  in steady state.

By contrast, in the Romer 1986 growth model in which technology is endogenised, an increase in the saving rate not only increases per capita output in steady state but also increases the growth *rate* of per capita output.

To formalise the existence of spill-over effects, the production function is written as:

$$Y = F(K_F, K.L) \quad (2)$$

Where  $Y$  denotes output,  $K_F$  denotes the physical capital stock used by firms, aggregated over the economy,  $L$  denotes the labour input into production, and  $K$  the spill-over effect from investment. The spill-over effects take the form of 'learning by doing'. Investment comes to augment labour input, increasing its impact on output. We further assume that there are positive but declining returns in all factors of production. The assumption is, further, that at the level of each firm there are constant returns to scale in  $K_i$  (where  $K_i$  is the capital stock of each firm) and labour,  $L$ , while at the social level, for a given labour input, there are constant social returns in  $K_i$  and  $K$ . The consequence of this is that the production function exhibits increasing returns to scale at the social level, though the production function of each firm continues to exhibit constant returns to scale.

Rewriting equation (2) in labour intensive form we get:

$$y = \frac{Y}{L} = f(k_F, K) \quad (3)$$

We can obtain the average product of capital as:<sup>2</sup>

$$\frac{y}{k} = f\left(\frac{K}{k}\right) = f(L)$$

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<sup>2</sup> We assume firms are homogeneous in equilibrium so that  $k_f = k$ ,  $K = kL$

(4)

We can see that there is a constant marginal product of capital as follows:

$$y = kf(L) \quad (5)$$

$$\therefore Y = Kf(L)$$

$$\therefore \frac{\partial Y}{\partial K} = f(L) > 0$$

$$\text{and } \frac{\partial^2 Y}{\partial^2 K} = 0$$

so that there is no change in the marginal product of capital as the capital labour ratio increases.

Now from the fundamental dynamic equation of growth:

$$\dot{k} = \frac{sy}{k} - g_L \quad (6)$$

$$= sf(L) - g_L$$

Where  $\dot{k}$  represents the growth rate of  $k$ .

Now since

$$\frac{\partial f(L)}{\partial k} = 0$$

It follows that:

$$\frac{\dot{k}}{k} = 0 \tag{7}$$

Thus since the growth rate of the capital labour ratio is not declining, it follows that the growth rate of per capita output is not declining in the capital labour ratio either. Thus an increase in the saving rate, not only increases the growth rate of the capital labour ratio, and per capita output, but the increase in the growth rate would persist indefinitely.

The difference between the Solow-Swan model and the Romer model relates to the nature of the capital stock. Since, in the Romer model, the social returns to scale in capital are constant, the marginal product of capital is also constant. Unlike in the Solow-Swan model, there is no incentive in the Romer model to discontinue investing in capital as the capital labour ratio increases. Thus, there is no incentive for the economy to stop expanding.

The above discussion illustrates how an increase in the saving rate can indeed lead to growth and more so, when technological change is seen as being endogenous, the increase in the growth rate will persist indefinitely. Thus, while the Solow-Swan model shows the saving rate to have a temporary effect on the growth rate, the Romer model shows the effect to be permanent.

### **2.3 The Effect of Growth on Saving: The Lifecycle Theory of Consumption and Saving**

The theory that I presented above supports the notion that the direction of association runs from savings to growth. Conversely, I present a model developed by Japelli & Pagano, (1994) supporting the notion of the direction of association running from growth to saving. The life-cycle saving model has income-earning households saving to finance consumption when they become old, non earning households. We assume individuals live for three periods. We assume they only earn labour income in the second period of their life. This provides an incentive for

intergenerational borrowing. When young, individuals borrow to finance current consumption. When middle aged, they repay the loan taken out in the first period and save for retirement. When old, they consume the assets accumulated in the second period of their life. With liquidity constraints, the young can borrow at most a proportion  $\phi$  of the present value of their lifetime income.

Preferences are given by:

$$u(c_{t,t}, c_{t,t+1}, c_{t,t+2}) = \ln c_{t,t} + \mathbf{b} \ln c_{t,t+1} + \mathbf{b}^2 \ln c_{t,t+2} \quad (8)$$

where  $\beta$  is the discount factor and the first subscript refers to the generation, while the second refers to the timing of consumption.

Households maximize utility subject to:

$$c_{t,t} + \frac{c_{t,t+1}}{R_{t+1}} + \frac{c_{t,t+2}}{R_{t+1}R_{t+2}} \leq \frac{e_{t+1}}{R_{t+1}} \quad (9a)$$

$$c_{t,t} \leq \mathbf{f} \frac{e_{t+1}}{R_{t+1}} \quad (9b)$$

Where  $e_{t+1}$  is real labour earnings at time t+1,  $R_{t+1}$  is the real interest factor between time t and t+1 and  $\phi$  is the proportion of the present value of their lifetime income that the young can borrow . Equation 9a is the budget constraint. Equation 9b is a liquidity constraint. If the liquidity constraint (9b) is not binding, the consumption of the young is:

$$c_{t,t} = \mathbf{g} e_{t+1} / R_{t+1} \quad (10)$$

Where  $g = 1/(1 + b + b^2)$

At any point in time, aggregate net wealth is given by the difference between the wealth of the middle aged and the debt of the young: Assuming a liquidity constraint that is binding we get:

$$W_t = \frac{b(1-f)}{1+b} e_t L - f \frac{e_{t+1}}{R_{t+1}} L \quad (11)$$

Where L represents the population and  $W_t$  represents net wealth.

The first term on the right hand side represents the net wealth of the middle aged at time t. This net wealth can be seen as net savings. The second term on the right hand side represents the amount the young, at time t, are borrowing against their future income in order to finance current consumption. This can be seen as a dissaving.

Wealth (or savings) is greater when liquidity constraints are more severe, i.e. when  $\phi$  is lower. The more severe are liquidity constraints, the smaller will be the overall consumption level in the economy thus increasing savings.

We will model growth using the following production function:

$$Y_t = A_t K_t^a L^{1-a} \quad (12)$$

$A_t$  represents technological progress. For the purpose of this proof we will assume Hicks- neutral technological progress, making total factor productivity  $A_t$  an increasing function of time:

$$A_t = A(1 + r)^t \quad (13)$$

Where  $r$  denotes the productivity growth rate.

It can be shown that using the first-order conditions for profit maximization and substituting the expression for wealth (4) into the capital market equilibrium condition  $W_t=K_{t+1}$ , we obtain:

$$(1 + b)[a + f(1 - a)]K_{t+1} = b(1 - f)a(1 - a)A(1 + r)^t K_t^a \quad (14)$$

Rearranging and taking logs of equation 14 we see that in steady state the capital stock grows according to:

$$K_t = K_0(1 + r)^{t/(1-a)} \quad (15)$$

$$\text{Where: } K_0 = \left[ \frac{b(1 - f)a(1 - a)A(1 + r)^{-1/(1-a)}}{(1 + b)[a + f(1 - a)]} \right]^{1/(1-a)}$$

Thus in steady state capital and output grow at the common rate:  $(1 + r)^{1/(1-a)} - 1$ .

The steady state net saving rate  $(K_{t+1} - K_t)/Y_t$  is equal to the growth rate,

$\hat{K}_{t+1} = (K_{t+1} - K_t)/K_t$ , multiplied by the constant capital-output ratio:

$$\frac{S_t}{Y_t} = \hat{K}_{t+1} \frac{K_t}{Y_t} = [(1 + r)^{\frac{1}{1-a}} - 1] \frac{K_0}{Y_0} \quad (16)$$

$$= [(1 + r)^{\frac{1}{1-a}} - 1] \left[ \frac{b(1 - f)a(1 - a)A(1 + r)^{-1/(1-a)}}{(1 + b)[a + f(1 - a)]} \right]$$

The above expression indicates that a rise in steady-state growth increases the saving rate since<sup>3</sup>:

$$\frac{d(S_t / Y_t)}{d(K_{t+1} / K_t)} = (1 + r)^{\frac{1}{1-a}} \frac{K_0}{Y_0} \quad (17)$$

We also note that the effect of growth on saving is stronger when there are liquidity constraints, since the higher the  $\phi$  parameter, the greater will be  $K_0/Y_0$ .

We can explain this result intuitively. Growth has contrasting effects on saving. On the one hand it increases the current income of the middle aged and hence their savings. On the other hand, it increases the future income of the young, thereby enabling them to borrow more. This second effect is attenuated by the presence of liquidity constraints and disappears entirely if the young have no access to credit markets. Growth has an additional positive effect on saving. The interest rate responds positively to an increase in growth, which reduces the discounted lifetime income of the young, and thereby their desired borrowing

Japelli & Pagano also show that the above proposition holds not only in steady-state but also in the transition between steady states i.e. growth affects the saving rate both in steady- state and in transition between steady-states.

Theory can thus justify not only an impact of savings on growth, but also an impact of growth on the savings rate. The implication is that the direction of association between savings and output growth must remain one that is settled in empirical determination. It is to this question for South Africa that we now turn.

### **3. Econometric Analysis: Methodology and Data**

#### **3.1 Methodology**

Annual time series data from 1946 to 1992 are analysed using the Johansen VECM estimation technique (Johansen and Juselius (1990) and Johansen (1991)) in which a vector error correction framework will be employed. The Johansen

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<sup>3</sup> Note  $K_{t+1}/K_t$  is equal to  $Y_{t+1}/Y_t$  in steady state

technique represents advancement over any single equation estimation technique since it allows the possibility of dealing with more than one cointegrating vector. The technique also allows us to separate the long-run equilibrium relationships from the short-run dynamics.

We can generalise the specification of VAR's (Vector Autoregressive Estimation) as follows:

$$z_t = A_k z_{t-1} + \dots + A_m z_{t-k} + \mathbf{d} + v_t \quad (18)$$

Where  $z_t$  is a  $(n \times 1)$  matrix i.e. the VAR model has  $n$  variables.  $k$  is the lag length,  $\mathbf{d}$  deterministic terms and  $v_t$  a Gaussian error term.

Reparametrization provides the VECM specification:

$$\Delta z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta z_{t-i} + \Pi z_{t-k+1} + \mathbf{d} + v_t \quad (19)$$

Where:

$$\Pi = \mathbf{a}\mathbf{b}' \quad (20)$$

$\mathbf{a}$  is referred to as the loading matrix and contains the short-run dynamics while  $\mathbf{b}$  is the matrix containing the long run equilibrium relationships.

The rank,  $r$ , of the matrix represents the number of cointegrating vectors and will be tested for using the Trace and Maximal Eigenvalue test statistics. Where  $r > 1$  issues of identification arise and will require restrictions on the  $\mathbf{a}$  matrix and the  $\mathbf{b}$  matrix.

### 3.2 The Specification

While Aron and Muelbauer (2000) look at the personal and corporate saving rate separately, this paper considers only the aggregate private sector saving rate. Focus on the private sector savings rate is motivated by the fact that the government savings rate does not have the same behavioural foundations that can be advanced for the private sector. Further research into the separate impact of the personal saving rate and the corporate saving rate on growth would be desirable. However, we know from the work of Aron and Muelbauer (2000) that the determinants of the personal and corporate savings rates are somewhat different. The consequence would likely be a proliferation of the number of cointegrating vectors present in the data (a hypothesis confirmed by an examination of the data), and a related increase in the data requirements appropriate for estimation. Given the relatively small sample of data available for the study, the aggregate private saving rate was chosen instead.

Aron and Muelbauer investigate the determinants of corporate and personal rates using a single equation estimation technique. My work is done in a multivariate context thereby encapsulating the significance of endogeneity between the variables and the relevance of feedback effects between saving, investment and growth.

The following equations identify the VAR:

$$\text{LNPCGDP} = F(\text{PINVRAT}, \text{PSAVRAT}, \text{PDEGPC}, \text{GOVRATE}, \text{INTRATE}) \quad (21)$$

$$\text{PINVRAT} = G(\text{PSAVRAT}, \text{LNPCGDP}, \text{CREDRATE}, \text{POL}, \text{UC}) \quad (22)$$

$$\text{PSAVRAT} = H(\text{INTRATE}, \text{LNPCGDP}, \text{CREDRATE}, \text{POL}, \text{WRAT}, \text{TAXRATE}) \quad (23)$$

Where

LNPCGDP= natural log of per capita GDP;

PINVRAT = private investment rate = ratio of private investment to GDP;

PSAVRAT = ratio of private saving to GDP;

PDEGPC= the human capital variable I use is 'NES' degrees per capita<sup>4</sup>. NES degrees refer to natural, engineering and mathematical science degrees;

GOVRATE= ratio of government consumption expenditure to GDP;

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<sup>4</sup> See Fedderke, de Kadt & Luiz (2000, 2001).

INTRATE= real interest rate measured by the Treasury bill rate;

UC= user cost of capital. It is a combined measure of the interest rate, depreciation and the corporate tax rate;

CREDRATE = credit ratio which will be estimated by the ratio of the quantity of loans and advances issued by banks to the private sector to GDP. It is an indication of the extent of liquidity in the economy<sup>5</sup>;

POL = index of political instability;

WRAT= measure of wealth or assets (from non labour income) which will be a combined measure of the ratios of the capital stock, money and near money to GDP;

TAXRATE = tax rate = ratio of government inland revenue to GDP.

Per capita output is proposed to be a function of the private investment rate, the ratio of private saving to GDP, human capital, government consumption expenditure, and the interest rate.

We use private investment because for savings we focused on the private sector. In the Solow-Swan (1956) production function, physical capital is seen to be an explicit factor of production. An increase in the saving rate and thus investment in physical capital will increase per capita output.

The theoretical section above motivates extensively for the inclusion of the saving rate in the per capita output equation<sup>6</sup>. Both the investment rate and the saving rate are included in the output equation, since in the case of South Africa over the sample period, both prove to be I (1).

Human capital is central to much of modern growth theory<sup>7</sup>. I use 'NES' (natural, engineering and mathematical science) degrees per capita to measure the quality of human capital. These are the degrees that are likely to give rise to technological innovation and are thus important for growth. This variable has been used in prior studies by Fedderke (2001) in which he uses the same variable for the manufacturing sector, as well as by Mariotti (2002) & Kularatne (2002) in order to measure the quality of human capital.

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<sup>5</sup> See Kularatne (2002).

<sup>6</sup> See section 2 of this paper.

<sup>7</sup> See Hanushek and Kimko (2000), Mankiw, Romer and Weil (1992), Romer (1986).

Government consumption expenditure is seen to have a negative impact on growth in the majority of the literature<sup>8</sup>. Mariotti (2002) investigates both the linear and non-linear impact of government spending on growth. The linear model showed a negative impact of government spending on growth. The non linear model showed that while initially government spending has a positive effect of growth, there is some optimal government expenditure after which the impact on growth becomes negative. Since I am looking at the linear situation, I expect government spending to negatively impact on growth. Romer (1990) argues that a higher interest rate will be detrimental to economic growth since it results in human capital moving away from knowledge production and into final goods production. This is because with higher interest rates, agents discount future output relative to current output at a higher rate.

The private investment rate is hypothesized to be a function of the private saving /GDP ratio, per capita output, the interest rate, the private sector credit ratio, political instability, and the user cost of capital. Per capita output is anticipated to have a positive effect on investment due to an accelerator effect. Per capita output can be seen as a proxy for future earnings. A higher credit ratio should increase investment<sup>9</sup>. Credit extension is a comprehensive indicator of the activity of financial intermediaries. It shows the extent to which the financial system can channel savings into investment. Fedderke (2000) finds investment in South Africa to be negatively effected by uncertainty. It is due to the irreversibility of investment that uncertainty is an issue to the investor. Uncertainty is proxied using political instability<sup>10</sup>. The user cost of capital is a more comprehensive measure of the opportunity cost of investing than merely the interest rate. It is a combined measure of the real interest rate, the depreciation rate of capital stock and the corporate tax rate.<sup>11</sup>

The private saving rate is hypothesized to be a function of the interest rate, per capita GDP, the private sector credit ratio, political instability, wealth and the tax rate. A higher interest rate should have a positive effect on saving since interest is viewed as the reward for delaying consumption. Higher steady state per capita GDP is likely to increase the private saving rate as the theoretical section

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<sup>8</sup> See Barro (1990)

<sup>9</sup> See Kularatne (2002).

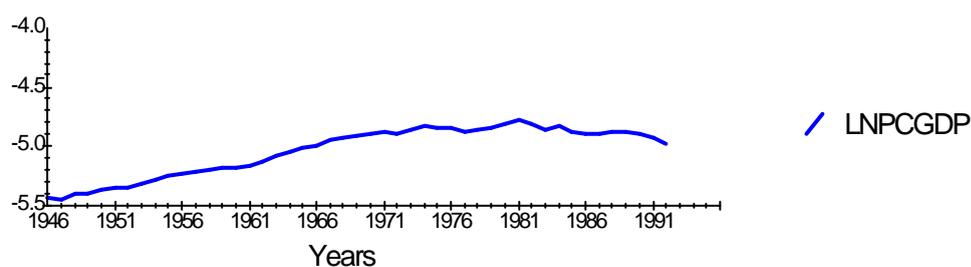
<sup>10</sup> See Fedderke, de Kadt and Luiz (2001).

<sup>11</sup> See Fedderke (2000).

demonstrates<sup>12</sup>. A higher credit ratio should negatively affect the saving rate because it puts less of a constraint on current consumption. We use the credit ratio as a proxy for liquidity constraints in the sense that liquidity constraints will be more binding when credit extension is low. Political instability should increase saving since uncertainty about the future would encourage one to guard more aggressively against shocks. An increase in exogenous wealth i.e. assets (from non-labour income) should decrease saving at a given level of disposable income, since there is less of a need for savings to serve consumption smoothing.<sup>13</sup> A higher tax rate will decrease the private saving rate since when income from saving is taxed, the incentive to save decreases.

### 3.3 Univariate characteristics of the data

The univariate characteristics of the data are analysed using augmented Dickey-Fuller test statistics and in the case of structural breaks, Perron statistics. . These are shown in tables 1 and 2, for the variables in levels and first differences respectively. Rejection of the null hypothesis of a unit root is shown by an asterix. Figures 2 through 4 report plots of the log of real GDP per capita, the private investment rate and the private saving rate.

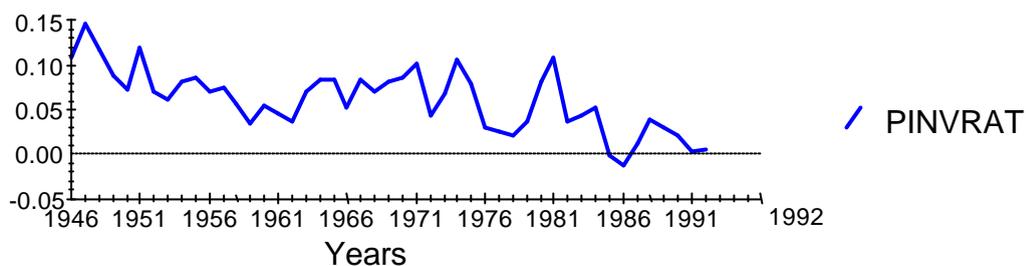


**Figure 2:** log of per capita GDP

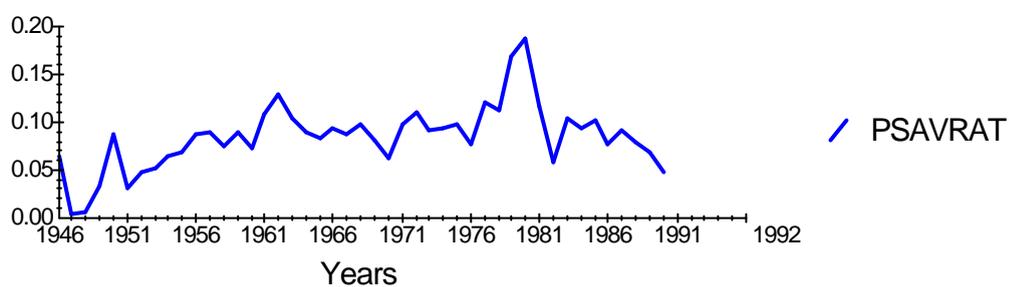
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<sup>12</sup> See Japelli & Pagano (1994).

<sup>13</sup> See Ando & Modigliani (1963).



**Figure 3:** private investment rate



**Figure 4:** private saving rate

variable	$t_{\mu}$	$t_t$	Perron	Breaks
LNPCGDP	-2.2309	1.1751		
PINVRAT	-1.6342	-3.3614	-4.0992	D80, gold
PSAVRAT	-2.1205	-2.9898		
INTRATE	-.11627	-2.9992	-3.609	D80
UC	-1.8446	-2.0597		
POL	-3.1521*	-3.1306		
PDEGPC	-1.5651	-1.7957		
WRAT	.18394	-1.7484		
GOVRATE	2.0717	-1.1583		
TAXRATE	1.6755	-1.5436		

CREDRATE	1.1633	-0.71925		
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**Table 1:** Augmented Dickey fuller /Perron (in the case of structural breaks) test statistics of the variables in level form

Variable	$t_{\mu}$	$t_t$
DLNPGDP	-4.0905*	-5.1825*
DPINVRAT	-7.6082*	-7.4927*
DPSAVRAT	-7.1709*	-4.5874*
DINTRATE	-5.6002*	-5.6140*
DUC	-5.78678*	-5.7203*
DPOL	-7.2403*	-7.1664*
DPDEGPC	-3.6265*	-8.8954*
DWRAT	-4.2894*	-4.3776*
DGOVRATE	-5.2375*	-6.1115*
DTAXRATE	-4.2030*	-4.5279*
DCREDRATE	-5.3841*	-5.7982*

**Table 2:** ADF statistics of variables in first difference form<sup>14</sup>

Table 1 shows the augmented Dickey-Fuller statistics with the null-hypothesis that the series contains a unit root. Accepting the null would imply that the series is non-stationary, while rejecting the null would imply that the series is  $\sim I(0)$ . We use two test statistics: The  $t_{\mu}$  statistic implies that the Dickey- Fuller regressions contain an intercept but no trend, while the  $t_t$  statistic implies that there is both an intercept and a trend. For the variables PINVRAT and INTRATE we conduct Perron tests in order to take possible structural breaks into account. The structural breaks shown in the table are D80, for the structural break in 1980 probably due

---

<sup>14</sup> The asterisk shows significance at the 5% level

to financial liberalisation in this year, and 'Gold' which represents the second structural break between 1979 and 1984 due to the gold price boom.

We see that for all the variables, excepting the political instability variable, the test statistics confirm that the variables are non-stationary. The political instability variable, however, has the  $t_{\mu}$  statistic indicating stationarity, while the  $t_t$  statistic indicates non-stationarity. When we look at the spectrum and autocorrelation coefficients for the 'pol' variable it is evident that the variable is indeed non-stationary.

Table 2 shows the test statistics for the variables in first difference form. Table 2 confirms that all the variables are I (1) and can thus be included in the long-run solution.

## 4. Estimation and Analysis

While in section 3 I explained the methodology I would use in order to analyse the data, in this section I apply the methodology and present the results thereof.

### 4.1. Johansen VECM Estimation

#### 4.1.1 Testing for the Rank

I present both the trace and the maximal eigenvalue test statistics below.

Null	Alternative	Maximal eigenvalue statistic	95% critical value	Trace statistic	95% critical value
r=0	r=1	80.5252*	54.8400	257.8273*	160.8700
r<=1	r=2	64.3424*	49.0200	177.3021*	125.8600

$r \leq 2$	$r = 3$	54.9065*	42.6800	112.9597*	95.1400
$r \leq 3$	$r = 4$	34.3000	36.3800	58.0532	66.9400
$r \leq 4$	$r = 5$	16.7822	29.7900	23.7531	42.7300
$r \leq 5$	$r = 6$	6.9710	22.1900	6.9710	22.1900

**Table 3:** Maximal eigenvalue and Trace statistics

Both the maximal eigenvalue and trace statistics indicate that there are 3 cointegrating vectors present in the data.

#### 4.1.2 Estimation and Results

The trace and maximal eigenvalue statistics confirm the appropriateness of proceeding with an application of the VECM methodology elaborated in section 3.1 to the three equations identified in section 3.2.

Since there are 3 cointegrating vectors, 9 restrictions are required for the just-identification of the system. The restrictions are based on the a priori reasoning that governed the identification of the equations of section 3.2, and can be represented by the following system:

$$\Pi Z_{t-k+1} = \begin{bmatrix} a_{11} a_{12} a_{13} \\ a_{21} a_{22} a_{23} \\ a_{31} a_{32} a_{33} \\ a_{41} a_{42} a_{43} \\ a_{51} a_{52} a_{53} \\ a_{61} a_{62} a_{63} \\ a_{71} a_{72} a_{73} \\ a_{81} a_{82} a_{83} \\ a_{91} a_{92} a_{93} \\ a_{101} a_{102} a_{103} \\ a_{111} a_{112} a_{113} \end{bmatrix} \begin{bmatrix} 1 - \beta_{21} - \beta_{31} - \beta_{41} + \beta_{51} + \beta_{61} & 0 + \beta_{81} + \beta_{91} & 0 & + \beta_{111} \\ -\beta_{12} & 1 & -\beta_{32} - \beta_{42} & 0 & 0 & -\beta_{72} + \beta_{82} + \beta_{92} & -\beta_{102} & + b_{112} \\ -\beta_{13} & 0 & 1 & -\beta_{43} & 0 & -\beta_{63} + \beta_{73} - \beta_{83} - \beta_{93} & + \beta_{103} & + \beta_{113} \end{bmatrix} \begin{bmatrix} LNPCGDP \\ PINVRAT \\ PSAVRAT \\ PDEGPC \\ GOVRATE \\ INTRATE \\ CREDRATE \\ POL \\ UC \\ WRAT \\ TAXRATE \end{bmatrix} \quad (24)$$

We make LNPCGDP, PINVRAT and PSAVRAT the dependent variables in each of the cointegrating vectors, respectively. Since we do not expect the credit rate and wealth to directly affect growth, we impose zero restrictions on the coefficients of CREDRATE and WRAT in the first cointegrating vector. We impose zero restrictions on the coefficients of GOVRATE and INTRATE in the second cointegrating vector since we do not expect government expenditure to have a direct effect on investment, while the interest rate is already included in the user cost variable. In the third cointegrating vector, we impose zero restrictions on the coefficients of GOVRATE and PINVRAT since neither government expenditure nor investment should have a direct effect on the savings rate.

Results from estimation give the following long-run relationships:

$$LNPCGDP = .25469 \text{ PINVRAT} + .046589 \text{ PSAVRAT} - .040018 \text{ INTRATE} \\ - .17591 \text{ GOVRATE} + .66081 \text{ PDEGPC} \quad (25)$$

$$\text{PINVRAT} = .262395 \text{ LNPCGDP} + 1.2970 \text{ PSAVRAT} - .1291\text{E-}3 \text{ UC}$$

$$+ .24122 \text{ CREDRATE} - .2636\text{E-}5 \text{ POL}$$

(26)

$$\text{PSAVRAT} = .30483 \text{ LNPCGDP} - .17812 \text{ CREDRATE} + .0040991 \text{ INTRATE}$$

$$- .121257 \text{ WRAT} + .2321\text{E-}5 \text{ POL} - 1.5751 \text{ TAXRATE}$$

(27)

We see that the signs on the coefficients of the equilibrium relationships conform to a priori theory as was put forward in section 3.2. Private investment positively affects per capita GDP. We see that the private saving rate has both a direct and an indirect effect on per capita GDP. The indirect effect is through private investment expenditure. The negative effect of the interest rate on per capita GDP supports the Romer (1990) theory<sup>15</sup>. NES degrees, confirming endogenous growth theory has a positive effect on GDP. While Mariotti (2002) shows in her non-linear model the impact of government spending on growth to start off being positive and then become negative as government spending increases, her linear model shows an overall negative effect. Our results show a negative effect confirming Mariotti's (2002) linear model. The positive effect of per capita GDP on private investment suggests that GDP growth is a proxy for future returns on capital. The negative effect of the user cost of capital on investment confirms Fedderke (2000)<sup>16</sup>. The user cost of capital is a comprehensive measure of the opportunity cost of investing. It comprises the interest rate, the depreciation rate and the corporate tax rate. The positive effect of the credit ratio on private investment confirms Kularatne (2002). The credit ratio is an indicator of the activity of financial intermediaries. Political instability has a negative effect on investment, confirming Fedderke (2000). Political instability is a proxy for uncertainty. Uncertainty negatively affects investment due to the irreversible nature of investment.

We see that per capita output has a positive effect on private saving consistent with the life-cycle hypothesis of saving and consumption. We thus see that the direction of association between saving and growth does indeed run both ways.

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<sup>15</sup> See section 3.2

<sup>16</sup> See section 3.2

Confirming Japelli & Pagano (1994), an increase in the private sector credit rate will negatively affect the saving rate by limiting the constraints on consumption. The real interest rate positively affects the private saving rate. An increase in wealth (assets) decreases the saving rate as proposed by Ando & Modigliani (1963)<sup>17</sup>. Political instability increases the private saving rate since people want to “save for a rainy day”. An increase in the tax rate decreases the private saving rate due to a decrease in the incentive to save.

The short-run dynamics are given by the error-correction models reported in the appendix of the paper. A significant error correction term between zero and negative two implies that the long run equilibrium is stable. Since the ECM terms for equations 25, 26, 27 are  $-0.10199$  (table A1-ECMY(-1)),  $-0.20834$  (table A2-ECMI(-1)) and  $-0.89014$  (table A3-ECMS(-1)) respectively, all our cointegrating relationships represent stable equilibrium relationships.

The error correction models<sup>18</sup> show that financial liberalisation in 1980 had a positive and significant effect on GDP. The Gold Price Boom had a positive and significant effect on private saving.

The three cointegrating relationships above portray the complex relationships that exist between saving, investment and growth. Saving affects growth directly, as well as indirectly through the investment rate. Growth also feeds back into savings, thus further enhancing growth. In the theoretical section of the paper I provided theory supporting this two-way direction of association between savings and growth. The empirical evidence for South Africa supports this theory. The empirical evidence also shows the importance of other factors in determining each of the cointegrating relationships. Interest rates, government spending and human capital are also important determinants of growth. In addition to GDP and saving, uncertainty, credit rates and the user cost of capital are important factors in the investment equation. In addition to the growth effect, saving rates are determined by credit rates (measure of liquidity), interest rates, wealth factors, uncertainty and tax rates.

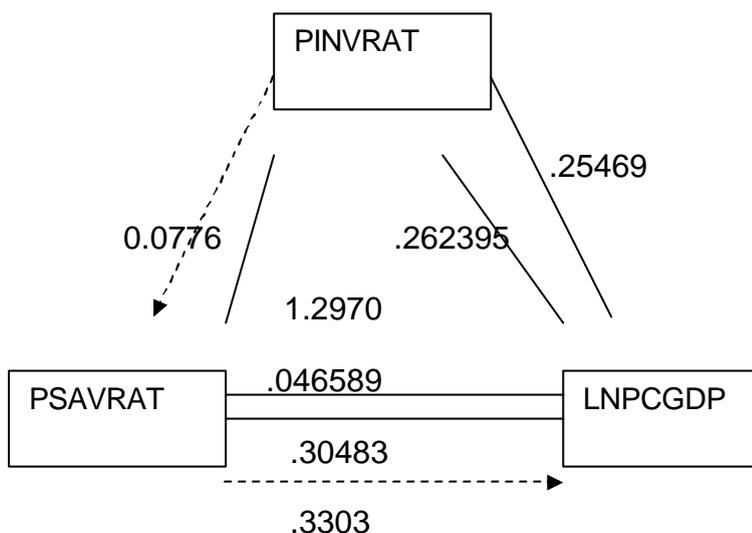
Figure 5 shows the direct and indirect relationships between the endogenous variables PSAVRAT, PINVRAT and LNPCGDP. The solid lines represent the direct effects and the dashed lines represent the indirect effects. Note that the

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<sup>17</sup> Less of a need to save for the unexpected- ‘saving for a rainy day’ effect. See section 3.2

<sup>18</sup> See appendix tables A1, A2 & A3

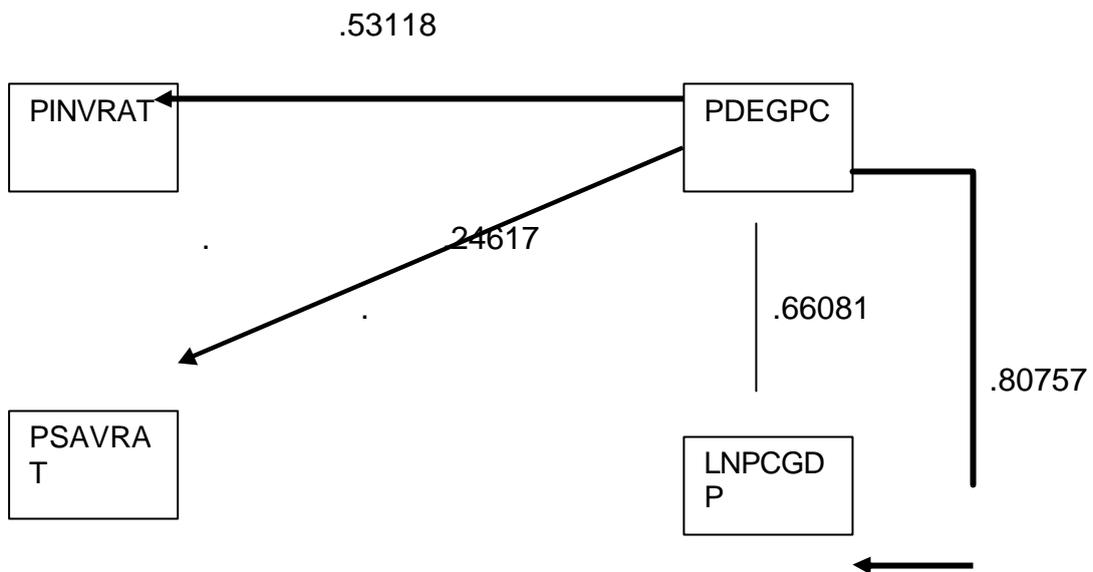
private saving rate has both a direct and indirect effect on per capita output, while the private investment rate has an indirect effect on the private saving rate.



**Figure 5:** The magnitude and direction of association between the endogenous variables:

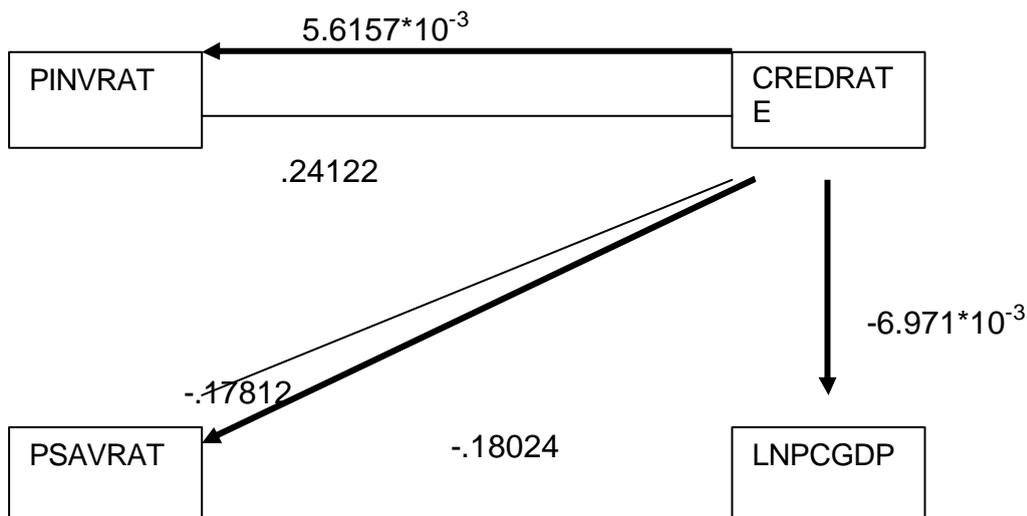
It is due to these complex feedback relationships between savings, investment and growth that the effect of an exogenous variable, such as human capital, on growth is magnified. Figure 6 shows the effect of human capital on savings, investment and growth (given the interrelationships between the latter three portrayed in figure 5). The bold lines represent the reduced form effects of human capital on these variables<sup>19</sup>. It is important to notice that once we look at the system of equations as a whole, taking into account the presence of feedback effects, the net effect of human capital on growth is greater than when we merely looked at the direct effect in equation 25 (.80757 as against .66081). This is due to the fact that an initial increase in human capital ‘jump starts’ growth, which in turn promotes saving and investment (hence the reduced form effect of human capital on savings and investment), which then further promotes growth.

<sup>19</sup> These effects were obtained by solving for the reduced form equations.



**Figure 6:** The effect of PDEGPC on LNPCGDP, PSAVRAT and PINVRAT

We can see a similar effect for the credit rate in figure 7. Again, the solid lines represent the reduced form effect and the thinner lines the direct relationships given in the cointegrating vectors. Notice, that in the reduced form context, the credit rate has a stronger negative effect on the saving rate than when we simply look at the direct effect in equation 27.



**Figure 7:** The effect of CREDRATE on LNPCGDP, PINVRAT and PSAVRAT

## 5. Conclusion

We have seen in this paper that not only is saving important for growth but growth is also important for saving. The private saving rate affects steady state per capita output directly, as well as indirectly through the private investment rate. Conversely, we see that a higher steady state per capita output positively affects the saving rate. It is important to note that the severity of liquidity constraints will influence the extent to which growth affects the saving rate. The more binding are the liquidity constraints, the greater will be the effect of growth on saving. This is because with greater liquidity constraints, current consumption of the young is constrained by present income. They cannot react to lifetime income when planning their consumption decisions.

The results have significant policy implications. Firstly, financial intermediation has two contrasting effects on growth. It promotes growth because it increases the rate of return on capital via a more efficient allocation of credit to investment. We see from the empirical section of the paper that savings are indeed channelled into investment. On the other hand, an efficient capital market can inhibit growth by reducing savings due to the lack of liquidity constraints. If banks make credit available to firms, and to households intending to invest in either physical capital or human capital, while rationing it at other times, capital accumulation and growth will be enhanced.

Second, the effect of factors such as human capital and technological innovation which are necessary for economic growth is twofold. Not only do they have a direct effect on growth, but also, by promoting growth they promote a higher saving rate and thus investment rate, which further promotes growth. Thus, if policy aims to promote growth by increasing the saving rate, it need not only focus on factors affecting savings but also on those factors directly promoting growth.

## Data Sources

Wharton Economic Forecasting Associates database

South African Reserve Bank Quarterly Bulletins 1946-1992

ERSA (Human capital data and political instability indexes)

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# Appendix<sup>20</sup>

## Error Correction Models

Ordinary Least Squares Estimation			
*****			
Dependent variable is DLNPGDP			
43 observations used for estimation from 1948 to 1990			
*****			
Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CONST	-.082610	.27386	-.30166[.765]
DPINVRAT(-1)	.15802	.10088	1.5664[.129]
DLNPGDP(-1)	-.73306 *	.31728	-2.3105[.029]
DPSAVRAT(-1)	.17338	.11743	1.4764[.152]
DGOVRATE(-1)	-.45723 *	.18207	-2.5113[.019]
DINTRATE(-1)	-.6680E-3	.0016386	-.40764[.687]
DUC(-1)	.2133E-3	.3616E-3	.58999[.560]
DCREDRATE(-1)	.090049	.14229	.63288[.532]
DTAXRATE(-1)	.97476	.76683	1.2712[.215]
DPDEGPC(-1)	-.027808	.025771	-1.0791[.290]
DWRAT(-1)	-.24476*	.10263	-2.3848[.025]
DPOL(-1)	-.5324E-6	.4139E-6	-1.2863[.210]
GOLD	.0039931	.0094802	.42121[.677]
D80	.010566 *	.012826	.82374[.044]
ECMY(-1)	-.10199 ***	.023535	-4.3334[.000]
ECMI(-1)	-.17862 **	.052703	-3.3892[.002]
ECMS(-1)	-.18747	.14893	-1.2588[.219]
*****			
R-Squared	.82678	R-Bar-Squared	.72018
S.E. of Regression	.012171	F-stat. F( 16, 26)	7.7562[.000]
Mean of Dependent Variable	.012634	S.D. of Dependent Variable	.023009
Residual Sum of Squares	.0038517	Equation Log-likelihood	139.3751
Akaike Info. Criterion	122.3751	Schwarz Bayesian Criterion	107.4049
DW-statistic	2.1016	Durbin's h-statistic	*NONE*
*****			
Diagnostic Tests			
*****			
* Test Statistics *	LM Version	* F Version	
*****			
* A:Serial Correlation*	CHSQ( 1)= .27475[.600]	*F( 1, 25)= .16077[.692]	
*****			
* B:Functional Form	*CHSQ( 1)= .047110[.828]	*F( 1, 25)= .027419[.870]	

<sup>20</sup> For the 3 tables, \* denotes significance at the 10% level, \*\* at the 5% level and \*\*\*at the 1% level.

\* C:Normality \*CHSQ( 2)= 2.0164[.365]\* Not applicable

\* D:Heteroscedasticity\*CHSQ( 1)= .25679[.612]\*F( 1, 41)= .24631[.622]

\*\*\*\*\*

A:Lagrange multiplier test of residual serial correlation  
 B:Ramsey's RESET test using the square of the fitted values  
 C:Based on a test of skewness and kurtosis of residuals  
 D:Based on the regression of squared residuals on squared fitted values

Table A1: Error correction model for LNPCGDP

Ordinary Least Squares Estimation

\*\*\*\*\*

Dependent variable is DPINVRAT  
 43 observations used for estimation from 1948 to 1990

\*\*\*\*\*

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CONST	.34147	.52073	.65576[.518]
DPINVRAT(-1)	-.35385 *	.19182	-1.8447[.077]
DLNPGDP(-1)	-.71358	.60329	-1.1828[.248]
DPSAVRAT(-1)	.20560	.22329	.92077[.366]
DGOVRAE(-1)	-.65424 *	.34620	-1.8898[.070]
DINTRATE(-1)	-.0031327	.0031158	-1.0054[.324]
DUC(-1)	.7043E-3	.6875E-3	1.0244[.315]
DCREDRATE(-1)	-.079132	.27055	-.29249[.772]
DTAXRATE(-1)	1.4355	1.4581	.98453[.334]
DPDEGPC(-1)	-.064364	.049003	-1.3135[.200]
DWRAT(-1)	-.40545 *	.19515	-2.0776[.048]
DPOL(-1)	-.5577E-6	.7870E-6	-.70857[.485]
GOLD	.017703	.018026	.98209[.335]
D80	.015868	.024389	.65062[.521]
ECMY(-1)	-.073412	.044751	-1.6404[.113]
ECMI(-1)	-.20834 **	.10021	-2.0790[.008]
ECMS(-1)	-.30841	.28318	-1.0891[.286]

\*\*\*\*\*

R-Squared .58901 R-Bar-Squared .33609  
 S.E. of Regression .023143 F-stat. F( 16, 26) 2.3288[.027]  
 Mean of Dependent Variable -.0028970 S.D. of Dependent Variable .028404  
 Residual Sum of Squares .013926 Equation Log-likelihood 111.7423  
 Akaike Info. Criterion 94.7423 Schwarz Bayesian Criterion 79.7721  
 DW-statistic 2.1528 Durbin's h-statistic \*NONE\*

\*\*\*\*\*

### Diagnostic Tests

```

*****
* Test Statistics *   LM Version   *   F Version
*****
*
*
* A:Serial Correlation*CHSQ( 1)= 1.9013[.168]*F( 1, 25)= 1.1566[.292]
*
*
* B:Functional Form *CHSQ( 1)= .96471[.326]*F( 1, 25)= .57375[.456]
*
*
* C:Normality *CHSQ( 2)= .52207[.770]* Not applicable
*
*
* D:Heteroscedasticity*CHSQ( 1)= .33263[.564]*F( 1, 41)= .31963[.575]
*****

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

```

**Table A2: Error correction model for PINVRAT**

### Ordinary Least Squares Estimation

```

*****
Dependent variable is DPSAVRAT
43 observations used for estimation from 1948 to 1990
*****

```

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CONST	1.9253 ***	.43876	4.3880[.000]
DPINVRAT(-1)	-.14936	.16162	-.92413[.364]
DLNPGDP(-1)	.39355	.50832	.77420[.446]
DPSAVRAT(-1)	.28003	.18815	1.4884[.149]
DGOVRATE(-1)	.16353	.29170	.56060[.580]
DINTRATE(-1)	-.0038584	.0026254	-1.4697[.154]
DUC(-1)	-.5172E-3	.5793E-3	-.89287[.380]
DCREDRATE(-1)	.16225	.22796	.71172[.483]
DTAXRATE(-1)	-2.3512 *	1.2286	-1.9138[.067]
DPDEGPC(-1)	-.010568	.041289	-.25596[.800]
DWRAT(-1)	.089970	.16443	.54716[.589]
DPOL(-1)	-.1000E-5	.6631E-6	-1.5087[.143]
GOLD	.034716 *	.015189	2.2856[.031]
D80	-.0074589	.020550	-.36296[.720]
ECMY(-1)	.066791 *	.037707	1.7713[.088]
ECMI(-1)	.091367	.084438	1.0821[.289]

ECMS(-1)	- .89014 ***	.23861	-3.7306[.001]
*****			
R-Squared	.68623	R-Bar-Squared	.49314
S.E. of Regression	.019500	F-stat. F( 16, 26)	3.5539[.002]
Mean of Dependent Variable	.0010102	S.D. of Dependent Variable	.027390
Residual Sum of Squares	.0098869	Equation Log-likelihood	119.1072
Akaike Info. Criterion	102.1072	Schwarz Bayesian Criterion	87.1370
DW-statistic	2.2746	Durbin's h-statistic	*NONE*
*****			
Diagnostic Tests			
*****			
* Test Statistics *	LM Version	* F Version	
*****			
* A:Serial Correlation*	*CHSQ( 1)= 2.3405[.126]*F( 1, 25)= 1.4391[.242]		
* B:Functional Form	*CHSQ( 1)= 3.2960[.069]*F( 1, 25)= 2.0753[.162]		
* C:Normality	*CHSQ( 2)= .86761[.648]*	Not applicable	
* D:Heteroscedasticity*	CHSQ( 1)= .056702[.812]*F( 1, 41)= .054136[.817]		
*****			
A:Lagrange multiplier test of residual serial correlation			
B:Ramsey's RESET test using the square of the fitted values			
C:Based on a test of skewness and kurtosis of residuals			
D:Based on the regression of squared residuals on squared fitted values			

Table A3: Error correction model for PSAVRAT