Institutional dynamics and capital accumulation: Evidence from Namibia and Tanzania

B.P. Zaaruka

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B.P. Zaaruka*

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Abstract

The purpose of this study is to examine the impact of institutions on fixed capital accumulation over time in two developing countries, both former German colonies: Namibia and Tanzania. This is motivated by two recent underpinning theories: the new institutional theory, which views institutions as fundamental determinants of economic outcomes and income variations among countries (the institutional hypothesis); and the theory of irreversible investment under uncertainty, which emphasis the impact of uncertainty on investment and capital-stock accumulation. Using the theoretical framework of irreversible investment under uncertainty, we apply the Vector Error Correction Model (VECM).The findings highlight the importance of uncertainty (political instability) in explaining capital accumulation over time in Namibia. The empirical evidence for Tanzania indicates the importance of property rights in explaining capital accumulation over time.

Keywords: Namibia, Tanzania, institutional indicators, capital stock, irreversible investment, uncertainty

JEL Codes: E02, K00, N4, O1

1 Introduction

One of the key channels through which institutions affect long-term economic performance is capital accumulation. According to the institutional hypothesis, protection of property rights enhances the incentives to invest. North (1990, 1991) suggested that institutions shape the incentive structure that may impede or increase economic activity.

Despite this assertion, studies have generally estimated the impact of institutions on capital accumulation within economic-growth models (see Scully 1992;

*PhD Candidate, School of Economics, University of Witwatersrand, Email:berniez09@yahoo.com. I am very grateful to Professor J.W.Fedderke for his helpful comments.

Knack and Keefer, 1995; Easton and Walker, 1997). A few studies have examined the relationship between institutions and capital accumulation directly (Serven, 1997; Dawson, 1998, 2007; Svennson, 1998; Gwartney et al., 2006).

Serven (1997) argues that a great part of weak investment performance in sub-Saharan Africa is explained by weak institutions, such as political instability and a lack of property rights. This paper builds on this assertion and the institutional hypothesis, and seeks to analyse the role of institutions in explaining investment performance in Namibia and Tanzania. The few studies that have used time-series techniques to establish causation links between institutions and capital formation (Fielding, 1999; Fedderke and Luiz, 2005), however, have focused their attention on South Africa, which is an emerging-market economy. They cannot, therefore, be generalised to developing countries with supposedly poor institutional arrangements and relatively low investment levels. This study, therefore, is contributing to the literature by carrying out a detailed time-series study that explicitly introduces institutional indicators and investment determinants in a context of developing countries, with Namibia and Tanzania as case studies.

The study extends the empirical research by testing the impact of institutional indicators on irreversible investment behavior under uncertainty, using aggregate data from Namibia and Tanzania. This section continues with a brief overview of capital formation in Namibia and Tanzania, followed by a review of the literature and the theoretical framework in section two. The empirical-model specification and data used in the study are also set out. In section three, the econometric methodologies employed are described. Section four present the estimation results and analyses for Namibia and Tanzania. Conclusions and policy recommendations are drawn in section five.

2 A brief overview of capital formation in Namibia and Tanzania

2.1 Capital formation in Namibia

The Namibian economy is agrarian and resource-based, with heavy dependence on the contributions of mining and quarrying to output. Several structural features and characteristics of the Namibian economy pose significant challenges to capital formation and economic growth. Namibia is one of the most arid countries in sub-Saharan Africa, with low and erratic rainfall. The percentage of arable land is estimated at 1 percent. The harsh ecological environment therefore imposes a formidable constraint on the agricultural sector's performance and overall economic development. As a result, Namibia has witnessed a gradual increase in government-sector involvement in terms of public investment throughout the period under review.

Before 1944, the trend of gross capital formation as a percentage of gross domestic product (GDP) fluctuated, recording an average of 13.8 percent be-

tween 1923 and 1943. The period between 1944 and the mid-1970s signify the status of a settlers' economy in Namibia, as shown by growing confidence in the economy by the minority white South African government. Despite the start of the armed struggle and increasing international pressure[1] over this period, both public and private investment continued to increase.

In terms of sectoral percentage contributions to total gross capital formation, the tertiary sector, dominated by the provision of government services, accounted for an average of 48.3 percent over the sub-period 1920 to 1949. The primary industries accounted for an average of 39.3 percent of total gross fixed investment over the sub-period 1920 to 1949.

Real fixed-capital formation grew gradually from the 1950s and reached a peak during the mid-1970s, as seen in figure 1. Between 1960 and 1979, gross capital formation averaged about 30 percent of GDP. In the period 1950 to 1979, the average contribution of tertiary industries increased from to 48.3 percent to 53.3 percent, thus continuing its dominance. The average share of primary industries declined from 39.3 percent to 34.1 percent over the same sub-period. This was mainly driven by the average decline in agriculture and fishing contribution to gross capital formation, which decreased from an average of 29.1 percent over the sub-period 1920 to 1949 to an average of 19.0 percent over the sub-period 1950 to 1979.

From 1980 to the eve of independence in 1987, the average rate of investment fell to 17.9 percent of GDP, from 30 percent for the period 1960 to 1979. The uncertainties about political and economic policies of a prospective independent Namibia significantly dampen economic activity over this sub-period.

Table 1 reveals the neglect of the secondary industries during the major part of the review. Primary industries attracted almost twice as much investment as secondary industries, underscoring the high reliance on the primary-industry focus on the exploitation of Namibia's vast natural resources. Within the primary sector, mining and quarrying attracted more investment than agriculture and fishing on average.

At the time of independence, the Namibian government adopted a number of measures and programmes to entice local and foreign investment in the economy. These included, among others, the creation of an Investment Centre under the Ministry of Trade and Industry with the adoption of Foreign Investment Act of 1990. The aim of the centre is to co-ordinate the investment-promotion activities of the government and to identify potential investment opportunities in Namibia. Other initiatives include business-tax and special-investment incentives, as well as the creation of an export-processing zone through the adoption of the Export Processing Zone Act of 1995.

In spite of all these incentives and secure property rights in Namibia, the first decade of the post-independence period recorded a rapid decline in the rate of investment. Between 1990 and 1999, gross capital formation averaged about 15.8 percent of GDP. A slight improvement in the rate of investment is, however,

[1] This coincides with refusal of the South African government to place Namibia under UN trusteeship in 1945.

noticeable, with an average of 21.7 percent of GDP over the sub-period 2000 to 2009. Even so, investment performance failed to return to the levels of the 1960s and 1970s, despite the all-inclusive institutional framework.

2.2 Capital formation in Tanzania

Gross capital formation in Tanzania during the colonial period is tied to the establishment of the plantation-agriculture economy introduced by the German colonial government. Although official figures are hard to come by, the first German tobacco and sugar plantations were started in the 1880s in Pangani, extending to East Usambaras in the 1890s. The sisal plantations, which become one of the major export earners, started in 1893. By 1912, there were 750 European-owned sisal plantations, mostly owned by individuals.

In terms of public investment, railway development, which started in 1891, is viewed as the major contributor to gross capital formation in then Tanganyika. Transport development mainly centred on areas that promoted agriculture plantation. The railways started inland from Tanga along the Pangani valley, in the direction of Kilimanjaro, reaching East Usambara by 1893 (Coulson, 1982). A similar development brought a railway to West Usambara by 1905. The last ten years of German rule, from 1905 to 1914, saw the creation of most of the colonial infrastructure, indicating a considerable investment in Tanganyika by then.

From 1920 to 1960, the British maintained the balance among peasants, settlers and plantations inherited from the Germans (Iliffe, 1979). Capital formation was dominated by private investment in plantations and public-sector investment in infrastructure. No official data exist for the larger part of the period under review.

In the post-independence period, the Arusha Declaration in 1967 instituted a structural transformation that increased state control in the economy. During this period, until the reforms of the mid-1980s, public-sector investment was promoted, while that of the private sector diminished, hampered by complex systems and regulations (Likwelile, 1998; Bigsten and Danielson, 2001). The public sector dominated investment activity, with bulk of the finance coming from donors. The country's investment strategy gave heavy emphasis to long-term-oriented investment activities, often infrastructure projects, rather than directly productive investments (Bigsten and Danielson, 2001). Between 1971 and 1974, public investment was dominated by an effort to improve transit routes with Zambia, involving the construction of the Tazara Railway, the Tanzam Highway and the Tazara Pipeline. During that period infrastructural investment accounted for 53.4 percent of total gross capital formation (Moshi and Kilindo, 1999). Gross fixed-capital formation stood at 17 percent of GDP on average from 1967 to 1985.

The reform period witnessed stable investment rates throughout, with 21 percent of GDP on average from 1986 to 2009. The launching of the Tanzania investment policy (1996) paved the way for the enactment of the Tanzania Investment Act 1997, which established the Tanzania Investment Centre (TIC)

as the primary agency of government to co-ordinate, promote and facilitate investment in Tanzania.

3 Main theories and institutional determinants of capital accumulation

Many theories have been constructed to assess the determinants of capital accumulation. For the purpose of this study, a brief review of the traditional theories is provided, while the main focus is on irreversible investment under uncertainty theory.

3.1 Theoretical perspectives

3.1.1 Traditional theories of investment

The starting point of conventional capital accumulation theorisation is the Keynesian, or accelerator, theory of investment (1947),[2] according to which investment is a linear proportion to changes in output. A more general form of the accelerator model is the flexible accelerator model.[3] The basic notion behind this is that the larger the gap between the existing capital stock and the desired capital stock, the greater the firm's investment.

The neoclassical theory of investment attributed to Jorgenson (1963) and Hall and Jorgenson (1967) was an attempt to focus on optimal capital stock adjustment by incorporating the cost of capital. The key drawback of the initial Jorgenson neoclassical theory of investment was that it assumed that the firms have the ability to adjust their capital stock to desired optimal level instantly and without cost. The importance of the adjustment cost in theory of investment was recognised by Eisner (1964), Lucas (1967), Gould (1968), Uzawa (1969) and Treadway (1969).This led to the introduction of the cost of installing new investment in the firm's optimization problem;[4] and consequently a separation of the influence of output on investment from that of the cost of capital.

A seminal paper by Tobin (1969) provided a framework for incorporating the marginal cost of adjustment in the theory of investment. The Tobin q- theory of investment argues that investment is the function of the ratio of the market value of capital to its replacement cost, a ratio known as q. The work of Abel (1979) and Hayashi (1982) made a theoretical contribution by introducing an observable average q in the q-model, given that marginal q is unobservable to the econometricians.

[2] The acceleration principle has been at the heart of economic theory since the writings of Carver (1903), Aftalion (1909) and Clark (1917).

[3] Advocated for through the work of Chenery (1952) and Koyck (1954).

[4] This modification of the neoclassical theory was supported in the work Jorgenson (1971).

3.1.2 Investment under uncertainty theory

The modern theory of investment expenditure focuses extensively on the investment–uncertainty relationship.[5] We distinguish between two strands of theoretical analysis with different conclusions on the sign and magnitude of the effect of uncertainty on investment applied in a dynamic stochastic environment.

The first strand of literature using a neoclassical model without capital-stock adjustment costs predicts a positive impact of uncertainty on capital productivity (Hartman, 1972). The results depend on the assumptions of perfect competition, constant returns to scale, full reversibility of capital and convexity of the marginal product of capital. This implies that increased uncertainty will yield a raise in marginal valuation of investment, leading to a positive link between capital accumulation and uncertainty. This was supported by Abel (1983), who argued that regardless of the characteristics of the adjustment cost function, increased uncertainty leads to increased investment spending. According to Lee and Shin (2000), the balance between the positive and negative effects of uncertainty may depend on the labour share of firms' costs.

Another strand of literature on investment under uncertainty links uncertainty to the main characteristics[6] of most investment decisions: (i) irreversibility and (ii) the timing of investment. For a neoclassical model with asymmetric capital adjustment costs, i.e. (partial) irreversibility of capital, greater uncertainty is likely to affect investment level negatively due to an option value of waiting (Bernanke, 1983; Mc Donald and Siegel, 1986; Dixit and Pindyck, 1994; Abel and Eberly, 1999). The central point to this theory is that uncertainty becomes an important investment decision because of the ability to delay an irreversible investment in anticipation of more information about the future. This makes investment decisions a real option problem, first developed by McDonald and Siegel (1986). It means that it may pay to wait before investment; as irreversibility attaches an opportunity cost to undertaking the investment expenditure. The neoclassical model relates investments to user cost of capital, while the call-option approach underscores the irreversibility of investment as the main source of friction.

Theoretically, the impact of irreversibility and uncertainty on long-run average investment and the capital stock remains unclear. Caballero (1991) and Abel and Eberly (1994) argued that under the assumption of constant returns and an infinitely elastic demand curve, an increase in uncertainty will increase investment, even in the presence of irreversibility. They show that for the relationship between uncertainty and investment to be negative depends on both the degree of market power, and aspects of the firm's technology. According to Caballero (1991), higher uncertainty leads to lower investment under the assumption of decreasing returns to scale and or imperfect competition, either of which makes the marginal revenue product of capital a decreasing function of

[5] See Carruth et al. (2000) for an earlier survey on the investment-uncertainty literature.

[6] According Pindyck 1993, investment expenditure has two important characteristics. Firstly, it is irreversible, thereby instituting an adjustment cost i.e a large sunk cost. Secondly, the wait to invest due to uncertainty lowers investment.

capital stock.

Abel and Eberly (1999) argued that the relationship may be presented by an inverted U-curve. At low levels of uncertainty, the investment–uncertainty relationship may be positive, whereas at high levels of uncertainty the relationship starts to become negative. They showed that since firms with irreversible investment face a higher user cost of capital, investment and the capital stock tend to be lower. However, when the irreversibility constraint binds, the firm would like to sell capital but cannot, and this "hangover" effect tends to increase the average capital stock.

Given these contrasting theoretical results and the ambiguity of the net effect of uncertainty on investment, empirical work is vital.

3.1.3 Institutional determinants of investment and capital accumulation

The previous section focused on output demand and/or prices as the basic sources of uncertainty. This section looks at uncertainty arising from other sources, as it might have exactly the same effect on irreversible investment decisions (Serven, 1997). A variety of studies using different proxies of uncertainty have been carried out. At the forefront are the macroeconomic uncertainties[7] such as volatility of the terms of trade, inflation and real exchange rate. However, few institutional indicators, such as property rights, political instability and the political and civil liberties index, are often used to offer insights into the determinants of capital accumulation.

The issue of political freedom and its impact on capital accumulation is encompassed in the broader debate on democratic institutions and economic performance. The theoretical links among democracy, economic performance and capital accumulation remain an empirical problem and this has led to two main strands of theoretical analysis, with different outcomes on the relationship. The first strand of literature emphasises that democratic rights might help to promote economic growth (Przeworski and Limongi, 1993; Clague et al., 1996). It is argued that democracy might reduce uncertainty and raise private investment. The counterargument states that broadened political participation might lead to deterioration in economic performance (Huntington, 1968; Olson, 1982). The main theoretical support is that broader participation might generate increased pressures for redistribution, thus lowering allocative efficiency.

As for the effect of political instability on factor accumulation, Alesina and Perotti (1996) showed that there is a negative correlation between political instability and investment. The theory is that political instability leads to uncertainty about future policies and hence reduced investment demand and, consequently, reduced physical capital accumulation.

Economists have argued that the protection of property rights is a fundamental ingredient for investment and growth (Scully, 1992; Gwartney et al.,

[7] See, for example, Aizenman and Marion, 1993; Serven and Solimano,1993 and Bleaney and Greenaway, 2001.

1996). The underlying theoretical argument is that greater respect for property rights and the fulfilment of contracts would encourage private investment. Furthermore, it has been shown by Leblang (1996) that economies that protect citizens' property rights grow more rapidly than those that do not.

The hypothesis that judicial independence (as a proxy of legal effectiveness) matters for long-term economic development has also received attention in economic-growth empirics. The theoretical understanding underpinning this hypothesis is that independent courts ensure secure property rights and contract enforcements, and this encourages investment, which is vital for economic growth. North and Weingast (1989) argue that political institutions characterised by checks and balances can have beneficial effects on investment by allowing governments to commit credibly not to engage in ex-post opportunism with respect to investors.

3.2 Theoretical framework

The framework of the analysis is captured within the theory of (partly) irreversible investment under uncertainty (Dixit and Pindyck, 1994; Abel and Eberly, 1999). The focus is the incorporation of uncertainty in investment models that recognise the existence of adjustment costs in capital stock.[8] This recognition places the focus on irreversible capital investment that shows diminishing returns. For simplicity we assume that the firm, whose production function is given by Y = G (K), where K is units of capital in place, faces an uncertain industry demand function for its output given by P = V.D(Y), where the shift variable denoted by V follows geometric Brownian motion,[9]

$$dV = \alpha V dt + \sigma V dz \tag{1}$$

where dt, is a time increment dz is the increment of a Wiener process, α is the drift parameter and σ is the variance parameter. Equation (1) implies that the current value of output is known, but future values of output will be lognormally distributed with a variance that grows linearly with time. The future value of output is always uncertain. Another assumption is that there are no variable costs,[10] so that the firm then experiences the profit flow given by:

$$\pi = V.D(G(K)).G(K) = S.H(K) \tag{2}$$

The marginal revenue product of capital is VH/K. We assume that there are diminishing returns to capital in the sense that the marginal revenue product is decreasing in K, or the revenue function is concave in K, such that H"(K) <

[8] The discussion follows the work of Dixit and Pindyck (1994), with reference to chapter 11. See also Fedderke (2004).

[9] The Brownian motion is commonly used for three main reasons: (i) the process is a Markov process (ii) the probability distribution for a change in the process over a time interval is independent of other time intervals; (iii) over any given time interval, the changes in the process are normally distributed, and the variance increases linearly with the time interval.

[10] Assume zero depreciation of the capital stock.

0.[11]Irreversibility and delay lead to the creation of an option to invest. Given the initial value of its capital stock, K_o, and the initial level of the stochastic demand shift variable V, the dynamic optimisation problem of the firm is to maximise its expected present value, its operating profits, net of the cost of investment. Suppose that the firm considers an increase in capital stock to K_1 at the end of the period, such that the expected value of the increase in capital stock is given by:

$$w = V.H(K)dt + e^{-pdt}E[W(K_1, V + dV) - k(K_1 - K_0)] \tag{3}$$

Where $V + dV$ denotes the demand shift, k the price of capital, and E is the expectations operator. The objective is to choose K_1 in order to maximize the expected value, providing the initial value $W(K, V)$ of the Bellman function. Solution of the dynamic programming problem provides the investment frontier V (K): The threshold in this instance is given by:

$$V(K) = \frac{\beta}{\beta - 1}\frac{\delta}{H'(K)} \tag{4}$$

Where β is the positive root of

$$\varphi = \frac{1}{2}\sigma^2\beta(\beta - 1) + \alpha\beta - p \tag{5}$$

Hence

$$\beta = \frac{1}{2} - \frac{\alpha}{\sigma^2} + \sqrt{(\frac{\alpha}{\sigma^2})^2} + \frac{2p}{\sigma^2} > 1 \tag{6}$$

The crucial result is the emergence of the investment threshold given by equation 4, which is shown to lie above the standard net present value rule of investment, due to the incorporation of uncertainty. The equation (investment threshold) above indicates that first, investment will occur only if the expected marginal profit from additional capital $\frac{V(K).H'(K)}{\delta}$, is greater than the cost of installation of the additional unit of capital by $\frac{\beta}{\beta-1}$. This investment boundary depends on the discount rate (p), the trend parameter (α) and its associated volatility (σ).

An increase in any of these variables will lead to a decrease in β,[12] which leads to an increase in the option value through $\frac{\beta}{\beta-1}$, raising the investment boundary. Note that even though σ is increasing the boundary, increased volatility may allow the boundary to be hit more often than in a situation with lower volatility, leaving the sign of the impact of uncertainty ambiguous a priori (see Fedderke, 2004). It is therefore unclear if there will be increased or decreased investment in the presence of increasing uncertainty.

[11] There are justifications for the decline of the marginal revenue product of capital. This could be the case because of physical diminishing returns in production, $G"(K) < 0$,or because of the downward sloping industry demand curve ($D'(Y) < 0$), or some combination of both.

[12] $\frac{\partial\beta}{\partial\alpha} < 0, \frac{\partial\beta}{\partial\sigma} < 0, \frac{\partial\beta}{\partial p} < 0$

3.3 Empirical literature survey

The empirical literature on investment determinants has developed substantially over the past two decades, drawing on larger and richer databases and utilizing better econometric tools. Given the many explanatory variables used in empirical literature, here we intended to focus on studies that have offered insights regarding the interplay between institutions and investment. The rest of this section discusses the impact of these institutional factors on capital accumulation.

(i) *Political instability and capital accumulation*

A number of empirical studies have shown a link between political instability and the accumulation of capital. Alesina and Perotti (1996) provide an empirical test to show that socio-political instability has a negative effect on investment accumulation, using a sample of 71 countries. Fedderke (2001, 2004) explicitly tests the relationship between uncertainty (as proxied by political instability) and investment using a panel of 28 manufacturing sectors' data in South Africa, and finds that political instability has a lowering effect on the investment rate. In other words, political instability depresses the accumulation of capital. These results seem to enhance the findings of Feng (2001), Fielding (2002) and Aysan et al. (2007) that political instability has a negative effect on investment.

The work of Le (2004), using a panel of 25 developing countries, distinguishes between the types of political instability. According to Le, socio-political instability in the form of non-violent protests encourages private investment, while violent uprisings hinder private investment. However, Campos and Nugent (2003), investigating the causal relationship between aggregate investment and political instability, find that there is a positive causal relation in the long run going from instability to investment, which is particularly strong in low-income countries. In contrast, an earlier study by Svensson (1998) indicates that once property rights are accounted for, political instability has no direct effect on private investment.

(ii) *Political freedom and capital accumulation*

In order to distinguish between political freedom and political instability, this section reviews studies that use the political-rights and civil-liberties indices. Several empirical works have shown that there exists a positive correlation between political freedom and investment. Feng (2001) analysed the impact of political freedom on private investment for a sample of 42 developing countries, using a composite index of political rights and civil liberties from Gastil indices. The results showed a positive and significant relationship between political freedom and private investment. This supports earlier findings that civil liberty has a positive impact on investment (Kormendi and Meguire, 1985), and that democracy has a positive impact on private investment (Helliwell, 1994; Pastor and Sung, 1995).

An index of political and civil liberties (as a proxy of property rights) was used by Hadjimichael and Ghura (1995) and found to have a positive but insignificant effect on the private-investment performance of 32 African countries over the period 1986 to 1992. Kumar and Mlambo (1995) argued that civil lib-

erties appear to exert a stronger impact on investment than political rights do. However, Mlambo and Oshikoya (2001) failed to detect any insignificant impact of the two measures individually, while they found that the interaction term between political rights and civil liberties did have an impact on investment. A contradiction to these findings is provided by Tavares and Wacziarg (2001), who found that increases in political freedom reduce investment in physical capital. Democratic institutions tend to respond to the demands of the poor through expansion of access to education and attempts to lower income inequality.

(iii) *Property rights and capital accumulation*

The importance of secure property rights and their positive links to investment formation underscores the recent empirics in growth determinants theory. Empirically, a positive relationship between secure property rights and investment has been found by Knack and Keefer (1995), Fedderke and Luiz (2005), and Acemoglu and Johnson (2005).

Knack and Keefer (1995) constructed a property-rights index from the International Country Risk Guide (ICRG) and Business Environmental Risk Intelligence (BERI) data sets and applied it to the United States data. They found that property rights have huge impact on investment and growth. Knack and Keefer also showed that property rights not only affect the magnitude of investment, but also the efficiency with which inputs are allocated.

Similarly, Fedderke and Luiz (2005) using annual data covering the period from 1954 to 1992 for South Africa found that secure property rights stimulate investment. The study also used a system of equation and incorporated a number of measures of institutional dimensions which provided insights into the webs of association between institutions and investment rates.

The importance of property rights in explaining investment is supported by Acemoglu and Johnson (2005); using a multiple instrumental variables strategy, they found that property rights institutions have a major influence on investment, long-run economic growth and financial development.

(iv) *Independence of the judiciary and capital accumulation*

Empirical evidence on the impact of judicial independence on investment and growth is rare. A series of papers by La Porta et al. (1997, 1998, 2004), Djankov et al. (2003) and Beck et al. (2006) in the law and finance literature have emphasised the importance of the economic value of judicial independence. This line of studies showed that there is a strong correlation between legal systems and financial development. Countries with common-law origins are more likely to provide strong protections for investors (La Porta et al., 1997, 1998), and better financing of firms (Beck et al., 2006).

The work of Feld and Voigt (2003) is among the few empirical studies linking judicial independence directly to economic growth. Using two indicators capturing the de jure and de facto judicial independence in a sample of 57 countries, they found that de jure independence does not impact economic growth, but de facto independence does positively influence real GDP growth per capita. The paper indicated that one of the transmission channels of the positive impact might be via investment, although this not was investigated. Investment was added as an explanatory variable in the growth model. Based on this hypoth-

esis, the present study explores the relationship between judicial independence and investment.

3.4 Empirical model and data issues

3.4.1 Empirical model

The choice of the model is based on the new theory of investment which clearly specifies that uncertainty and the possibility of postponing investment will affect capital formulation. Section 5.2.1.3 has shown that uncertainty stemming from poor-quality institutions, such as weak enforcement of property rights and of the legal system, influences the accumulation of capital. Furthermore, the importance of good institutions in promoting economic development indirectly through capital accumulation has been shown. A realistic model of investment for Namibia[13] and Tanzania therefore depends on three broad categories of variables: standard investment variables, uncertainty variables and institutional variables.

The basis of all investment functions is an attempt to identify net rates of return to investment, with output (Yt) frequently serving as an indicator of expected future returns to investment, while the user cost of capital (UC) serves as a measure of the marginal cost of investment. This paper extends the standard model of irreversible investment under uncertainty by integrating property rights (Prop), political freedom (Polfree) and judicial independence (JI) as institutional indicators. This is in line with the hypothesis that capital accumulation is vulnerable from any form of uncertainty stemming from the quality of institutions. Also, the North (1990) hypothesis on the importance of secure property rights for investment is captured. Most empirical studies have used investment models that assume linearity; this suggests an empirical model stated as follows:

$$LK = f(+LY - UC \pm INST + LPROP + LPOLFREE + LJI) \quad (7)$$

From equation (7) LK is defined as the natural log of capital stock; LY is natural log of expected output, UC is user cost of capital, LProp is the natural log of property rights, LPolfree is the measure of political freedom in log. LJI denotes the de jure judicial independence in log. INST is political instability (i.e. uncertainty measure).

The choice of using capital stock in the study is more appropriate in time-series analyses, given that fixed investment is a net addition to capital stock. The time-series behaviour is better captured by using models of capital stock that provide a long-term measure of the act of accumulation of fixed capital over time (Kumo, 2006).

The signs in equation 7 provide the prior expectations. The expectation is a positive association between expected output and physical capital stock. This

[13] An investment model for Namibia must allow for the impact of institutional changes particularly the political institutions due to the protracted colonial era.

is in line with the flexible accelerator theory of investment, which suggests that investment responds to changes in demand for output. The user cost of capital is expected to have a negative effect on capital stock. Firms invest up to the point where the marginal efficiency of capital equals the user cost of capital. A rise in the user cost reduces optimal capital stock and investment. In line with empirical literature on uncertainty and investment irreversibility, the sign on the political instability (Inst), which is the proxy of uncertainty in the study, is ambiguous.

The institutional-hypothesis arguments support a positive association between strong institutional variables and capital stock. Secure property rights generally lead to lower expected expropriation and higher net returns. The increase in judiciary independence, which underscores checks and balances as postulated by North and Weingast (1989), is expected to have a positive effect on capital accumulation. If an independent judiciary is able to make the representatives of the state stick to their promises, additional (physical) investment could lead to higher income and growth (Feld and Voigt, 2003).

3.4.2 Description of variables and data sources

From the outset, it should be noted that reliable economic data (GDP, gross capital formation) on Tanzania prior to the 1960 are hard to come by. Peacock and Dosser (1958) made a systematic construction of national incomes series and they published GDP only for 1952 to 1954. Their work was continued by the East African Statistical Department and later by the Bureau of Statistics. However, data reconciled with publications of current national income is not available.

In this study, available data on GDP was successively rebased until all data was based on 2001 constant prices. The data span for the analysis on Tanzania is from 1946 to 2009; for Namibia the data span is from 1923 to 2009.

Dependent and control variables

The log of *physical capital stock* is the dependent variable (LK_t). The method used to calculate capital stock is the perpetual inventory method, using data on gross fixed capital formation from the SWA/Namibia Department of Economic Affairs and extended with data from CBS-Namibia National Accounts.[14] The data on gross fixed capital formation in Tanzania are from the East African Statistical Department Reports and National Accounts of Tanzania. The depreciation rate used in this study is 6 percent as in Hall and Jones (1999).

The log of *real gross domestic product* is used as a proxy for the expected return on capital (LY_t). Data for the period 1920 to 1987 were obtained from SWA/Namibia Department of Economic Affairs and extended with data from CBS-Namibia National Accounts. In the case of Tanzania, data for the period 1952 to 2009 were obtained from the East African Statistical Department Reports and National Accounts of Tanzania.

[14] The calculation of capital stock is based on the modified Harberger approach as used by Nehru and Dhareshwar (1993).

The *user cost of capital* (UC_t) is a proxy for the marginal cost of capital. The real user cost of capital is computed using an analytical expression formulated as $UC_t = (i - \pi + \delta)$ where i is the average commercial bank lending rates; π is the rate of inflation; and the depreciation rate δ is assumed to be constant at 6 percent level.

The data on inflation and nominal interest rate (lending rate) were extrapolated backwards using the South African (SA) data growth rates on these variables, as there is a lack of data on Namibia between 1920 and 1950. The SA data was obtained from *Union Statistics for Fifty Years (1910–1960), Jubilee Issue*. Given lack of data on Tanzania from 1946 to 1966, the data on nominal interest rate (lending rate) were extrapolated backwards using the growth rates on interest rate data from United Kingdom (UK). According to the International Monetary Fund (IMF) (1969), the rate charged by commercial banks before March 1967 on prime loans usually followed the London rate. The UK data was obtained from Abildgren (2005).

Uncertainty is proxied by the political instability index (Inst). Fedderke (2001) argues that investment is adversely affected by uncertainty. The political instability index is computed using the principal component analysis of five subcomponents of political repression and opposition. The data is available for the period 1884 to 2009 for both countries.[15]

Institutional Indicators

The variables employed by this study to represent economic and political institutions are constructed by the author (see Zaaruka and Fedderke, 2011a; b). The above-mentioned two studies provide the description of the respective subcomponents used as inputs into the indices and the methodology applied. The data is available for the period 1884 to 2009, except for judicial independence de facto, which coverage starts from 1950 onwards, and therefore it is excluded from this analysis. The analysis on Tanzania is from 1946 to 2009, while for Namibia the data span is 1923 to 2009. This is dictated by the availability of reliable economic variables data.

The log of *property rights index* (LProp): The log of the property right index is computed using the factor analysis of seven sub-components of full liberal ownership.

The log of j*udicial independent de jure index* (LJI): Both de jure and de facto measures have been developed. The log of JI de jure covers the period 1884 to 2009; the JI de facto covers the period 1950 to 2009. In this study the JI de jure, due to its longer dated span, was used.

The log of *political freedom index* (LPolfree): The log of the political freedom index is computed using the factor analysis of 12 sub-components of indicators of political rights and civil liberties based on theoretical dimensions of a contemporary liberal democracy advanced by Jaggers and Gurr (1995).

The plots of the variables are presented in figure 3 for Namibia, while figure 4 plots the Tanzania variables.

[15] See Zaaruka and Fedderke, (2011a; b) for a detailed discussion on the methodology and the data.

4 Econometric methodology

There are two stages involved in the methodology. The first is the test for the existence of a long-run relationship in levels among the variables by the Pesaran, Shin and Smith (PSS) F-test (Pesaran et al., 2001) statistics technique. Once the long-run relationship has been verified in step one and relying on theory, an estimation of the parameters of the long-run relationship and the associated short-run dynamic error correction models is conducted by applying the Johansen Vector Error Correction Model (VECM).

4.1 Testing for the direction of association between variables

The estimation of the empirical model in equation 7 is potentially subject to the problem of endogeneity of the explanatory variables because of the feedback effects from capital accumulation to institutions or vice versa. It seems reasonable to argue that institutions and economic outcomes are jointly determined which is key argument in Acemoglu et al. (2004). Therefore, it is necessary to determine the long-run association between the variables in the model. To explore the direction of association between the variables included in this paper, the PSS F- test is employed. For a comprehensive description of this technique, see Pesaran et al. (2001).

Pesaran et al. (2001) tabulate two asymptotic critical values, a lower bound and an upper bound. When the order of integration of the variables is known and all the variables are I (0), the decision is made based on the lower bound, and in the case of all the variables being I (1), the decision is based on the upper bound. The test is analogous to a Granger causality test, but in the presence of non-stationary data (Fedderke and Luiz, 2008).

The test statistic is computed with each of $y_t, x_{i,t}, ...x_{n,t}$ as the dependent variable. If the calculated F-statistics exceeds the upper critical value, then reject the null of no long-run relationship. If the calculated F-statistics lies below the lower bound value, infer the absence of a long-run relationship. The test is inconclusive if the calculated F-test falls between the two bounds. Narayan (2005) however argued that critical values generated by Pesaran et al.(2001) cannot be used in small samples since they are based on large samples (they are generated for samples sizes of 500 and 1000 observations and 20 000 and 40 000 replications respectively). Narayan (2005) compares the critical values generated from smaller samples, 30-80 observations, using the same GAUSS code as (Pesaran et al.,2001) and find critical values reported in Pesaran et al.(2001) are smaller than those generated from a larger sample. Hence given the sample size in the present study (84 observations for Namibia analysis and 64 observations for the Tanzanian case) the analyses adopt the critical values as provided by Narayan (2005).

The empirical specification of the PPS (2001) procedure is presented as

follows:

$$\begin{aligned}\Delta LK_t &= \alpha_0 + \alpha_1 D_i + \sum_{i=0}^{p} \beta_{1i} \Delta \ln Y_{t-i} + \sum_{i=0}^{p} \beta_{2i} \Delta UC_{t-i} + \sum_{i=0}^{p} \beta_{3i} \Delta Polinst_{t-i} \\ &+ \sum_{i=0}^{p} \beta_{4i} \Delta \ln o\Pr op_{t-i} + \sum_{i=0}^{p} \beta_{5i} \Delta \ln Polfree_{t-i} + \sum_{i=0}^{p} \beta_{6i} \Delta \ln JI_{t-i} \\ &+ \sum_{i=0}^{p} \gamma_i \Delta \ln K_{t-i} + \delta_1 \ln K_{t-1} + \delta_2 \ln UC_{t-1} + \delta_3 \ln Polinst_{t-1} + \delta_4 \ln \Pr op_{t-1} \\ &+ \delta_5 \ln Polfree_{t-1} + \delta_6 \ln JI_{t-1} + \delta_7 \ln Y_{t-1} \end{aligned} \tag{8}$$

All variables in equation (8) are defined except Di which is dummies for specific structural breaks. In the Namibia empirical analysis, the three dummies are included to represent events such as the World War II (1939–1945 =1 and zero otherwise) and intense liberation hostilities (1970–1988 =1 and zero otherwise), and the independence dummy (1990–2009 =1, and zero otherwise), which are verified and found to affect the economic and institutional variables.

In the Tanzania analysis, three dummies are introduced to capture various economic and political structural changes during the period under review. The three periods are defined as follows: The pre-Arusha period runs from 1946 to 1966. This is followed by Arusha declaration period which started in 1967 and continued until 1985, with President Nyerere's resignation. The third is the reform period, from 1986 to 2009.

The ordinary least squares (OLS) is applied to equation 8 in order to test for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficient of the lagged levels of the variables.

4.2 Johansen VECM Estimation Technology

4.2.1 Methodology

This section gives a brief description of the standard Johanssen-Juselius technique[16] for multivariate cointegration that is applied in the empirical analysis. The basic vector autoregressive (VAR) is specified as follows:

$$z_t = A_1 z_{t-1} + \cdots + A_m z_{t-m} + \delta + v_t \tag{9}$$

Where z_t is a n x 1 matrix of endogenous variables, m is the lag length, δ is a matrix of deterministic terms and v_t is a Gaussian error term. Reparametrization provides the following VECM specification:

$$\Delta z_t = \sum\nolimits_{i=0}^{k-1} \Gamma_i \Delta z_{t-1} + \Pi z_{t-k+1} + \delta + v_t \tag{10}$$

[16] For more detailed discussion refer to Johansen and Juselius (1990, 1992).

where $\Pi = \alpha\beta'.\alpha$ is referred to as the loading matrix, containing the short run dynamics, while β is the matrix containing the long run equilibrium (cointegrating) relationships. The rank, r, of the matrix represents the number of cointegrating vectors and is tested for by using the standard Trace and Maximal Eigenvalue test statistics. Where r >1 issues of identification arise.[17] These can be resolved by means of restrictions on the loading matrix (α), the matrix representing short-run dynamics (Γ) and the cointegration space β.[18] Various ways of imposing restrictions are proposed in the literature (Johansen, 1988, 1991, 1995; Phillips, 1991; Pesaran and Shin 1995b, 2001). The study follows Johansen (1988, 1991, 1995).

4.2.2 Model specification

(i) *The co-integrating relationships*

The aim is to examine the impact of institutions on fixed capital accumulation over time. A theoretical and empirical review supports a possibility of two long-run relationships, linking capital stock and institutions with economic outcomes, on the one hand, and, on the other hand, a strong feedback effect from capital stock to output (GDP). Dawson (1998) argues that the effect of institutions on growth is via their effect on capital stock (investment). This supports a separation of two cointegrating vectors in estimation, one capturing investment and the other explaining output.

It is also worth noting that the extension of standard investment with an institutional variable might pose a third cointegrating vector. This is line with Fedderke and Klitgaard (1998) who showed that there exist a diverse and often strong web of associations among these social and political variables, and among these variables and measures of economic activity, such as output and investment.

In restricting the cointegrating vectors, Pesaran and Shin (1995a) show that r^2 restrictions are needed for exact identification. The common approach of imposing r^2 identifying restrictions in Johansen's statistical approach was criticised as being a purely mathematical convenience.

The signs and zero restrictions on the long-run parameters are shown in equation 12, which represents an *a priori* just-identified model guided by theoretical and empirical work. The empirical specification is as follows:

$$\begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} \\ \alpha_{61} & \alpha_{62} & \alpha_{63} \\ \alpha_{71} & \alpha_{72} & \alpha_{73} \end{bmatrix} \begin{bmatrix} 1 & \beta_{12} & \pm\beta_{13} & -\beta_{14} & \beta_{15} & 0 & 0 \\ \beta_{21} & 1 & -\beta_{13} & 0 & \beta_{25} & 0 & \beta_{27} \\ 0 & \beta_{32} & 1 & 0 & \beta_{35} & \beta_{36} & \beta_{37} \end{bmatrix} \begin{bmatrix} LK_t \\ LY_t \\ Inst_t \\ UC_t \\ L\,\mathrm{Pr}\,op_t \\ LPolfree_t \\ LJI_t \end{bmatrix} \quad (11)$$

[17] See Pesaran and Shin (1995a, 1995b), Johansen and Juselius (1990, 1992).

[18] Refer to Greenslade et al.(1999)

All variables in equation (11) are defined (see equation (7)) and their description and sources are discussed in section 2.4.2 of this study.

(ii) *Identification Strategy*

An emphasis was placed on using an economic theory to guide the choice of long-run exact/over-identifying restrictions. This is aided by the PSS F-test, whereby normalisation restrictions are placed on those variables found to be endogenous. With a prior of three vectors, nine restrictions for just-identification must be imposed on the long-run model. In each vector, three restrictions are imposed, i.e. one normalisation restriction and two exclusion restrictions.

According to the neoclassical approach, the desired or optimal capital stock is proportional to output and the user cost of capital. Therefore, in the analysis both the output measure (as proxied by GDP) and the user cost of capital are retained in the first vector, representing the capital stock relation. Furthermore, the new theory of investment clearly specifies that uncertainty (as proxied by political instability) and the possibility of postponing investment will affect capital formulation.

Relative to other institutional determinants, the New Institutional theory argues that property rights have a first-order effect on long-run investment (Acemoglu and Johnson, 2005).

In the first vector, a normalisation restriction is imposed on LKt, while the exclusion restrictions are imposed on de jure judicial independence (LJIt) and political rights (LPolfree). The expectation is that these variables affect capital stock indirectly via other institutional variables. This is applied to both the Namibian and the Tanzanian analyses in the next section.

In the second vector, which represents the output relation, a normalisation is imposed on GDP while a zero restriction is put on user cost of capital. Under the neoclassical theory of investment, user cost of capital will affect capital stock, thereby exerting an effect on output indirectly. Another exclusion restriction was put on political rights. Again the expectation is that these variables will affect output indirectly via other institutional variables.

The literature acknowledges that both political and economic institutions are fundamental causes of economic development. Fedderke and Klitgaard (1998) showed that when considering a set of approximately 67 indicators of social and political dimensions of society, there exists a diverse and often strong web of association among these variables, and among them and measures of economic activity such as output and investment.

The third vector normalises on political instability (Inst) and imposes an exclusion restriction on user cost of capital (UCt) and capital stock (LKt) in the Namibia analysis. In the case of Tanzania, a normalisation is on judicial independence (JIt), while exclusion restrictions are imposed on user cost of capital (UCt) and capital stock (LKt). The choice of the normalising variable, i.e. political instability or judicial independence, is an empirical outcome, based on PSS F-test results. There is no theory or hypothesis to guide the selection, except the work of Fedderke and Klitgaard (1998), which draws our attention to the web of association among the institutional variables.

In the study judicial independence is not just defined as the extent of the de

jure structural independence of the judiciary within the government system, but also in terms of the behavioral independence of individual judges. The latter consideration includes the method of appointments of the judiciary and their tenure security, among other aspects. A sound judiciary is key to enforcement.

The political instability index, on the other hand, captures the number and magnitude of identifiable events reflecting de facto constraints of political, social and economic rights. These events include: political fatalities, civil protest, politically motivated arrest, declarations of state of emergencies, and the banning of political parties and publications.

Over-identification of the system is done by further restrictions on the just-identified model.

5 Empirical analysis and econometric model estimation

This section presents the analysis of empirical results using the time-series data from Namibia. Country parameters are estimated separately using time-series regression for each country. The analysis of empirical results starts with the unit root test. The standard ADF and Phillips and Perron (1988) (PP) tests for the null of a unit root are applied. The period under review for Namibia is 1923 to 2009 is long, and potential structural breaks are anticipated in the data. This study applies the Zivot and Andrews (1992) unit root test and the sequential procedure of Bai and Perron (1998, 2003) to verify the timing of structural breaks.

Secondly, the Pesaran, Shin & Smith (PSS)-F-test (Pesaran et al., 2001) is then examined to explore the direction of relationship between the variables within models. This is followed by cointegration tests using the maximum likelihood procedure of Johansen (1988) and Johansen and Juselius (1990).

5.1 Empirical analysis: Namibia

5.1.1 The univariate characteristics of the data

Variables whose means and variances change over time are known as non-stationary or unit root variables. Economic theory often suggests the existence of long-run equilibrium relationships among non-stationary time-series variables. If variables are non-stationary, the estimation of the long-run relationship between those variables has been shown to be based on the cointegration method. Hence, pretesting for unit roots is the first step in vector-error -correction modelling.

The standard ADF and Phillips and Perron (1988) (PP) tests for the null of a unit root are applied. Table 2 reports the unit roots results, where c denotes the inclusion of a constant.

The ADF confirm that all variables contain a unit root. All the other variables have to be differenced once to transform them to stationary at 1% critical

values. Under the PP test, all variables are confirmed to be I (1) at 1% critical level, with an exception of UC_twhich is I (0) at 5% critical level. However, a closer visual plot inspection of the UC_t reveals that the variable might be non-stationary at levels (see figure 2(g)).

Next the variable unit root characteristics is further explored using the Zivot-Andrews unit root test, given that neither the ADF nor the PP test account for presence of structural change in the economic variables.

5.1.2 Dealing with structural breaks in the data series

The period under review, from 1923 to 2009, is long, and potential structural breaks are anticipated in the data. Therefore we relied on Zivot-Andrews (1992) to test for unit root. Also, we used the sequential procedure of Bai and Perron (1998, 2003) to verify the timing of structural breaks. In both test the timing of the structural break is endogenously determined, with no ex ante preference for any particular year or event. Table 3 present the results.

The Zivot-Andrews unit root confirmed that LK_t and LY_t are I (1) subject to the presence of a structural break in 1945 and 1946 respectively. The chosen breakpoint is not surprising, given World War II and its aftermath. In the case of variable UC, the breakpoint is in 1984. When Zivot-Andrews unit root test was applied in levels, it showed that UC_t is not an I (0) subject to the presence of a structural break in 1984. However, differencing it once, UC_t does become stationary at 1% critical level. Therefore, we proceed with UC_t as I (1) in the study.

All institutional variables are confirmed to I(1) subject to the presence of a structural break in 1990, which could be ascribed to the attainment of Namibian independence, except political instability (Inst), which showed a breakpoint in 1989. Here we conclude that all unit roots are present in all the variables even when structural breaks are accounted for.

The use of the Bai-Perron breakpoint test is intuitive in timing multiple breaks, which is crucial for the inclusion of dummies in the study. In line with the Zivot-Andrews unit root, we confirm the importance of World War II, which started in the late 1930s and lasted through 1945. Another crucial timing for Namibia is the period between the 1970s and late 1980s. The year 1989 is confirmed as important as it signifies the onset of Namibia's independence.

5.1.3 ARDL PSS F-test estimation results

We apply the PSS F-test to determine the direction of association between capital stock and its economic and institutional determinants in the specified model (see equation 8). Table 4 presents the PSS F-statistics when each variable is considered as a dependent variable in the ARDL-OLS regressions. The conclusions are based on the critical values provided in Narayan (2005) for a sample size 80, for the case of unrestricted intercept and no trend with seven variables (i.e. k=7).

The calculated F-statistics F_{Kt}(Kt|Prop, Polfree, JI, UC, Inst, Y_t) = 4.75 and F_{Yt}(Yt |Prop, Polfree, JI, Kt, UC, Inst) = 4.48 are higher than the upper-bound critical value 3.74 at the 5% level. Thus the null hypotheses of the absence of relationship are rejected, implying a long-run relationship among the variables when the regressions are normalised on both Kt and Yt variables. In terms of institutional variables, political instability, which is our proxy for uncertainty, appears to be an outcome variable relative to a number of institutional variables (property rights, political rights and judicial independence).

The use of a single-equation cointegration approach such as the ARDL is valid only where there is a unique cointegration vector (Pesaran et al., 2001). Our results have shown the existence of more than one possible equilibrium relationship in the model. For us to proceed with estimating the model in equation 7, we adopt the Johansen VECM technique as specified in equation 12.

5.1.4 Johansen cointegration results

The present study uses the Johansen test for cointegration. There are two important issues in specifying a VAR model: the choice of appropriate lag length and the number of variables to be included in the model. Based on statistical tests, a VAR with the lag order of two is estimated. Table 5 reports the results for the cointegration test under the assumption of unrestricted intercepts and restricted trend, which is chosen following the summary of all possible models.

Both the trace and eigenvalue tests indicate that there are at least three cointegration equations at the 5% level of significance. This is in line with the PSS F-tests results, which suggested that LKt, LYt and Inst are potential outcome variables in this study.

The results of the unidentified cointegrated VAR for the three cointegrating vectors are hard to interpret economically. Therefore, one needs to impose appropriate restrictions and normalisation on the long-run betas (see section 3.2.2 of this paper for discussion). Three normalisation and six parameter restrictions are imposed to obtain a just-identified model, the results of which are given in the next subsection.

Long-run and short-run estimate analysis[19] Once the model was just-identified through these restrictions, the next step was to impose and test further over-identifying restrictions. A likelihood ratio test compares the less restricted with the more restricted model (Johansen, 1988). If the likelihood test is statistically significant, then the less restricted model is said to fit the data better than the more restrictive, and vice versa.

All the variables in the just-identified model (a) are significant based on their t-statistics values as shown in table 6: (i), with the exception of property rights in both the LYt vector and political instability (Inst) vector. Zero restriction

[19] See section 3.2.2 for discussion of identification restrictions of the model.

is imposed on the coefficient of property rights in the Yt vector in the over-identified model. In the over-identified model (b), the restriction is accepted with the likelihood ratio given by Chi-square = 0.263 and a p-value 0.608. The normalised equations are presented below:

$$Lkt = 0.06t + 0.65LYt - 0.07Inst - 5.02LProp - 0.114UCt \quad (12)$$

$$LYt = -0.20t + 4.62LKt - 0.485Inst + 13.1LJI \quad (13)$$

$$Inst = -0.03t + 1.7LYt - 6.58LProp - .02LPolfree + 10.3LJI \quad (14)$$

From economic point of view, the results from equations 12 to 14 are mixed. In the *LKt vector*, all variables are significant and carry the expected coefficients' signs, apart from property rights.

According to equation 12, capital stock (Lkt) showed a significantly negative relation with the property right index (LProp) in long-run with an elasticity coefficient of -5.02 This result is counterintuitive, since property rights are expected to have a higher positive impact on capital accumulation, especially to the extent that secure property rights increase investors' confidence, thereby increasing the level of investment. Plausible explanations might be the use of our proxy for property rights, which is based on land rights.

Firstly, given the historical dual land ownership in Namibia, an anticipated land reform[20], i.e. the process to achieve a more equal distribution of land since mid-1980s and the onset of independence in 1990, might induce some level of uncertainty among some economic actors.[21]High uncertainty is detrimental to formation of capital stock due to irreversibility of investment. Although property rights in Namibia are generally secured, they are not broad-based. Therefore, it appears that perceived fear of land lost during a reform might hinder more fundamental long term investment in Namibia. This is shown by a declining share of capital formation in the agriculture sector especially since the 1980s onwards. Similar results were obtained in the work of Ayalew et al. (2005), which have shown that perceived land tenure insecurity due to land reform negatively affect investment in the case of Ethiopia. According to Beasley (1995), reducing the risk of expropriation, secure property rights encourage land users to make long-term land –related investments.

Secondly, the negative correlation between property rights and investment could be due to omitted factors which influence both the measure of property rights and investment. The factor that land rights under the colonial regime were poor for blacks, while at the same time leading to investment by the whites is a possible explanation. It should be noted that whites enjoyed a number of incentives such as financial assistance via a number of land settlement legislations.

[20] Since 1995, The Namibian government has pursued policies of land reform through tenure reform and redistributive land reform through buying of farmland and few cases of land expropriations.

[21] This mainly refers to land owners under the freehold tenure system where major capital investment undertakings are taking place.

Thirdly, the results might also show that investors are more sensitive to the signal coming from the political environment as represented by political instability index rather than the constitutional one (i.e. de jure indicators such as property rights index). This might be due to the long history of brutal colonization, independence war and struggle for the control of the land.

Uncertainty, as proxied by political instability (Inst), has a negative and statistically significant influence on capital-stock accumulation. Empirical support for a negative link between capital stock and measures of political instability is found in the work of Fielding (2002) and Fedderke and Luiz (2005) for South Africa. Alesina and Perotti (1996) show that socio-political instability generates an uncertain political-economic environment, raising risks and reducing investment. This result is also consistent with historical episodes of high political instability and the rapid decline in gross capital formation in Namibia, particularly between the 1970s and late 1980s.

Normalised equation 12 shows that there is a significant positive relationship between GDP and the accumulation of capital. The result is consistent with the findings of many researchers (inter alia Fielding, 1997, 1993; Ndikumana, 2000; Mlambo and Oshikoya, 2001). This is supported by the flexible accelerator theory, which shows that high output is associated with a high rate of capital-stock accumulation.

The impact of user cost of capital is seen to be negative and relatively statistically significant. This finding is corroborated by empirical studies (Greene and Villanueva, 1991; Oshikoya, 1994; Ndikumana, 2000; Ghura and Goodwin, 2000) in which increased user cost of capital discourages investment formation. The significant negative influence of user cost of capital on capital stock is also consistent with the investment theory.

Turning to the *GDP vector (Yt)*,[22] as shown by equation 13, all variables are significant and carry the expected coefficients' signs. LKt has a positive and significant effect of 4.62 on GDP, thus confirming that capital stock is a key factor contributing to real GDP growth. Another important result is the positive relation of judicial independence to GDP, with a significant elasticity of 13.1. Theory suggests that effective independent courts promote investment and economic growth. As expected, political instability negatively influences GDP.

The last vector represents political instability (Inst), shown in equation 14. The results are quite mixed: while property rights appear to have a negative relation to political instability, judicial independence shows a positive association with political instability. Improvements in property rights significantly dampen political instability (elasticity of -6.58). The positive significant relation between increases in output and instability, with an elasticity of (1.7), is in line with the findings of Fedderke and Luiz (2005). Political rights report a significant negative sign, implying a rise in freedom rights being associated with decreasing levels of political instability, with an elasticity of -3.02.

We now turn to the impact of the dummy variables representing World War

[22] This vector is likely to be underspecified in this regression.

II, the hostilities from the 1970s to 1980s, and the independence and post-independence period in Namibia. The World War II dummy (WW2DU) has a negative and statistically significant coefficient of -0.03, in the LKt cointegration vector only, while the DU1970 is statistically significant in the Y_t and Inst cointegration vectors respectively. In the instability vector the sign is positive, reaffirming their association. The independence and post-independence period dummy (DU1990) shows a positive and statistically significant coefficient of 0.06 in the vector representing capital stock. In the political instability vector the sign is negative and statistically significant. This indicates the onset of the stable political and macroeconomic environment period in Namibia, which is still lingering.

Robustness analysis The last step in evaluating the cointegration model is an impulse-response analysis. Building on Sims's (1980) seminal paper, Lütkepohl and Reimers (1992) argued that an impulse-response analysis of vector autoregressive systems with cointegrated variables can be considered. Although the individual variables are non-stationary, there are linear combinations of them which are stationary. These are interpreted as the long-run equilibrium relations. Assuming that variables are in equilibrium at some time t, say t=0, any shock to one of the variables results in time paths of the system that eventually settle down in a new equilibrium, provided no further shocks occur. If a relationship is cointegrated, the shock will have impact, but will tend to zero even though the shock will have a permanent effect on the individual variables.

After estimating the vector-error-correction model using the Johansen technique with the Namibian data, the estimation of the persistence profile of the effect of a system-wide shock to the cointegrated vectors (CV) in the just- and over-identified models was carried-out. In addition, impulse-response functions with respect to one standard error shock to the capital stock, output and political instability equations are also estimated. The results of the plots are based on the over-identified model, as shown in figures 5 to 8 for Namibia. It should be noted that the same impulse responses are obtained from a system with just identified restrictions on the cointegrated vectors (available from the author upon request).

Figure 5 show a rapid convergence to equilibrium of all vectors in the long run due to a system-wide shock. According to the plots, all the three cointegrated vectors shocks rapidly die out, indicating stability of the equilibrium relation.

A symmetrical result emerges for the shocks to individual equations. Figure 6 shows that the shocks to the capital stock equation have minimal and less persistent effect on all three cointegrated vectors in the short run. The shocks tend to die out rapidly restoring the equilibrium relation among the vectors.

From figure 7 an output equation shocks has minimal initial impact on three cointegrated vectors in the short run. This however tend to converge very quickly to the equilibrium. The political instability equation shocks are shown by figure 8. The shocks tend to smooth out in the long run, confirming the stability of the model. In summary, this exercise demonstrates that the system

might be adequate for studying the impact of institutions on capital stock

5.2 Empirical analysis and model estimation: Tanzania

This section extends the empirical research by testing the impact of institutional indicators on irreversible investment behaviour under uncertainty using aggregate data from Tanzania.

5.2.1 The univariate characteristics of the data

It is crucial to detect whether the series are stationary or not. Three different tests are used: the standard ADF and PP tests for the null of a unit root, and, to account for structural breaks in the dataset, the Zivot and Andrews (1992) test. Table 7 reports the two unit roots results. The result for the Zivot and Andrews (1992) test is presented in table 8.

The purpose of using three unit root tests is to get insight into the order of the variables, when one or more tests are not in conformity. This is important particularly in a long-dated time-series study, due to the fact the standard unit root tests used to behave poorly in the presence of structural breaks in the data. The ADF and PP tests confirm that all variables contain a unit root.

5.2.2 Dealing with structural breaks in the data series

There are anticipated structural breaks in the data due to the period under review, from 1946 to 2009. The Zivot and Andrews (1992) test and the sequential procedure of Bai and Perron (1998, 2003) are applied to verify the timing of structural breaks. Table 8 reports the results.

The Zivot-Andrews unit root confirmed that all variables are I (1) in the presence of structural breaks. The chosen breakpoints for the political freedom and judicial independence indices is the year 1965, while for the property rights and political instability indices they are the years 1973 and 1970 respectively. These breakpoints capture the one-party regime and the Arusha declaration period.

The economic-variables breakpoints are identified in the 1970s and 1980s. Therefore, we proceed with the fact that all variables are I (1). These breakpoints are linked to structural changes under the Arusha declaration periods, while the mid-1980s signify the onset of the structural reform period with the resignation of President Nyerere.

The use of the Bai-Perron breakpoint test is intuitive in timing multiple breaks, which is crucial for the inclusion of dummies in the study. Tanzania has undergone major political and economic structural changes, and multiple breakpoints are identified. Three dummies are introduced to capture this period of changes in the study. The three periods are aided by the work of Bigsten and Danielson (2001) and defined as follows: The pre-Arusha period runs from 1946 to 1966. This is followed by the Arusha declaration period from 1967 to 1985,

ending with President Nyerere's resignation. The third is the reform period, from 1986 to 2009.

5.2.3 ARDL PSS F-test estimation results

Table 9 presents the PSS F-statistics when each variable is considered as a dependent variable in the ARDL-OLS regressions in equation 9. The results are derived from case III – an unrestricted intercept without trend in Narayan (2005). The sample size is 65 (i.e. n=65) with seven variables (i.e. k=7).

The calculated F-statistics F_{Kt}(Kt|Prop, Polfree, JI, UC, Inst, Yt) = 3.85 and F_{Yt}(Yt |Prop, Polfree, JI, Kt, UC, Inst) =4.45 are both higher than the upper- bound critical value 3.82 at the 5% level. Thus the null hypothesis of the absence of relationship is rejected, implying a long-run relationship among the variables when the regressions are normalised on both Kt and Yt variables.

In terms of institutional variables, judicial independence appears to be a possible outcome variable relative to a number of institutional variables (property rights, political rights and political instability) in the case of Tanzania. This result is different from the Namibian case, where political instability is shown to be a possible outcome variable. There is growing evidence that institutional arrangements have an element of context specificity arising from differences in historical trajectories. In terms of political instability, Tanzania, as opposed to Namibia, enjoyed a period of peace.

Furthermore, for the most part of the review period Tanzania witnessed the repression of the judicial system under the one-party state. In the period between independence from Great Britain in 1961 and the late 1980s, there was a subordination of the law and the legal system to the executive, effectively weakening the courts and rendering the law a relatively unimportant facet of economic and social life in Tanzania.

These results have significant implications for the analysis. The ARDL cointegration test assumed that only one long-run relationship exists between the variables (Pesaran et al., 2001). The PSS F-test results indicate the presence of more than one cointegration vector. We adopt the Johansen VECM technique and proceed with estimating the model in equation 7 in section 2.4.1 using the Tanzanian dataset. We estimate the VAR equation specified in equation 11 with minor changes to the third vector. The log of judicial independence (LJI) becomes the normalising variable rather than political instability, (Inst) as shown in equation 11.

5.2.4 Johansen cointegration results

Based on statistical tests, a VAR with the lag order of 2 is estimated. Table 10 presents the Johansen co-integration test results. The trace test results indicate three cointegrating equations at the 5% level of significance. Taking the maximum eigenvalue test results indicates one cointegrating equation. This is not in line with the postulated theory. Therefore, we decided to opt for the results of the trace test which show that there are at least three cointegrating

vectors. The decision is also aided by the PSS F-tests, which suggested that LKt, LYt and LJI are possible outcome variables in the n analysis.

The cointegration vectors describing the economic long equilibrium can be estimated only if meaningful economic restrictions are imposed. With three cointegrating vectors, I imposed three normalisation and six parameter restrictions for exact identification.

Long run and Short run estimates analysis Once the model was just-identified through these restrictions, the next step was to impose and test further over-identifying restrictions (see table 11).

All the variables in the just-identified model (c) carry the expected sign as shown in table 11, with the exception of political instability and property rights in the LKt and Yt vectors respectively. Equation 15 to 17 allow us to over-identify the vectors that comprise three long-run relations and these (over-identifying) restrictions are not rejected (table 11). The results from equation 15 to 17 carry expected signs and are significant.

The normalised equations are presented below:

$$LKt = 0.95C + 1.02LYt + 0.25LProp - 0.01UCt \tag{15}$$

$$LYt = -0.62C + 0.57LKt - 0.29Inst + 0.71LJI \tag{16}$$

$$LJI = -2.3C + 0.03LYt + 0.21LProp + 0.14LPolfree \tag{17}$$

In the *LKt vector*, all variables are significant and carry the expected coefficients' signs. According to equation 18, capital stock (LKt) showed a significantly positive relation with property rights index (LProp) in the long run with an elasticity coefficient of 0.25. Secure property rights have been emphasised in the empirical literature as crucial factors for encouraging investment (Glaeser et al., 2004; Acemoglu et al., 2004; Fielding, 2002; Hall and Jones, 1999; La Porta et al., 1997; Knack and Keefer, 1995).

Normalised equation 15 showed that there is a significant positive relationship between accumulation of capital and GDP. According to the neoclassical theory of investment, this implies that anticipations of economic growth induce more investment. The significant negative influence of user cost of capital on capital stock is consistent with the user-cost-of-capital theory and other empirical results.

Turning to the *GDP vector (Yt)*,[23] as shown by equation 16, all variables are significant and carry the expected coefficients' signs. LKt has a positive and significant effect of 0.57 on GDP, thus confirming that capital stock is a key factor contributing to real GDP growth. Another important result is the positive relation of judicial independence to GDP with a significant elasticity of 13.1. This is in line with the findings of Feld and Voigt (2003). Theory suggests that effective independent courts promote investment and economic growth. The other important institutional variable that came out very strongly with

[23] This vector is likely to be underspecified in this regression.

a negative and significant impact on GDP is political instability, representing uncertainty in the political macroeconomic environment.

The last vector is judicial independence (JI), represented in equation 17. The most interesting results are that the two institutional variables, property rights and political freedom, are significant in the JI vector. According to La Porta et al. (2004), countries with independent judiciaries are more likely to have strong protections of property, political, and human rights. It should be noted that causation is unclear (not implied). Property rights appear to have a positive relation to judicial independence. Improvements in property rights are associated with increased judicial independence. Political rights report a significant positive sign, implying a rise in rights being associated with increasing levels of judicial independence, with an elasticity of 0.14.

We now turn to the interpretations of dummies in the three cointegration vectors. All dummies except the DU1986, which captures the onset of the economic reforms in Tanzania, are insignificant. The reform dummy (DU1986) has positive and statistically significant coefficients of 0.05 and 0.18, in the LKt and LJI cointegration vectors, respectively. This is consistent with the work of Moshi and Kilindo (1999), which showed that only the dummy capturing the reform period had a positive influence on private-sector investment in Tanzania.

Robustness analysis The study focused on the impulse-response analysis of the cointegrated vectors. Figure 9 plots impulse response of the cointegrated vectors to a system-wide shock. The response in the three cointegrated vectors is transitory. The initial response of the three cointegrated vectors is negative, but dies out very fast. The overall relationship between vectors is stable.

Figure 10 shows the response of the three cointegration vectors to a one standard deviation shock in the equation for capital stock. The initial reaction of the three cointegrated vectors is insignificant and dies out rapidly. In figure 11 the initial response of capital stock vector (cv1) and output (cv2) to an output shock is muted and dies out immediately. However the response of the judicial independence (cv3) to a shock in output is positive and significant in the initial period, then it becomes negative and dies out.

Figure 12 shows the responses of three vectors to a positive shock in the judicial independence equation is initially positive before tending to zero. Overall, there is convergence in the long run.

6 Conclusions and Implications

6.1 Conclusions

The institutional hypothesis argued that a solid institutional framework is a key determinant of capital accumulation. When property rights are weak and poorly protected, investors will be reluctant to risk their capital for fear of expropriation. Also, the theory of irreversible investment under uncertainty tells us that greater uncertainty is likely to affect investment levels due to the

option value of waiting. This has been used to justify the estimation of the impact of institutional indicators on capital-stock accumulation in Namibia and Tanzania, applying the Johansen VECM technique.

Given that the relationship between institutions and economic development is almost certain to differ across countries; time-series evidence may offer better insights than can cross-section studies. The data span for Namibia is from 1923 to 2009, while for Tanzania is from 1946 to 2009. Given the length of the time span, one expects that structural changes could have taken place, therefore several tests such as the Zivot and Andrews (1992) and Bai and Perron (2003) tests are applied to take into account structural breaks in testing for unit roots.

Econometrically, the dynamic structure of our empirical model suggests that a multi-cointegration framework exists, in which separate long-run relationships are identifiable. Relying on theoretical and empirical literature and aided by the PSS F-test, a distinction was made between outcome and forcing variables in the model. This in turn informed the a priori specification of the long-run relationship estimated in the study. A Johansen VECM technique was used, exploiting the long-series measures of institutions constructed by the author, and other economic variables. Dummy variables were introduced to capture the detected structural breaks. Over-identifying restrictions on the long-run relationship are all accepted.

The empirical results of this study confirmed that political instability does impact on capital-stock accumulation in Namibia. The evidence also suggested that capital stock is positively related to GDP, while user cost of capital relates to it negatively.

Another important aspect of the paper is the institutional underpinnings of the accumulation of capital stock. The long-run relationship representing political instability equilibrium provided an insight into the webs of association between different institutional variables. Property rights and political rights prove to be important in dampening political instability. However, the impact of property rights on capital stock remained negative in Namibia.

In the case of Tanzania, the findings highlight the importance of property rights in explaining capital accumulation over time. The standard investment variables carried the signs expected according to theory.

The most interesting result is the importance given to judicial independence, which showed a positive relation to GDP. It is also shown that uncertainty in the political macroeconomic environment (political instability) has had a negative impact on economic development over time in Tanzania.

Lastly, the paper shows that other institutional variables (property and political rights) have a positive relation with judicial independence. Unlike in the case of Namibia, judicial independence is found to be a possible outcome variable, as opposed to political instability. This is not surprising, as Tanzania on average was quite peaceful during the period under review, while other institutional oppressions were experienced under the one-party system.

6.2 Implications

The findings of the study suggest that institutional factors are important determinants of long-term capital formation, and hence economic development.

In case of Namibia, the main policy implications are:

- The government should promote an institutional framework that ensures political stability to attract investors.
- The property-rights structure in Namibia, which is slow changing, appears to affect capital formation negatively. Therefore, the government should address a framework that ensures secure property rights, not just for a minority but for the broad cross-section of the society. This is not only because secure property rights attract investment, but also because it would dampen political instability within the country.

In case of Tanzania, the main policy implications are:

- The government should promote an institutional framework that guarantees the independence of the judiciary. This would constitute a check-and-balance mechanism and promote rule of law, thereby promoting economic development.
- The government should ensure secure property rights because they attract capital formation, which is vital for Tanzania's sustainable economic development.

Finally, in order to achieve broad-based economic development, future institutional and policy reform in developing countries should take into account the historical specificities of each country, and even of smaller political units, as institutional frameworks tend to persist over time.

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Appendix

Tables -Namibia

Table 1: Average contribution to gross capital formation (%) in Namibia

Categories	1920–1949	1950–1979	1980–1987	1993–2010
Primary sector	**39.3**	**34.1**	**20.6**	**25**
Agriculture& Fishing	29.1	19.0	4.9	7
Mining	10.2	15.1	15.7	18
Secondary	**12.4**	**12.8**	**9.9**	**19**
Tertiary	**48.3**	**53.1**	**69.5**	**56**
Government	13.8	29.7	48.0	20

Source: South West Africa/Namibia (1988), Statistical Economic Review and National Income Accounts, CBS various issues

Table 2: ADF and PP unit root test for Namibia

Variable	Levels	First Differences	Order of Integration
	c	***c***	**I(d)**
LK_t	-0.60	-13.18***	I(1)
LYt	-0.33	-7.41***	I(1)
Uct	-1.31	-7.54***	I(1)
Inst	-2.27	-14.13***	I(1)
LProp	-2.53	-9.37***	I(1)
LJI	-0.02	-8.41***	I(1)
LPolfree	-0.73	-6.88***	I(1)
Phillips-Perron Unit Root Test			
LK_t	-2.56	-10.06***	I(1)
LY_t	-0.64	-7.38***	I(1)
Uc_t	-3.45**		I(0)

Notes: All variables are significant at 1% critical values denoted by ***, except UCt which is significant at 5 % critical value denoted by **.

Table 3 Zivot-Andrews unit root test and Bai-Perron breakpoint test – Namibia

Variable	Levels	First Differences		Order of Integration	Chosen break
	Intercept	Intercept		I(d)	
LK_t	-3.95	-4.58***		I(1)	1945
LYt	-4.56	-6.70***		I(1)	1946
Uct	-4.22	-7.96***		I(1)	1984
LProp	-4.7	-10.1***		I(1)	1990
LPolfree	-4.13	-7.15***		I(1)	1990
LJI	-2.80	-6.41***		I(1)	1990
Inst	-3.75	-10.0***		I(1)	1989
Bai-Perron breakpoint test					
	No of breaks	**Year**	**Year**	**Year**	**Link**
LK_t	2	1935	1971		WW2 and the 1970s-1980s War
LY_t	3	1935	1948	1970	WW2 and the 1970s-1980s War
Uc_t	2	1941	1981		WW2 and the 1970s-1980s War
LProp	3	1939	1967	1989	WW2 &1970s-1980s & Independence
LPolfree	3	1948	1974	1988	WW2 &1970s-1980s & Independence
LJI	3	1945	1976	1989	WW2 &1970s-1980s & Independence
Inst	3	1939	1969	1989	WW2 &1970s-1980s & Independence

Note: For the Zivot-Andrews unit root test ***denotes a 1% level of significance

Table 4 ARDL estimation of long-run relationship for Namibia

Dependent Variable	Lag Order	F-statistics	Probability	Interpretation
F_{Kt} (Kt|Prop,Polfree, JI, UC, Inst,Yt)	2	4.753	0.0003	Possible Outcome variable
F_{prop} (Prop|Kt,Polfree, JI, UC, Inst,Yt)	2	0.710	0.663	Forcing variable
$F_{polfree}$ (Polfree |Prop,Kt, JI, UC, Inst,Yt)	2	1.844	0.0975	Forcing variable
F_{Yt} (Yt |Prop,Polfree, JI, Kt ,UC, Inst)	2	4.488	0.0005	Possible Outcome variable
F_{UC} (UC|Prop,Polfree, JI, Kt , Inst,Yt)	2	2.0968	0.0895	Forcing variable
F_{JI} (JI|Prop,Polfree, Kt, UC, Inst,Yt)	2	1.4944	0.1890	Forcing variable
F_{Inst} (Inst|Prop,Polfree, Kt ,JI, UC, Yt)	2	5.1550	0.0002	Possible Outcome variable
Narayan (2005)	**Table CI(iii) Unrestricted intercept and no trend K=7**			
Critical Values	**Lower bounds I(0)**		**Upper bounds I(1)**	
At 5%	2.476		3.746	

Table 5 Johansen test for multiple-co-integrating vectors

Test statistics							
Ho	**Alternative**	**Trace**	**5% Critical Value**	**Prob.****	**Max.Eigen**	**5% Critical Value**	**Prob.****
r = 0*	r=1	195.943	125.615	0.0000	62.566	46.231	0.0005
r<=1*	r= 2	133.378	95.754	0.0000	48.800	40.078	0.0041
r<=2*	r=3	84.577	69.819	0.0021	44.193	33.877	0.0021
r<=3	r=4	40.384	47.856	0.2090	24.078	27.584	0.1320
r<=4	r=5	16.306	29.797	0.6906	10.817	21.132	0.6655

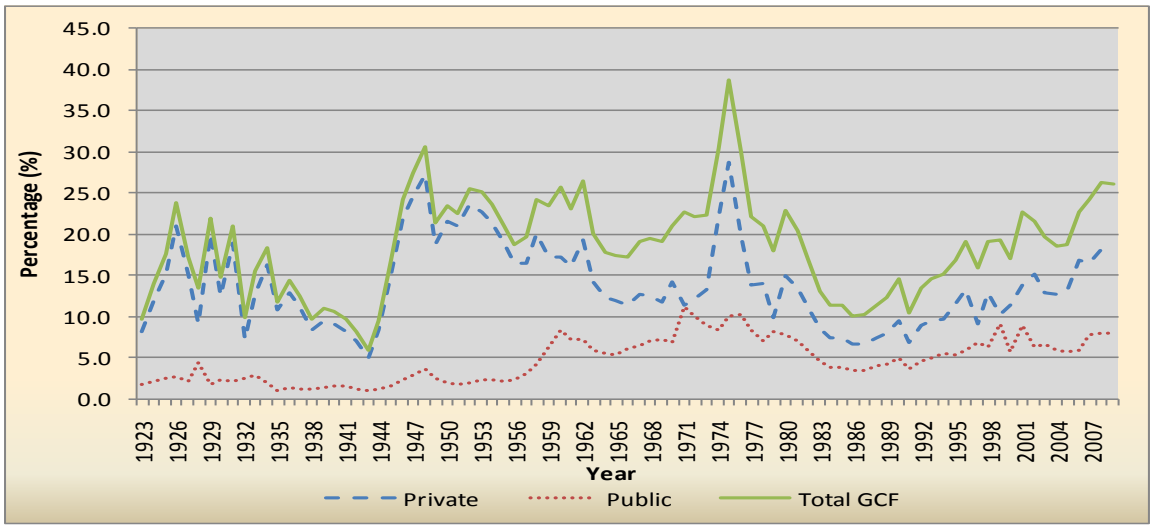
Table 6 Normalised cointegration coefficients for Namibia

	(a) Just identified			**(b) Over-identified**		
(i) Long-run Vector Error Correction Estimates						
Cointegrating Eq	**Lkt**	**LYt**	**Pol Inst**	**Lkt**	**LYt**	**Pol Inst**
LKt	1.000	-8.569 (-12.95)	0.000	1.000	-4.62 (-13.7)	0.000
LYt	-0.667 (-6.14)	1.000	-2.604 (-4.97)	-0.652 (5.79)	1.000	-1.70 (-3.57)
Inst	0.071 (1.652)	0.953 (5.857)	1.000	0.07 (1.66)	0.48 (6.13)	1.000
LProp	4.82 (7.95)	-2.454 (0.828)	3.479 (1.37)	5.02 (8.01)	0.000	6.58 (4.23)
LPolfree	0.000	0.000	2.765 (3.84)	0.000	0.000	3.02 (4.6)
UCt	0.111 (7.47)	0.000	0.000	0.114 (7.45)	0.000	0.000
LJI	0.000	-26.72 (-12.62)	-12.46 (-6.37)	0.000	-13.06	-10.3 (-6.3)
Trend	-0.05 (-7.485)	0.44 (8.92)	0.10 (3.16)	-0.06 (-7.53)	0.20 (8.8)	0.03 (1.32)
LR Test of restrictions				$X^2(1) = 0.263[0.608]$ Accepts restriction		
(ii) Short-run Vector Error Correction Estimates						
Dummies						
WW2DU	-0.03 (-2.42)	0.09 (1.17)	-0.141 (-0.29)	-0.03 (-2.3)	0.07 (0.91)	-0.01 (-0.01)
DU1970	0.00 (0.171)	-0.11 (-1.67)	1.53 (3.66)	-0.00 (-0.101)	-0.01 (-1.298)	1.46 (3.74)
DU1990	0.06 (2.09)	-0.05 (-0.31)	-2.22 (-2.05)	0.06 (2.14)	-0.06 (-0.35)	-2.17 (-2.06)

Notes: figures in round brackets are t-statistics

Figures – Namibia

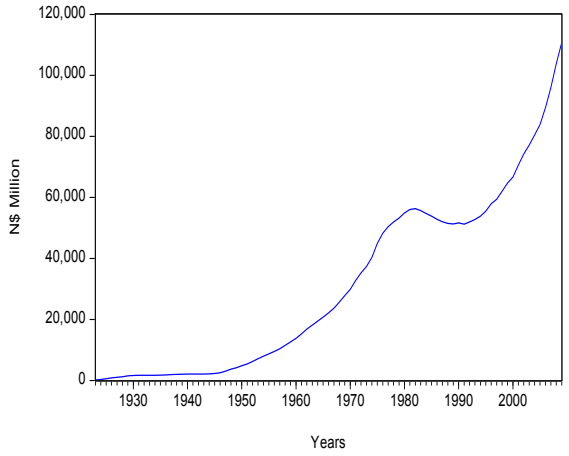
Figure 1 Composition of gross capital formation in Namibia (As % of GDP)



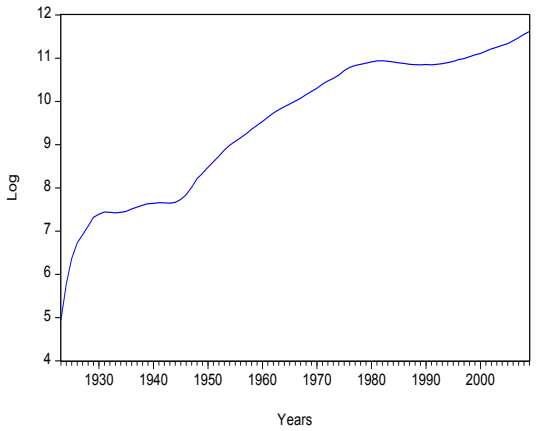
Source: South West Africa/Namibia (1988), Statistical Economic Review

Figure 2: Time-series plots of variables for Namibia

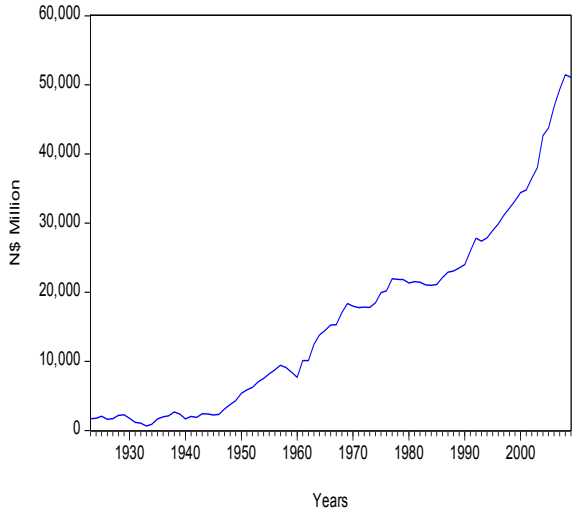
(a) Capital Stock (Kt)



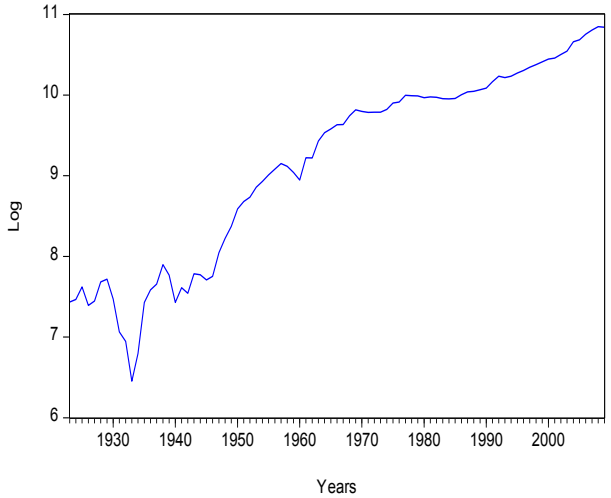
(b) Log of Capital Stock (LKt)



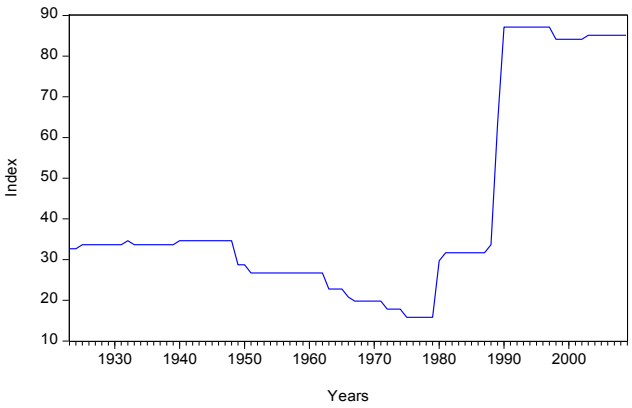
(c) Real GDP (RGDP)



(d) Log of Real GDP (LRGDP)



(e) Political Freedom Index (Polfree)



(f) Political Instability Index (Inst)

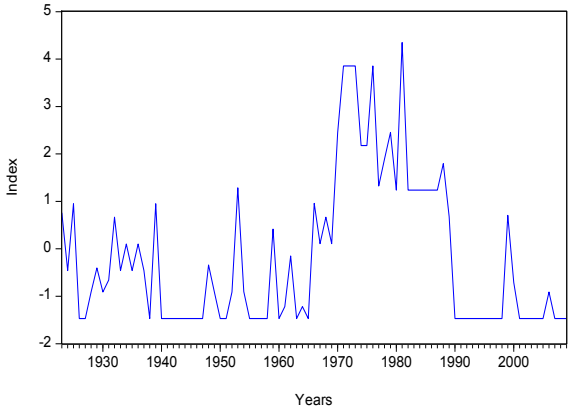
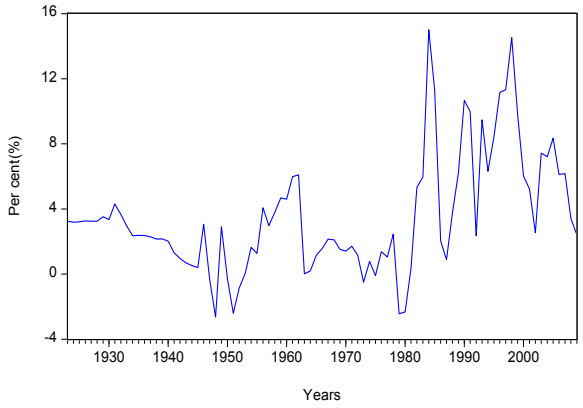
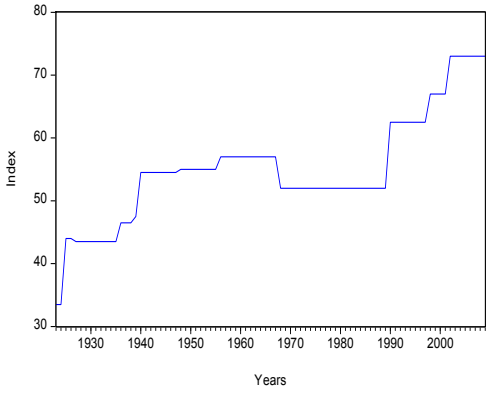


Figure 2 Time-series plots of variables for Namibia (continued)

(g) User Cost of Capital (UCt)



(h) Property Rights Index (Prop)



(i) Independence of Judiciary Index (JI de jure)

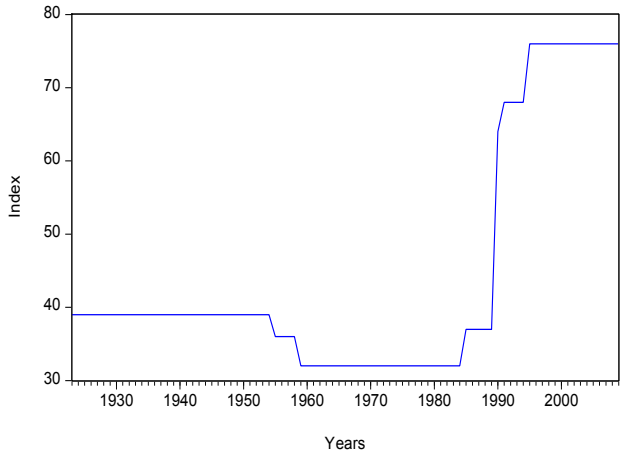


Figure 5 Persistence profiles of CV's to system-wide shock: over-id model for Namibia

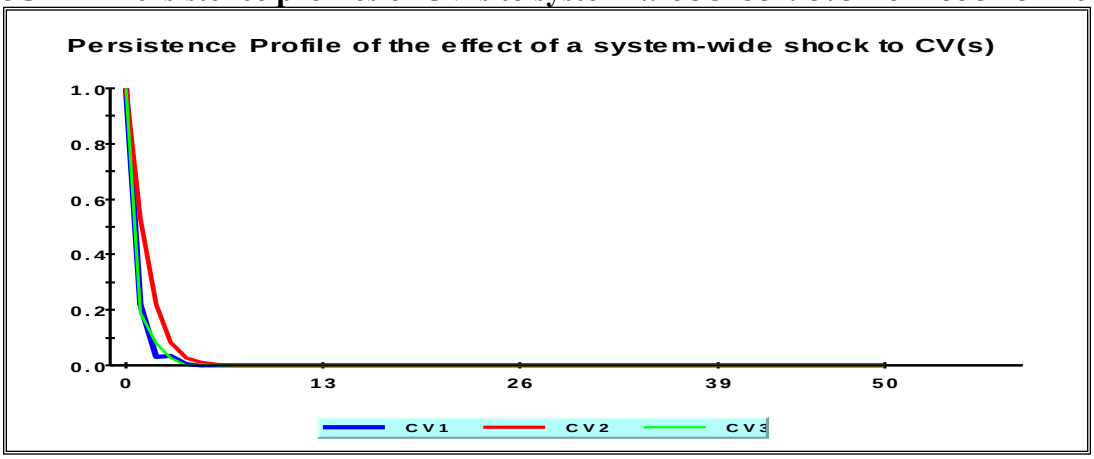


Figure 6 Impulse responses of CV's to shock in the equation of LKt: over-id model

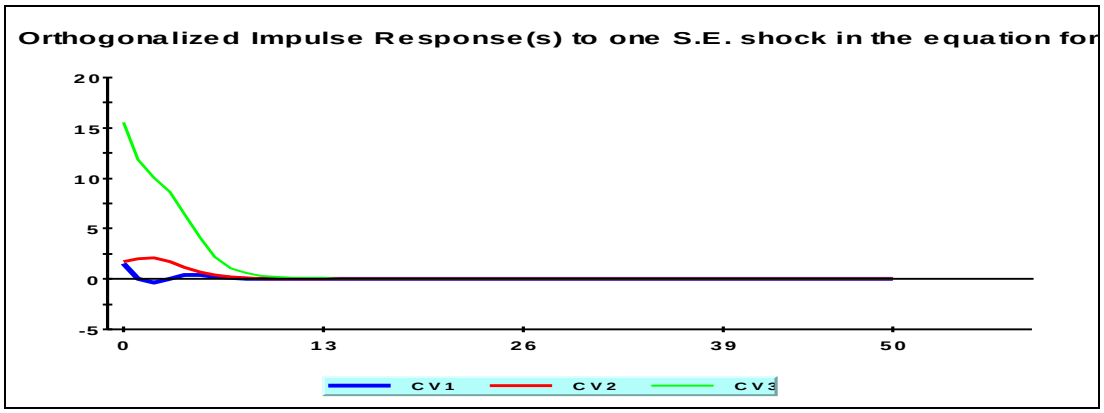


Figure 7 Impulse responses of CV's to shock in the equation for LRGD: over-id model

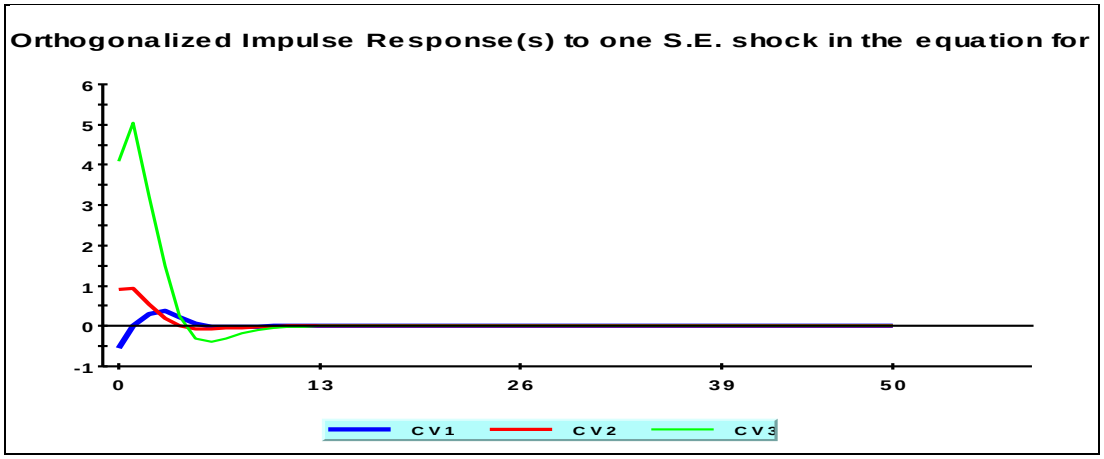
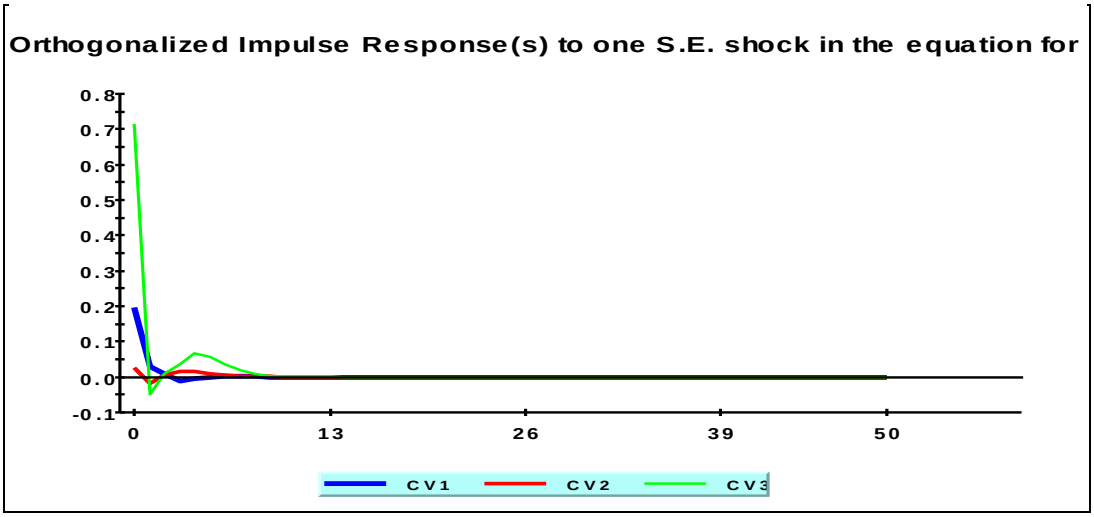


Figure 8 Impulse Responses of CV's to shock in the equation for Inst: over-id model



Tables – Tanzania

Table 7 ADF and PP unit root test for Tanzania

Variable	ADF Statistics		PP Statistics		I(d)
	Levels	1st Differences	Levels	1st Differences	
LK_t	-0.66	-16.86***	-2.89	-5.07***	I(1)
LYt	0.46	-2.02	1.98	-9.91***	I(1)
Uct	-2.09	-9.68***	-2.64	-10.73***	I(1)
Inst	-0.98	-6.86***	-1.02	-7.12	I(1) & I(1)
LProp	-1.13	-7.75***	-1.13	-7.75***	I(1)
LJI	-1.84	-9.06***	1.73	-9.06***	I(1)
LPolfree	-1.55	-7.53***	-1.65	-7.53***	I(1)

Notes: All variables are significant at 1% critical values denoted by ***

Table 8 Zivot-Andrews unit root tests and Bai-Perron breakpoint test

Zivot-Andrews Unit Root Tests					
Variable	**Levels**	**First Differences**	**Order of Integration**	**Chosen break**	
	Intercept	Intercept	I(d)		
LK_t	-3.97	-9.12	I(1)	1972	
LYt	-0.89	-9.96	I(1)	1977	
Uct	-5.07	-10.04	I(1)	1985	
Inst	-4.09	-7.93	I(1)	1970	
LProp	-4.54	-8.29	I(1)	1973	
LJI	-5.27	-9.65	I(1)	1965	
LPolfree	-3.47	-8.17	I(1)	1965	
Bai-Perron breakpoint test					
	No of breaks	**Year**	**Year**	**Year**	**Year**
LK_t	2	1954	1975		
LY_t	3	1954	1979	1999	
Uc_t	3	1965	1979	2000	
Inst	1		1972		
LProp	3	1962	1972	1983	
LJI	4	1960	1974	1985	1999
LPolfree	4	1954	1964	1978	1991

Zivot-Andrews unit root test ***denotes a 1% level of significance.

Table 9 ARDL estimation of long-run relationship

Dependent Variable	Lag Order	F-statistics	Probability	Interpretation
F_{Kt} (Kt|Prop,Polfree, JI, UC, Inst,Yt)	2	3.85	0.004	Possible Outcome variable
F_{prop} (Prop|Kt,Polfree, JI, UC, Inst,Yt)	2	0.48	0.837	Forcing variable
$F_{polfree}$ (Polfree |Prop,Kt, JI, UC, Inst,Yt)	2	2.70	0.02	Forcing variable
F_{Yt} (Yt |Prop,Polfree, JI, Kt ,UC, Inst)	2	4.45		Possible Outcome variable
F_{UC} (UC|Prop,Polfree, JI, Kt , Inst,Yt)	2	1.99	0.008	Forcing variable
F_{JI} (JI|Prop,Polfree, Kt, UC, Inst,Yt)	2	6.57	0.000	Possible Outcome variable
F_{Inst} (Inst|Prop,Polfree, Kt ,JI, UC, Yt)	2	2.00	0.087	Forcing variable
Narayan(2005)	**Table CI(iii) Unrestricted intercept and no trend k =7**			
Critical Values	**Lower bounds I(0)**		**Upper bounds I(1)**	
At 5%	2.513		3.823	

Table 10 Johansen test for multiple co-integrating vectors for Tanzania

Test statistics							
Ho	**Alternative**	**Trace**	**5% Critical Value**	**Prob.**	**Max.Eigen**	**5% Critical Value**	**Prob.**
r = 0*	r=1	173.52	125.61	0.000	65.43	46.23	0.000
r<=1*	r= 2	107.09	95.75	0.005	36.28	40.07	0.126
r<=2*	r=3	71.81	69.81	0.034	24.88	33.87	0.392
r<=3	r=4	46.92	47.85	0.061	21.55	27.58	0.244
r<=4	r=5	25.37	29.79	0.148	17.12	21.13	0.166

Notes: * denotes rejection of the null hypothesis at the 0.05 level

Table 11 Normalised cointegration coefficients for Tanzania

	(c) Just identified			**(d) Over-identified**		
(i) Long-run Vector Error Correction Estimates						
Cointegrating Eq	**LKt**	**LYt**	**LJI**	**LKt**	**LYt**	**LJI**
LKt	1.000	-0.562 (-25.8)	0.000	1.000	-0.573 (-10.1)	0.000
LYt	-1.771 (-18.5)	1.000	-0.01 (-0.132)	-1.021 (-7.62)	1.000	-0.029 (-1.15)
Inst	-0.55 (-5.85)	0.28 (5.81)	0.01 (0.65)	0.000	0.290 (5.15)	0.000
LProp	0.38 (3.71)	0.23 (4.14)	-0.251 (-9.32)	-0.25 (-1.87)	0.000	-0.208 (-7.11)
LPolfree	0.000	0.000	-0.08 (-5.18)	0.000	0.000	-0.136 (-2.283)
UCt	0.01 (3.22)	0.000	0.000	0.01 (1.786)	0.000	0.000
LJI	0.000	-1.569 (-34.0)	1.000	0.000	-0.712 (-3.83)	1.000
C	4.58	1.68	-2.48	0.95	-0.62	-2.26
LR Test of restrictions				$X^2(1) = 0.567[0.143]$ Accepts restriction		
(ii) Short-run Vector Error Correction Estimates						
Dummies						
DU1961	0.001 (1.12)	0.02 (0.36)	0.186 (5.89)	0.01 (1.33)	0.01 (0.26)	0.174 (5.46)
DU1967	-.001 (-0.08)	0.03 (0.05)	0.23 (6.42)	0.03 (1.45)	0.08 (0.95)	0.22 (4.48)
DU1986	0.01 (0.77)	0.01 (0.22)	0.19 (5.65)	0.05 (2.45)	0.14 (1.51)	0.183 (3.59)

Notes: figures in round brackets are t-statistics

Figures: Tanzania

Figure 2 Gross capital formation in Tanzania

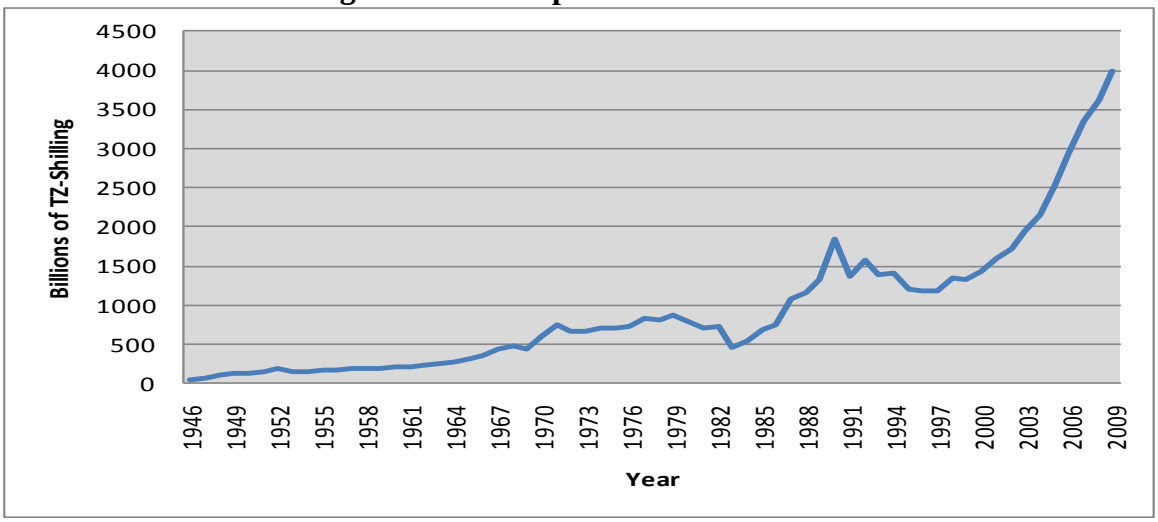
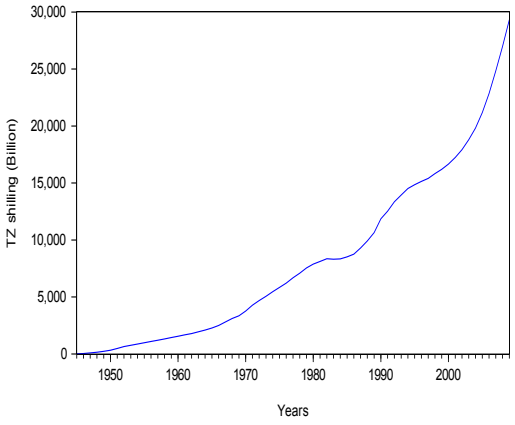
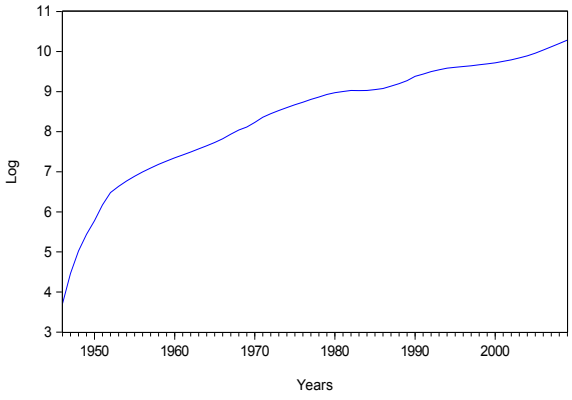


Figure 4 Time-series plots of variables for Tanzania

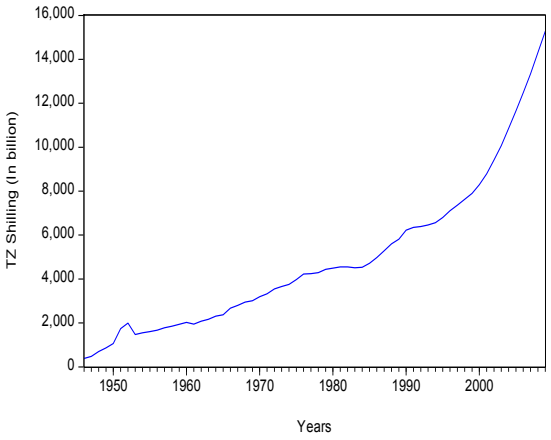
(a) Capital Stock (Kt)



(b) Log of Capital Stock (LKt)



(c) Real GDP (RGDP)



(d) Log of Real GDP (LRGDP)

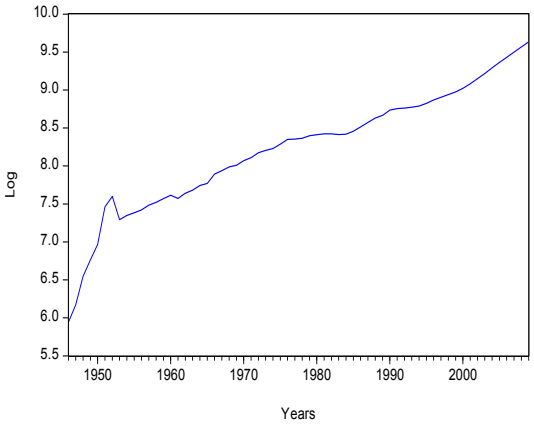
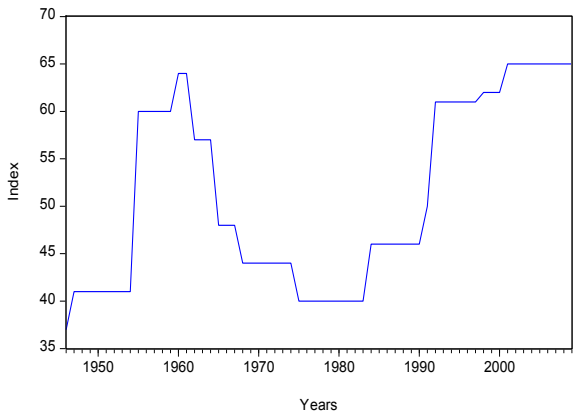
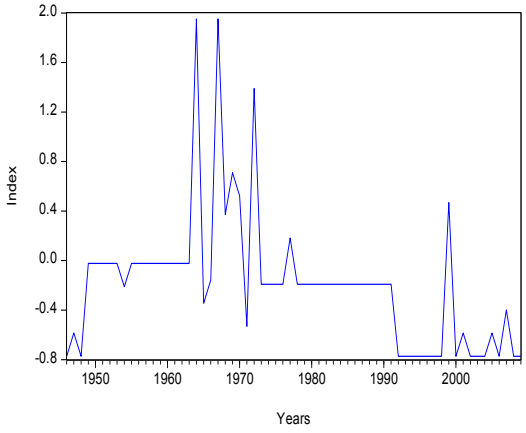


Figure 4 Time-series plots of variables for Tanzania (continued)

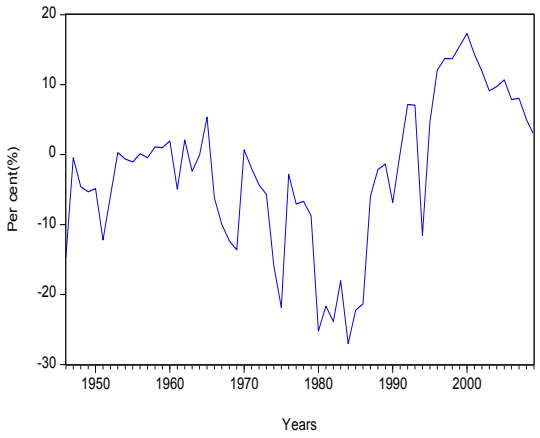
(e) Political Freedom Index (Polfree)



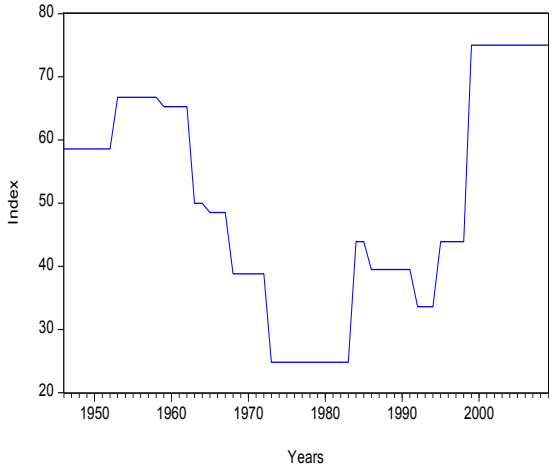
(f) Political Instability Index (Inst)



(g) User Cost of Capital (UCt)



(h) Property Rights Index (Prop)



(i) Independence of Judiciary Index (JI de jure)

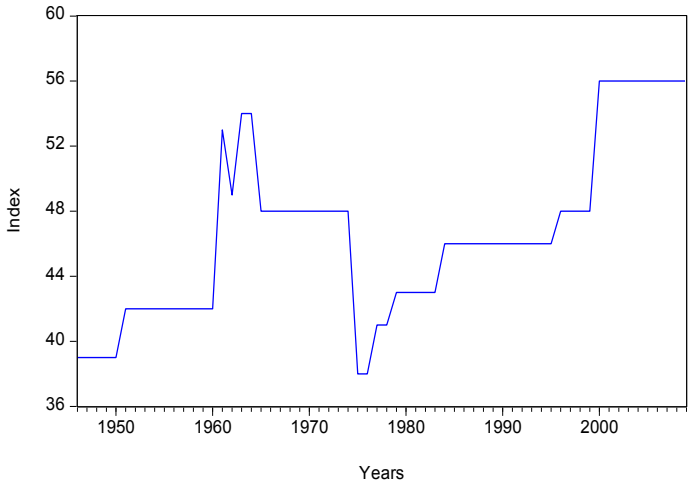


Figure 9 Persistence profiles of CVs to system –wide shock: over-id model for Tanzania

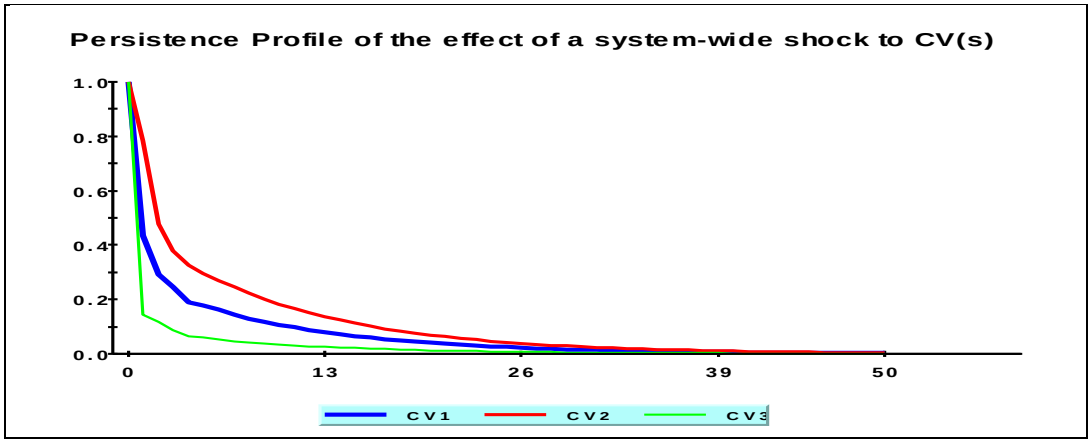


Figure 10 Impulse responses of CVs to shock in the equation for LKt: over- id model

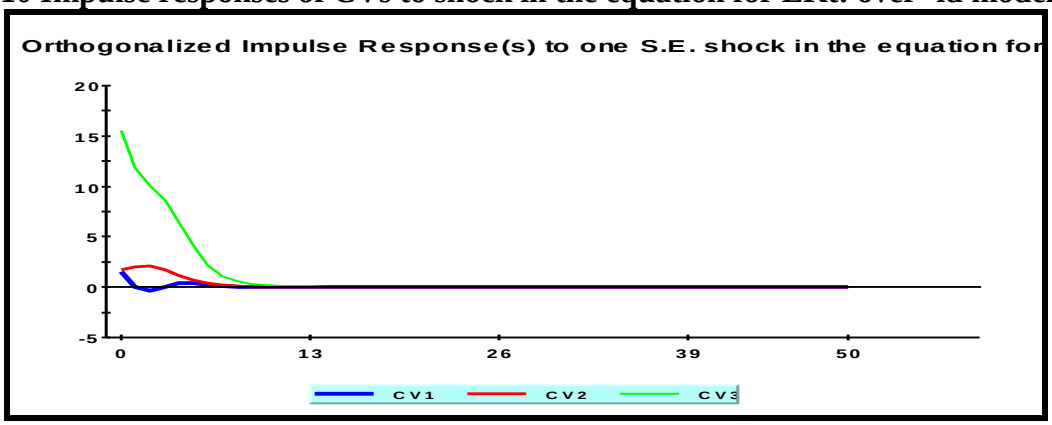


Figure 11 Impulse Responses of CVs to shock in the equation for output: over- id model

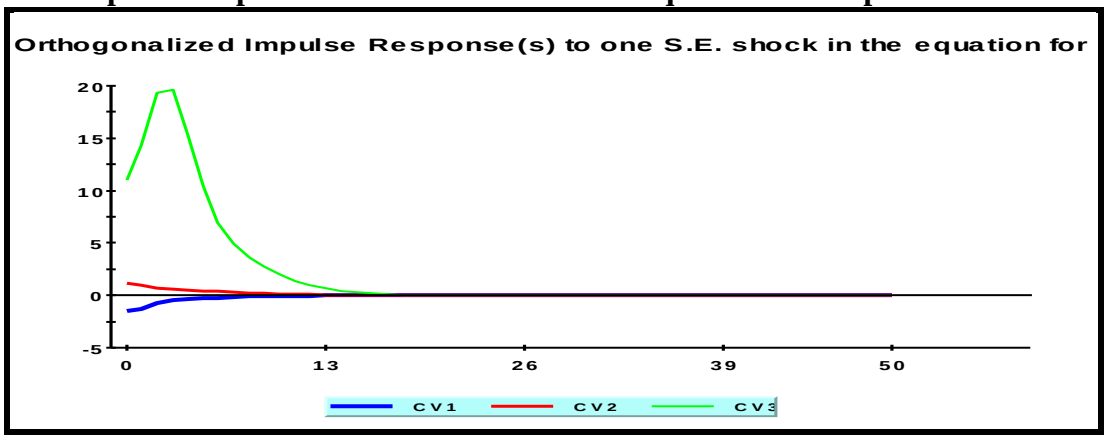


Figure 12 Impulse Responses of CV's to shock in the equation for LJI: over-id model