Asymmetric co-integration and causality effects between financial development and economic growth in South Africa

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ASYMMETRIC COINTERGATION AND CAUSALITY EFFECTS BETWEEN FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH IN SOUTH AFRICA

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ABSTRACT: This paper investigates asymmetric cointegration and causality effects between financial development and economic growth for South African data spanning over the period of 1992 to 2013. To this end, we make use of the momentum threshold autoregressive (MTAR) approach which allows for threshold error correction (TEC) modelling and granger causality analysis between the variables. In carrying out our empirical analysis, we employ six measures of the financial development variables against gross domestic per capita, that is, three measures which proxy banking activity and another three proxies for stock market development. The empirical results generally indicate an abrupt asymmetric cointegration relationship between banking activity and economic growth, on one hand, and a smooth cointegration relationship between stock market activity and economic growth, on the other hand. Moreover, causality analysis generally reveals that while banking activity tends to granger causes economic growth, stock market activity is, however, caused by economic growth increase.

Keywords: Financial development, Economic growth, Threshold cointegration, Asymmetric causality, Emerging economy, South Africa.

JEL Classification code: C32, E51, E58, G21, G23, G28.

1 INTRODUCTION

The relationship between financial development and economic growth has attracted a considerable amount of attention by academics and policymakers alike, after the pioneering empirical work by Schumpeter (1912) placed emphasis on the positive contribution of financial intermediation towards economic growth. According to Levine (1997), the Schumpeterian view of a financial system plays five important roles in influencing positive economic growth levels, namely; mobilising savings; allocating resources; monitoring managers and expert corporate control; facilitating the trading, hedging, diversifying and pooling of risk; as well as facilitating the exchange of goods and services. In particular, greater access to financial services for the economy, especially for small and medium-sized enterprises and lower-income households, improves their ability to invest (Akinboade and Kinfack, 2013). In this regard, the central role of capital and financial markets is information-gathering, with a particular focus in assessing which investments are most likely to yield the highest returns and monitoring to ensure that these investment funds are used in an appropriate manner (Stiglitz, 2000). Therefore, the financial sector is considered an important mechanism in transferring deposits to financial assets and channelling funds from surplus units to deficits and, as a consequence, facilitates the creation of wealth trade and the formation of capital (Eita and Jordan, 2010).

The predominant view presented in the literature depicts financial development as exerting a positive influence on economic growth for both industrialized economies (Levine (1997, 2002, 2005); Leahy et. al. (2001); Rousseau (2003); Rousseau and Sylla (2005)) as well as in emerging economies (Khan and Senhadji (2003); Eita and Jordan (2007); Akinlo and Egbetunde (2010); Acaravci et. al. (2009) and Odiahmbo (2004, 2005, 2011)). On the other hand, a considerable number of studies oppose this contention by arguing that the restrictions imposed by government on the financial sector could cause problems in the development of the financial sector and as a consequence, this inhibits growth in the real sector (Lucas (1998), Fry (1978, 1980); Galbis (1977); Boyreau-Debray (2003) and Akinlo (2004)). As a means of reconciling the aforementioned opposing views regarding the relationship between financial development and economic growth, a new wave of studies in the empirical paradigm have recently put into question the validity of a linear relationship between financial development and economic growth (Diedda and Fattouh (2002); Khan and Senhadji (2003); Lee and Wong (2001); Chiou-Wei et. al. (2010) and Jude (2010)). The notion of asymmetries existing in the relationship between financial development and economic growth can be traced to a number of fundamental theoretical underpinnings. Take for example, the endogenous growth models presented by Huybens and Smith (1999) as well as Bose (2002) which depict that equity markets and bank lending activity are highly correlated through internal project finance and therefore exerts a significant influence on economic activity at high levels of capital accumulation. However, at low levels of capital accumulation, little or no financial activity transpires and the relevance of bank lending activity to equity market decreases thus exerting no positive influence on productivity levels. From an econometric perspective, these theoretical underpinnings can be accounted for as an asymmetric transition in the cointegration relationship between financial development and economic growth.

And even beyond the notion of asymmetric cointegration, a more pressing issue in the literature concerns the causal relationship established between the two variables, of which not properly accounted for, could lead to misleading policy implications. As highlighted by Akinlo and Egbtunde (2010), four possible causal relationships can be identified between financial development and economic growth, namely; finance-led growth; growth driven finance; two way causal relationship and no causality effects. Under the finance-led-growth hypothesis, causality is assumed to run from financial development to economic growth and in this instance, improvements in financial development result in improved economic growth levels and yet direct improvements in productivity levels do not affect financial development. This "supply-leading view" postulates that productivity levels can be increased by either an improvement in the efficiency of capital accumulation or an increase in the rate of savings or investment (Eita and Jordaan, 2010). In the second type of causal relation (i.e. growth driven finance) direct improvements in economic growth which result in higher development of financial system whilst direct improvements in financial development do not affect economic growth. This "demand-leading view" postulates that economic growth creates various types of financial services to which the financial system responds (Chakraborty, 2010). In the third case of causality, commonly referred to as feedback causality, improvements in either financial development or economic growth will exert a positive influence on the counter variable. Under such a circumstance, economic development can be best achieved when macroeconomic policies are designated towards simultaneously influencing both financial depth and real sector development. And finally, there can also exist a case in which there can be no causality found to exist between financial development and economic growth, and implications under such a scenario are that policymakers can only affect financial development and economic through separate policies.

By taking into consideration the above presented arguments, our paper makes a novel contribution to the empirical literature by addressing the issue of cointegration asymmetry and causality effects under a singular comprehensive framework. In particular, our paper employs the cointegration momentum threshold autoregressive (M-TAR) model of Enders and Granger (2001) and we further augment this framework into a momentum threshold vector error correction (M-TVEC) to also facilitate for causality analysis in the Granger (1969) sense. On a broad level of contribution to the academic paradigm, our study fills an existing hiatus in the empirical literature by simultaneously conducting formal causality tests and error correction modelling from an asymmetric perspective, which, to the best of our knowledge, has not been previously addressed in the literature. As a by-product, the approach adopted in our study presents a deviation from the norm of previous studies conducted for the South African economy which rest on the assumption of a linear relationship existing between financial development and economic growth (see Odhiambo (2004), Gondo (2009); Acaravci et. al. (2009) and Sunde (2012) for illustrative examples). As conveniently argued by Chiou-Wei et. al. (2010), such an assumption of linear cointegration may be restrictive in capturing multiple equilibriums induced by reciprocal externalities between the financial and real sectors.

Against this backdrop, we present the remainder of our paper as follows. The following section presents a review of a selected portion of the available empirical literature. Section 3 of the paper provides a review of the proxies used to represent financial development whereas section 4 outlines the empirical framework of the paper. We conduct our empirical analysis in section 5 and interpret the results obtained thereof in chapter 5. We then conclude the paper in section 6 by drawing relevant policy implications associated with our obtained empirical results.

2 *REVIEW OF SELECTED LITERATURE*

The investigation into the effects of financial development on economic growth has exclusively evolved into an econometrical phenomenon with the methodological advancements made in the empirical literature accounting for a significant portion of the developments found in the academic paradigm. In the earlier empirical literature, reliance on linear cointegration analysis, such as the Johansen (1991) cointegration technique, the vector autoregressive (VAR) approach and vector error correction models (VECMs) sufficed for providing evidence on the correlation between financial development and economic growth. In this regard, an illustrative list of studies can be identified in the literature employing linear cointegration techniques, with the works of McKinnon (1973) and Shaw (1973) paving a way for other empirical investigations such as those presented by Jung (1986); King and Levine (1993); De Gregorio and Guidotti (1995); Demetriades and Hussein (1996); Odedokun (1996) and Rousseau and Wachtel (1998) amoungst a plethora of other earlier empirical papers. However, it is worth noting that the empirical results obtained from these earlier studies provided a variety of conflicting empirical evidences, hence warranting further research on the subject matter. In this regard, the literature provides a number of reasons as to account for the earlier conflicting evidence, which range from the period span of the data employed (Khan and Senhadji, 2003), to differences in cross-sectional data that treat different economies as homogenous entities (Loayza and Ranciere, 2006) as well as differing mechanics existing between or linking financial development and economic growth (Benhabib and Spiegel, 2000).

As previously mentioned, a new strand of empirical literature has emerged with the intention to reconcile previous empirical irregularities by incorporating asymmetric behaviour into the design of empirical frameworks investigating the effects of financial development on economic growth. Initial detection of asymmetries in the finance-growth relations can be traced back to the studies of Boyd et. al. (1996) and Rousseau and Wachtel (2002). In their seminal paper, Boyd et. al. (1996) find that as inflation increases, the relationship between inflation, the volume of financial market activity and economic growth flattens out. By using piecewise linear regressions which are segregated by a predetermined critical inflation rate of 15 percent, the authors establish that below this "critical level of inflation", inflation and financial market performance are positively and strongly correlated, whereas above this critical level, the relationship between these two variables dampens and may even be insignificant. On the other hand, Rousseau and Wachtel (2002) employ a series of rolling panel regressions to show that there exists an inflation threshold for the finance-growth relationship that lies between 13 and 25 percent, of which in high inflation regimes finance is negatively related with growth, whereas this relationship turns positive at low levels of inflation. The overall implication drawn from the study of Rousseau and Wachtel (2002) is that the level of financial depth varies inversely with inflation in low-inflation environments and that disinflation at all levels of inflation is associated with a positive effect of financial depth on economic growth. In appreciation to the contribution made to the literature, the aforementioned studies were able to provide substantial evidence that the co-relationship between financial development and economic growth was not monotonic but rather evolves asymmetrically in what is more popularly referred to as a "U-shaped relationship”. One notable shortcoming associated with these aforementioned studies is that the threshold levels are selected by judgement rather than through a formal empirical search which renders it difficult to determine an inflexion or optimal point at which the co-relationship between financial development and economic growth switches.

More recent developments in econometric modelling of time series variables has allowed for research academics to more adequately model the finance-growth relationship according to varying regimes segregated by a unique threshold. Essentially, these nonlinear econometric models assume that the relationship between financial development and economic growth can be best captured by different regimes which are segregated by a threshold variable which is estimated for a unique threshold level. For instance, Diedda and Fattouh (2002) use the threshold autoregressive (TAR) model specification, a la Hansen (2000), to distinguish the finance-growth relationship between a panel data set of 119 developing and industrialized economies as previously used in the study of King and Levine (1993). By using the initial income per capita as the threshold variable, the authors are able to establish a strong positive relationship between financial development and economic growth in high income economies whereas for low income countries this relationship becomes non-existent. Consequentially, these findings discard the notion of financial development being associated with economic growth at all levels of economic development. Other researchers who have followed in pursuit of Diedda and Fattouh (2002) include Lee and Wong (2005) who extend the TAR framework to identify asymmetries in the finance-growth relationship for the Taiwanese and Japanese economies. In differing from Diedda and Fattouh (2002), the authors ascertain that finance-growth relationship is best modelled as a three-regime TAR process. In particular, the authors establish that for Taiwanese data financial development and economic growth are significantly correlated below a 7 percent threshold level, whereas above this level, the relationship turns weakly insignificant. On the other hand, they find that the finance-growth relationship for Japanese data is strongest between the estimated 2.5 and 9 percent inflation threshold levels and turns insignificant negative at levels above 9 percent. However, the overall use of the TAR model in the analysis of time series variables has come under severe criticism based upon its abrupt regime switching mechanism between regime coefficients. On the forefront of these criticisms is that a smooth rather an abrupt transition may be more realistic to describe nonlinear behaviour between financial development and economic growth. Henceforth, as argued by Omay and Hasanov (2010) amoungst others, the carrying out of the transition between economic regimes in smooth manner ensures coherency with the stylized fact that economic agents within the macroeconomy do not behave simultaneously and in the same direction.

The above criticisms of the TAR model paved way for the next development advanced in the empirical literature, which saw researchers turn to the use of smooth transition regression (STR) model of Terasvirta (1994). Apart from ensuring a smooth transition between the regime coefficients, the STR framework provides an additional advantage of allowing the econometrician to determine which variable is responsible for the switching behaviour between the model regime coefficients. Take for example, Mehrara et. al. (2012) who investigate the nonlinear effects of financial development on economic growth for Iran using a smooth transition regression (STR) and find that the nonlinear dynamics governing the relationship is facilitated by the inflation rate. In particular, the authors find that in the low-inflation regimes, defined by inflation rates below 10.4 percent, the effects of financial development on economic growth are positive whereas this relationship turns negative at inflation rates exceeding the threshold level. Similarly, Jude (2010) investigates the linkage between financial development and economic growth using a panel STR model for 71 developing and developed economies. The author establishes that the nonlinearity existing in the finance-growth relationship can be attributed to a number of factors inclusive of the inflation rate, government expenditure, degree of openness to trade and financial development. In other words, this result implies that the asymmetric relationship between financial development and economic growth can be affected by both financial and economic development factors. Another study worth taking note of is that presented by Chiou-Wei et. al. (2010) who opt to use a smooth transition error correction model (STECM) framework to investigate the relationship between financial development and economic growth for South Korean data. The obtained empirical results reveal that whilst there may be a positive long-run relationship between financial development and economic growth, the authors take caution in interpreting these results, as the short run effects of financial development on economic growth prove to be negative.

And even with these empirical advances made in the methodological literature, these frameworks, however, do not account for causality effects under their asymmetric frameworks and, at best, opt to investigate causality effects separately under linear frameworks. As pointed out by Samargandi et. al. (2013), current empirical frameworks investigating the asymmetric behaviour in the finance-growth co-relation rely on a wide range/variety of cross-section techniques which do not allow for comprehensive testing of causality effects amongst the observed data. Of recent, a number of empirical works have opted to use the momentum threshold autoregressive (M-TAR) model of Enders and Granger (1998) and Enders and Granger (2001) to investigate asymmetric behaviour between time series variables and this framework provides the advantage of facilitating for both cointegration and causality analysis in the asymmetric sense (see Frey and Manera (2005) for a review of studies employing the MTAR cointegration technique). And yet it should be noted that a limiting factor of the MTAR framework is that it does not currently allow for the modelling of multivariate cointegration relations but is rather confined to the bivariate analysis. Fortunately, the focus of our paper is not in modelling the various multivariate mechanisms existing between financial development and economic growth but rather our paper seeks to exclusively determine cointegration and causality effects between the two time series variables in an asymmetric sense. Such a bivariate investigation between various measures of financial development and economic growth has been previously undertaken for South African case studies (see Odhiambo (2004); Gondo (2009); Acaravci et. al. (2009) and Eita and Jordan (2010)), even though the aforementioned studies restrict their analysis to linear cointegration frameworks. Our paper therefore extends this previous empirical work by directly modelling asymmetric effects into the cointegration framework.

3 MEASURING THE FINANCIAL DEVELOPMENT VARIABLE

Apart from deciding upon an appropriate choice of econometric model, another crucial consideration faced by empirical economists concerns the choice of variable used to proxy different aspects of the financial system. From a theoretical perspective, the literature indicates that financial development can affect economic growth either through the banking sector channel (i.e. bank-based system) or via capital markets (i.e. market-based system). Proponents of the bank-based system put forth claims that in comparison to capital markets, the banking sector is more efficient at mobilizing savings, identifying good investments and exerting sound corporate control, particularly during the early stages of economic development and weak institutional environments (Levine, 2002). On the other end of the spectrum, proponents of the market-based systems argue that capital markets are more efficient at enhancing risk management, information dissemination, corporate control and capital allocation (Levine and Zervos, 1998). Furthermore, efficient capital markets provide guidelines as a means to keep appropriate monetary policy through the issuance and repurchase of government securities in the liquid market and could modify the money demand pattern, thus creating liquidity that would eventually enhance economic growth (Caporale et. al., 2004). Therefore, in screening through financial development proxies, it would be ideal to obtain detailed information that enables researchers to access how the financial system fulfils it roles either through the banking systems or through capital markets (Ndikumana, 2001). Generally, researchers tend to rely on money and credit variables in proxing banking sector activity whereas size and liquidity measures of stock market activity are deemed as appropriate proxies for stock/capital market development.

Initially, the empirical literature almost exclusively focused on measuring the effects of financial development on economic growth through banking sector activity. The variables used to proxy banking activity were based on the ratio of monetary aggregates to nominal gross domestic product (GDP), which in accordance with the McKinnon (1973) and Shaw (1973) framework, reveals that a high degree of monetization reflects a highly developed financial system (Choong and Chen, 2011). However, the use of these monetary aggregates came under severe criticism since these measures reflect the ability of the financial system to provide transactions services rather than reflecting the ability to channel funds from savers to borrowers. Furthermore, these variables were also seen as an inappropriate measure in evaluating the functioning efficiency of financial systems seeing that these proxies concentrate on the size, as opposed to direct activity within financial systems (Pietrovito, 2012). In other words, most economies with underdeveloped financial systems may reflect a high ratio of aggregate money to GDP since money may be used more as a store of value in the absence of other more attractive alternatives (Khan and Senhadji, 2003). Such criticisms ultimately drove academics into introducing measures of private credit to the private sector as a preferred alternative measure of financial depth. This was seen as an improvement over the traditional financial depth ratios, in the sense that this measure of financial depth solely accounts for credit granted by deposit money banks and other financial institutions to the private sector and discards credit issued by the Central Bank to government and other non-private institutions (Favara, 2003). This alternative proxy of financial depth, therefore, provides a more accurate measure of the role played by financial intermediaries in channelling funds to the private sector for more effective productivity usage.

Up until recent, researchers have been adamant in empirically modelling developments in the financial sector strictly through banking activity since several monetary economists view capital markets in developing economies as 'burgeoning casinos' which exert very little effect on economic growth. However the efficiency of capital markets in contributing towards economic development cannot be taken for granted, especially if stock market development is complimentary to banking activity in promoting long-run economic growth, as Odhiambo (2013) has, for example, established for the case of South African financial intermediaries. Although theory does not provide us with clear-cut guidelines for identifying a specific indicator of stock market development, it does, however, suggest that stock market development, as a multi-dimensional concept, is indeed influenced by stock market size, liquidity and risk diversification (Demirgic-Kunt and Levine, 1996). For instance, Levine (1991) builds a theoretical model which shows that by reducing liquidity costs, and increasing the average productivity of capital and the rate of savings, the liquidity and size of stock markets can foster higher economic growth through capital accumulation. Similarly, Holmstrom and Tirole (1993) demonstrate on how liquid stock markets can increase incentives to acquire information about firms and improve corporate governance, which in turn promotes efficient resource allocation and productivity. Moreover, Greenwood and Smith (1997) use an endogenous growth model to demonstrate how large, liquid and efficient stock markets can ease resource mobilization, by agglomerating savings as a means of enlarging the set of feasible investment projects, which boosts productivity efficiency and hence improves long-run economic growth.

Deriving from the above outlined theoretical insinuations, academics began considering a variety of time series variables which could proxy the contribution of stock market developments towards economic growth. One of the earliest proxies used for stock market development was presented by Levine (1991) who used the ratio of the stock of the total value of listed shares to economic growth as a means of measuring the size of stock markets in terms of their ability to mobilize capital and diversify risk (Hsin-Hu, 2002). Empirically, this measure is derived as a ratio of the total value of listed shares divided by economic growth and is assumed to be positively related to economic growth. Following the work of Levine (1991), Atje and Jovanovic (1993) introduced two alternative proxies as measurements for stock market development. The first of these alternative measures is the value traded ratio which is extracted as a ratio of the total value of shares traded on the stock market divided by economic growth and indicates the activity or liquidity of the stock markets (Demetriades and Hussein, 1996). This proxy is considered an important compliment to the market capitalization ratio since a large stock market may produce a high market capitalization ratio and yet have very little activity as signalled by a low value traded value ratio. Conversely, a small but active stock market would not contribute to economic growth through its size but may positively contribute to economic growth through its high activity as indicated by a high value traded ratio. The second alternative measure of stock market development presented by Atje and Jovanovic (1993) is the turnover ratio which is computed as a ratio of the value traded ratio divided by the market capitalization ratio and measures trading value relative to the size of the market. This proxy is considered a compliment measure to both the market capitalization ratio as well as the value traded value ratio since it measures the trading value relative to the size of the stock market (Levine and Zervos, 1998). So while the market capitalization ratio captures trading relative to the size of an economy, the value traded ratio and the turnover ratio measure trading relative to the size of the economy and the market, respectively.

4 EMPIRICAL FRAMEWORK

Taking the Engle Granger cointegration framework as a benchmark, we begin our empirical analysis in pursuit of Odhiambo (2004) Gondo (2009); Acaravci et. al. (2009) and Eita and Jordan (2010), who specify bivariate cointegration relations between various measures of financial development and economic growth per capita. However, a point of departure in our study is that we follow Enders and Siklos (2001) by introducing asymmetric adjustment between the observed time series variables in allowing the residual deviations from the long-run equilibrium to behave as a TAR process. Formally, our threshold cointegration regressions are specified as follows:

$$\Delta gdp = \psi_{10} + \psi_{11} fin + I_t \rho_1 \xi_{t-1} + (1 - I_t)\rho_2 \xi_{t-1} + \sum_{i=1}^{p} \beta_i \Delta\xi_{t-i} + \varepsilon_t \quad (1)$$

$$fin = \psi_{20} + \psi_{21} \Delta gdp + I_t \rho_1 \xi_{t-1} + (1 - I_t)\rho_2 \xi_{t-1} + \sum_{i=1}^{p} \beta_i \Delta\xi_{t-i} + \varepsilon_t \quad (2)$$

From the above long-run regressions Δgdp is a measure of output growth rate per capita, fin is the corresponding measure of financial development; ψ_i are the associated regression coefficients and asymmetric cointegration adjustment is capture by the different values of ρ_1 and ρ_2. The regime switching behaviour governing the threshold cointegration regressions (1) and (2) are governed by an indicator function, $I_{.t}$, which is set as

$$I_{.t} = \begin{cases} 1, if\, \xi_{t-1} \geq \tau \\ 0, if\, \xi_{t-1} < \tau \end{cases} \tag{3}$$

The TAR cointegration models, as derived by combining equation (3) with equations (4) and (5) are designed to capture potential asymmetric deep movements in the residuals if, for example, positive deviations are more prolonged than negative deviations. Enders and Granger (1998) and Caner and Hansen (2001) suggest that by permitting the Heaviside indicator function, I_t, to rely on the first differences of the residuals, $\Delta\xi_{t-1}$. A MTAR version of the residual modelled in equation (3) can hence be developed. The implication of the MTAR model is that correction mechanism dynamic since by using $\Delta\xi_{t-1}$, it is possible to access if the momentum of the series is larger in a given direction relative to the direction in the alternative direction. Given such a scenario, the MTAR model can effectively capture large and smooth changes in a series. Unlike the TAR model which shows the "depth" of the swings in equilibrium relationship, the MTAR can capture spiky adjustments in the equilibrium relationship since it permits decay in the relationship to be captured by $\Delta\xi_{t-1}$ instead of ξ_{t-1}. TAR and MTAR models allow the residuals to exhibit different degrees of autoregressive decay depending on the behaviour of the lagged residual and its first difference respectively. In the MTAR model with a nonzero threshold, the indicator function, $M_{.t}$, is set as:

$$M_{.t} = \begin{cases} 1, if\; \Delta\xi_{t-1} \geq \tau \\ 0, if\; \Delta\xi_{t-1} < \tau \end{cases} \tag{4}$$

The threshold variable governing asymmetric behaviour is denoted by τ and Enders and Silkos (2001) suggest the use of a grid search procedure to derive a consistent estimate of the threshold. Since the threshold is unknown, a consistent estimator of τ can be attained through grid-search procedure for is applied where the boundaries are defined between the largest and smallest values of τ. Hansen (1999) has shown that the threshold can be estimated consistently be means of the following minimization function:

$$\hat{\tau} = \arg\min_{\tau \epsilon T} \widehat{\sigma^2}(\tau) \qquad (5)$$

Where $T = \{\tau | y_{([\pi(n-1)])} \leq \tau \leq y_{([\pi(n-1)])}\}$; $y_{()}$denotes the order statistic and $\widehat{\sigma^2}(\tau)$ denotes the error term variance of the regression for a given estimate of τ. The chosen value for $\hat{\tau}$ is that which ultimately minimizes the error variance of the estimated regressions. In keeping consistency with Hansen (1999), we set the trimming parameter π to the value of 0.15 throughout our analysis.

In referring back to regressions (1) and (2), asymmetric cointegration between the time series variables is examined as follows. Firstly, we examine whether the residuals, ξ_{t-1}, are stationary to ensure that the least squares (LS) estimates of ρ_1 and ρ_2 have an asymptotic multivariate normal distribution for any given value of a consistently estimated threshold. Enders and Silkos (2001) demonstrate that a sufficient condition for stationary of ξ_{t-1} is that $(1-\rho_1)(1-\rho_2) < 1$. A more formal cointegration test as proposed by Enders and Dibooglu (2001) suggests testing the null hypothesis of no cointegration against the alternative of cointegration i.e.

$$H_0^{(1)} : \rho_1 = \rho_1 = 0 \qquad (6)$$

The F-statistic for this null hypothesis using the TAR and MTAR specifications are, respectively denoted as φ and φ^*. The test statistics are similar to conventioanl F-statitstics but the asymptotic distribution of these two statistics is nonstatndard. Enders and Silkos (2001) use a Monte Carlo study to obtain asymptotic critical values for the F-statistics when the threshold is estimated through a grid search. If the null hypothesis of no cointegration is rejected, then we can proceed to the second cointegration test which involves testing the null hypothesis of symmetric adjustment against the alternative of asymmetric adjustment i.e.

$$H_0^{(2)} : \rho_1 = \rho_2 \qquad (7)$$

The null hypothesis of symmetric cointegration can be examined using standard F-test statistics. According to the granger representation theorem, an error correction model can be estimated once a pair of time series variables is found to be cointegrated. When the presence of threshold cointegration is validated, the error correction model can be modified to take into account asymmetries as in Blake and Fombly (1997). The asymmetric error-correction model also can exist between a pair of time series variables of Δgdp_t and fin_t when they are formed in an asymmetric cointegration relationship. The error correction mechanism for the TAR-VEC model can be expressed as:

$$\Delta X_t = \begin{cases} \Psi_i^{+} \Delta x_{t-1}^{+} \, I.\{\xi_{t-1} < \hat{\tau}\} + \\ \Psi_i^{-} \Delta x_{t-1}^{-} \, I.\{\xi_{t-1} \geq \hat{\tau}\} + \varepsilon_t \end{cases} \tag{8}$$

Whereas, the MTAR-TEC model is specified as:

$$\Delta X_t = \begin{cases} \Psi_i^{+} \Delta x_{t-1}^{+} \, I.\{\Delta\xi_{t-1} < \hat{\tau}\} + \\ \Psi_i^{-} \Delta x_{t-1}^{-} \, I.\{\Delta\xi_{t-1} \geq \hat{\tau}\} + \varepsilon_t \end{cases} \tag{9}$$

Where the regression variables are represented as: $X_t = \begin{pmatrix} fin_j^i \\ gdpcap_i \end{pmatrix}$, $\Delta x_{t-1}^{+} = \begin{pmatrix} \xi_{t-1}^{+} \\ \Delta fin_i^{+} \\ \Delta gdpcap_i^{+} \end{pmatrix}$, and $\Delta x_{t-1}^{-} = \begin{pmatrix} \xi_{t-1}^{-} \\ \Delta fin_i^{-} \\ \Delta gdpcap_i^{-} \end{pmatrix}$ with the associated regression coefficients are given as $\Psi_i^{+} = \begin{pmatrix} \lambda^{+} & 0 & 0 \\ 0 & \alpha_i^{+} & 0 \\ 0 & 0 & \beta_i^{+} \end{pmatrix}$ and $\Psi_i^{-} = \begin{pmatrix} \lambda^{-} & 0 & 0 \\ 0 & \alpha_i^{-} & 0 \\ 0 & 0 & \beta_i^{-} \end{pmatrix}$. Through the above described systems of error correction models, the presence of asymmetries between the variables could initially be examined by examining the signs on the coefficients of the error correction terms. In particular the null hypothesis of no error correction mechanism can be tested as:

$$H_0^{(3)}: \lambda^{+} \xi_{t-1}^{+} = \lambda^{-} \xi_{t-1}^{-} \tag{10}$$

Furthermore, from the specified TEC models granger causality tests can be implemented by testing whether all fin_t and Δgdp_t are statistically different from zero based on a standard F-test and if the coefficients of the error correction are also significant. The null hypothesis that fin_t does not lead to Δgdp_t can be denoted as:

$$H_0^{(4)}: \alpha_k = 0; \; i = 1, \dots, k \tag{11}$$

Whereas the null hypothesis that Δgdp_t does not lead to fin_t is:

$$H_0^{(5)}: \beta_k = 0;\ i = 1, \dots, k \tag{12}$$

In the case that both hypothesis in equations (11) and (12) are simultaneously rejected, then there is evidence of bidirectional causality between financial development and economic growth. Similarly, if both hypothesis in equation (11) and (12) cannot be simultaneously rejected, then we can assume that there is no causality between financial development and economic growth.

5 *DATA AND EMPIRICAL ANALYSIS*

5.1 *DATA DESCRIPTION AND CONSTRUCTION*

Having provided an overview of the motivation behind the use of various proxies of financial development as previously used in earlier empirical literature as well as outlining the empirical framework to be used in our study, this section of our paper presents the data used for our empirical analysis. For the estimation of the MTAR and TEC models, we collect quarterly data ranging between the period of 1992:Q1 and 2013:Q3. Notably this period covers an era in which the South African economy experienced financial liberalization and other economic reforms which may reinforce the need to account for asymmetries in the estimation of the time series data. The original intention was to use monthly data, but given that gross domestic product per capita can only be collected on a quarterly basis and the different measures of financial development are limited to monthly data, we use cubic spline interpolation to convert the monthly financial data into quarterly data. All the time series used in constructing our data are collected from the South African Reserve Bank (SARB) website and the definition of all the time series variables used in our study are reported below in Table 1.

TABLE 1: DESCRIPTION OF TIME SERIES VARIABLES

$variable\ definitions$	$SARB\ time\ series\ code$
$gross\ domestic\ product\ per\ capita\ (gdpcap)$	$(kbp3270j)$
$M1\ money\ supply\ monetary\ aggregate (M1)$	$(kbp1374j)$
$M3\ money\ supply\ monetary\ aggregate (M3)$	$(kbp1371j)$
$total\ credit\ extended\ to\ the\ private\ sector (priv)$	$(kbp1347j)$
$total\ volume\ of\ shares\ traded\ on\ the\ JSE\ (mrkt)$	$(kbp2038j)$
$total\ value\ of\ shares\ traded\ on\ the\ JSE (value)$	$(kbp2039j)$

Note: Developed by author

As previous mentioned, one critical aspect in adequately determining the effects of financial development on economic growth, is the choice of variable describing financial development in the financial sector. Our study uses a total of six proxies for financial development; that is, three measures for banking sector activity and another three proxies for stock market development. In particular, we use the ratio of monetization (M1) to GDP ($i.e. fin_{M1/GDP}^{bank}$); the ratio of liquid liabilities (M3) to GDP ($i.e. fin_{M3/GDP}^{bank}$); and the ratio total credit extended to the private sector ($i.e. fin_{PRIV}^{bank}$) as measures of banking activity. We choose the ratio of M3 to GDP as a supplementary indicator to financial depth, because the M1 monetary aggregate is considered a poor proxy in economies with underdeveloped financial systems as this measure of financial depth is more related to the ability of the financial system to provide transaction services than to the ability to channel funds from savers to borrowers (Khan and Senhadji, 2000). Furthermore, we also credit granted to the private sector which, by excluding credit issued to government and other non-private institutions, provides a more accurate measure of the savings of financial intermediaries channel to private sector. In turning to the case of providing proxies for stock market development, we use the ratio of total volume of shares traded on the Johannesburg Stock Exchange (JSE) expressed as a ratio of GDP as a measure of market capitalization ratio ($i.e. fin_{MCR}^{stock}$); the ratio of total value of shares traded on the JSE to GDP ($i.e. fin_{VTR}^{stock}$) and the ratio of the total value of shares traded on the JSE to total volume of shares traded on the JSE ($i.e. fin_{TURN}^{stock}$). The motivation behind the use of the selected stock market proxies is to capture the direct effects of both stock market size and liquidity on economic development.

5.2 *UNIT ROOT TESTS*

The empirical long-run relationship between financial development and economic growth crucially depends upon the integration and stationary properties of the time series and as a preliminary exercise prior to examining cointegration and causality effects, it is important to test for unit roots. We therefore begin our empirical analysis by investigating the integration properties of the individual time series variables using the augmented dickey-fuller (ADF) and Phillips and Perron (PP) unit root tests. On deciding upon the optimal lag length for the unit root test, we account for 8 lags and thereafter select the optimal lag length based upon the lag length which minimizes the residual variance of the Akaike information criterion (AIC). Table 2 below summarizes the results of the unit root tests which show that the null hypothesis of a unit root cannot be rejected for any level of the time series. However, after first differencing, the null hypothesis is rejected at least 5 percent significance level of all the time series. We thus draw the conclusion that all the time series variables used in our study are integrated of order I(1). This result satisfies the Engle and Granger (1989) precondition which states that a pair of time series must be integrated of order I(1) in order to produce a combined cointegration vector of order I(0) and consequentially, this result raises confidence about the prospect that the time-series variables tends to move more or less together over time, a phenomenon which needs to be proved via formal co-integration analysis.

TABLE 2: ADF AND PP UNIT ROOT TESTS

$variable$	$ADF\ test\ statistics$		$PP\ test\ statistics$		$decision$
	$constant$	$trend$	$constant$	$trend$	
$gdpcap$	-1.67 $(-11.22)^{***}$	-3.07^{*} $(11.79)^{***}$	-2.63^{*} $(-11.36)^{***}$	-2.71 $(-12.21)^{***}$	$I(1)$
$fin_{M1/GDP}^{bank}$	-1.68 (-1.76)	-2.06 (-1.05)	-1.37 (-1.43)	-2.00 $(-0.93)^{***}$	$I(1)$
$fin_{M3/GDP}^{bank}$	-2.26^{*} (-0.50)	-1.25 $(0.64)^{***}$	-1.27 (-0.25)	-1.50 (0.76)	$I(1)$
fin_{PRIV}^{bank}	1.48 $(-2.60)^{*}$	-1.44 $(-3.13)^{*}$	2.78 $(-2.92)^{**}$	-1.27 $(-3.75)^{**}$	$I(1)$
fin_{MCR}^{stock}	-1.37 $(-7.32)^{***}$	-2.15 $(-7.32)^{***}$	-1.30 $(-9.37)^{***}$	-2.22 $(-9.33)^{***}$	$I(1)$
fin_{VTR}^{stock}	0.94 $(-6.49)^{***}$	-1.67 $(-6.75)^{***}$	1.02 $(-9.98)^{***}$	-1.76 $(-10.24)^{***}$	$I(1)$
fin_{TURN}^{stock}	0.72 $(-5.67)^{***}$	-0.54 $(-5.89)^{***}$	-1.54 $(-8.27)^{***}$	-1.78 $(-8.71)^{***}$	$I(1)$

Significance Level Codes:"***", "**' and '*' denote the 1%, 5% and 10% significance levels respectively. The unit root test statistics for the first differences of the time-series variables are reported in ().

5.3 *COINTEGRATION AND ERROR CORRECTION ANALYSIS*

Having already confirmed stationarity within the time series variables, our paper proceeds to test for threshold cointegration and threshold error correction effects for the

TAR-TEC and the MTAR-TEC specifications. In order to perform our cointegration and error correction analysis, we first pair up each of the six measurements of financial development against gross domestic product per capita ($gdpcap$) and then apply a battery of threshold tests to the cointegration regressions formed thereof. As previously discussed the paper employs three threshold cointegration tests, with the first one testing whether there are any significant cointegration relations, that is, whether the threshold regression coefficients are significantly different from zero ($H_0^{(1)} = \rho_1 = \rho_1 = 0$ from equation 6). The second test evaluates whether there are any corresponding threshold effects; that is, we determine whether the regression coefficients are indeed regime switching ($H_0^{(2)} = \rho_1 = \rho_2$ from equation 7). And finally we test for any corresponding threshold error correction effects, that is, we evaluate whether we can model an associated error correction model for the threshold regressions ($H_0^{(3)}: \lambda^+ \xi_{t-1}^+ = \lambda^- \xi_{t-1}^-$ from equation 10). The threshold cointegration and error correction test results are shown below in Table 2.

TABLE 3: THRESHOLD COINTEGRATION AND ERROR CORRECTION TESTS

		$TAR-TEC$			$MTAR-TEC$		
dependent variable	independent variable	$H_0^{(1)}$	$H_0^{(2)}$	$H_0^{(3)}$	$H_0^{(1)}$	$H_0^{(2)}$	$H_0^{(3)}$:
$gdpcap$	$fin_{M1/GDP}^{bank}$	1.73 (0.18)	2.45 (0.12)	0.46 (0.50)	10.2 (0.00)***	10.84 (0.00)***	1.54 (0.22)
$fin_{M1/GDP}^{bank}$	$gdpcap$	11.63 (0.00)***	9.98 (0.01)**	2.13 (0.14)*	14.41 (0.00)***	14.83 (0.00)***	2.53 (0.12)*
$gdpcap$	$fin_{M3/GDP}^{bank}$	3.74 (0.03)*	4.4 (0.04)*	0.52 (0.48)	15.24 (0.00)***	26.60 (0.00)***	0.08 (0.77)
$fin_{M3/GDP}^{bank}$	$gdpcap$	10.54 (0.00)***	2.82 (0.09)*	1.27 (0.26)**	12.77 (0.00)***	6.47 (0.01)*	0.74 (0.39)
$gdpcap$	fin_{PRIV}^{bank}	7.98 (0.00)***	9.46 (0.01)**	2.87 (0.09)*	15.94 (0.00)***	24.33 (0.00)***	0.23 (0.64)
fin_{PRIV}^{bank}	$gdpcap$	16.55 (0.00)***	8.00 (0.01)**	4.48 (0.04)**	18.23 (0.00)***	10.63 (0.01)**	0.30 (0.59)
$gdpcap$	fin_{MCR}^{stock}	2.99 (0.06)*	5.95 (0.02)*	1.48 (0.23)	4.50 (0.01)*	8.97 (0.01)***	4.74 (0.03)**
fin_{MCR}^{stock}	$gdpcap$	2.60 (0.08)*	0.12 (0.73)	0.02 (0.88)	10.59 (0.00)***	15.16 (0.00)***	0.14 (0.71)
$gdpcap$	fin_{VTR}^{stock}	4.85 (0.01)*	1.59 (0.21)	1.09 (0.30)	5.59 (0.01)**	2.94 (0.09)**	0.20 (0.66)
fin_{VTR}^{stock}	$gdpcap$	5.59 (0.01)**	0.99 (0.32)	0.12 (0.73)	5.19 (0.01)**	0.27 (0.60)	0.55 (0.46)
$gdpcap$	fin_{TURN}^{stock}	6.82 (0.01)**	9.73 (0.01)**	3.97 (0.05)**	8.43 (0.00)***	12.81 (0.00)***	0.69 (0.41)
fin_{TURN}^{stock}	$gdpcap$	22.52 (0.00)***	3.11 (0.08)*	2.06 (0.16)	24.93 (0.00)***	6.31 (0.01)*	10.47 (0.00)***

Significance Level Codes:"***", "**' and '*' denote the 1%, 5% and 10% significance levels respectively. The unit root test statistics for the first differences of the time-series variables are reported in ().

For the sake of convenience, the results reported in Table 2 are sub-divided for the two model specifications, namely the TAR-TEC and the MTAR-TEC regression models. For each model specification, using various measures of financial development against economic growth per capita, we test for cointegration, asymmetric cointegration and error correction effects and report the results of these threshold cointegration tests. The results reported in Table 2 provide evidence of all estimated models rejecting the null hypothesis of no cointegration regardless of the evaluated model specification. Similarly, when proceeding to test for threshold cointegration within these nonlinear models, we are also unable to reject the hypothesis contending for threshold cointegration between finance and growth for all measures of financial development under all model specifications, with the only exception being for fin_{VTR}^{stock} under both TAR and MTAR specifications. However, when testing the null hypothesis of no associated error correction mechanism for the threshold cointegration regressions, the results obtained prove to be less encouraging. In particular, we find that the null hypothesis of no error correction effects can only be rejected for the financial variables of $fin_{M1/GDP}^{bank}$;$fin_{M3/GDP}^{bank}$; fin_{PRIV}^{bank} under the TAR-TEC model specifications; whereas the null hypothesis is rejected for $fin_{M1/GDP}^{bank}$; $fin_{M3/GDP}^{bank}$, fin_{MCR}^{stock} and fin_{TURN}^{stock} for the MTAR-TEC specifications.

As a consequence of these findings, we have four pairs of finance-growth TAR-TEC cointegration regressions which could be under investigation for threshold error correction and causality effects; namely $fin_{M1/GDP}^{bank}$~$gdpcap$; $fin_{M3/GDP}^{bank}$~$gdpcap$; $gdpcap$ ~fin_{PRIV}^{bank} ; and fin_{PRIV}^{bank} ~$gdpcap$, whereas we estimate five pairs of threshold error correction models and thereafter perform causality effects for the following MTAR-TEC regressions; $fin_{M1/GDP}^{bank}$~$gdpcap$; $fin_{M3/GDP}^{bank}$~$gdpcap$; fin_{MCR}^{stock} ~$gdpcap$; $gdpcap$~fin_{TURN}^{stock}; and fin_{TURN}^{stock}~$gdpcap$. From the above analysis, one can also observe that the correlation between financial development and economic growth is best explained by the TAR-TEC for banking activity whereas the MTAR-TEC model is a more appropriate model framework when using stock development proxies as measures of financial development. It is also worth noting that we are able to model asymmetric cointegration and error correction effects for all combinations of finance and economic growth with the exception for the case when the value traded ratio ($i.e. fin_{VTR}^{stock}$) is used as a proxy measure of financial development. Following the above analysis, we can proceed to estimate the TAR-TEC and MTAR-TEC models for the identified significant cointegration regressions. Estimations of the TAR-TEC and MTAR-TEC specification are given in Table 4 and 5, respectively.

TABLE 4: TAR-TEC REGRESSION ESTIMATES

	eq 1		eq 2		eq 3		eq 4	
	y	x	y	x	y	x	y	x
	$gdpcap$	$m1.gdp$	$m3.gdp$	$gdpcap$	$gdpcap$	$priv.gdp$	$priv.gdp$	$gdpcap$
ψ_{10}	11.01		−0.01		10.59		8.66	
	(0.00)***		(0.00)***		(0.00)***		(0.00)***	
ψ_{10}	0.58		1.26		0.32		1.18	
	(0.00)***		(0.00)***		(0.00)***		(0.00)***	
τ	−0.44		−0.25		−0.42		−0.32	
$\rho_1\xi_{t-1}$	0.11		−0.79		0.10		−0.83	
	(0.20)		(0.00)***		(0.33)		(0.00)***	
$\rho_2\xi_{t-1}$	−0.34		0.04		−0.54		0.04	
	(0.00)***		(0.91)		(0.00)***		(0.91)	
$\beta_i\Delta\xi_{t-i}$	−0.33		−0.13		−0.23		−0.10	
	(0.00)***		(0.29)		(0.03)**		(0.35)	
$\Delta gdpcap^{+}_{t-k}$	−0.04	1.55	−0.01	−1.34	−0.04	0.80	1.01	−0.04
	(0.78)	(0.58)	(0.22)	(0.00)***	(0.76)	(0.88)	(0.86)	(0.76)
$\Delta gdpcap^{-}_{t-k}$	−1.76	12.62	0.01	−0.04	−1.51	2.38	2.38	−1.54
	(0.05)*	(0.53)	(0.25)	(0.79)	(0.10)*	(0.55)	(0.95)	(0.11)*
Δfin^{+}_{t-k}	−0.04	−1.34	−0.05	−0.63	0.01	−0.66	−0.86	−0.01
	(0.04)**	(0.00)***	(0.71)	(0.91)	(0.25)	(0.09)*	(0.00)***	(0.53)
Δfin^{-}_{t-k}	0.01	0.08	−1.27	51.86	0.01	0.03	0.04	0.01
	(0.10)*	(0.58)	(0.19)	(0.22)	(0.23)	(0.77)	(0.72)	(0.24)
$\lambda^{+}\xi^{+}_{t-1}$	−0.04	0.34	−0.01	−0.18	−0.01	−0.42	-0.53	−0.01
	(0.03)**	(0.41)	(0.31)	(0.61)	(0.21)	(0.26)	(0.09)*	(0.16)
$\lambda^{-}\xi^{-}_{t-1}$	−0.01	0.17	−0.02	−0.89	−0.02	0.63	0.56	−0.01
	(0.58)	(0.54)	(0.12)*	(0.09)*	(0.04)**	(0.11)*	(0.88)	(0.47)
R^2	0.12	0.44	0.50	0.11	0.12	0.53	0.52	0.11
dw	2.07	1.88	2.06	1.82	2.08	1.96	2.04	2.07
$p-value$	0.87	0.32	0.94	0.19	0.85	0.50	0.83	0.91

Significance Level Codes:"***", "**' and '*' denote the 1%, 5% and 10% significance levels respectively. t-statistics are reported in ().

Based on the estimated slope parameters reported in the second column of Table 4, we find a positive long-run relationship between financial development and economic growth with finance-growth elasticities ranging from 0.34 to 0.57 for the banking sector. In determining the regime switching behaviour governing the error terms, we apply Hansen (1999) conditional least squares (CLS) method to estimate the threshold parameter for all model specifications and obtain reasonable estimates ranging from -0.25 to -0.44; which are relatively close to zero. In examining the coefficients of the error terms of the threshold cointegration regression, we note that all estimated TAR-TEC models satisfy the condition $(1-\rho_1)(1-\rho_1) < 1$, a result which ensures the stationarity (convergence) of the regime-switching residuals. Further given that the regression coefficients satisfy the condition $|\rho_2| > |\rho_1|$when economic growth is the dependent variable, and $|\rho_1| > |\rho_2|$ when financial development is placed as the dependent variable, we draw inference/implications that discrepancies from the equilibrium are more persistent when financial development is decreasing relative to economic growth, suggesting a sluggish adjustment in banking activity relative to economic growth. The estimations results also indicate that the absolute values of all coefficients on the lagged differenced variables are less than unity in both regimes.

Table 4 further provides estimates for the corresponding error correction mechanisms as well as for the coefficients of the lagged first differences of the variables which are reported between columns 7 to 12. The coefficients on the lagged differences of the variables denote the short-run dynamics whereas the coefficients on the lagged asymmetric error correction terms represent the long-run adjustment back to equilibrium. Concerning the short-run dynamics, we find most significant effects on the lagged differences of most financial development variables. For all regression estimates we are able to obtain at least one negative coefficient on the error correction terms which indicate long-run convergence of the model to equilibrium as well as explaining the proportion and the time it takes for the disequilibrium to be corrected during each period to return the disturbed system to equilibrium. We therefore summarize the equilibrium adjustment mechanisms for the estimates TAR-TEC as follows:

- Between $gdpcap$ and $fin^{bank}_{M1/GDP}$, we find adjustment equilibrium only when shocks are to $gdpcap$ in the upper regime, of which 4 percent of the deviations from steady-state equilibrium are corrected every quarter.
- Between $gdpcap$ and $fin^{bank}_{M3/GDP}$, we find adjustment equilibrium when shocks are to both $gdpcap$ and $fin^{bank}_{M3/GDP}$.in the lower regime, of which 89 percent and 2 percent of disequilibrium caused by shocks to $gdpcap$ and $fin^{bank}_{M3/GDP}$ respectively, are corrected every period.
- Similarly between $gdpcap$ and fin^{bank}_{PRIV} , we find adjustment equilibrium when shocks are to both $gdpcap$ and fin^{bank}_{PRIV} , of which 2 percent and 89 percent of disequilibrium caused by shocks to $gdpcap$ and fin^{bank}_{PRIV} respectively, are corrected every period.
- Between fin^{bank}_{PRIV} and $gdpcap$, we find adjustment equilibrium when shocks are to fin^{bank}_{PRIV}, of which 53 percent of deviations from steady-state equilibrium are corrected every quarter.

TABLE 5: MTAR-TEC REGRESSION ESTIMATES

	eq 5		eq 6		eq 7	
	y	x	y	x	y	x
	$m1$	$gdpcap$	$gdpcap$	fin_{MCR}^{stock}	fin_{TURN}^{stock}	$gdpcap$
ψ_{i0}	-4.65		-12.37		-195.83	
	$(0.00)^{***}$		$(0.00)^{***}$		$(0.00)^{***}$	
ψ_{i1}	0.57		8.83		17.68	
	$(0.00)^{***}$		$(0.06)^{*}$		$(0.00)^{***}$	
τ	-0.07		-0.01		1.55	
$\rho_1\xi_{t-1}$	-0.62		0.02		-1.09	
	$(0.00)^{***}$		(0.37)		$(0.00)^{***}$	
$\rho_2\xi_{t-1}$	0.06		-0.13		-0.03	
	(0.82)		$(0.01)^{***}$		(0.94)	
$\beta_i\Delta\xi_{t-i}$	-0.19		-0.29		0.03	
	$(0.11)^{*}$		$(0.01)^{***}$		(0.78)	
$\Delta gdpcap_{t-k}^{+}$	-0.04	1.55	-0.02	0.00	90.73	0.01
	(0.78)	(0.58)	(0.85)	(0.99)	(0.55)	(0.98)
$\Delta gdpcap_{t-k}^{-}$	-1.76	12.62	-0.80	0.63	-207.41	-1.87
	$(0.05)^{*}$	(0.53)	(0.41)	(0.88)	(0.85)	$(0.04)^{**}$
Δfin_{t-k}^{+}	-0.04	-1.34	-0.63	-0.99	1.60	0.01
	$(0.04)^{**}$	$(0.00)^{***}$	$(0.08)^{*}$	$(0.00)^{***}$	$(0.05)^{*}$	(0.36)
Δfin_{t-k}^{-}	0.01	0.08	0.25	-0.04	0.01	0.00
	$(0.10)^{*}$	(0.58)	(0.39)	(0.75)	(0.99)	(0.26)
$\lambda^{+}\xi_{t-1}^{+}$	0.04	0.34	-0.01	-0.01	-2.73	-0.01
	$(0.03)^{**}$	(0.41)	(0.42)	(0.22)	$(0.00)^{***}$	(0.35)
$\lambda^{-}\xi_{t-1}^{-}$	-0.01	0.17	-0.03	-0.01	0.29	0.01
	(0.58)	(0.54)	$(0.01)^{**}$	(0.46)	(0.55)	(0.99)
R^2	0.45	0.10	0.08	0.44	0.57	0.12
dw	1.90	2.06	2.07	1.98	1.94	2.07
$p-value$	0.44	0.89	0.83	0.73	0.45	0.82

Significance Level Codes:"***", "**' and '*' denote the 1%, 5% and 10% significance levels respectively. t-statistics are reported in ().

Having diagnosed the results for the TAR-TEC specification, we now turn our attention to the results for the MTAR-TEC model which are reported above in Table 5. In particular, we report the estimates of the MTAR-TEC regression, which, for banking activity (i.e. $fin_{M1/GDP}^{bank}$), almost produce identical results in comparison to those obtained for the TAR-TEC model. We also retain finance-growth elasticities ranging from 0.34 to 0.85 for banking activity whereas for stock market development we find relatively lower elasticities of between 0.01 and 0.11. This result re-emphasizes the fact that banking activity is more prominent in its relation towards economic growth in comparison to stock market activity in South Africa. We also find that all estimated MTAR-TEC models satisfy the convergence condition of $(1-\rho_1)(1-\rho_1) < 1$ and further given that $|\rho_1| > |\rho_2|$, when financial development is the dependent variable, and $|\rho_2| > |\rho_1|$, when economic growth is the dependent variable, we also establish sluggish adjustment behaviour in stock market activity relative to economic growth. The threshold estimates also lie within the range of between -0.07 and 1.55, which are reasonable threshold estimates.

In turning to the error correction mechanisms we find at least one negatively significant error correction term for all estimated regression equations. However, a major difference from the results previously reported for the TAR-TEC models in Table 4 concerns the error correction mechanism established between $fin^{bank}_{M1/GDP}$ and $gdpcap$ of which the adjustment equilibrium is, in this case, found to be initiated by $fin^{bank}_{M1/GDP}$ and yet the dynamics governing the error correction mechanism remains the same (i.e. 4 percent of the deviations from steady-state equilibrium are corrected every quarter). Furthermore, the MTAR-TEC models are the only specifications which can account for the error correction dynamics governing all stock market development proxies, with the exception of the value traded ratio ($i.e. fin^{stock}_{VTR}$), and these equilibrium adjustment mechanisms can be summarized as follows:

- Between $gdpcap$ and fin^{stock}_{MCR}, we find adjustment equilibrium when shocks are directed to $gdpcap$ in the lower regime, of which 3 percent of deviations from long-run equilibrium are corrected in every period.
- Between fin^{stock}_{TURN} and $gdpcap$, we find adjustment equilibrium when shocks are to fin^{stock}_{TURN} in the upper regime, of which 273 percent of deviations from long-run equilibrium are corrected in every period.

5.4 *CAUSALITY ANALYSIS*

In order to assess the causal relationship between financial development and economic growth, we then test the hypothesis. The null hypothesis that financial development does not granger-cause economic growth is rejected if the coefficients on the distributed-lagged financial development variables are found to be statistically significant. Similarly, the null hypothesis that economic growth does not granger-cause financial development is rejected if the coefficients on the distributed-lagged economic growth variables are found to be statistically significant. And since the causality tests are sensitive to the selection of the lag length, we determine the lag lengths using the AIC criterion. The empirical results for the causality analysis are given in Table 6.

TABLE 6: GRANGER CAUSALITY TESTS

$model\ type$	$regression\ equations$	$dependent\ variable$	$independent\ variable$	H_{03} $y\ granger\ causes$	H_{03} $x\ granger\ causes$	$decision$
				$f-stat$	$f-stat$	
$TAR-TEC$	$eq\ 1$	$gdpcap$	$fin^{bank}_{M1/GDP}$	2.47 (0.08)*	2.63 (0.07)*	$bi\ directional$
	$eq\ 2$	$fin^{bank}_{M3/GDP}$	$gdpcap$	7.75 (0.00)***	0.39 (0.67)	$fin^{bank}_{M3/GDP}\ to\ gdpcap$
	$eq\ 3$	$gdpcap$	fin^{bank}_{PRIV}	1.45 (0.24)	1.40 (0.25)	$no\ causality$
	$eq\ 4$	fin^{bank}_{PRIV}	$gdpcap$	8.15 (0.00)***	0.03 (0.97)	$fin^{bank}_{PRIV}\ to\ gdpcap$
$MTAR-TEC$	$eq\ 5$	$fin^{bank}_{M1/GDP}$	$gdpcap$	0.8 0 (0.45)	0.41 (0.66)	$no\ causality$
	$eq\ 6$	$gdpcap$	fin^{stock}_{MCR}	1.86 (0.16)	0.46 (0.63)	$no\ causality$
	$eq\ 7$	fin^{stock}_{TURN}	$gdpcap$	0.18 (0.84)	1.95 (0.14)*	$gdpcap\ to\ fin^{stock}_{TURN}$

Significance Level Codes:"***", "**' and '*' denote the 1%, 5% and 10% significance levels respectively

The results shown in Table 6 paint a mixed picture concerning the causal relationship between different measures of financial development and economic growth. For instance, when the ratio of liquid liabilities to gross domestic product ($i.e. fin^{bank}_{M3/GDP}$) and the ratio total credit extended to the private sector ($i.e. fin^{bank}_{PRIV}$) are the driving factors in the regressions equations, these variables are found to granger-cause economic growth whereas there is bi-directional causality between the monetization ratio ($i.e. fin^{bank}_{M1/GDP}$) and output per capita for the banking sector activity. The first result is reminiscent of that obtained in the works of Acaravci et. al. (209) as well as Akinlo and Egbtunde (2010) who find a bi-directional causality between financial depth and economic growth for sub-Saharan African countries. The second result is in coherence with that obtained in other studies for developing countries such as Adusei (2013) for Botswana. And even though we find no causal effects between banking activity and economic growth when both fin^{bank}_{PRIV} and ($i.e. fin^{bank}_{M1/GDP}$) are the driving force in the adjustment equilibrium mechanism under the TAR-TEC and MTAR-TEC specifications respectively, the general implication thus derived from the empirical results so far, is that banking sector activity exerts a positive influence and is also responsible for economic growth in South Africa.

In examining the causality effects between stock market activity and economic growth, we find no causal relationship between market capitalization ratio ($i.e. fin^{stock}_{MCR}$) and economic growth whereas we find that gross domestic product per capita granger-causes the turnover ratio ($i.e. fin_{TURN}^{stock}$). This result proves that while there may not be any causal relationship between economic growth and the actual size of the stock market; however, higher economic growth leads to higher activity and liquidity levels within the JSE. Chakraborty (2008) elaborates on how such growth-driven-finance towards stock market development may result when higher economic growth leads to higher ease and efficiency with which firms can raise funds through the issue of equity finance. While this result is in line with that obtained in Levine and Zervos (1996), who report a positive and significant link between liquidity of stock markets and economic growth but no robust relationship between the size of stock markets and economic growth for industrialized economies, this result is, however, in contrast with other studies conducted for other developing economies such as Odhiambo (2005) who find bi-directional causality between stock market development and economic growth in Tanzania. Our empirical analysis may emphasize the point that the JSE is a more developed stock market in comparison to stock markets in other developing economies as it has been deemed as most developed stock market in Africa and has recently been ranked by the World Economic Forum (WEF) as the most efficiently regulated stock exchange in the world.

CONCLUSIONS

Our study sought to investigate the asymmetric relationship between financial development and economic growth in South Africa over the past two decades. The empirical findings and their policy implications can be summarized as follows. First and foremost, the empirical results provide some strong support of asymmetric cointegration effects between financial development and economic growth in South Africa for each employed measurement of financial development, whether it is banking activity or stock market development, with the exception for the volume traded ratio. Secondly, our findings also reveal that the correlation between financial development and economic growth is dependent upon the proxy used to measure financial development; that is, the observed effects financial development on economic growth differ depend upon whether the overall financial activity is measured via banking activity or through stock market developments. In particular, the empirical results provide evidence in support of existing theoretical views including the "supply-leading hypothesis" between banking activity and economic growth; and also for the "demand-leading hypothesis" being found between stock market development and economic growth.

In general the findings confirm the significance of banking activity as an engine for economic growth whereas economic growth proves to be a driving force behind stock market development, particularly for the trading value of shares relative to the size of the JSE. This indeed represents one of the most striking features found within the empirical results, in that economic growth solely granger causes stock market development at a very high significance level and yet no measure of stock market development is found to granger cause economic growth. Our results, therefore, emphasize on the importance that policymakers should place in distinguishing between banking and stock market activity when assessing/evaluating their policy effects on economic growth. We therefore conclude that while financial liberalization has been successful in improving the South African financial sector, policymakers should, on one hand, focus on directing banking activity, in terms of size and depth, as an instrument directed towards economic growth and, on the other hand, stock market development should be an outcome of economic growth polices directed towards stock market activity.

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