Financial Innovation and Economic Growth in the SADC

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Abstract

The study empirically establishes the causal relationship between financial innovation and economic growth in SADC. Using an Autoregressive Distributed Lag (ARDL) Model, estimated by Pooled Mean Group and Dynamic Fixed Effects, the study finds that financial innovation has a positive relationship to economic growth in long run for SADC. The long run estimations, however, show existence of a weak relationship. Introducing a direct measure of financial innovation buttresses the role of financial innovation in growth in SADC. Panel Granger causality tests establish that there is no causality, in any direction, between financial innovation and growth both in the short and long run.

Keywords: Innovation, Financial Innovation, Economic Growth, SADC, Autoregressive Distributed Lag (ARDL).

JEL Classification: G21, G28, O31, O33

1 Introduction

Financial innovation is generating increased economic activity in most African countries through promoting financial inclusion, mobile money transfers and enabling remittances, which in turn has an impact on economic growth. Financial innovation presents opportunities for financial sector growth in Africa (Napier 2010). In SADC, the effects of innovation in financial services on economic activity cross-countries, including efficient financial transfers and increasing the volume of trade (Maimbo, Saranga and Strychacz, 2010) are evident. Innovations such as the Shoprite Money Transfers Model enable remittances from South Africa to regional countries, efficient financial transactions across countries and efficient movement of investor funds across borders (Ramsamy 2014, Mochiko 2015). Furthermore, through facilitating cross border movement of money, financial innovation is also facilitating trade flows within the SADC

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region. Notwithstanding these positive developments, the impact of financial innovation on economic growth in SADC has not been extensively pursued. How innovation benefits countries in terms of economic growth is a topical issue that requires further investigation.

Globally, financial innovation has transformed and restructured financial services and its impact on economies is becoming increasingly noteworthy. The World Economic Forum (2012) contends that “leapfrog” (financial) innovation is a driving force for broad economic growth. High growth rates in Southern African countries in recent years have been sustained by natural resources and agriculture on the back of improved macroeconomic management (Mlachila et al., 2013). There has been no mention of growth being linked to finance. So far, literature suggests that financial innovation drives economic growth (Levine, 1997); however, the extent to which high growth rates registered by SADC countries are driven by financial innovation, had not been specified as yet. Precisely, there are no studies known that have attempted to establish the relationship between financial innovation and economic activity in the SADC region.

This study aims at assessing the role of financial innovation on growth in SADC. Precisely, the study empirically evaluates the nature of the relationship between financial innovation and economic growth in SADC. Further, the study empirically tests causality between financial innovation and economic growth in SADC. The study employs an Autoregressive Distributed Lag (ARDL) Model, estimated by Pooled Mean Group and Dynamic Fixed Effects.

1.1 Stylised fact about financial innovation in SADC

Observable relationship between financial innovation and economic growth in SADC displays contradicting trends (Figure 1). Trends plotted from the World Development Indicators (2015) data shows that when financial innovation is measured by growth in banking credit to private sector, the relationship is positive though weak as the trend line is nearly flat. The trend turn to negative when financial innovation is measured by ratio of broad to narrow money. For both variables, however, the scatter plots are highly dispersed indicating a high variance from the mean, confirming the weak relationship. The observed trend, however, is based on data that was transformed into time series by taking simple averages across all the countries, in the process ignoring country effects and country heterogeneity.

Despite the observable trend, it is undisputable that financial innovation has, generated increased economic activity in the SADC region over the years. GSMA (2015) indicated that the SADC regional block hosts the most developed mobile markets in Sub-Saharan Africa and estimated that in 2014, the broader mobile ecosystem generated 5.7% of GDP in Sub-Saharan Africa. The Boston Consulting Group (BCG) estimated that of about US$1billion in remittances that flows out of South Africa to other countries in the SADC annually, about 40% of these are conducted through integrated financial systems (Mochiko, 2015). Banking systems in Botswana, Namibia, Mauritius and South Africa are relatively well capitalised and dynamic, and the banks pursue in-
novative banking practices (Allen et al. 2011). These countries also represent four of the top five middle-income members of SADC (the other being the Seychelles) which, based on their level of development, would be expected to be the most banked (and financially innovative) (South African Reserve Bank 2014). Countries such as Lesotho, Swaziland and Tanzania have higher mobile phone usage for payments and transactions than the financially developed countries in the region, despite the underdeveloped financial sectors. The assumption is that such increase in access and usage of mobile financial service generates high economic activity in the region resulting in increased economic growth. Given that financial sectors in SADC countries are bank based, through reforms and increased competition, banks can potentially be the main source of financial innovation and efficiency (Moyo et al, 2014).

2 Theoretical and Empirical Literature Review

Conceptually, innovation is the use of technological or market knowledge to offer a new product or service that the customer wants (Afuah, 1998). Financial innovation is technological advances that facilitate access to information, trading and means of payment. It also refers to the emergence of new financial instruments and services, new forms of organization and more developed and complete financial markets (Solans, 2003). Financial innovation is a result of the desire of market participants to establish new, efficient ways of increasing profits when providing goods and services (Bilyk, 2006). Lewis and Mizen (2000) associate the appearance of financial innovation with the changing requirements of customers, conditions of suppliers, environmental conditions, policy conditions and technology. Financial innovation allows cost or risk reduction and/or an improvement of the services (Arnaboldi and Rossignoli, 2009). There is no agreed measure of financial innovation; hence, researchers tend to proxy it with different variables. Laeven, Levine and Michalopoulos (2012) explain that financial innovation is not limited to the invention of new financial instruments, products or institutions. According to them financial innovation includes mundane financial improvements, such as, the new financial reporting procedures, improvements in data processing and credit scoring.

Financial innovation has been an integral component of economic activity for several millennia (Laeven et al., 2015). Joseph Alois Schumpeter, in his work “Theory of Economic Development” in 1912, highlighted the crucial role of financial intermediaries in innovation and economic development (Mishra, 2008). Extensive empirical work by Goldsmith (1969) illustrates the close tie between financial structure and economic development (Mishra, 2007). Models of economic growth, however, generally ignore financial innovation and instead take the financial system as given and inert (Michalopoulos et al., 2009). The New-Growth Theory regards innovation merely as a function of capital, labour and knowledge inputs - while the institutional environment is assumed to be universal across countries (Block, 2002). Michalopoulos et al. (2009) developed a model that explains the financial innovations -growth relationship. Their
model’s deduction is that economies without financial innovation will stagnate, irrespective of the initial level of financial development. Available literature confirms that financial innovation drives economic growth (Lumpkin, 2010; Sekhar, 2013). Laeven, Levine and Michalopoulos (2015) point out that financial innovation has been a driving force behind financial deepening and economic development over the past centuries.

Innovation is a double edged-sword (Arnaboldi and Rossignoli 2013) with a ‘good’ side, which includes of driving economic growth, and a ‘dark’ side (Beck et al, 2014). The right kind of innovation spurs banks to invest in new technologies that would help the financial system fulfill its intermediation role and, consequently, deliver growth. Financial innovation mobilizes financial surpluses from ultimate savers and channel them into most productive investment avenues - thereby raising the rate of capital accumulation, and hence, the rate of economic growth (Mishra, 2007). Financial innovation can contribute significantly to infrastructure investment; financial inclusion, for example, mobile banking in Kenya and Philippines; mobilization of funds; and the strengthening of overall financial regulation - which support balanced economic growth (Prior and Santomá, 2010). Product and service delivery innovations contribute positively to regional GDP, investment and gross savings growth (Valverde, Paso and Fernández 2007). Financial innovation influences the structure of financial markets and a well-developed financial system can promote economic growth by enabling economic agents to diversify their portfolios and meet their liquidity requirements (Ho 2006).

In an online debate organized by The Economist on whether financial innovation can boost growth or not, moderator Beddoes (2010) argues that the last few centuries demonstrate that financial innovation is crucial, indeed indispensable, for sustained economic growth and prosperity. Levine (2010), arguing for the motion, makes a persuasive case that financial and technical innovation are inextricably linked and evolve together, suggesting that financial innovation is essential for improving the wealth of nations. He adds that the adaptation of corporate financing techniques have greased the wheels of technological inveniveness underlying economic growth. Overall, financial innovation results in the advent of new financial technologies that enhance the productivity of capital, reduces the transaction costs and hence stimulates higher level of economic growth (Mishra 2007).

On the “dark side” of financial innovation, Beck et al, (2014) conclude that financial innovation is associated with higher growth volatility among industries more dependent on external financing and on innovation. Allen (2011) and Llewellyn (2009) argue that the Global Financial Crisis of 2007 was caused by financial innovation. Allen (2011) is of the view that securitization and subprime mortgages may have exacerbated the problem. Henderson and Pearson (2011) argue that financial innovation can introduce complexity to exploit uninformed investors. The results of the twenty-first century financial innovation process are increased product and institutional complexity, and increased market fragility (Gubler 2011). Paul Volcker, former chairman of the Federal Reserve and an advisor to President Obama, claim that there is "very little evidence" that
massive financial innovation in recent years has done anything to boost the economy. Beddoes (2010), in The Economist online debate, mentions that the last few years demonstrated that financial innovations can be used as tools of economic destruction. Stiglitz (2010) notes that some of the financial products increased the problems of information asymmetry, exacerbating problems of moral hazard, and so contributed to the current economic crises. Too much or inefficient innovation can have serious consequences for the overall economy (Beck et al., 2014).

There is limited empirical evidence of the relationship between financial innovation and economic growth. Valverde, Del Paso, and Fernadez (2007) found a positive relationship between product and service innovations and regional gross domestic product, investment and gross savings in Spain. Laeven, Levine, and Michalopoulos (2015) developed a model in which financial and technological entrepreneurs interact to shape economic growth, by highlighting the vital role of financial innovation in the process of economic growth. They conclude that institutions, laws, regulations, and policies that impede financial innovation slow technological change and economic growth (Laeven, Levine, and Michalopoulos, 2015). Bassa (2013), however, hints that although there is lack of empirical evidence on the impact of financial innovation on the economy, it is acknowledged that financial innovation has a clear incidence on highly-financially-dependent economies.

There are merely a few empirical studies on the relationship between financial innovation and economic growth for African countries. Idun and Aboagye (2014) find a negative relationship between financial innovation and economic growth in the long run, and a positive relationship in the short run in Ghana. The results also show bidirectional Granger causality between financial innovation and economic growth. Mwinzi (2014) in a study on Kenya established that financial innovation has a significant, positive impact on economic growth with mobile transactions having a major impact.

3 Data and Methodology

The study uses panel data of all the 15 SADC countries for the period 1985-2014, sourced from the World Bank (World Development Indicators 2015). Data were analyzed using the E-Views 9 econometric package.

The study uses Growth in Banking Sector Credit to Private Sector (GBCP) (following Michalopolous et al, 2009, 2014 and Aboagye and Idun, 2014); ratio of Broad Money to Narrow Money (M2M1), following (Ansong et al., 2011; Mannah-Blankson and Belnye, 2004) and Mobile Banking proxied by ‘mobile penetration’ rate1 (in line with Asongu (2012), Ondiege, 2010 and Aker & Mbiti, 2010) as proxies for financial innovations. GBCP is more likely to gauge improvements in financial services since it omits credit to the government or public

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1 Caution, however, needs to be taken with the variable given that mobile penetration does not necessarily translate to mobile banking. In most SADC countries, mobile phones services was introduced in the early 1990s and finance was only integrated in mobile phones after 2011.
enterprises (Laeven, Levine and Michalopoulou, 2014). In addition, increases in bank credit across states promote financial innovation in the non-financial sector (Amore et al., 2013). M2M1 affects the demand for real cash balances as well as the income and interest elasticities of money demand (Arrau et al., 1995). Besides, a greater array of money substitutes reflects in broad money M2 than in narrow money M1 (Mannah-Blankson and Belnye 2004).

Mobile banking is one of the key innovations that have managed to increase financial access and depth and in the process enhancing economic growth. Most mobile transactions in the developing world enable users to store value (currency) in an account accessible via a handset, convert cash into and out of the store value account and transfer stored value between accounts (Jonathan & Camilo 2009). Financial development is proxied by Domestic Credit to Private Sector (DCP), which includes non-bank financial sectors credit to the private sector but excludes leading to the public sector, including Government. In any case, in developing countries, domestic credit extended to the private sector is not significantly different from the credit extended by the banking sector. Growth is measured by real GDP per capita growth.

The definitions of all the variables are presented in Table 2. A priori expectations are that variables for financial innovation have a positive impact on growth. The rational is that financial innovation reduces the cost of financial transactions, increases access to credit and enhances efficiency in the financial sector, which in turn drives economic activity and growth. Other variables, Gross Fixed Capital Formation (GCF) and Trade Openness (TO) are expected to have positive coefficients, implying a positive impact on economic growth. Consumer Price Index (CPI) and Government Expenditure (GEXP) are expected to have a negative effect.

3.1 Methodology - The Extended Aghion, Howitt, and Mayer-Foulkes (AHM) Model

The study uses an extended Aghion, Howitt, and Mayer-Foulkes’ (AHM) model developed by Laeven, Levine and Michalopoulou (2012). Laeven et al. (2012) tested the role of financial innovation on endogenous growth in the model with a key feature that states “economies without financial innovation will stagnate, irrespective of the initial level of financial development”. The AHM model was developed from the basic Schumpeterian growth model where entrepreneurs earn profits by inventing better goods and financiers arise to screen entrepreneurs.

\[ g - g_1 = b_0 + b_1 F + b_2(y - y_1) + b_3 F(y - y_1) + b_4 X + u \]  

(1)

where \( g - g_1 \) is average growth rate of per capita income relative to U.S. growth over the period ranging from 1960-95; \( F \) is financial development in 1960, which is measured as credit to the private sector as a share of GDP; \( y - y_1 \) is log of per capita income relative to U.S. per capita income; \( X \) is the set of control variables; and \( u \) is an error term. In contrast to the AHM model, the Laeven et al. (2012) model stresses the importance of financial innovation.
In their model, they stipulated that the level of financial development in any period is an outcome of previous financial innovations. Building on the model in equation (1) the panel cross-country regression that Michalopoulos, Laeven & Levine (2009, 2011) estimated was:

\[ g_{i,t} - g_{1i,t} = b_0 + b_1 F_{i,t} + b_2 (y_{i,t} - y_{1i,t}) + b_3 X_{i,t} + b_4 (y_{i,t} - y_{1i,t}) + \delta_i + \mu_{i,t} \]  

where the \( t \) subscripts indicate the particular period, so that \( t = 1, 2, \ldots, 7 \), for each country \( i \), data permitting, \( \delta_i \) is the coefficient on a country-specific effect, and where they also control for a time-specific effect in each period in the panel. This study estimates a reduced form of equation (2) by dropping comparative variables such that interpretation of coefficients becomes that of responsiveness rather than speed of convergence. Given the controversy that surrounds the true measures of financial innovation, the study introduces Broad to Narrow Money and Mobile Banking as additional variables for financial innovation to the model for comparison purposes. Mobile Money captures recent innovation in the financial sector. The dynamic regression model to be estimated in this study becomes:

\[ \frac{Y}{GGDP_{C_{it}}} = \frac{X}{GEXP_{it}, GCF_{it}, CPT_{it}, TO_{it}} + \frac{y_{t-1}}{GGDP_{PC_{it-1}}} + \frac{F}{DCP_{it}} + \frac{f_i}{(GBCP_{it}, M2M_{it}, MM_{it})} \]  

where \( Y \) is economic growth; \( X \) are control variables; \( F \) is the financial development variable; and \( f_i \) are financial innovation variables.

3.2 The Autoregressive Distributed Lag (ARDL) Model

The Autoregressive Distributed Lag (ARDL) model is comparatively more robust in small or finite samples (Ghatak and Siddiki 2001) consisting of 30 to 80 observations (Afzal et al. 2013 citing Mah, 2000). The approach is appropriate where variables have different orders of integration or for mutually integrated data (Giles, 2013). Modeling the ARDL with the appropriate lags correct for both serial correlation and endogeneity problems (Pesaran et al., 2001). ARDL co-integration estimates short and long run relationships simultaneously and provide unbiased and reliable estimates. In other words, the Error Correction Model ‘ECM’ joins together short run adjustments with long run equilibrium without losing long run information (Pesaran et al., 1999). A simplified panel ARDL model (see Baltagi, 2005) for variables X, Y and Z can be expressed as:

\[ \Delta y_{it} = \beta_0 + \beta_1 \Delta y_{it-1} + \gamma_1 \Delta x_{it-1} + \delta_1 \Delta z_{it-1} + \theta_0 y_{it-1} + \theta_1 x_{it-1} + \theta_2 z_{it-1} + \varepsilon_{it} \]  

where \( \theta_0; \theta_1 \) and \( \theta_2 \) are long-run coefficients whose sum is equivalent to the error correction term of the Vector Error Correction Model. Based on Pesaran et
(1999), the dynamic heterogeneous panel regression can be incorporated into
the Error Correction Model using the Autoregressive Distributed Lag ARDL
(p,q) technique and stated as follows (Loayza and Ranciere, 2006):

\[
\Delta(y_i)_{t} = \sum_{j=1}^{p-1} \gamma_j \Delta(y_i)_{t-j} + \sum_{j=0}^{q-1} \delta_j \Delta(X_i)_{t-j} + \varphi'[(y_i)_{t-j} - \{\beta_0^i + \beta_1^i (X_i)_{t-j}\}]' \epsilon_{it}
\]

where \(y\) is the GDP growth rate, \(X\) is a set of independent variables including
the financial development indicator, \(\gamma\) and \(\delta\) represent the short-run coefficients
of lagged dependent and independent variables respectively, \(\beta\) are the long-run
coefficients, and \(\varphi\) is the coefficient of speed of adjustment to the long run-
equilibrium. The subscripts

\(i\) and \(t\) represent country and time, respectively and \(p,q\) are the maximum
lags for dependent and independent variables, respectively. The term in the
square brackets contains the long-run growth regression. Equation (5) can be
estimated by three different estimators: the mean group (MG) model of Pe-
saran and Smith (1995), the pooled mean group (PMG) estimator developed by
Pesaran et al. (1999), and the dynamic fixed effects estimator (DFE).

The generalized ARDL model for testing the relationship between financial
innovation and economic growth in this study is:

\[
\Delta GGDPPC_{it} = C_0 + \beta_1 \Delta GGDPPC_{it-1} + \gamma_1 GBCP_{it-1} + \rho_{1} \Delta \frac{LM2}{M1_{it-1}} + \\
\alpha_1 MM_{it-1} + \delta_1 \Delta GEXP_{it-1} + \tau_1 \Delta GCF_{it-1} + \eta_1 \Delta CPI_{it-1} + w_1 \Delta TO_{it-1} + \\
\delta_1 \Delta GPC_{it-1} + \theta_0 GGDPPC_{i-1} + \theta_1 GBCP_{i-1} + \theta_2 \frac{LM2}{M1_{i-1}} + \theta_2 MM_{i-1} + \\
\theta_3 GEX_{i-1} + \theta_4 GCF_{i-1} + \theta_5 CPI_{i-1} + \theta_6 TO_{i-1} + \theta_7 GPC_{i-1} + \epsilon_{it}
\]

where \(\Delta\) indicates differencing of a variables, while \(\epsilon_{it}\) is white noise or the
error term \(t-1\) is the lagged period and all other variables are as defined
above. The long run co-integration is assessed by testing significance of the
\(\theta\) coefficients. \(\theta\) represents the long-run multipliers corresponding to long-run
relationships.

After estimating the ARDL model, the study carries out panel Granger
causality test to ascertain direction of causality between economic growth and
financial innovation. The set of equation for testing the causality are in Equation
(7).

\[
g_{it} = \sum_{j=1}^{J} \alpha_j^i g_{i(t-j)} + \sum_{j=1}^{J} \beta_j^i F_{i(t-j)} + u_{it}
\]

\[
FD_{it} = \sum_{j=1}^{J} \alpha_j^i F_{i(t-k)} + \sum_{j=1}^{J} \beta_j^i g_{i(t-j)} + u_{it}
\]

with \(J \in \mathbb{N}_*\) and \(u_{it}\) i.i.d.

Equation 7 is an autoregressive (AR) model that can be converted into an
AR (2) by setting \(N = 2\). A panel test for Granger causality test the significance
of $\beta_1 = \beta_2 = 0$ using a $\chi^2$ with two degrees of freedom. To establish if there is a long-run linkage between financial development and economic growth, this study tests the restriction $\beta_1 + \beta_2 = 0$, under the null hypothesis that there is no long-run effect (Caporale et al., 2009).

4 Empirical Results and Analysis

4.1 Panel Stationarity Test

Table 3 shows the panel unit root tests results for the variables. Panel unit roots tests establish that Domestic Credit to Private Sector (DCP), Broad Money to Narrow Money (M2M1) and Mobile Banking are difference stationary. All the other variables are stationary in levels. Given the small sample data set, and that the variables have different orders of integration, the Autoregressive Distributed Lag (ARDL) Model is more ideal for testing the relationship between financial innovation and economic growth.

4.2 ARDL Model Estimations

In the study, the ARDL model is estimated using the Pooled Mean Group (PMG) as well as the Dynamic Fixed Effects method. PMG allows short-run coefficients, including the intercepts, the speed of adjustment to the long-run equilibrium values, and error variances to be heterogeneous country by country, while the long-run slope coefficients are restricted to be homogeneous across countries (Samargandi, Fidrmuc, and Ghosh 2013). Table 4 shows the estimated long and short run coefficients for the Pooled Mean Group (PMG) and Dynamic Fixed Effects (DFE) estimations. Two models were estimated, Model 1 has Growth in Banking Sector Credit to Private Sector (GBCP) and ratio of Broad Money to Narrow Money (M2M1) as measures of financial innovation. Model 2 introduces Mobile Banking to Model 1. The estimations were separated for two reasons: first, there is always controversy on what constitute financial innovation, as such having a model that has a variable that is a direct financial innovation product would enable comparison across variables. Second, data for Mobile Banking only start from 1994 and there would be need for a model with variables that has data for a longer period (1985-2014).

**Without Mobile Money (Model 1)**

When estimated with PMG, before introducing mobile banking, Broad to Narrow Money (M2M1) is the only significant coefficient, with a negative effect on growth (-0.4188) in the long run. The negative coefficient is in contrast with a priori expectations and against findings by Petkovski & Kjosevski (2014). The negative effect is against theory presented by Shaw in 1973 that savings deposits increases more rapidly than transaction balances as the financial system expands and helps growth by facilitating economic activity (Petkovski & Kjosevski 2014). Shaw explains these changes in system of finance as financial deepening, which in Keynesian and Structuralist view could be satisfied by actively applying financial
liberalisation and financial reforms actively (Mohan, 2006). For SADC, the most probable explanation is that excessive increase in liquid perhaps trigger increase in inflation our increase in imports, both of which hurt growth, given production constraints in most countries.

Growth in Bank Credit to Private Sector (GBCP) has a negative and statistically insignificant effect in the long run. In the short run, broad money is positive and growth private credit is negative, although statistically insignificant. When estimated under DFE, all financial innovation variables do not have significant coefficients. GBCP, however, has a negative sign in the long run and a positive in the short run across both models. Broad money consistently retains a negative sign in both the short and long run. Although the variables are statistically insignificant, the interpretation of the persistent negative sign could be that the measures are picking effects of financial development. In addition, for credit, the negative sign could be indicative of non-performing loans that affected some SADC countries (Cojocaru, Hoffman & Miller, 2013), distribution and crowding out of credit to private sector. There are SADC countries which recorded high non-performing loans over the period under study, including, Zambia (26% in 2000; 23.6% in 2001) Tanzania (25.2% in 1999), Mozambique (23.4% in 2001) and Madagascar (19.6% 2002). Non-performing loans have a negative effect of discouraging financial institutions from lending, which in turn would impact negatively on economic growth (Romer, 2012). Regarding distribution of credit, where credit is directed to non-productive private sectors, it does not drive production or economic growth. Beck et al. (2012) show that there is a tight correlation between credit to enterprise and economic growth, and that no significant correlation exits between credit to households and economic growth. Credit extension to the private sector in the SADC countries was probably crowded out by credit to the household sector, which normally goes towards financing final consumption (Phakedi 2014).

**With Mobile Banking/Money (Model 1)**

When mobile banking is introduced, the model estimated by PMG shows that Growth in Bank Credit to Private Sector and Mobile Banking have a positive (2.1247 and 0.0099 respectively) and statistically significant effect on growth, at 1% and 5% levels of significance in the long run. Broad Money retains the negative effect at -0.4504, significant at 5% in the long run. In the short run only growth in private credit (GBCP) has a negative statistically significant effect at -2.0409, significant at 5%. When the same model was estimated under DFE, only mobile banking had a positive statistically significant effect on growth (0.0186) in the long run. Other variables, broad money retains a negative sign, whilst growth in private credit maintains a positive sign. In the short run, mobile money and broad money have positive signs whilst credit has a negative sign.

The long run result on credit is consistent with Michalopoulos, Laeven & Levine (2009, 2011), who find a positive relationship between growth rate of private credit to GDP and economic growth. The short run result is consistent with Ikhun & Aboagye (2014), who find a negative impact of financial innovation on economic growth the long run in Ghana. The possible explanation to this result is that, in the short run, innovation driven credit is not well spread and
well developed to have an effect on growth. Over the long run, given increased financial access and depth, innovation increases access to credit and encourages saving that enhances economic activity.

Mobile banking generally has a positive effect on economic growth, both in the short run and long run, consistent with a priori expectations. The result support arguments that in SADC, innovation in financial services support economic activity cross-countries, including efficient financial transfers and increasing the volume of trade (Maimbo, Saranga and Strychacz, 2010). Mobile money innovations enable remittances from South Africa to regional countries, efficient financial transactions across countries and efficient movement of investor funds across borders (Ramsamy 2014, Mochiko 2015). The results are in line with an argument by Napier (2010) that mobile phone companies in Africa have been engaged in innovations that have more impact than traditional microfinance. The introduction of mobile banking in the model causes private credit to drop the elements of financial development and assume net effects of financial innovation. Mobile Money variable has a strong effect in revealing and isolating the effect of financial innovation on growth by pulling out the positive effects suppressed in other variables.

Overall, the results show mixed effects of financial innovation on growth depending of the measure used, with a balanced number of positive and negative coefficients. However, given that three out of the five statistically significant long run coefficients on financial innovation variables are positive suggests that the net effect could be positive. Besides, the positive coefficients are statistically significant at higher levels than the negative coefficients. This can be used as a basis for concluding that generally financial innovation has a positive effect on economic growth in SADC. This position is supported by the fact that Mobile Banking, a direct measure of financial innovation, consistently displays a positive effect on growth. The dominant positive effect is, however, diluted by the negative effect under some of the variables and in the short run, weakening the net effect of financial innovation. The fact that only 30% of the 20 estimated financial innovation coefficients are statistically significant implies there is a weak relationship, although overly positive.

There are no similar studies on SADC and comparison, therefore, would be against studies in other regions or countries. The obtained results are in line with Michalopoulos, Laeven & Levine (2009, 2011), Valverde, Del Paso and Fernandez (2007), Amore, Schneider and Zaldokas (2013), Bassa (2013) and Mwinzi (2014) who find a positive relations between financial innovation and grow. The findings are not consistent with Idun & Aboagye (2014), who find that financial innovation is negatively related to economic growth in the long run in Ghana.

**Control variables**

Domestic Credit to Private Sector (DCP) has a negative significant effect on growth in the long run, consistent with Allen and Ndikumana (1998), Phaledi (2014) and Le Roux & Moyo (2015) who find a negative relationship between financial development and growth. Gross Fixed Capital Formation maintained an expected positive effect on growth in all cases, but significant only in DFE,
consistent with results by Shaheen et al (2013) and Asiedu (2013). Consumer Price Index (CPI) displays negative effects on growth consistent with its detrimental effect to growth in the SADC region (Bittencourt, van Eyden & Selleteng 2015). Government Expenditure (GEXP) has a negative in all cases but one when mobile banking in introduced under PGM estimations. Government expenditure has a reducing effect on growth if directed at non-productive sectors (Gorlach & Le Roux, 2013) or is financed by taxation Barro, 1989) or by borrowing (Snowdon & Vane, 2005). The positive effect could indicating the long run effect that government expenditure have in helping drive innovation, particularly countries with high research and development budgets or support to government owned financial institutions. Trade Openness support economic growth in SADC, mostly in the long run, consistent with other studies Mbulawa (2015); Asiedu, (2013); Mercan et al, (2013); Tan, (2012) and Dava (2012).

4.3 Long Run Relationship

Innovations have a relatively long adoption cycle and have a prolonged period before their impact on economic growth is realised. As such, presence of a long run relationship with growth becomes critical. In the estimated models, the Wald Test F-Statistic and the Error Correction Term tests the presence of a long run relationship between financial innovation and economic growth. Wald Test, F-Statistic values are shown in Table 5. All the Wald Test, F-Statistic values are higher than the critical values, indicative of existence of a long-term co-integrating relationship among the variables both models and estimation technique. The Error Correction Term (ECT) shows the speed of adjustment to restore equilibrium in the long run after a one period shock in the short run. Ideally, a model with a stable long-run relationship should have a statistically significant coefficient with a negative sign (Pahlavani, Wilson and Worthington, 2005). The Error Correction Terms for the estimated models are shown in Table 3. The ECTs for Models 1 and 2 under PMG are -0.6751 and -0.8174 respectively, meaning that deviation from the long-run equilibrium following a short-run shock is corrected by about 67.5% and 81.7% respectively in one year. The Error Correction Terms for DFE estimations are also negative and significant, confirming existence of a long run relationship between financial innovation and economic growth.

4.4 Granger Causality Tests

Causality tests in this study are carried out on a panel Autoregressive Model of order 2, using Dynamic Fixed Effects. Table 6 shows the results of the Granger causality estimations across for the three measures of financial development. The Wald test statistics for testing short and long run causality relationship are all statistically insignificant across the three measures of financial innovation. The results suggest that there is no causality, in either way, between financial innovation and economic growth in SADC both the short and long run. In other words, there is independence between financial innovation and economic
growth in the SADC region. The long run effects of Growth in Bank Credit to Private Sector and Mobile Banking are, however, positive, a result consistent with the ARDL estimations results in Table 4. The long run net effect of Broad to Narrow Money on economic growth is negative when growth is dependent.

The no causality results are confirming earlier suggestions of a weak relationship between financial innovation and growth in SADC. The results are in support of the theoretical arguments by (Chou and Chin, 2004) that financial innovations lead to long-run growth solely through the technological innovation channel, which apparently is lacking in the SADC region. Results are contrasting assertions by Moyo et al. (2014) that financial sector reform engenders financial innovation potentially leading to higher economic growth. SADC countries introduced financial reforms in the 80s and 90s but the reforms have not triggered innovations that can drive growth.

5 Conclusions and Recommendations

The empirical estimations carried out in this study show that financial innovation generally has a weak positive effect on economic growth in the long run, although the effects vary with the variable used to measure financial innovation. Introducing mobile banking, a direct measure of financial innovation, buttresses the role of financial innovation in growth, including under private credit. In addition, the panel Granger causality test results suggest that there is no causality, in either direction, between financial innovation and economic growth in both the short and long run. The results counter models and theory of economic growth, which generally ignore financial innovation (Michalopoulos et al., 2009). Overall, the obtained results are consistent with theory, a priori expectations and recent developments in the SADC countries. Below are the possible explanations.

There are positive developments in the SADC countries in terms of financial innovations that are in support of the positive effect conclusion. Substantial progress has been made over the past two decades in terms of financial inclusion and financial innovation, as well as cross-border banking in Africa’s banking systems (Beck, Senbet and Simbanegavi 2015). SADC countries are continuously reforming their financial sectors, accommodating innovations such as microfinance, mobile money and mobile banking to increase financial inclusion. Financial sector reform engenders financial innovation and promotes efficiency in the financial system, potentially leading to higher economic growth (Moyo et al, 2014). In the SADC, the introduction of mobile banking increased depth and access of financial intermediation, generating increased economic activity as the previously marginalised are given access to credit or saving products on their mobile platforms. Theory says that financial innovation increases the variety of products offered by financial intermediaries and fosters the rate of technological progress (Chou & Chin 2004). This naturally explains the consistent positive relationship between mobile banking and economic growth.

Theory indicates that innovation is a double edged-sword (Arnaboldi and
Rossignoli 2013) with a ‘good’ side, which includes of driving economic growth, and a ‘dark’ side (Beck et al., 2014). In as much as the good side of financial innovation could be assumed to have contributed to positive effect on growth, it not given that the bad side of financial innovation has contributed to the negative effects. The negative effect could be indicative of the fact that the financial innovation in the countries is still low to have an impact on growth.

Deductions are that the effect of financial innovation on growth is, however, weakened by the underdeveloped financial sectors of SADC countries. Until recently when financial innovations such as mobile money that do not entirely rely on the financial sector were introduced, financial innovations were dependent on the financial sector and would occur with the financial sector. As such, advancement in innovation in the financial sector would depend on the level of financial development. In addition, private credit and broad money measures of financial innovation that have negative coefficients are derived from variables that reflect financial development. It would be logical to assume that their negative effect on growth could be picking the effect of financial development on growth given a negative relationship between financial development and economic growth in the SADC region (Allen and Ndikumana 1998, Phaledi 2014 and Le Roux & Moyo 2015).

The implication on causality findings is that the on-going innovation in financial sectors of most countries, though with positive effects, does not have a significant impact on economic growth. The results also suggest that growth in the SADC region does not influence or drive financial innovation. Implicitly, there is potential to increase financial innovation in SADC without being constrained by the country’s growth.

The positive relationship between financial innovation and economic growth support recommendations of increasing financial innovation in the SADC countries. SADC countries need to develop of their financial sectors in order to enhance financial innovations that support economic growth. In framing policies, SADC governments have to balance the distinctive priorities of promoting financial sector development, financial innovation, and financial inclusion; at the same time limiting risks to financial sector stability (Mlachila, et al., 2013). Where SADC countries receive assistance for promoting access to financial services, the target should be towards enhancing innovation-based platforms (Napier 2014). Financial innovation needs to be anchored on mobile banking as it has the net effect reaching out to the unbanked at the same time enhancing depth, access and convenience to the already banked. SADC countries, individually, are too small to support or attract huge investment in financial infrastructure that supports continuous financial innovations. As such, SADC countries should promote co-operation in the development of infrastructure, technology and innovations under the regional financial integration framework.
References


FIGURES

Figure 1: Observed relationship between financial innovation and growth in SADC

*gdGDPCC=growth in Gross Domestic Product per Capita (GDPPC)
Data Source: World Development Indicators (2015)

TABLES

Table 1: Measure of access and usage of innovative banking service in Southern Africa

<table>
<thead>
<tr>
<th></th>
<th>Access</th>
<th>Usage</th>
<th>Mobile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Account at a formal financial institution (% age 15+) (2011)</td>
<td>ATMs per 100,000 adults (2014)</td>
<td>Bank branches per 100,000 adults (2014)</td>
</tr>
<tr>
<td>Angola</td>
<td>39.2</td>
<td>21</td>
<td>13</td>
</tr>
<tr>
<td>Botswana</td>
<td>30.3</td>
<td>29</td>
<td>9</td>
</tr>
<tr>
<td>DRC</td>
<td>30.3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lesotho</td>
<td>18.5</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Madagascar</td>
<td>5.5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Malawi</td>
<td>16.5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Mauritius</td>
<td>80.1</td>
<td>44</td>
<td>22</td>
</tr>
<tr>
<td>Mozambique</td>
<td>39.9</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Namibia</td>
<td>-</td>
<td>53</td>
<td>13</td>
</tr>
<tr>
<td>Seychelles</td>
<td>-</td>
<td>66</td>
<td>51</td>
</tr>
<tr>
<td>South Africa</td>
<td>53.6</td>
<td>62</td>
<td>10</td>
</tr>
<tr>
<td>Swaziland</td>
<td>28.6</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>Tanzania</td>
<td>17.3</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Zambia</td>
<td>21.4</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>39.7</td>
<td>6</td>
<td>5</td>
</tr>
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### Table 2: Variables description and expected signs

<table>
<thead>
<tr>
<th>Variable Category</th>
<th>Variable</th>
<th>Description</th>
<th>Definition</th>
<th>Expected Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable</td>
<td>GGDPPC</td>
<td>Growth in Real Gross Domestic Product per capita</td>
<td>Growth in real Gross Domestic Product per capita</td>
<td>-</td>
</tr>
<tr>
<td>Financial Innovation</td>
<td>GBCP</td>
<td>Growth in Bank Credit to Private Sector</td>
<td>Growth in total credit by banks to private sector</td>
<td>positive</td>
</tr>
<tr>
<td></td>
<td>M2M1</td>
<td>Broad to narrow Money</td>
<td>Broad Money (M2) divided by narrow money (M1)</td>
<td>Positive/ negative</td>
</tr>
<tr>
<td></td>
<td>MM</td>
<td>Mobile Banking/Money</td>
<td>Mobile penetration rate</td>
<td>Positive</td>
</tr>
<tr>
<td>Financial Development</td>
<td>DCP</td>
<td>Domestic credit to private sector</td>
<td>Domestic credit to private sector as a proportion of GDP</td>
<td>positive</td>
</tr>
<tr>
<td>Control Variables</td>
<td>GCF</td>
<td>Gross Fixed Capital Formation</td>
<td>Gross fixed capital formation/GDP</td>
<td>positive</td>
</tr>
<tr>
<td></td>
<td>GEXP</td>
<td>Government Expenditure</td>
<td>Total Government expenditure/GDP</td>
<td>negative</td>
</tr>
<tr>
<td></td>
<td>CPI</td>
<td>Consumer Price Index (Inflation)</td>
<td>Growth in Consumer Price Index (Inflation rate)</td>
<td>negative</td>
</tr>
<tr>
<td></td>
<td>TO</td>
<td>Trade Openness</td>
<td>(Exports+ Imports)/GDP</td>
<td>positive</td>
</tr>
</tbody>
</table>

### Table 3: Panel Unit Root Tests at Level

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levin, Lin &amp; Chu</th>
<th>Im, Persaran and Shin W-state</th>
<th>ADF-Fisher Chi-Square</th>
<th>PP-Fisher Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>4.32753 (0.0000)***</td>
<td>-4.18841 (0.0000)***</td>
<td>87.4226 (0.0000)***</td>
<td>95.3842 (0.0000)***</td>
</tr>
<tr>
<td>DCP</td>
<td>0.8219 (0.7944)</td>
<td>2.2981 (0.9892)</td>
<td>21.1496 (0.8832)</td>
<td>19.4022 (0.9312)</td>
</tr>
<tr>
<td>D(DCP)</td>
<td>-12.8807 (0.0000)***</td>
<td>-13.0910 (0.0000)***</td>
<td>209.181 (0.0000)***</td>
<td>282.791 (0.0000)***</td>
</tr>
<tr>
<td>GBCP</td>
<td>-11.5212 (0.0000)***</td>
<td>-16.6741 (0.0000)***</td>
<td>268.504 (0.0000)***</td>
<td>278.349 (0.0000)***</td>
</tr>
<tr>
<td>M2M1</td>
<td>-0.0817 (0.4674)</td>
<td>1.1641 (0.8778)</td>
<td>22.8308 (0.8222)</td>
<td>27.2391 (0.6107)</td>
</tr>
<tr>
<td>D(M2M1)</td>
<td>-8.3502 (0.0000)***</td>
<td>-10.4926 (0.0000)***</td>
<td>161.840 (0.0000)***</td>
<td>332.072 (0.0000)***</td>
</tr>
<tr>
<td>MM</td>
<td>0.2851 (0.6122)</td>
<td>0.0218 (0.5087)</td>
<td>28.9690 (0.5192)</td>
<td>42.1354 (0.0697)***</td>
</tr>
<tr>
<td>D(MM)</td>
<td>-5.1318 (0.0000)***</td>
<td>-7.0212 (0.0000)***</td>
<td>111.397 (0.0000)***</td>
<td>426.667 (0.0000)***</td>
</tr>
<tr>
<td>GCF</td>
<td>-2.90409 (0.0018)***</td>
<td>-3.1336 (0.0009)***</td>
<td>54.0280 (0.0046)***</td>
<td>66.6563 (0.0001)***</td>
</tr>
<tr>
<td>GEXP</td>
<td>-4.01101 (0.0000)***</td>
<td>-3.96590 (0.0000)***</td>
<td>72.1170 (0.0000)***</td>
<td>69.2745 (0.0001)***</td>
</tr>
<tr>
<td>GGDPPC</td>
<td>-6.16933 (0.0000)***</td>
<td>-6.4979 (0.0000)***</td>
<td>100.094 (0.0000)***</td>
<td>189.686 (0.0000)***</td>
</tr>
<tr>
<td>TO</td>
<td>-3.58490 (0.0002)***</td>
<td>-2.8190 (0.0024)***</td>
<td>54.1696 (0.0044)***</td>
<td>46.4778 (0.0280)***</td>
</tr>
</tbody>
</table>

*Hashmark indicates t-statistic (probability); ***, **, * stationary at 1%, 5% and 10% levels respectively*
<table>
<thead>
<tr>
<th>Variables</th>
<th>Pooled Mean Group (PMG)</th>
<th>Dynamic Fixed Effect (DFE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1 HQ Criteria (1,1,1,1,1,1,0) (Without Mobile Banking)</td>
<td>Model 2: HQ Criteria (1,1,1,1,1,1,0) (with Mobile Banking)</td>
</tr>
<tr>
<td></td>
<td>Model 1 AIC (1,1,1,1,1,0) (Without Mobile Banking)</td>
<td>Model 2: AIC (1,1,1,1,1,1,0) (with Mobile Banking)</td>
</tr>
<tr>
<td>C</td>
<td>3.8485(0.0218)**</td>
<td>1.2282(0.5383)</td>
</tr>
<tr>
<td>GBCP</td>
<td>-0.3800(0.5038)</td>
<td>-1.782(0.6924)</td>
</tr>
<tr>
<td>M2M1</td>
<td>-0.4188(0.0496)**</td>
<td>-0.4504(0.0189)**</td>
</tr>
<tr>
<td>MM</td>
<td>0.0099(0.0435)**</td>
<td>0.0186(0.0430)**</td>
</tr>
<tr>
<td>DCP</td>
<td>-0.0400(0.0014)**</td>
<td>-0.0535(0.0003)**</td>
</tr>
<tr>
<td>GCF</td>
<td>0.0078(0.5444)</td>
<td>0.1188(0.0002)**</td>
</tr>
<tr>
<td>GEXP</td>
<td>-0.1247(0.0039)**</td>
<td>-0.1911(0.0001)**</td>
</tr>
<tr>
<td>CPI</td>
<td>-0.0638(0.0000)**</td>
<td>-0.0202(0.0197)**</td>
</tr>
<tr>
<td>TO</td>
<td>0.0249(0.0317)**</td>
<td>0.0108(0.2876)</td>
</tr>
</tbody>
</table>

**Long Run Estimations**

ECT (-1)  -0.6751(0.0000)***
D(GGDPPC(-1)) -0.0822(0.9206)
D(GBCP(-1)) -0.0822(0.9206)
D(M2M1(-1)) 0.0710(0.9584)
D(MM(-1)) 0.1550(0.1926)
D(DCP(-1)) -0.1630(0.1296)
D(GCF(-1)) 0.0968(0.2022)
D(GEXP(-1)) -0.1366(0.1346)
D(TO) 0.0159(0.6381)
D(CPI) -0.0160(0.6998)
C 3.5853(0.0000)***

**Short Run Estimations**

ECT (-1)  -0.8174(0.0000)***
D(GGDPPC(-1)) -0.0822(0.9206)
D(GBCP(-1)) -0.1130(0.0781)*
D(M2M1(-1)) -0.4421(0.2800)
D(MM(-1)) 0.1550(0.1926)
D(DCP(-1)) -0.1630(0.1296)
D(GCF(-1)) 0.1173(0.0554)*
D(GEXP(-1)) -0.2383(0.0879)*
D(TO) 0.0159(0.6381)
D(CPI) -0.1159(0.0480)***
C 3.5853(0.0000)***
### Table 5: Wald Test Results (F-Values) for Long run- Cointegration

<table>
<thead>
<tr>
<th>Pooled Mean Group</th>
<th>Model 1- (Without Mobile Banking)</th>
<th>F-Value</th>
<th>Cointegration (using Pesaran)</th>
</tr>
</thead>
<tbody>
<tr>
<td>∆GGDPPC_{it}[F_{GGDPPC}\left(\begin{array}{c}GBCP_{it}, M2M1_{it}, \DCP_{it}, GCF_{it}, GEXP_{it}, CPI_{it}, T0_{it}\end{array}\right)]</td>
<td>7.8117</td>
<td>Present</td>
<td></td>
</tr>
<tr>
<td>Model 2-With Mobile Banking</td>
<td>∆GGDPPC_{it}[F_{GGDPPC}\left(\begin{array}{c}GBCP_{it}, M2M1_{it}, MM_{it} \DCP_{it}, GCF_{it}, GEXP_{it}, CPI_{it}, T0_{it}\end{array}\right)]</td>
<td>7.2361</td>
<td>Present</td>
</tr>
<tr>
<td>Dynamic Fixed Effect</td>
<td>Model 1- (Without Mobile Banking)</td>
<td>∆GGDPPC_{it}[F_{GGDPPC}\left(\begin{array}{c}GBCP_{it}, M2M1_{it}, M_{it} \DCP_{it}, GCF_{it}, GEXP_{it}, CPI_{it}, T0_{it}\end{array}\right)]</td>
<td>16.775</td>
</tr>
<tr>
<td>Model 2, AIC(1,1,1,1,1,1)- With Financial Development</td>
<td>∆GGDPPC_{it}[F_{GGDPPC}\left(\begin{array}{c}GBCP_{it}, M2M1_{it}, MM_{it} \DCP_{it}, GCF_{it}, GEXP_{it}, CPI_{it}, T0_{it}\end{array}\right)]</td>
<td>11.2386</td>
<td>Present</td>
</tr>
</tbody>
</table>

#### Pasaran (2001) Critical Values

<table>
<thead>
<tr>
<th>k</th>
<th>1%</th>
<th>5%</th>
<th>10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I(0)</td>
<td>I(1)</td>
<td>I(0)</td>
<td>I(1)</td>
</tr>
<tr>
<td>6</td>
<td>3.15</td>
<td>4.43</td>
<td>2.45</td>
</tr>
<tr>
<td>7</td>
<td>2.96</td>
<td>4.26</td>
<td>2.32</td>
</tr>
</tbody>
</table>

Unrestricted intercept and no trend

### Table 6: Granger Causality tests- Wald Coefficient Restrictions tests

<table>
<thead>
<tr>
<th>Dependent: Economic growth</th>
<th>Dependent: Financial Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Real GDPPC and Growth in Bank Credit to Private Sector</strong></td>
<td><strong>Real GDPPC and Broad to Narrow Money</strong></td>
</tr>
<tr>
<td>Short run</td>
<td>GBCP(-1)=GBCP(-2)= 0</td>
</tr>
<tr>
<td>Wald test Chi-square</td>
<td>0.4948 (0.7808)</td>
</tr>
<tr>
<td>Long run</td>
<td>GBCP(-1)+GBCP(-2) = -0.4219</td>
</tr>
<tr>
<td>Wald test Chi-square</td>
<td>0.4048(0.5246)</td>
</tr>
</tbody>
</table>

| **Real GDPPC and Mobile Money/Banking** |
| Short run | MM(-1)=MM(-2)= 0 | GGDPPC(-1)=GGDPPC(-2)= 0 |
| Wald test Chi-square | 3.6676(0.1598) | Wald test Chi-square | 3.8963(0.1425) |
| Long run | MM(-1)+MM(-2) = -0.2458 | GGDPPC(-1) + GGDPPC(-2) = 0.0045 |
| Wald test Chi-square | 0.0145( 0.9041) | Wald test Chi-square | 1.8182( 0.1775) |