Is the relationship between financial development and income inequality symmetric or asymmetric ? new evidence from South Africa based on NARDL

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Abstract

Income inequality in South Africa has been increasing from a Gini-coefficient height of 0.57 in 2000 to 0.65 in 2014. It is therefore important to investigate whether, in a developing economy, financial sector development reduces or worsens income inequality by mobilising and allocating savings into productive investments. For this purpose, South Africa, with arguably the second-largest economy in Africa, has been identified. The Non-linear Auto Regressive Distributed Lag (NARDL) technique advanced by Shin et. al. (2014) has been applied. This paper contributes to existing literature both in terms of being country-specific as well as demonstrating for the first time, to the best of our knowledge, that there is no long-run asymmetry between financial development and income inequality. Our conclusions support the pressing need for double-digit economic growth in South Africa together with moderate increase in government consumption expenditures.

Keywords: Financial development, Income Inequality, South Africa, NARDL

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Introduction

From a theoretical point of view, there are conflicting predictions about the effect of financial development on income inequality. Nonetheless, most of the work already done seems to suggest that improvements in financial contracts, markets and intermediaries expand economic opportunities and reduce inequality. Research on South Africa is rather limited.

Two influential hypotheses relating to the finance-inequality nexus have been identified. The first is the inequality-widening hypothesis, while the second is the inequality-narrowing hypothesis.

According to the inequality-widening hypothesis, financial development tends to benefit the rich more than the poor. This is largely due to the rich having better potential to offer collateral to banks which the poor don't have. Consequently, the latter find it difficult to access financing even when financial markets are well developed.

On the contrary, according to the inequality-narrowing hypothesis proposed by Banerjee and Newman (1993), when financial markets develop, the poor who were previously excluded from getting loans will have access to financing. Such financial system development tends to improve efficiency of capital allocation and lessen funding constraints, thereby resulting in a positive relationship between financial development and income inequality.

Jovanovic (1990) suggest a third hypothesis which predicts a non-linear relationship, where the distributional effect of financial development depends on the level of economic development. Contrary to the above three hypotheses, Coskun (2016) finds neither support for a linear nor non-linear relationship between financial development and income inequality. They assess the finance-inequality-poverty nexus by taking the separate and simultaneous impacts of banks and stock market into account. Although their findings are mixed, they demonstrate that while financial development does promote economic growth, it does not necessarily benefit those in low income brackets within emerging economies. Like the finance-growth nexus, it is possible that poverty and income inequality reduction exerts a positive effect on financial development

through an increase in savings and demand for funds. An examination of this relationship not only helps to understand the role of financial deepening in sustainable development but also sets a framework for discussion of financial and distribution policies for the lower income group. Consequently, it is important to reveal the direction of causal relationship between finance and income inequality, one of the key objectives of this paper.

Just as the theoretical underpinnings emphasize conflicting opinions regarding financial development and income inequality, so does empirical study. The study of Watzka (2012) is surprising in that the data set consists of 138 developed and developing countries between 1960 and 2006 and it finds financial development worsening income inequality. Although the study of Giri (2015) is restricted to India for the period 1982 – 2012, it also supports the inequality widening hypothesis. The study by Sturm (2017) finds that all finance variables increase income inequality.

George Clarke (2006) rejects the finance-inequality widening hypothesis and at the same time does not find support for the inverted U-shaped hypothesis suggested by Greenwood. Using the GMM approach for the period 1980 – 2000, Tan (2009) investigates the impact of financial development on income inequality in 35 developing countries and shows that financial development improves income distribution, thereby supporting the inequality-narrowing hypothesis. In a study done by Kinkyo (2016) using PMG techniques, it is shown that financial development tends to reduce inequality in the long-run, while it can increase inequality in the short-run.

Most other studies, while being individual country approaches, find a linear and negative relationship between financial development and inequality. These studies include, inter alia, that of Liang (2006) on China, Piraee (2013) on Iran, Ang (2010) on India and Islam (2011) on Pakistan.

This paper is therefore an attempt to determine Granger-causal relationship as well as the linear/non-linear relationship between financial development and income inequality in South Africa particularly.

This paper makes a few contributions to the literature by: (1) filling the gap in existing literature which is dominated by cross-country analysis; (2) attempting to determine whether a symmetrical or asymmetrical relationship exists between financial development and income inequality and (3) using a wider credit definition of domestic credit provided by financial institutions rather than private credit provided by banks;

Our variance decomposition reveals that GDP is most exogenous, followed by government consumption expenditure. Therefore, a positive long-run relationship between GDP per capita and income inequality is established. We also find trade to GDP having a negative long-run relationship with income inequality, implying that if market participation is increased, it can play a role addressing income inequality. This study finds domestic credit to be negatively related to income inequality. This is an interesting finding for financial institutions to find innovative ways to tap into the SME market to address income inequality. Finally, we find that a long-run asymmetrical relationship does not exist between financial development and income inequality in the case of South Africa.

The remainder of this paper is structured as follows: Section 2 contains the literature review comprising of both theoretical as well as empirical underpinnings. Section 3 presents the data and methodology of the study. Section 4 discusses the empirical results, while Section 5 concludes the paper.

2.1. Theoretical underpinnings

From a theoretical point of view, there are conflicting predictions about the effect of financial development on income inequality. Nonetheless, most of the work already done seems to suggest that improvements in financial contracts, markets and intermediaries expand economic opportunities and reduce inequality. Research on South Africa is somewhat limited. When financial markets and institutions work, they are supposed to provide financing opportunities for all market participants. In the process of employing these funds to productive uses, economic growth should be enhanced.

Two influential hypotheses' relating to the finance-inequality nexus have been identified. The first is the inequality-widening hypothesis while the second is the inequality narrowing hypothesis.

According to the inequality-widening hypothesis, financial development tends to benefit the rich more than the poor. This is more-so under conditions of weak institutional quality according to George Clarke (2006). This is largely due to the rich having better potential to offer collateral to banks which the poor don't have. Consequently, the latter find it difficult to access financing even when financial markets are well developed. Income inequality would worsen, resulting in a positive relation between financial development and income inequality.

On the contrary, according to the inequality-narrowing hypothesis proposed by Banerjee and Newman (1993), when financial markets grow, the poor who were previously excluded from getting loans will have access to financing. Such financial system development tends to improve efficiency of capital allocation and lessen funding constraints, thereby resulting in a negative relationship between financial development and income inequality.

Jovanovic (1990) suggest a third hypothesis which predicts a non-linear relationship, where the distributional effect of financial development depends on the level of economic development. In other words, as the economy grows, the financial sector is more developed and thus able to provide broader financial access to the economy, and poor market participants. However, as the economy gains more steadiness, income inequality begins to shrink and hence this non-linear hypothesis suggests an inverted U-shaped theory.

Contrary to the above three hypothesis', Coskun (2016) find neither support for a linear nor non-linear relationship between financial development and income inequality. They assess the finance-inequality-poverty nexus by taking the separate and simultaneous impacts of banks and stock market into account. Although their findings are mixed, they demonstrate that while financial development does promote economic growth, it does not necessarily benefit those in low income brackets within emerging

economies. According to them, bank development has a more significant impact on income inequality and poverty than stock market development.

Like the finance-growth nexus, it is possible that poverty and income inequality reduction exerts a positive effect on financial development through an increase in savings and demand for funds. An examination of this relationship not only helps to understand the role of financial deepening in sustainable development but also sets a framework for discussion of financial and distribution policies for the lower income group. Consequently, it is important to reveal the direction of causal relationship between finance and income inequality.

This study makes an initial attempt to test the symmetrical or asymmetrical relationship between income inequality and financial development. This is done after testing the linear hypothesis of finance-inequality nexus.

In South Africa, various financial restructuring programmes aim to achieve a better financial system. Most notable is the Black Economic Empowerment scheme (BEE) and the National Development Plan Vision 2030. However, there is little empirical evidence providing policy makers with the necessary information as to whether these reforms have had any impact on the financial system, and consequently on income distribution.

2.2. Empirical review

Approaching the issue of income inequality and financial development from an empirical point of view allows one to understand the relationship between finance and inequality and the applicable theoretical models that apply to these concepts.

Just as the theoretical underpinnings emphasize conflicting opinions regarding financial development and income inequality, so does empirical study. On a broader level, most empirical studies demonstrate that financial development reduces income inequality. These studies are obviously subject to many qualifications and restrictions. Nonetheless, a summary of these findings can be found in the appendix of this paper.

In support of the inequality widening hypothesis is the study of Tan (2009) that argues no significant evidence supporting the effect of financial development on income inequality. They suggest that government should focus on improvement of institutional quality and maintain low inflation to combat inequality in addition to various public development programmes. The study of Watzka (2012) is surprising in that the data set consists of 138 developed and developing countries between 1960 and 2006 and it finds financial development exacerbating income inequality. Although the study of Giri (2015) is restricted to India for the period 1982 – 2012, it also supports the inequality widening hypothesis. The study by Sturm (2017) is interesting in terms of the sample of 121 countries covering 1975–2005. It is found that all finance variables increase income inequality. It also finds that the quality of political institutions tends to condition the impact of financial liberalization on income inequality, in contrast to the quality of economic institutions.

In support of the inequality narrowing hypothesis, Clarke (2006) rejects the finance-inequality widening hypothesis and at the same time does not find support for the inverted U-shaped hypothesis suggested by Greenwood. Results of the study by Clarke show that inequality is lower in countries with better developed financial markets and that inequality decreases as economies develop their financial intermediaries. Using the GMM approach for the period 1980 – 2000 Tan (2009) investigate the impact of financial development on income inequality in 35 developing countries and show that financial development improves income distribution, thereby supporting the inequality-narrowing hypothesis.

Kapingura (2013) uses ATM access as a measure of financial development in South Africa and finds that even though the variable is negative, it is still significant thereby implying a positive relationship between financial development and income inequality. Using panel estimation technique (GMM) Batuo (2010) finds that income inequality decreases as economies develop their financial sector. The result also confirms that educational advancement plays a significant role in narrowing income inequality. In a study done by Kinkyo (2016) using the PMG technique, it is shown that financial development tends to reduce inequality in the long-run, while it can increase inequality in the short-run. Furthermore, the study finds that good governance seems to be important for achieving inclusive growth though financial development. In a study

done by Odhiambo (2009) it is shown that both financial development and economic growth Granger-cause poverty reduction in South Africa. The study finds that this applies irrespective of whether the causality test is conducted in the short-run or in the long-run.

The study by Madsen (2017) examines the four main channels through which inequality transmits to growth: savings, investment, education, and knowledge production. Panel data for 21 OECD countries spanning 142 years is constructed for this purpose. External communist influence is used as a new time-varying instrument for inequality and the effects of inequality on the outcome variables are made conditional on the stage of financial development. The results show that inequality hampers growth at low to moderate levels of financial development but has little effect on growth at advanced levels of financial development.

Most other studies, while being individual country approaches, find a linear and negative relationship between financial development and inequality. These studies include, inter alia, Liang (2006) on China, Piraee (2013) on Iran, Ang (2010) on India and Islam (2011) on Pakistan. This makes a strong case for this paper to study the non-linear relationship between financial development and income inequality.

3. Data and methodology

3.1. Income Inequality (IE) and Financial Development (FD) variables

This study examines time-series data for South Africa from 1975 to 2015. All data is sourced from the World Bank with exception to that of Household Income Inequality Index. Income inequality can be measured using different indicators of which the most used ones are the Lorenz curve, Gini coefficient, quantile ratio and Palma ratio. In addition, there are others which are less commonly used, such as the Theil index, Robin Hood index, Atkinson index, Coefficient of Variation, Generalised Entropy Index and Sen Poverty Measure. Each of these indices have advantages and disadvantages.

While the Gini coefficient is a more commonly used measure of income inequality, its use has been dropped in this study due to the sparse availability of data on South

Africa. Therefore, the Estimated Household Income Inequality (HII) from the University of Texas Inequality Project has been adopted. The data is available annually for a group of both developed and developing countries for the period 1963-2016. The HII is expressed in percentage terms and ranges from '0' (perfect equality) to '100' (perfect inequality). The UTTP has developed the index based on data collected by the United Nations Industrial Development Organization (UNIDO). According to Galbraith and Kum, this measure of inequality is based on household and expenditure surveys due to its greater availability. Together with this, there seems to be a strong link between increased earning and wage inequality and income inequality in more industrialised countries. Based on this premise, the UTIP-UNIDO provides a denser data-set to facilitate time-series analysis.

The way in which financial development is measured in empirical literature is also quite varied. Both bank-based, as well as market-based indicators, have been used. For purposes of this study, banking sector development has been used and proxied by domestic credit as a percentage of GDP. This is supported by Clarke (2006), Islam (2011) and Piraee (2013).

Domestic Credit provided by the financial sector as a percentage of GDP has been added as a control variable to also capture financial development. Because it measures the role of all financial institutions in channelling funds to fund users, it tends to be a better indicator than Domestic Credit by banks only. The motivation for extending the definition of domestic credit through the adoption of this variable is that the data also captures Islamic Banking as well as development financial institution lending, which are both interest areas for this study.

As control variables, we have included GDP per capita, trade as a percentage of GDP, inflation and government consumption expenditure.

The justification for the use of GDP per capita is that it is highly correlated with financial sector development according to Clarke et al., (2006) The significance of trade as a percentage of GDP is that it captures the degree of openness of the economy in terms of how it is calculated, i.e. import and export value divided by GDP. The Stolper-Samuelson theorem suggests that trade liberalisation generates more jobs for the labour-intensive sector. By extension, the more unskilled labour is, the more it will benefit from trade openness. Due to inflation often being a driver of inequality, it has

been adopted as a control variable. Government Consumption Expenditure tends to be positively correlated with income inequality and is therefore adopted as a further control variable. Both inflation and government consumption expenditure as control variables are supported by Zhang (2016)

Symbol	Variable name	Nature of variable	Source of data	Comments on data
HII	Household income inequality	Focus	University of Texas Inequality Project	Denser data set
DC	Domestic credit as a percentage of GDP (bank-based)	Focus	World Bank	Data also captures Islamic Banking as well as development financial institution lending
MC	Market capitalisation as a percentage of GDP (Market-based)	Control	World Bank	
GPC	GDP per capita	Control	World Bank	
TG	Trade as a percentage of GDP	Control	World Bank	
IN	Inflation	Control	World Bank	
GCE	Government consumption expenditure	Control	World Bank	

3.2. Empirical Methodology

The empirical methodology used in this paper begins with unit root tests to proceed with Engle & Granger as well as Johansen co-integration tests. Since our variables comprised of both I(0) and I (1), we were compelled to move to ARDL. This was followed by the construction of a long-run Error Correction Model and Variance Decomposition. Finally, to test the symmetrical relationship, the NARDL technique was used.

Unit root / Stationarity test

The unit roots of all variables were taken using ADF, PP and KPSS tests. Only the ADF results are reported in the appendix based on the premise that ADF takes care of the autocorrelation problem, a characteristic of time-series data. The variables were found to be comprising of both I(0) and I(1) and therefore not integrated in the same order.

To test for cointegrating vectors, the Engle & Granger test for co-integration was then carried out, followed by Johansen & Juselius. As a result of having both I(0) and I(1) variables, the predictive power of these two co-integration tests are affected. The main weakness of the Engle & Granger test is that it is designed to only test up to one co-integrating vector, while the main weakness of the Johansen test is that it is sensitive to the sample size and, most importantly, is in favour of the null hypothesis. Its second weakness is that it requires all variables in a model to have the same number of lags. (See appendix for results)

The finding of both I(0) and I(1) variables as well as this cointegrating vector outcome, justified the adoption of ARDL developed by Pesaran (2001). ARDL accommodates both I(I) and I(0) variables and is able to determine long-run co-integration. The advantage of ARDL is that it provides robust results irrespective of sample size. It also allows the optimal lag lengths of the variables to differ. Akaike Information Criterion (AIC) was used for this study to determine the optimal lag lengths for the ARDL model. Nonetheless, SBC results are provided in the appendix. The advantage of AIC is that

it focuses on predicting the best and highest order of lags, rather than lowest as in SBC, and that it does not focus on over parameter.

ARDL test of co-integration

The first step in ARDL is to empirically investigate the existence of a long-run relationship between the variables. The calculated F-statistic is then compared against the lower and upper critical bound provided by Pesaran (2001). If the calculated F-statistics exceed the upper critical bound (UCB), then the null of no co-integration may be rejected, and the series is in fact co-integrated. If it is below the lower critical bound (LCB), then the null of no co-integration cannot be rejected. If the calculated F-statistic is between the LCB and the UCB, then co-integration is inconclusive. This may necessitate re-testing unit roots.

In the second step, once co-integration between the variables has been established, the long-run coefficients and the error correction term can be estimated. The ARDL co-integration procedure allows the co-integrating relationship to be estimated by OLS once the lag order is selected. The ARDL model can be specified as follows:

$$\Delta IE_t = \alpha_0 + \sum_{i=1}^{k} \beta_1 \Delta\, IE_{t-1} + \sum_{i=1}^{k} \beta_{2\,\Delta}\, DC_{t-1} + \sum_{i=1}^{k} \beta_{3\,\Delta}\, MC_{t-1} + \sum_{i=1}^{k} \beta_{4\,\Delta}\, GPC_{t-1} + \sum_{i=1}^{k} \beta_{5\,\Delta}\, TG_{t-1} + \sum_{i=1}^{k} \beta_{6\,\Delta}\, IN_{t-1} + \sum_{i=1}^{k} \beta_{7\,\Delta}\, GCE_{t-1} + \delta_1 LIE_{t-1} + \delta_2 LDC_{t-1} + \delta_3 LMC_{t-1} + \delta_4 LGPC_{t-1} + \delta_5 LTG_{t-1} + \delta_6 LIN_{t-1} + \delta_7 LGCE_{t-1} + u_t$$

where: -

IE = Income Inequality

FD = Financial Development

GDP = real income per capita in South African Rand and

TR = Trade Openness

FD is further proxied by

DC = Domestic Credit to GDP

MC = Market capitalisation/GDP

All variables have been transformed into logarithm. Δ denotes the first difference of the logged variables and u is the residual term. This is the standard VAR model in which a linear combination of lagged-level variables are added as proxy for lagged error terms. The coefficients β_1 - β_7 represent the short-run effects while δ_1 - δ_7 represents the long-run effects.

The ARDL co-integration test is testing the following hypotheses:

H0: δ1 = δ2 = δ3 = δ4 = δ5 = δ6 = δ7 = 0 i.e. there is no long-run relationship between the variables

H1 : δ1 ≠ δ2 ≠ δ3 ≠ δ4 ≠ δ5 ≠ δ6 ≠ δ7 ≠0 i.e. there is a long-run relationship between the variables

The error correction model (ECM) is derived from the ARDL model through linear transformation where the ECM integrates the short-run dynamics with long-run equilibrium. The advantage of this is that long-run information is not lost. The causality in the earlier step will be tested and confirmed through the t-statistic of the ECM while the coefficient of the ECT from the ECM indicates the speed of adjustment of the dependent variable towards its long-run equilibrium. The endogeneity or exogeneity of the variable is tested though the ECM, and the same equation is used with each proxy of financial development as well as income inequality in turn being the dependent variable.

The ECM tests the following hypothesis:

H0 : The variable is exogenous
H1 : The variable is endogenous

Finally, for purposes of determining the relative degree of endogeneity or exogeneity of the variables, we applied the generalised variance decomposition (VDC) technique. The VDC provides a decomposition of the variance of the forecast errors of the variables in the VAR (vector auto regression) at different horizons. The relative

exogeneity or endogeneity of a variable can be determined by the proportion of the variance explained by its past. The variable that is explained mostly by its past is deemed to be the most exogenous of all.

NARDL to test asymmetry

To test the symmetrical or asymmetrical relationship between financial development and income inequality, the non-linear auto regressive distributed lag (NARDL) technique proposed by Shin (2014) is adopted.

There are at least four reasons for choosing the model. First, it allows modelling the co-integration relation that could exist between financial development and income inequality. Second, it permits testing of both the linear as well as non-linear co-integration. Third, it distinguishes between the short and long-run effects from the independent variable to the dependent variable. Even though these three could also be tested within a non-linear threshold Vector Error Correction Model (VECM) or by smooth transition model, these models may suffer from the convergence problem due to the proliferation of the number of parameters, which is not the case with the NARDL model. Fourth, unlike other error correction models, where the order of integration of the considered time series should be the same, the NARDL model relaxes this restriction and allows combining data series having different integration orders. This flexibility is important for our series.

4. Results and discussion

Co-integration between variables

The variables were first tested for co-integration by applying ARDL bound testing and the results for testing the null that there is no long-run (LR) relationship among the variables are presented in Table 4.1.

The results demonstrate that the calculated F-statistics exceeded the upper critical value in two of the seven equations tested at standard acceptable significance levels. We conclude that the variables are co-integrated and there is a long-run theoretical relationship among them.

Evidence of cointegration implies that the relationship among the variables is not spurious, i.e. there is a theoretical relationship among them and that they are in equilibrium in the long-run.

Table 4.1: ARDL co-integration test results

VARIABLE ADDITION TEST			
Dependent Variable	**Independent variables**	**F Stat**	**Decision**
LHII	LDC, LMC, LGPC, LTG, LIN, LGCE	3.1767	Accept the null of no LR relation
LDC	LHII, LMC, LGPC, LTG, LIN, LGCE	3.9079**	Reject the null of no LR relation
LMC	LHII, LDC, LGPC, LTG, LIN, LGCE	2.8941	Accept the null of no LR relation
LGPC	LHII, LDC, LMC, LTG, LIN, LGCE	1.5105	Accept the null of no LR relation
LTG	LHII, LDC, LMC, LGPC, LIN, LGCE	1.9443	Accept the null of no LR relation
LIN	LHII, LDC, LMC, LGPC, LTG, LGCE	7.8209**	Reject the null of no LR relation
LGCE	LHII, LDC, LMC, LGPC, LTG, LIN	0.6039	Accept the null of no LR relation
Bound critical values	**Significance**	**LCB**	**UCB**
	1%	3.418	4.694
	5%	2.752	3.883
	10%	2,410	3.492

Results of Long-run coefficients

The long-run coefficients of the models were estimated after the co-integration evidence between our variables was established. As shown in Table 4.2, GDP per capita (LGPC) carries the correct sign, implying that economic growth is positively

related to income inequality. This is expected and tends to be in line with most existing theory, especially that relating to the inequality narrowing hypothesis.

Although the sign of trade to GDP (LTG) in Table 4.2. is negative and implying that increased trade to GDP worsens inequality, the p-value is significant, thereby supporting the idea that increased market participants do play a role in alleviating income inequality. Furthermore, there could be other domestic trade-related factors that play a role in addressing income inequality. Notable in the South African context is the prevalence of Spaza shops.

Table 4.2: Long-run ARDL estimation based on AIC

Dependent variable = LHII		
	Model 1	
	Financial Development	
Regressor	**Coefficient**	**T-ratio [Prob]**
LDC	-0.20705	-.56483[.577]
LMC	-0.30942	-1.2633[.219]
LGPC	0.40872**	2.2396[.035]
LTG	-0.15452**	-2.1071[.046]
LIN	-0.04203	-.56070[.580]
LGCE	-0.39968	-.92233[.366]
INPT	7.025	.66900[.510]

*Significant at 10% **Significant at 5% ***Significant at 1%

In Table 4.3. we see a negative, but at the same time significant, relationship between income inequality and domestic credit. This is expected, as when economic conditions are unfavourable in households, financial institution lending tends to contract. Consequently, inequality worsens.

For robustness purposes, we see a negative relationship between income inequality and trade to GDP in Table 4.4. Although the significance is at 10% level, this is expected, i.e. when income inequality is high, trade to GDP contracts due to unfavourable economic climate.

Table 4.3: Long-run ARDL estimation based on AIC

Dependent variable = LDC		
	Model 2	
	Income inequality	
Regressor	**Coefficient**	**T-ratio [Prob]**
LHII	-0.40015**	-3.3873[.002]
LMC	0.16568**	2.6078[.015]
LGPC	0.38984***	6.2267[.000]
LTG	-0.10483**	-2.8464[.009]
LIN	-0.24981***	-5.7668[.000]
LGCE	-0.7294***	-4.2927[.000]
INPT	19.5598	4.9956[.000]

*Significant at 10% **Significant at 5% ***Significant at 1%

Table 4.4: Long-run ARDL estimation based on AIC

Dependent variable = LTG		
	Model 3	
	Income inequality	
Regressor	**Coefficient**	**T-ratio [Prob]**
LGPC	2.239**	3.6075[.002]
LMC	1.7118**	2.4798[.021]
LDC	-3.3423*	-1.8025[.085]
LHII	-1.6795*	-1.7332[.097]
LIN	-0.77682*	-1.7514[.094]
LGCE	-5.4005**	-3.4482[.002]
INPT	130.905	3.2274[.004]

*Significant at 10% **Significant at 5% ***Significant at 1%

Results of Error Correction Model (ECM)

The advantage of VECM is that it can distinguish between short and long-term Granger-causality. Together with this, it is able to inform which variable is exogenous/independent and which is endogenous/following.

The VECM results are shown in Table 4.5. for income inequality and financial development.

Table 4.5. Error Correction Model

ecm1(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	C.V.	Result
dLHII	-.70839	.15982	-4.4325[.000]	5%	Endogenous
dLDC	-.66654	.11703	-5.6956[.000]	5%	Endogenous
dLMC	-.94297	.20152	-4.6792[.000]	5%	Endogenous
dLGPC	-.030526	.037783	-.80793[.426]	5%	Exogenous
dLTG	-.61248	.14999	-4.0835[.000]	5%	Endogenous
dLIN	-.83066	.20324	-4.0871[.000]	5%	Endogenous
dLGCE	.075471	.075052	1.0056[.323]	5%	Exogenous

From the p-value of error correction in these two tables, we can conclude that income inequality is endogenous while financial development, represented by GDP per capita is exogenous. The lagged ECM terms for GDP per capita carries a negative sign, implying that when there is increased financial development, it may worsen income inequality whereby the rich get richer and the poor get poorer. In the model, the value of lagged error correction term for Income Inequality is -.70839, suggesting that the change in income inequality was corrected each year adjusting towards its long-run equilibrium. We also find that Government Consumption Expenditure is exogenous, implying that increasing government expenditure can play a role in alleviating income inequality.

Result of symmetry test under NARDL

Asymmetry statistics:

Exog. var.	Long-run effect [+] coef.	F-stat	P>F	Long-run effect [-] coef.	F-stat	P>F
GPC	0.000	2.413	0.138	0.000	.	.

	Long-run asymmetry F-stat	P>F	Short-run asymmetry F-stat	P>F
GPC	2.413	0.138	2.34	0.144

Note: Long-run effect [-] refers to a permanent change in exog. var. by -1

Cointegration test statistics: t_BDM = -1.1966
F_PSS = 1.9930

These results demonstrate that there is neither long nor short-run asymmetry between income inequality and financial development. To the best of our knowledge, this is the first study of its kind demonstrating such a relationship in the case of South Africa specifically.

What this result implies is that there is no marginal difference between the negative and positive effect. In other words, there may be negative effect, but that it is in the same margin as the positive effect.

The transition from apartheid government to the democratically elected one in 1994, as well as the period leading up to the 2010 Soccer World Cup, are two significant events that occurred during the period under study. If there were any negative effects, our result demonstrates only a marginal difference between the positive and negative response.

Variance decomposition (VDC)

From VECM, we determine the endogeneity/exogeneity of a variable during the sample period. However, it is more important and meaningful for policy-makers to recognise the relative degree of endogeneity/exogeneity of the variables for some forecasted horizon so that policies can be targeted appropriately. This useful information can be derived from the VDC output presented in Table 4.6.

Table 4.6. Variance Decomposition

	Generalised									
	Horizon	**DHII**	**DDC**	**DMC**	**DGPC**	**DTG**	**DIN**	**DGCE**	**Total**	**SELF-DEP**	
DHII	3	35.6%	13.9%	7.2%	2.7%	13.4%	9.2%	18.1%	100.0%	35.6%	7
DDC	3	15.2%	38.3%	10.0%	7.3%	11.2%	13.9%	4.2%	100.0%	38.3%	6
DMC	3	11.4%	7.2%	54.4%	5.4%	5.7%	5.7%	10.1%	100.0%	54.4%	3
DGPC	3	2.8%	7.4%	5.1%	68.4%	6.6%	1.4%	8.3%	100.0%	68.4%	1
DTG	3	17.9%	14.8%	10.3%	6.0%	44.9%	2.8%	3.4%	100.0%	44.9%	4
DIN	3	7.1%	29.9%	2.8%	3.3%	9.7%	44.3%	2.9%	100.0%	44.3%	5
DGCE	3	5.7%	3.5%	4.6%	15.3%	3.1%	1.5%	66.3%	100.0%	66.3%	2
	Horizon	**DHII**	**DDC**	**DMC**	**DGPC**	**DTG**	**DIN**	**DGCE**	**Total**		
DHII	6	31.8%	14.4%	9.4%	4.3%	13.7%	10.8%	15.5%	100.0%	31.8%	7
DDC	6	15.7%	33.6%	12.9%	8.1%	9.9%	14.4%	5.3%	100.0%	33.6%	6
DMC	6	11.1%	7.8%	44.9%	5.7%	6.9%	8.2%	15.4%	100.0%	44.9%	3
DGPC	6	3.2%	6.6%	5.6%	64.8%	6.0%	2.4%	11.4%	100.0%	64.8%	1
DTG	6	17.3%	14.7%	9.9%	6.6%	42.4%	3.7%	5.3%	100.0%	42.4%	4
DIN	6	13.2%	22.8%	8.8%	3.7%	10.7%	35.6%	5.1%	100.0%	35.6%	5
DGCE	6	6.0%	4.0%	4.5%	15.4%	3.3%	2.0%	64.7%	100.0%	64.7%	2
	Horizon	**DHII**	**DDC**	**DMC**	**DGPC**	**DTG**	**DIN**	**DGCE**	**Total**		
DHII	9	31.2%	13.8%	9.5%	5.3%	14.0%	11.4%	14.8%	100.0%	31.2%	6
DDC	9	15.5%	32.5%	13.9%	8.9%	9.6%	13.3%	6.4%	100.0%	32.5%	5
DMC	9	10.7%	8.9%	44.2%	5.5%	7.1%	8.5%	15.1%	100.0%	44.2%	3
DGPC	9	3.3%	6.8%	5.8%	63.9%	6.0%	2.5%	11.8%	100.0%	63.9%	1
DTG	9	17.4%	14.6%	10.0%	6.6%	41.9%	3.9%	5.6%	100.0%	41.9%	4
DIN	9	14.6%	21.1%	8.8%	4.0%	12.2%	28.7%	10.6%	100.0%	28.7%	7
DGCE	9	5.9%	4.0%	4.6%	15.7%	3.7%	3.8%	62.4%	100.0%	62.4%	2
	Horizon	**DHII**	**DDC**	**DMC**	**DGPC**	**DTG**	**DIN**	**DGCE**	**Total**		
DHII	12	31.0%	14.0%	9.2%	5.1%	14.6%	10.9%	15.2%	100.0%	31.0%	6
DDC	12	15.9%	31.5%	14.4%	9.3%	9.4%	13.2%	6.4%	100.0%	31.5%	5
DMC	12	11.1%	8.9%	43.3%	5.6%	7.0%	8.5%	15.5%	100.0%	43.3%	3
DGPC	12	3.6%	6.8%	5.9%	63.1%	6.1%	2.5%	12.0%	100.0%	63.1%	1
DTG	12	17.5%	14.6%	10.1%	6.7%	40.9%	4.0%	6.2%	100.0%	40.9%	4
DIN	12	15.0%	20.7%	8.6%	4.1%	13.2%	27.7%	10.9%	100.0%	27.7%	7
DGCE	12	5.7%	4.3%	4.6%	16.8%	3.7%	4.6%	60.3%	100.0%	60.3%	2

VDC decomposes the variance of the forecast error of each variable into proportions attributable to shocks from each variable in the system including its own. The relative endogeneity/exogeneity of a variable can then be determined by the proportion of variance that is explained by its own past. The variable that is explained mostly by its

own past variations and depends relatively less on other variables is deemed to be the most exogenous (most leading) amongst the variables.

The highlighted percentages indicate the contribution of the variable's own shock towards explaining the forecast error variance of each variable. From the above ECM result, we find that GDP per capita and Government consumption expenditure are exogenous. The same result is the case with VDC, whereby these two variables emerge as exogenous. The relative rank in exogeneity/endogeneity of the variables is somewhat stable as time passes from a 6 – 9 year horizon to a 12-year horizon.

The VDC results imply that GDP growth is the most exogenous variable followed by government consumption expenditure. This is implying that if persistent and regular growth is pursued, income inequality may improve.

Market capitalisation features strongly and in the case of South Africa, enhancing its ZAR X exchange, a licensed stock exchange that uses disruptive fintech to create a more efficient market for all, could play a role in addressing income inequality through greater market participant access to formal stock exchanges. Financial markets and institutions should ideally play a pivotal role in economic development by bridging information asymmetries between borrowers and savers, thereby mobilizing savings, capital fund allocation, monitoring the use of funds and managing risks which together support the economic growth process.

Impulse Response Function (IRF)

The generalised Impulse Response Function maps out the dynamic response path of a one period standard deviation shock of one variable and its impact on others. The IRF produces the same information as the VDC, with the difference that it is a graphical representation. From Figure 1 it can be observed that when income inequality is shocked, GDP per capita, which the most exogenous variable, shows the least response. Trade to GDP and inflation tend to respond most significantly. This is expected under worsening income inequality.

Figure 1: Generalised Impulse Response

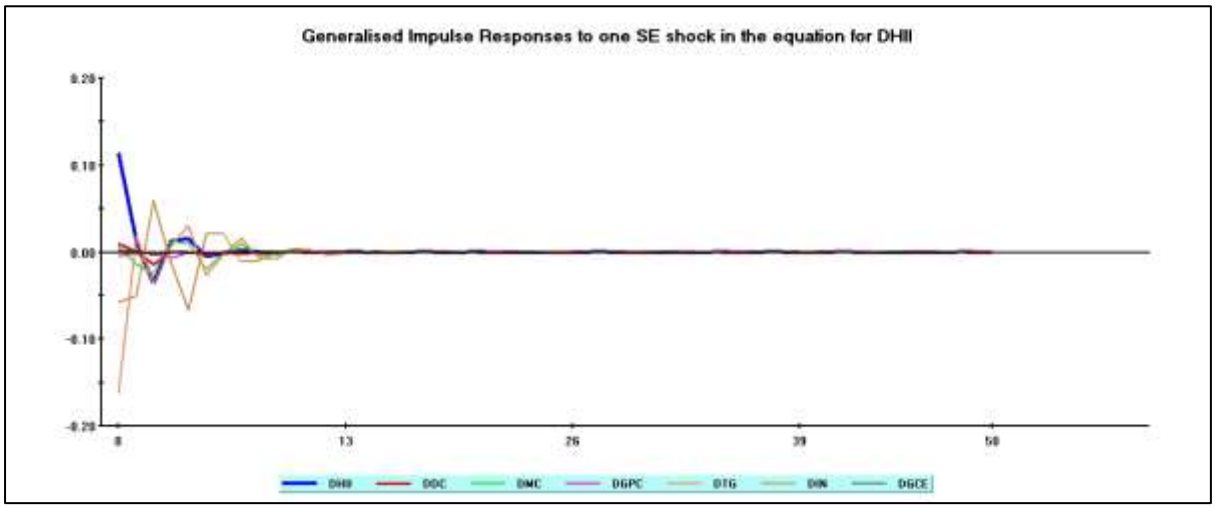


Figure 2 below further demonstrates that when income inequality is shocked, the exogenous variable of government Consumption Expenditure is not too responsive.

Figure 2

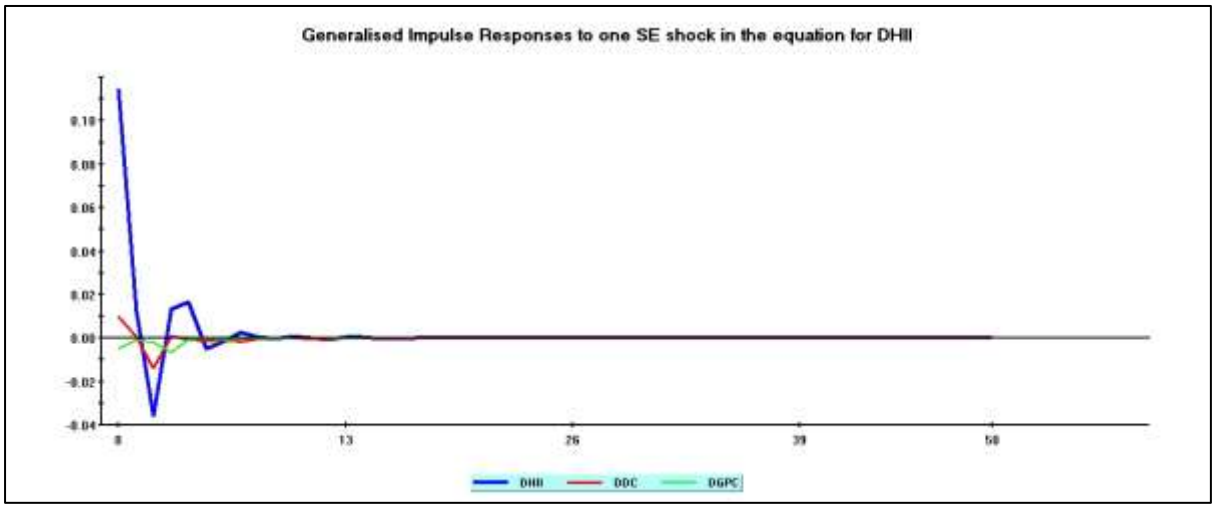
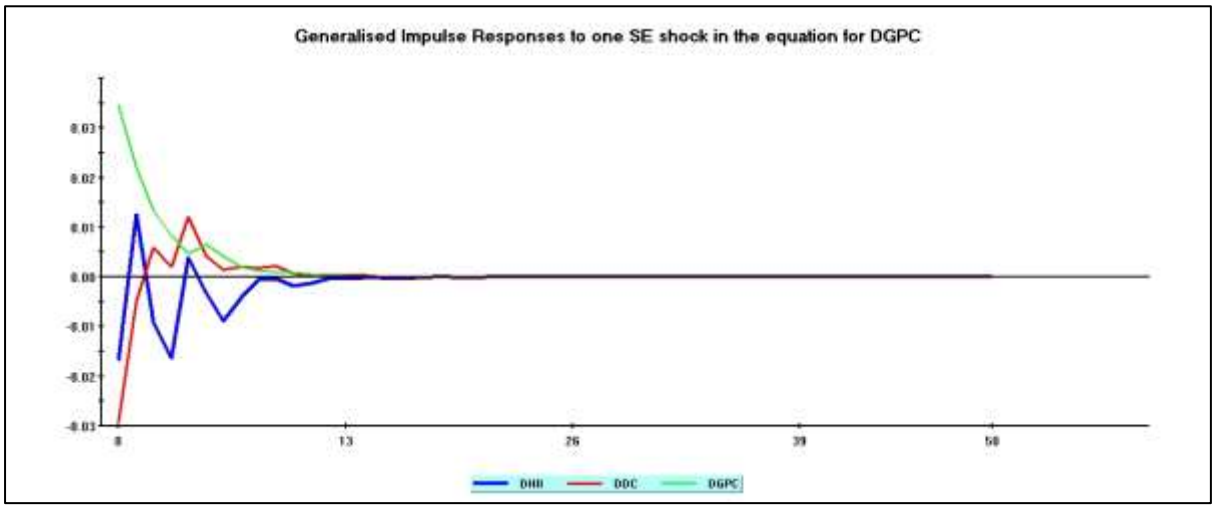


Figure 3 below is of significance because when GDP per capita is shocked, Income Inequality is quite responsive, pointing to the significance of targeting financial development as a tool to address income inequality.

Figure 3:



Robustness Checks

LRSM for testing long-run coefficient against theoretically expected values

In order to test the coefficients of the cointegrating vector in terms of consistency with the theoretical and *a priori* information of the economy, we applied Long-Run Structural Modelling (LRSM). Since the main focus of this paper is to identify the direction of causality between financial development and income inequality we first imposed a normalizing restriction of unity on the Household Income Inequality (HII) variable at the exact identifying stage (see appendix) and then experimented with a restriction of unity on the financial development variables at the over-identifying stage.

When we imposed a normalizing restriction of unity on the coefficient of HII, we found domestic credit, market capitalisation and inflation to be insignificant. This was supported by our over-identification restriction, the outcome of which was that the restriction was correct.

What this could mean is that there is a long-run relationship between income inequality, and some financial development variables like GDP per capita and government consumption expenditure, while there could be no long-run relation between income inequality, domestic credit, market capitalisation and inflation. Although one may be tempted to drop insignificant variables, this was not done due to having found the variables cointegrated at an earlier stage.

5 Conclusion and policy implications

The non-linear auto regressive distributed lag proposed by Shin et al. (2014) is useful to our research question since it allows us to discern not only the nonlinear but also the simultaneous short- and long-run asymmetric relationship between financial development and income inequality. We do not find neither short nor long-run asymmetry in the relationship between financial development and income inequality in the case of South Africa.

There is a positive long-run relationship between GDP per capita and income inequality. It goes without saying that single digit growth of the South African economy is not healthy, and persistence thereof could prove detrimental to the income inequality problem. In this regard, the structure of pursuing financial development is of crucial importance, for if it is done at the expense of increasing sovereign debt, then this could possibly worsen income inequality rather than improve it.

We also find trade to GDP having a negative long-run relationship with income inequality, implying that if market participation is increased, it can play a role addressing income inequality. The governments providing tax incentives for exporters and relaxation of trade barriers may be worthy considerations.

This study finds domestic credit to be negatively related to income inequality. This is an interesting finding for financial institutions to find innovative ways to tap into the SME market in order to address income inequality.

Our variance decomposition reveals that GDP is most exogenous, followed by government consumption expenditure. This makes the pursuit of economic growth an imperative for the new government. There is also room for the government to pursue its inflation targeting framework in order to address inequality. Finally, the implementation of pro-poor economic policy is a must for South Africa and ignoring this could result in disastrous consequences.

Literature review - Summary

Author	Country	Period under study	Methodology	Measure of Financial Development	Effect of FD on IE	Support Hypothesis		Other significant predictions on income inequality
						Linear	Inveted U shaped	
(Kapingura F. M., Financial Sector development and income inequality in South Africa, 2016)	South Africa	1990-2012	ARDL	Domestic Credit as % of GDP Market Capitalization as % of GDP	Yes	Yes	No	economic growth, external trade activities and government activities play an important role in reducing **inequality.** Increasing inflation is regressive on **inequality** in **South Africa**
(Michael Enowbi Batuo, 2010)	22 African countries	1990-2004	GMM	M2 as a share of GDP Bank credit to GDP Domestic Private Credit to GDP	Yes	Linear	No	Higher inflation rates can increase income inequality
(Kinkyo, 2016)	88 countries	1961-2012	GMM	private domestic credit as a percentage of GDP.	Yes			
(Keho, 2017)	9 African countries	1970-2013	ARDL	domestic credit to private sector by banks as share of GDP	Yes	Linear	No	
(Odhiambo, 2009)	South Africa	1960–2006	Trivariate Granger causality and ECM	M2 to nominal GDP	Yes	Linear	No	economic growth Granger-causes financial development
(Sturm, 2017)	121 countires	1975-2005	Dynamic panel model	private credit divided by GDP.	No			
(Shupp, 2002)	South Africa	1979-1994	endogenous growth model		Yes			
(Jakob B. Madsen, 2017)	21 OECD countries	1870–2011		bank credit to the non-bank private sector divided by nominal GDP.				External communist influence is used as a new time-varying instrument for inequal- ity
(Law, 2012)	35 Developing countries	1995 - 2000	GMM	private sector credit and liquid liabilities	Yes, up to a point. Thereafter, the impact worsens	No	Yes	

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