The Impact of Informal Economy on the Interest Rate Pass-through: Evidence from an ARDL model

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Abstract

In this study, we investigated the impact of the size of the informal economy on the interest rate pass-through. Results from an ARDL model showed that higher levels of the informal sector are associated with higher lending rates. Furthermore, the results indicated that the effect of the informal economy is much stronger in the long-run compared to the short-run. Finally, the results indicated that in both the short run and long run existence of an informal economy dampens the transmission of changes in the policy rate to retail rates as expected from theory and empirical evidence.

Keywords: ARDL; Interest Rate Pass-through; Informal Economy; Monetary Policy; Zambia

JEL Classification*:* O17; O23; E52

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1.0 Introduction

Recent years has seen the narrowing of monetary policy objective to price stability. To achieve price stability, central banks use instruments of monetary policy with a view to influence short-term interest rates such as the interbank rate or 3-month TB rate and consequently the long-term interest rates. For monetary policy to be effective, it is expected that changes in monetary policy are quickly and fully transmitted to retail rates. In other words, it is expected that the pass-through is complete implying that there is a one to one relationship between short-term interest rates and long-term rates. However, empirical evidence has shown that monetary policy transmission especially the interest rate pass-through is weak and incomplete in emerging and developing countries (Mishra et al., 2012). Furthermore, this literature shows that the effectiveness of monetary policy in influencing real economic variables is weaker in developing countries compared to developed countries (Tahir, 2012).

A number of factors have been attributed to this weak transmission of monetary policy in developing countries. For example Mishra, Montiel and Spilimbergo (2012) present several factors that make the MTM to differ between countries or regions at different levels of development. Among these are: larger size of the informal market; inefficiency in the capital markets; poorly developed money and interbank markets; and low competition in the commercial banking sector (Mishra *et al.,* 2012; Bhattacharya, Patnaik, and Shah, 2011). This study takes a look at the impact of informality in the economy on monetary policy effectiveness, an issue that has received little attention in the empirical literature. In particular, the study examines the impact of the size of informality in the economy on the interest rate pass-through. In addition, despite the impact of the size of the informal economy on monetary policy effectiveness not receiving much attention in the literature it is also a prominent feature in developing countries.

As figure 1 below shows, informal economic activity is larger in developing countries especially those in the Sub-Saharan Africa and South and Central American regions. So a study on the effects of informality on monetary policy is valuable to these countries' policy makers. This is because the existence of the informal economy could influence monetary policy in two important:

i) large informal sectors in the economy imply that the statistics on which monetary policy decisions are based maybe wrong or in the least incomplete resulting in monetary policy being ineffective or having unwanted side effects;
ii) there are important interactions between the formal and informal sectors in the economy. The informal sector could provide a buffer for factors of production losing employment in the formal economy due to monetary policy tightening. For example tight monetary policy aimed at reducing inflation pressure cannot be effective if firms are able to borrow from the informal markets.

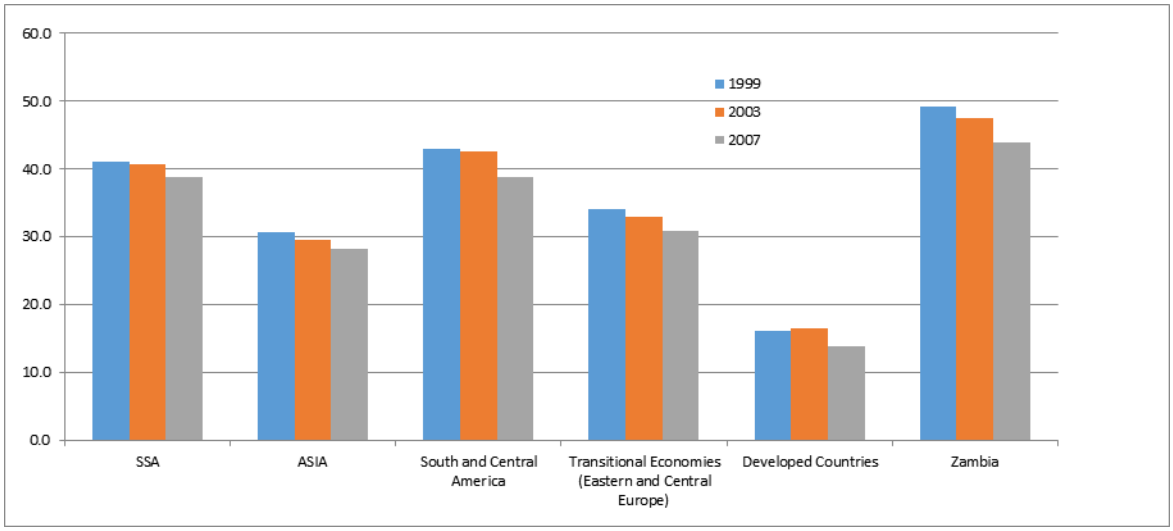

Figure 1: Trends in the size of the Informal economy across the world, 1999-2007
Source: Computations by Authors Using Schneider (2010)

Given the foregoing, this study attempts to answer the following research questions: Does existence of the informal economy hamper the transmission of monetary policy changes to retail rates? Does existence of informal economy lead to higher interest rates in the economy? To answer the research questions, the study utilises an Auto-Regressive Distributive Lag (ARDL) model while the size of the informal economy is estimated using the currency demand method. Results of the study indicate that although the size of the informal economy has been declining over time it still remains well above the SSA average and developing world in general in line with estimates by others (Phiri and Kabaso, 2012; Schneider, 2010). Importantly, results from the ARDL showed that higher levels of the informal economy are associated with higher lending rates. Furthermore, the results indicated that the effect of the informal economy is much stronger in the long-run compared to the short-run. Finally, the results indicated that in both the short run and long run existence of an informal economy dampens the transmission of changes in the policy rate to retail rates as expected from theory and empirical evidence (Carpenter, 1999; Kolev et al., 2005).

The rest of the paper is organised as follows: Section 2.0 provides an overview of the importance of informal economy in Zambia while Section 3.0 gives theoretical and empirical literature on the topic under investigation. Section 4.0 provides the econometric methodology while section 5.0 provides conclusions and some policy recommendations.

2.0 Informal Economy in Zambia

Zambia, like any other developing country, is characterised by the existence of large informal economy. Available estimates indicate that over the years the informal economy in Zambia has averaged well over 45%. Estimates by Schneider (2010) indicate that the size of the informal sector has been declining since 1999 from 49.3% in 1999 to just over 47% in 2007, while Zambia's informal economy is ranked fourth highest in Africa (see Table 1 below). These estimates are similar to those found by Phiri and Kabaso (2012) who estimate that the size of the informal economy has risen from 39.01% in the 1973-1980 periods to 56.2% in 1991-2000 before marginally declining to 48.9% in 2001-2010 periods (see Figure 2 below). Further, in comparison to other regions, Africa seems to lead in terms of the size of the informal economy followed by Central and South America and finally, the transition

economies. The developed economies have a relatively smaller size of the informal economy compared to the rest (see Table 1).

Table 1: Size of the Informal Sector as a Percentage of GDP

	COUNTRY	1999	2000	2001	2002	2003	2004	2005	2006	2007
Top Three Largest Informal Economy	Zimbabwe	59.6	59.4	61.5	62.8	63.7	62.3	62.0	62.3	62.7
	Tanzania	58.6	58.3	57.7	56.9	56.6	56.0	55.4	54.7	53.7
	Nigeria	58.0	57.9	57.8	57.6	56.3	55.1	53.8	53.0	
Fourth Ranked	Zambia	49.3	48.9	48.3	48.1	47.5	46.8	46.3	45.0	43.9
Bottom Three Smallest Informal Economy	Namibia	31.4	31.4	31.2	31.3	30.7	29.7	29.6	28.8	28.5
	Lesotho	31.7	31.3	31.1	31.0	30.7	30.1	30.2	29.3	28.8
	South Africa	28.4	28.4	28.4	28.0	27.8	27.1	26.5	26.0	25.2
Sub-Saharan Average		41.1	41.0	41.0	40.9	40.7	40.3	39.8	39.3	38.8
Asian Average		30.8	30.4	30.3	30.0	29.6	29.3	29.1	28.6	28.3
Central and South American Average		42.9	42.9	43.0	43.2	42.7	42.0	41.4	40.6	38.9
Transition Economies (East and Central Europe)		34.2	33.7	33.5	33.3	32.9	32.5	32.1	31.5	31.0
Developed Economies (OECD) Average		16.2	16.8	16.8	16.7	16.5	16.1	15.6	14.5	13.9

Source: Compilation from Schneider (2010)

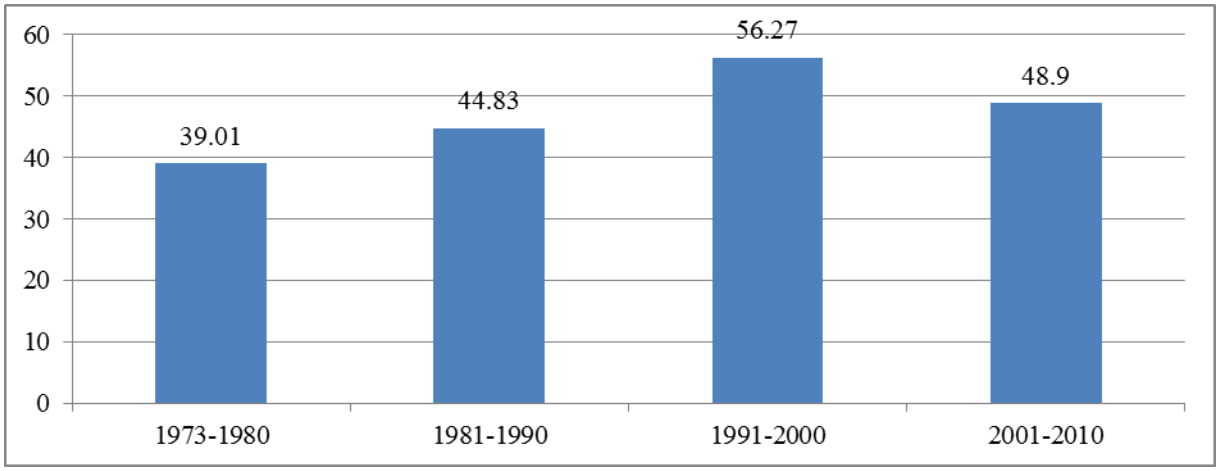

Figure 2: The Size of the Informal Economy in Zambia since 1973 as a Percentage of GDP
Source: Adapted from Phiri and Kabaso (2012)

Figure 3 below, presents the sectoral distribution of Zambia's informal economic activity. It shows that the wholesale and retail sector has the largest proportion of informal economic activity at 31%; followed by construction with 27%; agriculture, forestry, and fishing at 19%; Financial services at 12%. The larger size of wholesale and retail as well as the construction sectors' share in informal economic activity shows the ease with which it is to set up or start working in this sector. For example, there are a lot of traders who are not registered while most of the house construction in Zambia is done by individual bricklayers and not large

construction companies as is the case in other countries, especially those in developed countries.

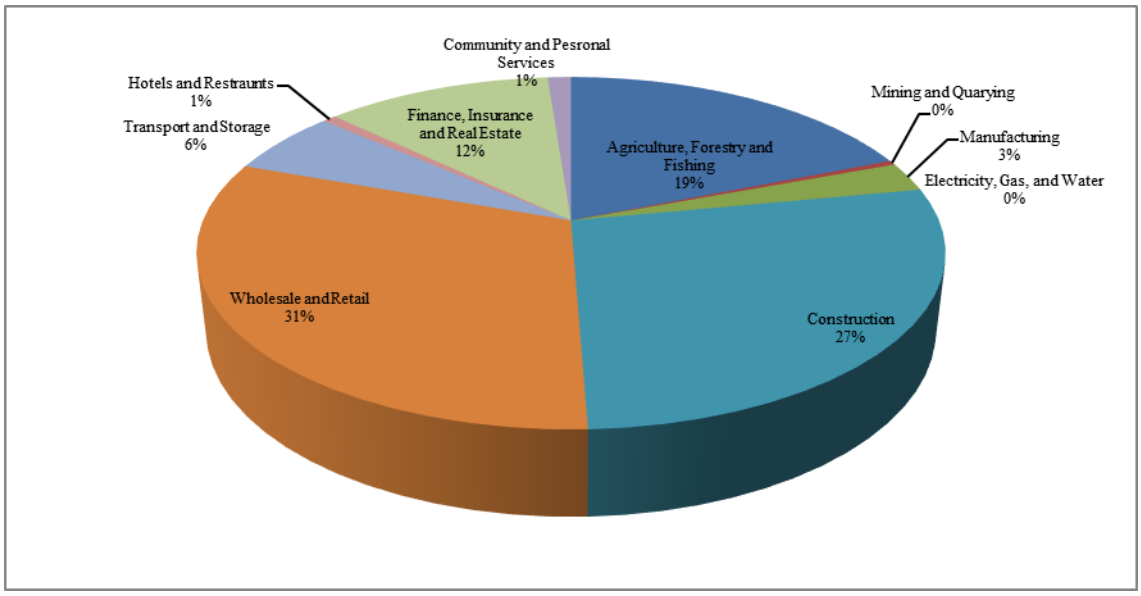

Figure 3: Sectoral Distribution of Informal Economic Activity, 2010

In terms of employment, according to 2004, 2008 and 2012 labour force surveys, the majority of the labour force is employed in the informal sector. As at 2004, a total of 88 per cent of the labour force was employed in the informal sector with the majority of them in the agriculture sector (figure 4 and figure 5, below). Furthermore, the 2008 report shows that informal sector employment rose slightly to 88.9 per cent while in 2012 it dropped to 83.4 per cent. Figure 5 below, shows that the majority of informal sector employees are working in the agriculture sector. However, the size of non-agricultural employment in the informal sector has been on the rise reaching 35 per cent in 2012 from 18.6 per cent in 2004. The growing size of the non-agriculture informal sector employment could be attributed to the growing size of youth entrepreneurship in the urban areas due to lack of employment in the formal sector (Kabaso and Phiri, 2012).

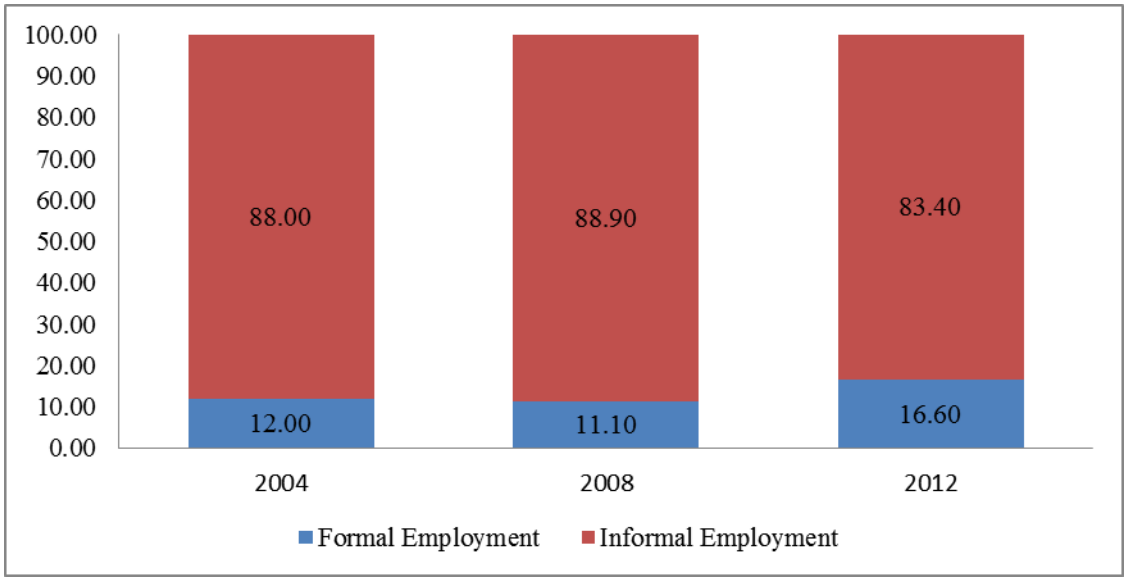

Figure 4: The Distribution of Formal Employment and Informal Employment in Since 2004
Source: Compiled from Zambia Labour Force Surveys of 2004, 2008, and 2012; CSO

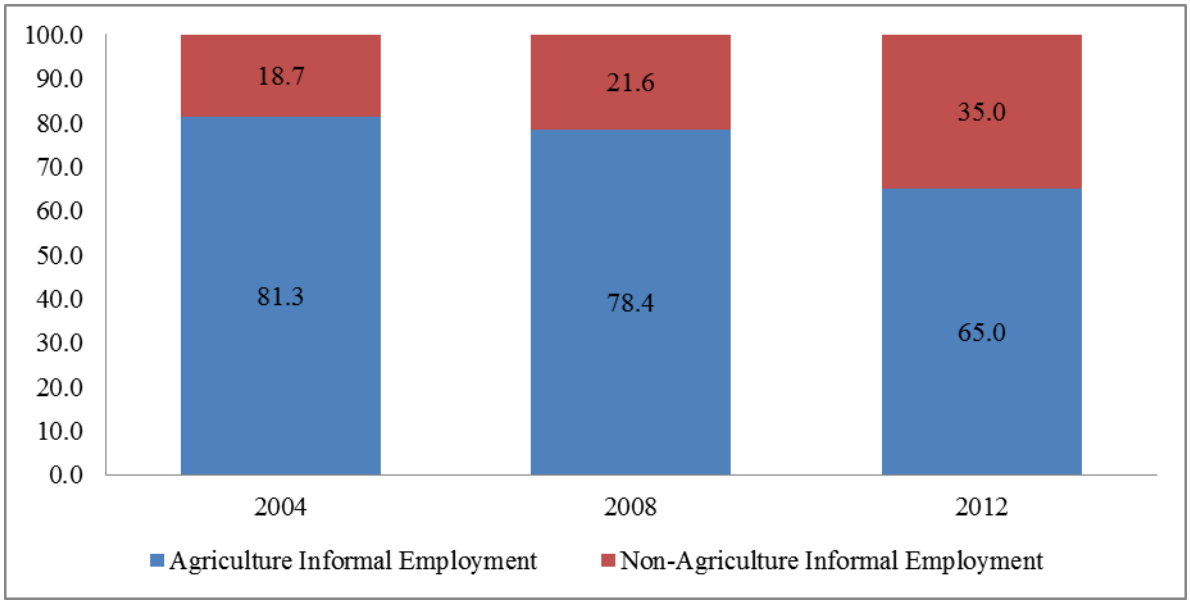

Figure 5: The Distribution of Informal Employment between Agriculture and Non-Agricultural Employment since 2004
Source: Compiled from Zambia Labour Force Surveys of 2004, 2008, and 2012; Central Statistical Office

The evidence provided above seems to suggest that the size of the informal economy is an important aspect of the Zambian economy and indeed all developing countries. The implication of this evidence is that a considerable part of the economic activity cannot be financed through bank credit since they could not present the requirements to overcome adverse selection and moral hazard problems. This is even worse for countries such as Zambia where the informal economy is in excess of 50%. In this regard, it is expected that the existence of this huge size of the informal economy can impede the effectiveness of

monetary policy and thus provides some evidence to suggest one reason why monetary policy transmission is weaker in developing economies.

3.0 Literature Review

3.1Theoretical Literature

Theoretical literature that makes an attempt to link the existence of the informal sector to monetary policy effectiveness is in its infancy and continues to evolve. Available theoretical writings attempt to extend existing theories such as the traditional classical, real business cycle (RBC), Keynesian and New Keynesian theories.

One attempt to explain the role that existence of the informal sector plays in monetary policy transmission is done by Carpenter (1999). In his paper, Carpenter (1999) extends the simple IS-LM model developed by Bernanke (1986) to incorporate the informal credit market and regulated credit markets. In this model, he argues that firms use credit from formal and informal markets to produce goods. In this kind of environment, a tight monetary policy which derives formal market interest rates up would increase the demand for informal market credit. Depending on the liquidity conditions obtaining in the informal credit markets tight monetary policy may have no effect on real economic variables. If the liquidity conditions are tight in the informal market an increase in the formal credit market interest rates due to tight monetary policy would cause the interest rates in the informal market to increase and reduce demand for credit in both markets. However, if informal credit markets are liquid increase in formal market interest rates, may have no effect on informal credit demand and supply and it may consequently become a buffer for monetary policy shocks.

Castillo and Montoro (2010) in their paper on the role informal labour markets play in the transmission of aggregate supply and aggregate demand shocks on the economy make an attempt to explain the link between informal sector and monetary policy transmission. Specifically, they extend the standard new Keynesian model by not only adding labour market frictions but also model a dual labour market economy by considering the existence of formal and informal labour markets. They introduce informality within the model by assuming that firms can choose between two types of production processes: formal and informal technology. They assume that production using the formal technology has higher productivity and larger labour costs while in the informal process worker productivity is less but with lower labour costs. Hence, the implication of this dual production technology is that firms marginal cost would depend not only on wages, productivity and unemployment but also on the level of informality in the labour market. Therefore, during episodes of high aggregate demand, firms find it more profitable to use more intensively the informal technology because marginal costs are lower than the formal sector. Hence, the behaviour of firms optimally lessens the impact of aggregate demand shocks on the marginal cost while during low demand periods firms use more formal technology. Therefore, they show that existence of an informal sector creates a buffer which could reduce the effectiveness of monetary policy shocks which influences aggregate demand.

3.2 Empirical Literature

In order to test his extended IS-LM model which incorporates the informal credit market, Carpenter (1999) uses structural Vector Auto-Regressive (SVAR) which includes the following variables informal interest rate, GDP, CPI, Discount rate, M2 or credit measured at quarterly interval. The results indicate that positive shocks to credit significantly increases output for two-quarters while shocks to money supply has no effect on output. However, they

find a puzzling response of informal credit market interest rate. They find that positive innovation to credit or money (interpreted as expansionary monetary policy) significantly increases informal credit market interest rates. The expected result from theory is that more credit from the formal sector should cause interest rates in the informal credit market to fall, given that they are substitutes. They explain their results by stating that the response of informal sector interest rates also depends on demand for credit occasioned by an increase in output due to expansionary monetary policy.

To study the effects of monetary policy shocks on the informal economic activity, Kolev *et al*. (2005) employ the recursive Vector Auto-Regressive (VAR) Model. They estimate a six-VAR model for the UK covering quarterly for the period 1971 to 2004 with the following variables; informal sector size, real GDP, CPI, Policy Rate, and Broad money. Using variance decomposition, they find that the Bank of England Policy rate accounts for over 19% variation in the size of the informal sector. Furthermore, the results indicate that a one standard deviation positive shock to the policy rate causes a statistically significant increase in the size of the informal sector which is opposite to the expected response of the official GDP. In short, it implies that an increase in the policy rate causes an expansion of the informal sector while the formal sector contracts. To help explain these results, they argue that a contractionary monetary policy reduces access to credit and hence lowers economic activity in the formal sector leading to unemployment. Unemployed resources in the formal sector are forced to seek employment in the informal sector which uses other sources of finance thereby leading to an expansion in informal economic activity.

Castillo and Montoro (2010) investigate the role of informal labour markets on the dynamics of inflation and the transmission of demand and supply shocks using a dynamic stochastic general equilibrium model based on the new Keynesian macroeconomic model. Using data from Peru they find that informal labour markets act as a buffer stock of labour, increasing the flexibility of the labour market and consequently affecting the transmission mechanism of shocks to the economy. Specifically, the results indicate that inflation response to a demand shock is 42% larger in an economy where all labour contracts are formal than in an economy where informal employment exists. Furthermore, they find that output increases more in economies with huge informal economy since informal employment helps to reduce pressure on wages in formal labour markets. Consistently, they find that inflation responds less in informal markets than in formal markets because wages in this sector do not quickly re-align. Hence, they conclude that this implies that in an economy with a large informal labour market the correlation between inflation and output gap conditional on demand shock is lower, thus the interest rate channel of monetary policy is weaker. These results are consistent with those obtained by Kolev *et al.* (2005) which show that the informal sector economic activity responds counter to monetary policy shocks and could essentially affect the effectiveness of monetary policy.

Although empirical studies presented above make an attempt to study the effects of informal sector on monetary policy effectiveness as well as effects of monetary policy on informal economy none of the directly attempt to evaluate its impact on the interest rate pass-through. Hence, this study differs significantly from the studies reviewed by looking at the impact of informality on the interest rate pass-through which is the first stage in the transmission mechanism.

4.0 Methodology

4.1 Econometric Model

Here a methodology for evaluation the impact of the level of informality in the economy is presented. In the model, the lending rate is the dependent variable while a measure of informality and the interbank rate or 3-month TB rate (monetary policy rate) are the independent variables. The reduced form equation takes the form:

$$r_{Lt} = \alpha_0 + \beta_1 r_{Et} + \beta_2 informality_t + \beta_3 r_E * informality_t \ldots\ldots 1$$

In the model, r_{tL} is the weighted average commercial bank lending rate at time t, r_{tE} is the Interbank money market rate or the 3-month TB rate at time t, or monetary policy stance at time t, and $informality_t$ is the estimated size of the informal sector at time t. It is expected that $\beta_1 > 0$ and $\beta_2 > 0$, indicating that increase in policy rates and size of informal economy will cause the lending rates to rise. Furthermore, from Equations 1 above, the coefficient on the interaction term, β_3, measures the effect of the size of informality on the response of banks to monetary policy changes. If the presence of high informality in the economy dampens monetary policy, then the interaction term should mitigate that coefficient, or $\beta_3 < 0$. Estimating Equation 1 using standard OLS methods could produce spurious results due to non-stationarity in the data. To avoid spurious results, econometricians often estimate the equation in differences as most time series data has been found to become stationary after first differences, as shown below;

$$\Delta r_L = \alpha_0 + \beta_1 \Delta r_E + \beta_2 * \Delta Informality_t + \beta_3 \Delta r_E * \Delta Informality_t \ldots\ldots\ldots 2$$

Although estimating equation 2 could avoid spurious results, it loses information about the long run relationship as well as dynamism among the variables (Enders, 2010: 345; Tsay, 2005: 37). One way to avoid losing the dynamism, as well as the long-run information, is to estimate an Error Correction Model (ECM) (Ononugbo, 2012). However, estimating an error correction model (ECM) requires that all the variables in the model are integrated of the same order (Favero, 2001; Enders, 2010), implying that if variables are differently integrated spurious results can't be avoided. In this regard, this study utilises the Auto Regressive Distributive Lag (ARDL) model using Bounds testing approach to capture the short-run and long-run effects (Pesaran, Shin, and Smith, 2001). The advantage of using this approach compared to other methods such as Engel-Granger (1987) and the Gregory-Hansen (1996) is that it is applicable regardless of the order of integration of the variables used in the model. Hence, the model actually estimated is as follows;

$$\begin{aligned} r_{Lt-1} = \alpha_0 + \varphi_1 r_{Lt-1} + \varphi_2 r_{Et-1} + \varphi_3 informality_{t-1} + \omega_4 r_{Et-1} * informality_{t-1} \\ + \sum_{t=1}^{p} \vartheta_i \Delta r_{Lt-i} + \sum_{t=0}^{q} \omega_i \Delta r_{Et-i} + \sum_{t=0}^{q} \delta_i \Delta informality_{Et-i} \\ + \sum_{t=0}^{q} \theta_i \Delta informality_{Et-i} * \Delta r_{Et-i} \ldots\ldots 3 \end{aligned}$$

4.2 Specification and Diagnostic Tests

Unit Root Tests

Testing for stationarity in regressional analysis involving time series data has become a standard. This effort is often aimed at checking whether the variables are either stationary or non-stationary. This is because if variables are non-stationary, estimating a regression using the standard OLS will produce spurious results (Enders, 2010, P.345; Ononugbo, 2012). Furthermore, it is highly likely that in the event that variables are non-stationary and a linear combination of the variables is stationary then there exists a long-run equilibrium among the variables (Engel and Granger, 1987). To check for non-stationarity in the data, three tests are utilised, namely; the Augmented Dickey-Fuller (ADF), the Philips-Perron (PP), and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS).

The ADF and PP tests are carried out under the null hypothesis of unit root while the KPSS is done under the null of stationarity. Unit root tests are undertaken to ensure that variables are stationary I(0) or integrated of order one I(1). According to literature (Ouattara, 2004; Pesaran *et al.,* 2001), in the presence of I(2) variables the computed F statistics in the Bounds approach are not valid because the test statistics in the bounds tests are computed under the assumptions of I(0) or I(1).

Cointegration Test

Once stationarity tests have been performed and some variables are found to be non-stationary, it is important to check for the existence of a long-run equilibrium relation among the variables, the co-integration test. To test for the existence of a long-run equilibrium relationship, the Bounds testing approach developed by Pesaran *et al.* (2001) is utilised. The test is performed under the null-hypothesis;

$$H_0: \varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = 0 \; vs. \; H_1: \varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4 \neq 0 \; \ldots \ldots 4$$

The computed F-statistic is compared to the two asymptotic critical values developed Pesaran *et al*. (2001). The two sets of asymptotic critical values: one set assumes that all the independent variables are I(1); and, the other set assumes that they are I(0). These two sets of critical values are then compared with the computed values to determine the existence of co-integration. If the computed statistic falls outside of the bands then it can be concluded that cointegration exists, otherwise, it is not conclusive and requires a re-examination of the stationarity of individual variables.

4.2 Data

In this study, time series on the weighted average lending rate, deposit rates, saving rates, the interbank rate and 91-day TB rate (as monetary policy variables) and a series of the estimated size of the informal economy. Specifically, monthly time series data from January 1998 to December 2015 are used. All the data on the various interests rates is obtained from the Bank of Zambia database. However, the size of the informal sector is not available and was estimated using the currency demand approach.

To estimate the size of the informal economy, the currency demand approach is used. In this regard, a currency demand function for the Zambian economy is estimated, and extract from it the currency demanded in the informal sector by assuming that transaction conducted in the informal sector are made to avert tax obligations (Cagan, 1958; Hernandez, 2005; Phiri and Kabaso, 2012). This demand for currency in the informal sector is then converted into

informal GDP using an appropriate velocity of income. The data used consists of monthly observations from January 1998 to June 2015 drawn from various secondary sources such as the Bank of Zambia, Zambia Revenue Authority (ZRA), and CSO. The econometric model used to estimate the currency demand model is given by:

$$\ln(C) = \alpha + \beta_0 \ln(1+t) + \beta_1 \ln(Y_t) + \beta_2 i_t + \beta_3 \pi_t \dots\dots\dots\dots 5$$

Where: C *is currency in circulation as a ratio of GDP*

t *is total tax revenue as ratio of GDP*

i *is the interest variable which is the opportunity cost of holding cash*

π *is the inflation*

To decompose annual GDP to quarterly GDP the study uses the index of industrial production and then to monthly data using the trend method. Equation 5 above poses a challenge of spurious results as a result of the existence of non-stationarity. In addition to having spurious results, in the presence of non-stationarity, literature has shown that there is a high possibility of co-integration of the series. In this regard, an error correction model is estimated with differenced series to avoid these problems.

$$\Delta\ln(C) = \alpha + \beta_0 \Delta\ln(1+t) + \beta_1 \Delta\ln(Y_t) + \beta_2 \Delta i_t + \beta_3 \Delta\pi_t + \gamma ECT_{t-1} \dots\dots\dots\dots 6$$

To estimate the size of the informal sector, it is assumed that the currency demanded at any period of time consist of two components; currency demand for formal transactions and informal transactions. That is;

$$C_t = C_f + C_i \dots\dots 7$$

In order to estimate currency demand for the formal transactions, it is assumed that informal activity is done to escape higher taxes in the formal sector. Hence, to estimate the currency demand in the formal sector from Equation 6, the tax burden is set at their lowest level during the period under consideration, to obtain estimates consistent with low levels of informal activity;

$$\Delta\ln(\widehat{C_f}) = \alpha + \beta_0 \Delta\ln(1+t_{min}) + \beta_1 \Delta\ln(Y_t) + \beta_2 \Delta i_t + \beta_3 \Delta\pi_t + \gamma ECT_{t-1} \dots\dots\dots\dots 8$$

Estimates of currency demand for formal transactions are then used to calculate the velocity of income. Assuming that the velocity is the same for the formal and informal sectors , then to estimate the size of informal income in each period Equation 6 below is used;

$$Y_i = vC_i \dots\dots 9$$

5.0 Results

5.1 Estimates of the informal Sector

Unit Root Test

Results in Table 2 below indicate that in the case of the ADF and PP tests all variables are integrated of order one, I(1) with an exception of 3-month TB rate and inflation rate. However, the KPSS indicate that all the series are integrated of order one, I(1). In this regard, it is concluded that all the variables are integrated of order one, I(1).

Table 2: Stationarity Tests for the currency Demand equation

	ADF			PP			KPSS		
	Levels	**1st Difference**	**I(d)**	**Levels**	**1st Difference**	**I(d)**	**Levels**	**1st Difference**	**I(d)**
3-month Rate	-4.69***	-12.77***	I(0)	-3.85**	-12.76***	I(0)	0.14*	0.02	I(1)
Average Lending Rate	-1.48	-6.47***	I(1)	-1.53	-6.38***	I(1)	0.84***	0.20	I(1)
Currency in Circulation	-0.21	-15.68***	I(1)	0.97	-17.29***	I(1)	0.39***	0.09	I(1)
Broad Money	0.03	-21.16***	I(1)	0.09	-21.19***	I(1)	0.44***	0.05	I(1)
Inflation Rate	-4.60***	-10.62***	I(0)	-3.69**	-10.65***	I(0)	0.19**	0.06	I(1)
GDP	-2.75	-3.79**	I(1)	-2.51	-9.54***	I(1)	0.45***	0.10	I(1)
Tax	-0.31	-7.70***	I(1)	-2.52	-28.99***	I(1)	0.43***	0.11	I(1)

*Source: Computations by the Author. In the table *,**,*** means statistically significant at 10%, 5% and 1% respectively.*

Co-integration Test

The unit roots conducted above indicate that the variables utilised in the estimation of the currency demand equation are integrated of order one, I(1) or they are non-stationary. In this regard, the study employs the Engel and Granger two step method and Johansen co-integration tests to check for the existence of co-integration among the variables. Table 3 present results of Engel and Granger two-step test.

Table 3: Engel-Granger Two Step Co-integration Test

Null Hypothesis: Residuals have a unit root				
	T-Value	T-critical Values		Decision
		5.02	1%	
		4.48	5%	Reject null at 10% and conclude that there is cointegration
ADF test statistic	-4.475*	4.18	10%	

Source: Computations by the Author

Results in Table 3 above indicate that the null hypothesis that the residuals of the long-run regression have a unit root can be rejected and conclude that the residuals are stationary. Hence, it can be concluded that there is co-integration among the variables namely; real currency in circulation, real GDP, deflator inflation, the 3-month TB rate, and the tax rate. Furthermore, results from the Johansen co-integration test, presented in Table E1 in Appendix E, also indicate that there is at least one co-intergrating relationship among the variables using both the trace test and the maximum Eigenvalue approach. These results justify the use of the error correction model (ECM) approach for estimating the currency demand equation which is then used to approximate the size of the informal sector.

Currency Demand Equation and Estimation of the Informal Sector

Following the results of the Engel-Granger test which indicate the existence of a co-integrating relationship among the variables included in the currency demand equation, an error correction model was estimated. The results of the regression for the currency demand model are provided in Appendix A TableA1. Results indicate that there is a weak correlation among the variables with adjusted R-squared of 0.35 but the F-statistic is significant for the entire regression. In addition, the DW test statistic is very close to 2 (1.99) implying that there is a little serial correlation. Using estimates of the currency demand equation the size of the informal economy are estimated. Estimates of the size of the informal economy in

Zambia over the period, from this study, compares well with those obtained by others on Zambia (Kabaso and Phiri, 2012; Schneider, 2010) see Table 4 below. Specifically, the study estimates that the informal economy averaged 57.6% between 1998 and 2000, 46.7% between 2001 and 2005, 43.8% between 2006 and 2010, and 42.5% from 2011 to 2014. Generally just like findings by Kabaso and Phiri (2012) as well as those by Schneider (2010) size of informal sector has been trending downwards.

Table 4: Informal Sector as Percentage of GDP, Comparison with other Studies

	1999-2000	2001-2002	2002-2003	2004-2005	2006-2007
Schneider	50.2%	49.9%	50.1%	49.1%	48.8%
Kabaso and Phiri	61.8%	50.9%	51.5%		
	1998-2000	2001-2005	2006-2010	2011-2014	
This Study	57.6%	46.7%	43.8%	42.5%	

Source: Computations for this study and adapted from Schneider (2010) and Phiri and Kabaso (2012)

5.2 Effects of Informal Economy on the Interest Rate Pass-through

Unit root test

Although empirical literature suggests that most financial time series data are integrated of order one, I(1), unit root tests were done to check for the order of integration. Empirical results from the ADF test indicate that the average lending rate, the size of informality, 30- and 180-day deposit have unit roots while 60-,90-day deposit rate, and both saving rates have no unit roots. On the other hand, results from the PP test indicate that all the series are I(1) with an exception of the 3-month TB rate and savings rate for amounts less than K100. However, the results from the KPSS indicate that all the variables are I(1). Although the three empirical tests provide conflicting results (that variables are either I(1) or I(0)), the model estimated in this study does not require that variables are integrated of the same order but either I(1) or I(0). Furthermore, all the tests conclude that none of the time series are I(2) which justifies the use of the ARDL methods.

Table 5: Stationarity Tests

	ADF			PP			KPSS		
	Levels	**1st Difference**	**I(d)**	**Levels**	**1st Difference**	**I(d)**	**Levels**	**1st Difference**	**I(d)**
3-month TB Rate	-4.69***	-12.77***	I(0)	-3.85**	-12.76***	I(0)	0.14*	0.02	I(1)
Average Lending Rate	-1.48	-6.47***	I(1)	-1.53	-6.38***	I(1)	0.84***	0.20	I(1)
Informality	0.66	-7.52***	I(1)	-2.14	-7.15***	I(1)	0.41***	0.06	I(1)
30-Day Deposit Rate	-1.79	-11.98***	I(1)	-2.14	-12.99***	I(1)	0.23***	0.03	I(1)
60-Day Deposit Rate	-3.25**	-12.21***	I(0)	-2.25	-12.75***	I(1)	0.16**	0.04	I(1)
90-Day Deposit Rate	-3.66**	-4.47***	I(0)	-2.37	-13.17***	I(1)	0.17**	0.03	I(1)
Saving Rate<K100	-3.16***	-5.33***	I(0)	-2.89**	-14.46***	I(0)	0.99***	0.33	I(1)
Saving Rate>K100	-3.62**	-5.01***	I(0)	-2.50	-13.99***	I(1)	1.20***	0.20	I(1)
180-Day Deposit Rate	-2.36	-11.56***	I(1)	-2.28	-11.57***	I(1)	0.14*	0.04	I(1)

*Source: Computations by the Author. In the table *,**,*** means statistically significant at 10%, 5% and 1% respectively.*

Analysis of the Effect of the Level of Informality in the Economy on IRPT

Empirical results from estimating equation 3 are presented in table 6 below. Specifically, the results provide evidence of the impact of the size of the informal sector on the pass-through

of changes in the 3-month TB rate (policy rate) to seven retail rates in the economy. The correlation among the policy variable, retail rates and size of the informal economy is relatively weak with the adjusted R^2 ranging between 0.1 and 0.45. Furthermore, the DW test statistic is close to 2 suggesting that there is less serial correlation in the estimates. Finally, the PSS test results reveal that there is a statistically significant long-run relationship among the retail rates, 3-month TB rate, the size of the informal economy and the interaction term between informality and the policy variable.

Despite the adjusted R^2 being low, estimated coefficients for both short and long-run parameters are correctly signed with an exception of the intercept for the 180-day deposit rate and the coefficient on the size of the informal sector for the 60-day rate. In addition, the co-efficient on the error correction term is negative and statistically significant in all the cases indicating that there is a long-run relationship among the variables. Further, other more important coefficients ($\varphi_3, \varphi_4, \delta_0, \theta_0$) have the correct signs with an exception of the 60-day deposit rate with a large number being significant.

Table 6: Empirical Results from the ARDL model

	Deposit rates for amounts above K20,000				*Saving rates for Amounts less or more than K100*		*Average Lending Rate*
	30-Day	***60-Day***	***90-Day***	***180-Day***	***Saving1***	***Saving2***	***Lending Rate***
$\alpha_0 (Intercept)$	0.001(1.601)	0.002	0.001(2.359)/**	-0.001(1.183)	0.003(1.443)	0.004(1.026)	0.010(0.857)
φ_1	-0.062(-4.513)***	-0.058(-4.459)***	-0.071(-4.908)***	-0.102(-6.104)***	-0.094(-3.447***	-0.087(-3.426)***	-0.054(-3.431)***
φ_2	0.031(2.299)**	0.028(1.669)*	0.041(1.655)*	0.066(1.656)*	0.026(1.962)*	0.024(3.347)***	0.047(1.841)*
φ_3	0.008(1.461)	0.010(1.654)*	0.007(2.177)**	0.001(1.607)	0.001(1.935)*	0.004(1.653)*	0.008(1.851)*
φ_4	-0.010(1.691)*	-0.009	-0.008(1.747)*	-0.007(-1.397)	-0.005(-0.946)	-0.010(-1.738)*	- 0.011(-2.517)**
ω_0	0.031(1.797*	0.056(1.816)**	0.041(2.800)***	0.074(1.657)*	0.007(1.346)	0.023(1.678)*	0.178(3.549)***
δ_0	0.001(1.532)	-0.002(1.032)	0.004(1.149)	0.001(1.128)	0.001(1.673)*	0.003(1.448)	0.013(1.387)
θ_0	-0.009(-2.859)***	-0.008(1.653)*	-0.006(-2.454)**	-0.014(-1.785)*	-0.012(1.779)*	-0.011(-1.306)	0.002(0.820)
$\beta_1\left[\frac{\varphi_2}{-\varphi_1}\right]$	0.500(1.673)*	0.477(1.848)**	0.570(2.833)***	0.645(1.797)*	0.278(2.769)***	0.274(2.378)**	0.880(4.584)***
$\beta_2\left[\frac{\varphi_3}{-\varphi_1}\right]$	0.133	0.173(1.708)**	0.108(2.070)**	0.105(1.601)	0.021(1.756)*	0.052(1.756)*	0.158(1.884)*
$\beta_3\left[\frac{\varphi_4}{-\varphi_1}\right]$	-0.154(-1.79)*	-0.162	-0.106(1.652)*	-0.069(2.163)**	-0.055(-3.47)***	-0.117(-1.763)*	-0.021(-3.165)***
R^2	0.413	0.348	0.438	0.266	0.115	0.162	0.357
$F-Statistic$	12.163***	9.222***	13.435***	6.271***	2.140**	3.353***	9.577***
$Durbin-Watson\ Statistic$	1.953	1.986	2.040	2.059	1.977	1.955	2.015
$PSS-TEST$	4.627***	4.679***	5.786***	7.264***	2.015*	2.556**	3.893***

Source: Computations by the Author.

, **, * means statistically significant at 10%, 5% and 1% respectively. T-Values are in the parentheses.*

Results for the effects of size of the informal economy on the transmission of changes in the policy rate to deposit and saving rates which are on the liability side of commercial banks' balance are reported in the first six columns. The results indicate that the short-run pass-through after including a measure of the informal economy for a 1% change in the 3-month TB rate though significant is still low ranging from 0.007 to 0.074. In addition, the results indicate that although the effect of the size of the informal economy is insignificant in all cases, they have the correct sign with an exception of the 60-day deposit rate. More importantly, the interaction term between the policy and the size of the informal economy, has the correct negative sign with two significant results for the 60-day deposit rate and the saving rate for amounts below K100. These results though insignificant are in line with theory as well as empirical results from other studies (Castillo and Montoro, 2010; Carpenter, 1999; Kolev *et al.,* 2005). They imply that when there is a large informal economy banks have to offer higher rates on deposits to attract funds from savers while at the same time its existence dampens the transmission of monetary policy.

However, parameter estimates for the long-run pass-through and the effect of the size of informal economy on monetary transmission have the correct signs and significant in most cases. Specifically, the interest rate pass-through of a 1% change in the 3-month TB rate will significantly lead to an increase in deposit rates in the range of 0.27-0.65%. Further, a 1% increase in the size of the informal economy will significantly cause deposit rates to rise by 0.02-0.18% with an exception of the 30- and 180-day deposit rates which are not significant but with the correct sign. This result is in line with theory and other empirical studies (Castillo and Montoro, 2010; Carpenter, 1999; Kolev *et al.,* 2005) implying that the existence of a large informal sector in the economy makes it expensive for commercial banks to raise funds from the depositors. Finally, and more importantly, the interaction term is negative and significant in all with an exception of the 60-day deposit rate. This implies that the existence of a large informal sector tends to dampen the transmission of monetary policy from changes in the policy rate to retail deposit and saving rate in line with the theory and other empirical studies.

The results of the impact of the size of informality in the economy on the transmission of changes in the 3-month TB rate (policy rate) to the average lending rate are presented in the last column of Table 6. The results indicate that a 1% change in the 3-month TB rate will significantly lead to lending rates contemporaneously increasing by approximately 0.18% within the month. On the other hand, the coefficient on the measure of informality in the economy has the expected positive sign but statistically insignificant. Furthermore the coefficient on the interaction term, though insignificant has a positive sign which is contrary to our theoretical and empirical expectations. This result implies that the existence of a large informal economy helps to enhance interest rate pass-through. The results for estimations of the long-run pass-through parameters are all significant. Specifically, a one per cent increase in the 3-month TB rate will significantly lead to almost 0.90% increase in lending rates while a similar increase in the size of the informal economy will significantly increase interest rates 0.16%. The long-run parameter estimate for the interaction term is negative and significant (-0.21%) in line with theoretical and empirical expectations. This implies that existence of a large informal economy tends to dampen the transmission of changes in the policy rate to lending rates.

6.0 Conclusion

The aim of this study was to investigate the impact of the size of the informal sector on the interest rate pass-through with data covering the period January 1998 to December 2015 using the ARDL bounds testing methods. Specifically, the study examined the effect of the size of the informal economy on retail as well as on the speed of transmission of changes in the policy rate. The results from the study showed that changes to policy rates have positive effects on retail while the existence of higher levels of informality in the economy leads to higher lending rates. Further, the results showed that the effect of the size of the informal economy on lending rates is much stronger in the long-run compared to the short-run. Finally, the results indicated that in both the short run and long run existence of an informal economy dampens the transmission of changes in the policy rate to retail rates as expected from theory and empirical evidence (Carpenter, 1999; Kolev et al., 2005).

From a policy perspective these results imply that there is need for more concerted efforts aimed at reducing the size of the informal economy in Zambia. This will not only help to enhance the transmission of monetary policy changes to retail rates and consequently improve the effectiveness of monetary policy but also help to bring down interest rates leading increased access to credit resulting in higher economic growth.

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APPENDIX A

Table 1: Error Correction Model for the Currency Demand Equation

Dependent Variable: $\Delta(LOG(CIC))$

	Coefficient	Std. Error	t-Statistic	Prob.
$Constant$	-0.010386	0.012197	-0.851550	0.3955
$\Delta(\log(cic(-1)$	0.377706	0.170522	2.235677	0.0019
$\Delta(\log(GDP)))$	1.952104	1.118330	1.745553	0.0204
$\Delta(\log(1+tax_{rate}))$	0.095483	0.110921	0.860814	0.3904
$\Delta(inflation)$	0.013426	0.004367	3.074422	0.0032
$\Delta(91\_day\_TB\_rate)$	-0.197558	0.193967	-1.018513	0.2097
$ECM(-1)$	-0.093562	0.027455	-3.407861	0.0008

R-squared	0.379980	Mean dependent var	0.017504
Adjusted R-squared	0.351672	S.D. dependent var	0.057154
S.E. of regression	0.055658	Akaike info criterion	-2.905159
Sum squared resid	0.604064	Schwarz criterion	-2.790516
Log likelihood	300.4210	Hannan-Quinn criter.	-2.858774
F-statistic	2.825319	Durbin-Watson stat	1.989770
Prob(F-statistic)	0.011668		