MONETARY POLICY AND INTERPOLATION OF INFORMAL SECTOR TIME SERIES IN LOW INCOME COUNTRIES: EVIDENCE FROM MALAWI

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Abstract

In nearly all low income countries, official monetary data excludes informal financial transactions although the informal financial sector (IFS) forms a large part of the financial sector. Using IFS data for Malawi constructed from two survey datasets, indigenous knowledge and elements of Friedman's data interpolation technique, this study employs innovation accounting in a structural vector autoregressive model to compare monetary policy outcomes in the country when IFS data is taken into account and when it is not. Consistent with conventional theories, the study finds that output increases following a rise in either formal financial sector (FFS) or IFS lending. Similarly, inflation rates increase when lending rises in both sectors. In addition, it is observed that consumer prices in Malawi do not respond significantly to lending in either sector. These findings provide evidence that the two sectors complement each other. However, further investigation shows that FFS lending declines when the bank rate increases while IFS loans are not responsive to bank rate variations; and an aggregation of the two is unaffected by bank rate changes. When IFS interest rates are raised, total loans decline, suggesting that lending in the IFS responds to IFS interest rates and not to FFS interest rates. The study, therefore, concludes that exclusion of IFS transactions in official monetary data has the potential to frustrate monetary policy through wrong inferences on the impact of monetary policy on economic activity.

JEL: Z13, E43, E44, E51.

Keywords: Informal financial sector; low income countries; interpolation; monetary policy

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1. INTRODUCTION

The principal objective of the Malawi's central bank as stipulated in the Reserve Bank of Malawi (RBM) Act of 1989 is "to implement measures designed to influence the money supply and the availability of credit, interest rates and exchange rates with the view to promoting economic growth, employment (and) stability in prices" (GoM, 1989, pp. 5). It is important, therefore, that the monetary authorities understand the process through which monetary policy affects economic activity, in order to achieve this objective.

Like most low income countries, monetary authorities in Malawi do not include informal financial transactions in official monetary data. The primary reason for this omission is the absence of the data. In some instances, data are available but from once off surveys. In other instances, where the data are available from more than one survey are available, the surveys are at irregular intervals and the data may not be comparable.

In most high income countries, the informal financial sector (IFS) is practically non-existent. In nearly all low income countries, however, the IFS is very large (see for example African Development Bank, 1994; Chipeta and Mkandawire, 1991). There is also evidence that the sector has been growing relative to the formal financial sector (FFS) in some of these countries (see for example Chipeta, 1998; Soyibo, 1997; Bagachwa, 1995; Aryeetey, 1994; Chipeta and Mkandawire, 1991). To the extent that official monetary data do not include informal financial transactions, the volume of aggregate financial transactions is underestimated, bringing into question the timing and effect of monetary policy on economic activity (Ngalawa, 2014).

The primary objective of this paper, therefore, is to investigate the difference in the impact of monetary policy when IFS data is included and when it is excluded. The paper employs IFS data constructed by Ngalawa (2014) using two survey datasets, elements of

indigenous knowledge and principles of the Friedman method of interpolating time series from related series. This is the first study that we are aware of that examines the impact of monetary policy on economic activity taking into account the IFS. The study argues that exclusion of IFS transactions in official monetary data has the potential to frustrate monetary policy through wrong inferences on the impact of monetary policy on economic activity.

Consistent with Ngalawa (2014), Soyibo (1997) and Chipeta and Mkandawire (1991), this study defines informal finance as legal but unregulated financial activities that take place outside official financial institutions, and are not directly amenable to control by key monetary and financial policy instruments.

The rest of the paper is organised as follows: Section 2 reviews the literature on the interaction of formal and informal financial markets. Section 3 presents a structural vector autoregressive (SVAR) model used for analysis. Estimation results are discussed in Section 4; and a summary and conclusion follow in section 5.

2. FORMAL AND INFORMAL FINANCIAL MARKETS

Many studies have demonstrated that the formal and informal financial sectors in low income countries are interlinked (see, for example Khoi et al, 2013; Ngalawa and Viegi, 2013; Bose, 1998; Hoff and Stiglitz, 1993, 1994; Bolnick, 1992; Chipeta and Mkandawire, 1991). Using a dynamic stochastic general equilibrium (DSGE) framework, Ngalawa and Viegi (2013) showed that total formal and informal sector loans are complementary in quasi-emerging market economies. Chipeta and Mkandawire (1991) state that formal and informal sector credit is complementary when an increase in demand for credit in one sector is accompanied by an increase in demand for credit in another sector.

Thus, a rise in investment financed by FFS credit creates additional productive capacity that can be utilised only with IFS credit in order to maintain the economy at an equilibrium level (see Chipeta and Mkandawire; 1992Aryeetey, 1992). Since the IFS

provides additional finance to firms in excess of what comes from the FFS, increasing the use of FFS credit increases the demand for credit in the IFS (Ngalawa and Viegi, 2013).

In a study of quasi-emerging market economies (QEMEs), Ngalawa and Viegi (2013) demonstrated that in Malawi, formal and informal financial sector credit are substitutes in a borrowing firm's utility function but they are complements in the aggregate. Khoi et al. (2013) found similar results in a study of Vietnam. They showed that in Vietnam, an increase in demand for informal credit increases the probability of borrowing from the formal sector, which is consistent with the complementarity hypothesis of formal and informal financial markets. Khoi et al. (2013) further argue that the high interest rate differential between the two markets leads households that borrowed in the informal market to take out a formal market loan to repay or roll-over the informal debt. Underscoring the high interest rate differential, they point out that IFS interest rates in Vietnam are five times higher than FFS interest rates.

Some studies have gone further to show that interest rates in the formal and informal financial sectors do not necessarily change together in the same direction. Ngalawa and Viegi (2013) have shown that under certain circumstances in QEMEs, interest rates in the formal and informal financial markets respond to a monetary policy shock by changing in diametrically opposed directions, with the implication that monetary policy may be frustrated by the nature of interest rate interaction between the two sectors. Chipeta and Mkandawire (1991, 1992), Chimango (1977) and Bolnick (1992) also report that interest rates in the formal financial sector in Malawi are not driven by the formal financial sector.

In some countries, governments have intervened in the formal sector in an attempt to provide cheap credit to households, usually in the agricultural sector. The expectation is that farmers would shift from the IFS as their primary source of credit to the FFS, which would force IFS interest rates down. This, however, has not happened (see for example, Basu, 1994; Siamwalla et al., 1990; Bell, 1990). Bose (1998) maintains that there is evidence that interest rates charged by the IFS have been relatively unaffected by FFS

interest rates, which are substantially below those charged by the IFS. Hoff and Stiglitz (1993, 1994) have argued that the cheap credit in the FFS may result in an increase, rather than a decrease, in the IFS interest rates.

Several studies have also found that funds flow between the formal and informal financial markets (see Ngalawa and Viegi, 2013; Bose, 1998; Bolnick, 1992). Often, creditors in the IFS have access to funds in the FFS. As suppliers of loans, IFS creditors usually possess enough assets to qualify as creditworthy to the lending institutions in the formal sector; and in many countries, credit from suppliers is routinely financed (at least indirectly) with bank loans or overdrafts (Bose, 1998). Funds have also been observed to flow in the reverse direction, from the informal to the formal financial sector. Bolnick (1992), for instance, reports that even the moneylender stores liquidity in the bank.

3. METHODOLOGY

3.1. Structural VAR Framework

Following Ngalawa and Viegi (2011), we assume the monetary transmission process in Malawi can be described by a dynamic system whose structural form equation is given by:

$$\mathrm{A}y_t = \Omega + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \cdots + \Phi_p y_{t-p} + \mathrm{B}\mu_t \quad (1)$$

where A is an invertible $(n \times n)$ matrix describing contemporaneous relations among the variables; y_t is an $(n \times 1)$ vector of endogenous variables such that $y_t = (y_{1t}, y_{2t}, \dots, y_{nt})$; Ω is a vector of constants; Φ_i is an $(n \times n)$ matrix of coefficients of lagged endogenous variables $(\forall\, i = 1,2,3, \dots, p)$; B is an $(n \times n)$ matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on more than one endogenous variable in the system; and μ_t are uncorrelated or orthogonal white-noise structural disturbances i.e. the covariance matrix of μ_t is an identity matrix $\mathrm{E}(\mu_t, \mu_t')$=1.

Feedback inherent in the structural VAR equation makes it impossible to directly estimate equation (1) (see Enders, 2004). We can, nonetheless, recover the information in the system by estimating a reduced form VAR implicit in primitive equation. Pre-multiplying equation (1) by A^{-1} yields a reduced form VAR of order *p*, which in standard matrix form is written as:

$$y_t = \Psi_0 + \sum_{i=1}^{p} \Psi_{\mathrm{i}} y_{t-i} + \varepsilon_t \qquad (2)$$

where $\Psi_0 = \mathrm{A}^{-1}\Omega$; $\Psi_{\mathrm{i}} = \mathrm{A}^{-1}\Phi_i$; and $\varepsilon_t = \mathrm{A}^{-1}\mathrm{B}\mu_t$ is an $(n \times 1)$ vector of error terms assumed to have zero means, constant variances and to be serially uncorrelated with all the right hand side variables as well as their own lagged values though they may be contemporaneously correlated across equations. The variance-covariance matrix of the regression residuals in equation (2) is defined as $\Sigma = \mathrm{E}(\varepsilon_t, \varepsilon_t')$. Given the estimates of the reduced form VAR in equation (2), the structural economic shocks are separated from the estimated reduced form residuals by imposing restrictions on the parameters of matrices *A* and *B* in equation (3):

$$\mathrm{A}\varepsilon_t = \mathrm{B}\mu_t \qquad (3)$$

which is derived from equation (2). To identify matrices *A* and *B*, we adopt structural factorisation, an approach which uses relevant economic theory to impose restrictions on the elements of matrices *A* and *B* (see Sims and Zha, 2006; Bernanke and Mihov, 1998; Sims, 1986; Bernanke, 1986). Seven variables are included in our SVAR namely, output (GY_t), consumer price level (CP_t), commercial bank loans (BL_t) (we also experiment with IFS loans $(IFSL_t)$ and total loans $(TOTL_t)$, which is the sum of bank loans and IFS loans), exchange rates (XR_t), aggregate money supply $(M2_t)$, bank rate (BR_t) (we also experiment with IFS interest rates $(IFSIR_t)$) and reserve money (RM_t). Output and consumer prices enter the SVAR as policy goals; bank rate and reserve money as operating targets; and commercial bank loans, exchange rates and monetary aggregates as

intermediate targets of monetary policy. The structural shocks in equation (3) are identified according to the following scheme:

$$\mathrm{A} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & a_{35} & a_{36} & a_{37} \\ a_{41} & a_{42} & 0 & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & 0 & 0 & 1 & a_{56} & 0 \\ 0 & 0 & 0 & a_{64} & 0 & 1 & 0 \\ 0 & 0 & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{pmatrix} \qquad \varepsilon_t = \begin{pmatrix} \varepsilon_t^{GY} \\ \varepsilon_t^{CP} \\ \varepsilon_t^{BL} \\ \varepsilon_t^{XR} \\ \varepsilon_t^{M2} \\ \varepsilon_t^{BR} \\ \varepsilon_t^{RM} \end{pmatrix}$$

$$\mathrm{B} = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} \end{pmatrix} \qquad \mu_t = \begin{pmatrix} \mu_t^{GY} \\ \mu_t^{CP} \\ \mu_t^{BL} \\ \mu_t^{XR} \\ \mu_t^{MA} \\ \mu_t^{BR} \\ \mu_t^{RM} \end{pmatrix} \tag{4}$$

The non-zero coefficients a_{ij} and b_{ij} in matrices A and B, respectively, show that any residual *j* in matrices ε_t and μ_t, in that order, has an instantaneous impact on variable *i*. The first two equations suggest that output and consumer prices are sluggish in responding to shocks to monetary variables in the economy. This scheme is based on the observation that most types of real economic activity may respond only with a lag to monetary variables because of inherent inertia and planning delays (Karame and Omedo, 2002). Proposed by Bernanke and Mihov (1997), the validity of this argument has been supported by a number of studies (see, for example Cheng, 2006; Becklemans, 2005; Vonnak, 2005; Karame and Olmedo, 2002).

Commercial bank loans are postulated to be contemporaneously affected by all variables in the system. Blundell-Wignall and Gizycki (1992) argue that expectations of future activity form an important determinant of credit demand. Assuming current output, price level, exchange rates, interest rates, and money supply give some indication of what is

expected in the future (Becklemans, 2005) and because economic agents are indeed forward looking, bank lending may respond contemporaneously to all variables in the system.

Modelling contemporaneous responses of exchange rates to other variables in an SVAR is relatively standard across studies. Since the exchange rate is a forward-looking asset price, most studies assume that all variables have contemporaneous effects on the exchange rate (Kim and Roubini, 2000). Becklemans (2005) uses a real trade-weighted exchange rate index in a study of Australia and assumes that the index responds instantaneously to all variables in the system. In a study of Kenya, Cheng (2006) employs a nominal effective exchange rate and maintains that the exchange rate responds contemporaneously to all variables in the SVAR. Similarly, Borys and Hovarth (2007) in a study of the Czech Republic and Piffanelli (2001) in a study of Germany assume all variables in the system affect exchange rates instantaneously.

In Malawi, however, the instantaneous response of exchange rates to all macroeconomic variables cannot be justified. The financial sector in the country lacks depth and is weakly integrated into global markets. It is safe, therefore, to assume that information delays will be prevalent, forcing players in the foreign exchange market to respond with a lag to changes in interest rates, bank loans and monetary aggregates. This study, therefore, takes a departure from the previous studies and postulates that exchange rates respond contemporaneously to changes in the level of output and consumer prices only and with a lag to movements in interest rates, bank loans and monetary aggregates. Besides being an asset price, the exchange rates also account for movements in external factors such as oil prices and interest rates on the international market.

The fifth equation is a standard money demand function. The equation postulates that demand for money in the country makes aggregate money supply respond contemporaneously to changes in consumer prices, output and interest rates but not to changes to other variables in the system, akin to Sims and Zha (1998). The last two

equations constitute the monetary policy feedback rule. While Malawi's official position is that it targets reserve money, there is reason to believe that the monetary authorities also target short term interest rates. The study, therefore, assumes that the country employs hybrid operating procedures, with the bank rate and reserve money as operating targets of monetary policy. In this framework, both interest rates and reserves are expected to contain information about monetary policy (Bernanke and Mihov, 1997). The country's effective operating target, accordingly, is determined empirically.

The monetary policy feedback rule is drawn on the assumption that information delays impede policymakers' ability to react immediately to economic activity and price level developments (Karame and Olmedo, 2002). Both the bank rate and reserve money, therefore, do not respond immediately to output and consumer prices. The bank rate, specifically, responds contemporaneously to changes in the exchange rates only. While exchange rate data is available real-time, data on other variables including bank loans and monetary aggregates is usually available to the monetary authorities with a lag. Reserve money, on the other hand, is assumed to respond contemporaneously to all monetary variables because by its definition, this information is inherent in the monetary aggregate.

3.2. Data, Data Sources and Measurement of Variables

The study employs monthly time series data for the period 1988:1 to 2005:12. The starting date has been chosen to capture the period when monetary authorities in Malawi migrated from using direct measures of monetary control to using indirect measures. The cut-off date corresponds to the date when the interpolated IFS data is available. Major sources of data include the RBM, the National Statistical Office (NSO) of Malawi, the Malawi Meteorological Department and the University of Malawi. Data for IFS credit and interest rates are obtained from Ngalawa's (2014) interpolation.

Bank rate (BR_t) is defined as the rate at which the central bank provides short term loans to commercial banks and discount houses in its function as a lender of last resort. The variable enters the SVAR as an instrument target of monetary policy. We also experiment

with IFS interest rates $(IFSIR_t)$. Reserve money (RM_t) is also employed as an instrument target of monetary policy in the SVAR. Components of RM_t are identified as total cash reserves held by the central bank, vault cash in commercial banks and currency held by the non-bank public. The variable BL_t captures commercial bank loans and advances and it enters the SVAR as an intermediate target of monetary policy. We also experiment with IFS loans $(IFSL_t)$ and total loans $(TOTL_t)$, which is the sum of bank loans and IFS loans. Similarly, exchange rate (XR_t) enters the SVAR as an intermediate target of monetary policy. Middle nominal exchange rates of the Malawi Kwacha vis-à-vis the United States Dollar are used as a proxy for XR_t. Aggregate money supply (M2) is measured by the sum of currency in circulation, demand deposits and time deposits. The variable also enters the SVAR as an intermediate target of monetary policy.

Consumer prices (CP_t) are measured by the all items national composite consumer price index with base year 2000. The variable enters the SVAR as a monetary policy goal. A measure of output (GY_t) enters the SVAR as a monetary policy goal as well. GDP data (used as a proxy for GY_t) for Malawi is, however, only available in annual frequency. This presents a case for interpolation. Several studies have used interpolated monthly GDP series in SVARs. Among them, Cheng (2006) used monthly production data of key sectors in Kenya to interpolate the country's annual GDP to monthly frequency and Borys and Hovarth (2007) used the quadratic-match average procedure to interpolate GDP from quarterly to monthly frequency in the Czech Republic. This study employs the Friedman method of interpolating time series by related series to compute the required monthly GDP series from annual data.

All variables, with the exception of interest rates, are expressed in natural logarithms. They are also seasonally adjusted using TRAMO (Time Series Regression with Autoregressive Moving Average (ARIMA) Noise, Missing Observations, and Outliers) and SEATS (Signal Extraction in ARIMA Time Series) with a forecast horizon of 12 months.

4. ESTIMATES AND INFERENCES

The estimation is carried out in five modular experiments. In the first experiment, only FFS data are used in a seven variable SVAR. The variables include reserve money *(RM)*, aggregate money supply *(M2)*, bank rate *(BR)*, aggregate output *(GY)*, exchange rate of the Malawi Kwacha vis-à-vis the US Dollar *(XR)*, consumer prices (*CP)* and commercial bank lending *(BL)*. This estimation is used as a basis for comparison with other scenarios. In the second experiment, the SVAR is re-estimated with commercial bank loans replaced by IFS loans. The third experiment is a re-estimation of the SVAR with commercial bank loans replaced by IFS loans *(IFSL)* and the bank rate replaced by IFS interest rates *(IFSIR)*. In the fourth experiment, the SVAR is re-estimated with commercial bank loans replaced by total loans *(TOTL)*, an aggregate of FFS and IFS loans. The final experiment is a re-estimation of the SVAR with the bank rate replaced by IFS interest rates *(IFSIR)* and bank loans replaced by total loans *(TOTL),* a sum of FFS and IFS loans. Impulse responses from these experiments are presented in Figures A1-A5 in Appendix A.

Figure A1 (in Appendix A) shows that commercial bank loans decline significantly following a monetary policy shock characterized by an unanticipated increase in the bank rate, which is consistent with *a priori* theoretical expectations. The bank rate shock, however, has no significant effect on IFS loans (see Figure A2 in Appendix A). In the IFS, it is observed that an unexpected increase in IFS interest rates causes an instantaneous increase in IFS credit (see Figure A3 in Appendix 2). This occurs because of a high positive correlation between interest rates and real output in the IFS. An increase in output in the IFS reflects higher expected returns and hence higher interest rates. In the IFS, interest rates are perceived as a tool in a profit sharing arrangement between lenders and borrowers. When the formal and informal financial sector credit are aggregated, it is observed in Figure A4 (Appendix A) that a bank rate shock has an insignificant impact on total credit. It must be, therefore, that the non-responsiveness of IFS credit to a bank rate shock coupled with the positive relationship between interest rates and credit in the IFS outweigh the inverse relationship between bank loans and a

bank rate shock so that on balance, total credit does not respond significantly to a bank rate shock.

An unexpected increase in commercial bank lending causes output to increase significantly, peaking after about two years (see Figure A1 in Appendix A). Figure A2 shows that an unanticipated increase in IFS credit also causes aggregate output to rise. Not surprisingly, total output increases significantly following an unexpected increase in aggregate credit (the sum of formal and informal financial sector credit) (see Figure A4 in Appendix A). It is tempting, therefore, for the monetary authorities to formulate and implement policy that will increase domestic credit, with the ultimate objective of stimulating economic growth. If they choose to loosen monetary policy by reducing the bank rate in order to increase domestic credit and consequently accelerate the growth of real output, the results will be unexpected. As observed in the foregoing discussion, aggregate credit does not respond significantly to a bank rate shock if the IFS is taken into account. Accordingly, there is no reason to believe that output will be affected.

Figure A1 (in Appendix A) also shows that consumer prices increase following a sudden increase in commercial bank lending. The consumer prices are also observed to rise in response to an unexpected increase in IFS loans (see Figure A2 in Appendix A). As expected, an unanticipated rise in total credit causes consumer prices to go up. This suggests that credit (formal, informal or both) can be used as an intermediate target of monetary policy in the fight against inflation. The problem, as observed previously, is that if the IFS is taken into account, total loans do not respond to a monetary tightening characterised by an unexpected increase in the bank rate. If the monetary authorities are unaware of the impact of the IFS, they may be misled into believing that an increase in the bank rate will cause a decline in bank lending, consequently easing pressure on consumer prices as shown by a partial picture in Figure A1. If, on the other hand, they understand the role of the IFS, they will realize that increasing the bank rate will have no effect on total credit and there will be subsequently no impact on consumer prices.

It is further observed in Figure A1 that output decreases significantly following bank rate shock characterized by an unexpected increase in the bank rate. This is consistent with a priori theoretical expectations. Figure A3, however, reveals that output initially increases in response to an IFS shock. As argued previously, increasing IFS interest rates are associated with increasing output because they reflect increasing productivity/production. When productivity/production in the IFS is increasing, the return on investment is also increasing and lenders tend to tie their interest rate to this. Thus, in an economy with a large IFS, the impact of interest rates on aggregate output cannot be generalized. A positive interest rate shock in the FFS depresses output which in the IFS, a positive interest rate shock (IFS interest rates) has a positive impact on output.

In Figure A1, it is demonstrated that consumer prices do not respond significantly to a bank rate shock. In Figure A3, it is also observed that consumer prices do not respond significantly to IFS interest rate shocks. It is also shown in all the figures that consumer prices in Malawi do not respond significantly to unexpected changes in aggregate money supply. This confirms the findings of Ngalawa and Viegi (2011) that monetary factors may not be primary determinants of inflation in Malawi. The representative basket of commodities used for measuring national consumer price indices in Malawi puts a preponderant weight to food costs (58.1 percent), which indicates that structural rigidities in food production may be a more important determinant of inflation than monetary variables.

Figure A1, however, reveals that consumer prices increase significantly following a positive commercial bank lending shock. Similarly, Figures A2 and A3 show that consumer prices rise significantly in response to an unexpected increase in IFS lending. Unsurprisingly, an unanticipated increase in total lending causes consumer prices to increase (see Figures A4 and A5). This finding provides evidence that fluctuations in lending in the two sectors complement each in influencing consumer prices.

Against the foregoing discussion, we conclude that exclusion of IFS transactions in official monetary data has the potential to frustrate monetary policy through wrong inferences on the impact of monetary policy on economic activity.

5. SUMMARY AND CONCLUSIONS

In nearly all low income countries, official monetary data excludes informal financial transactions although the informal financial sector (IFS) forms a large part of the financial sector. This occurs due to the non-existence of IFS data. However, excluding informal financial transactions in official monetary data underestimates the volume of financial transactions and incorrectly presents the cost of credit, bringing into question the accuracy of expected effects of monetary policy on economic activity. Using IFS data for Malawi constructed from two survey datasets, indigenous knowledge and elements of Friedman's data interpolation technique, this study employs innovation accounting in a structural vector autoregressive model to compare monetary policy outcomes in the country when IFS data is taken into account and when it is not.

Consistent with conventional theories, the study finds that output increases following a rise in either formal financial sector (FFS) or IFS lending. Similarly, inflation rates increase when lending rises in both sectors. In addition, it is observed that consumer prices in Malawi do not respond significantly to lending in either sector. These findings provide evidence that the two sectors complement each other. However, further investigation shows that FFS lending declines when the bank rate increases while IFS loans are not responsive to bank rate variations; and an aggregation of the two is unaffected by bank rate changes. When IFS interest rates are raised, total loans decline, suggesting that lending in the IFS responds to IFS interest rates and not to FFS interest rates. The study also finds that output declines following an increase in FFS interest rates but declines when IFS interest rates go up. The study, therefore, concludes that exclusion of IFS transactions in official monetary data has the potential to frustrate monetary policy through wrong inferences on the impact of monetary policy on economic activity.

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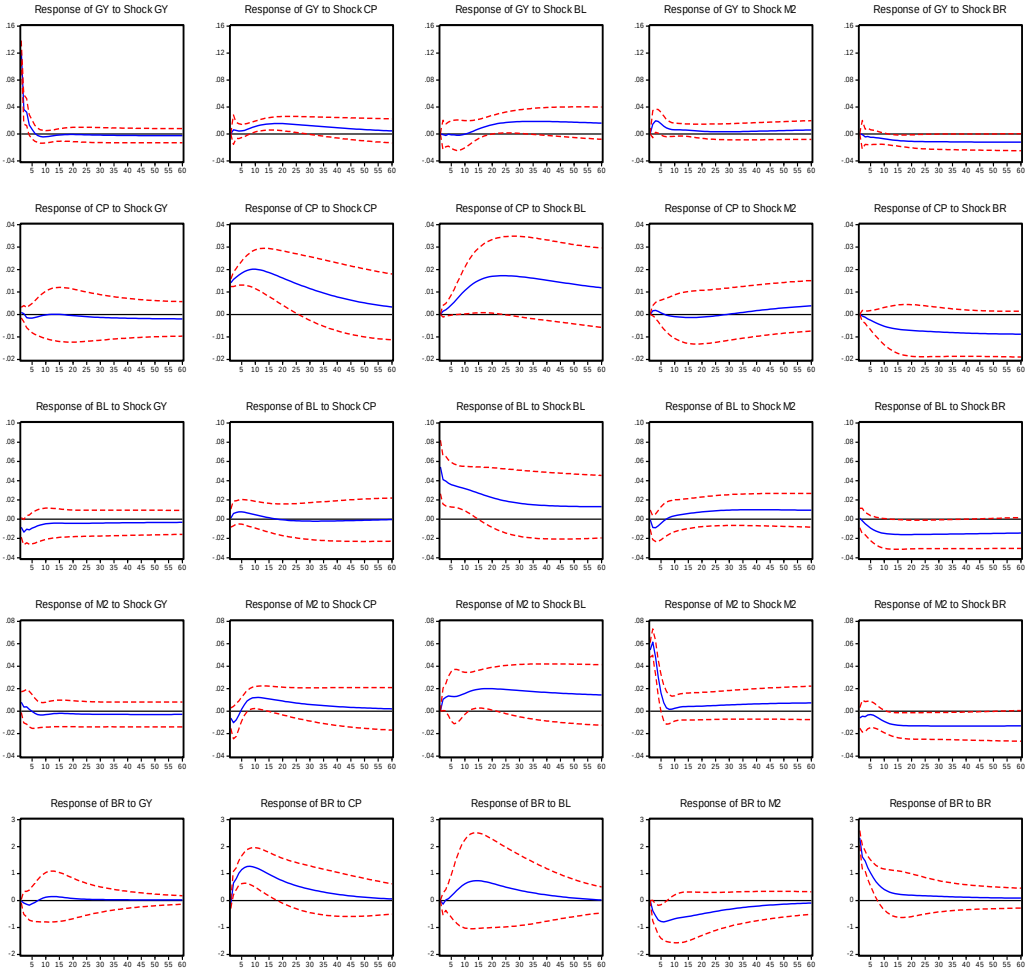
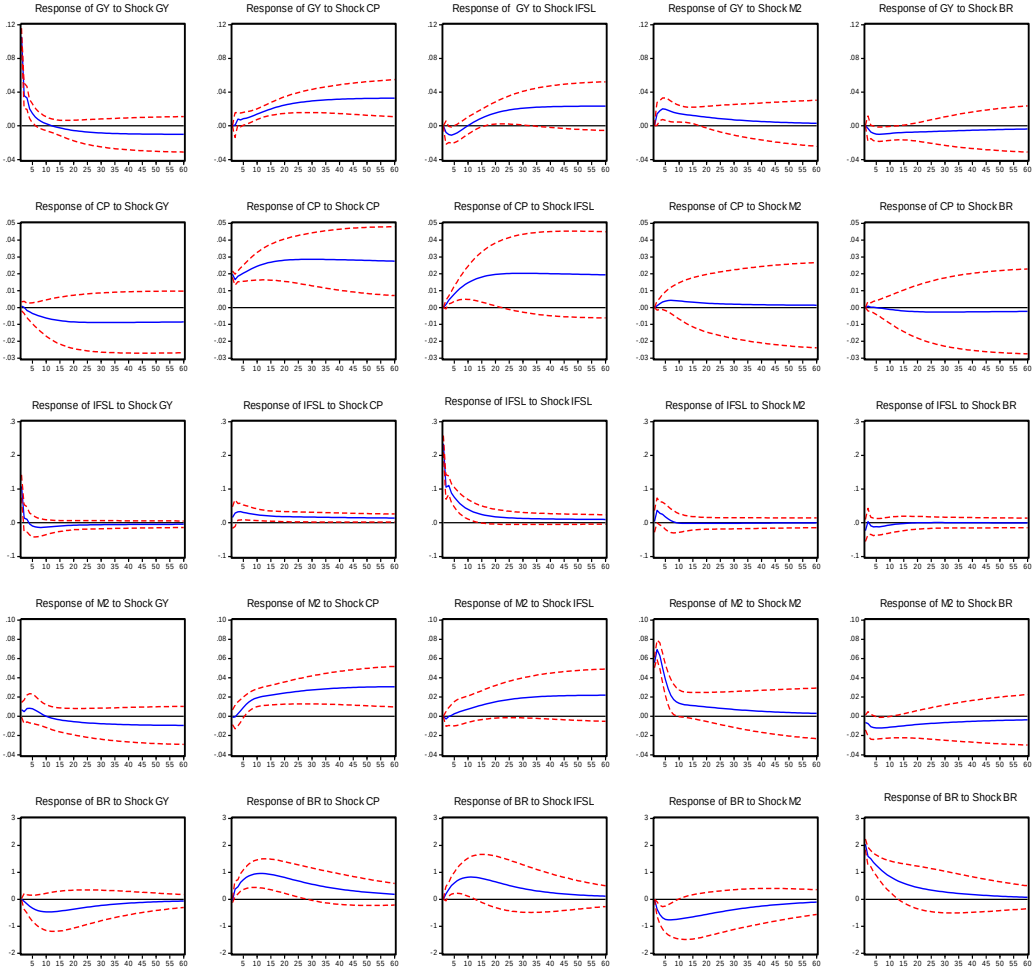
APPENDIX A

Figure A1: Impulse Responses with FFS Data Only



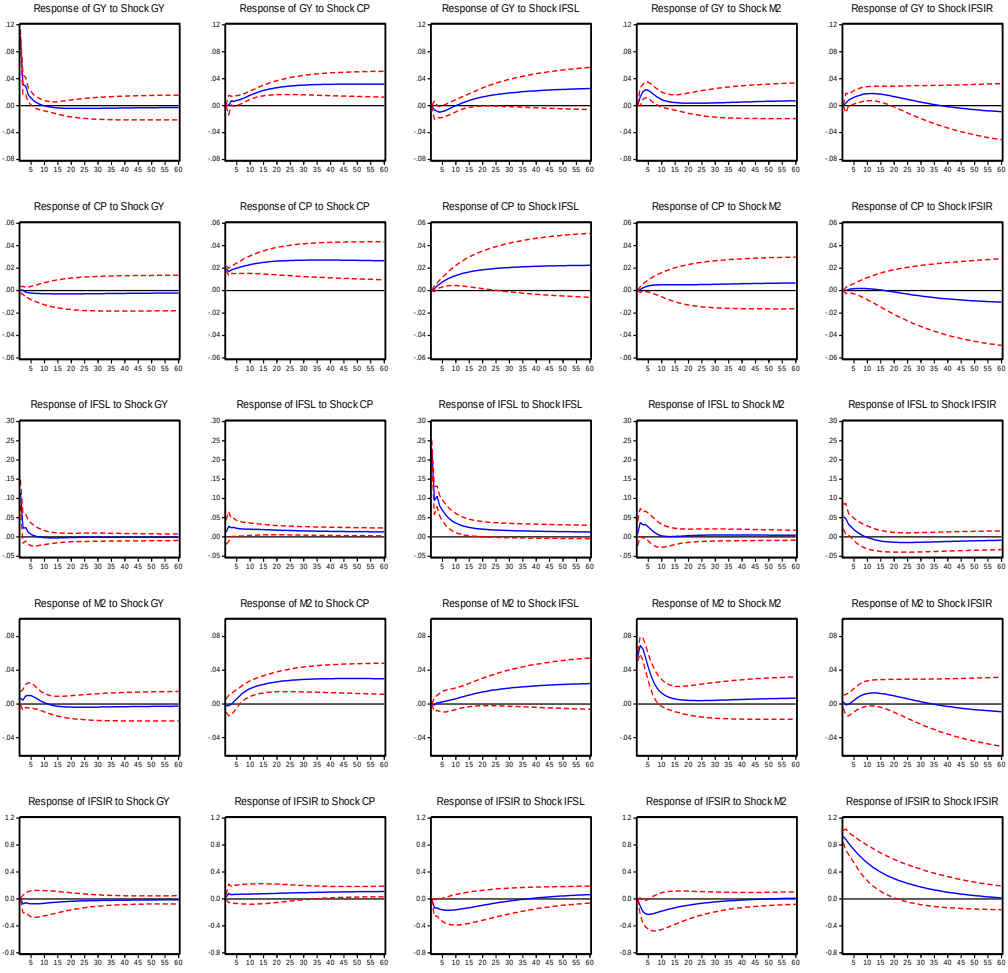
APPENDIX A

Figure A2: Impulse Responses with IFS Loans



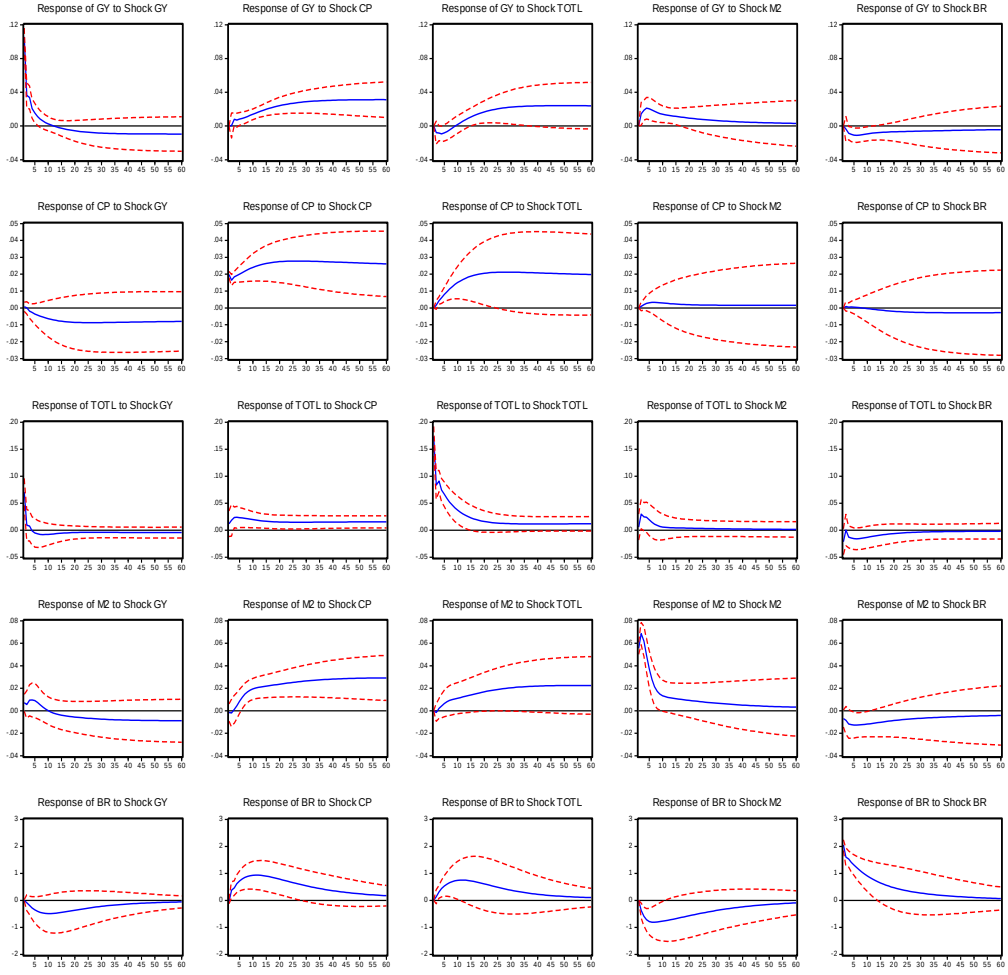
APPENDIX A

Figure A3: Impulse Responses with IFS Credit and Interest Rates



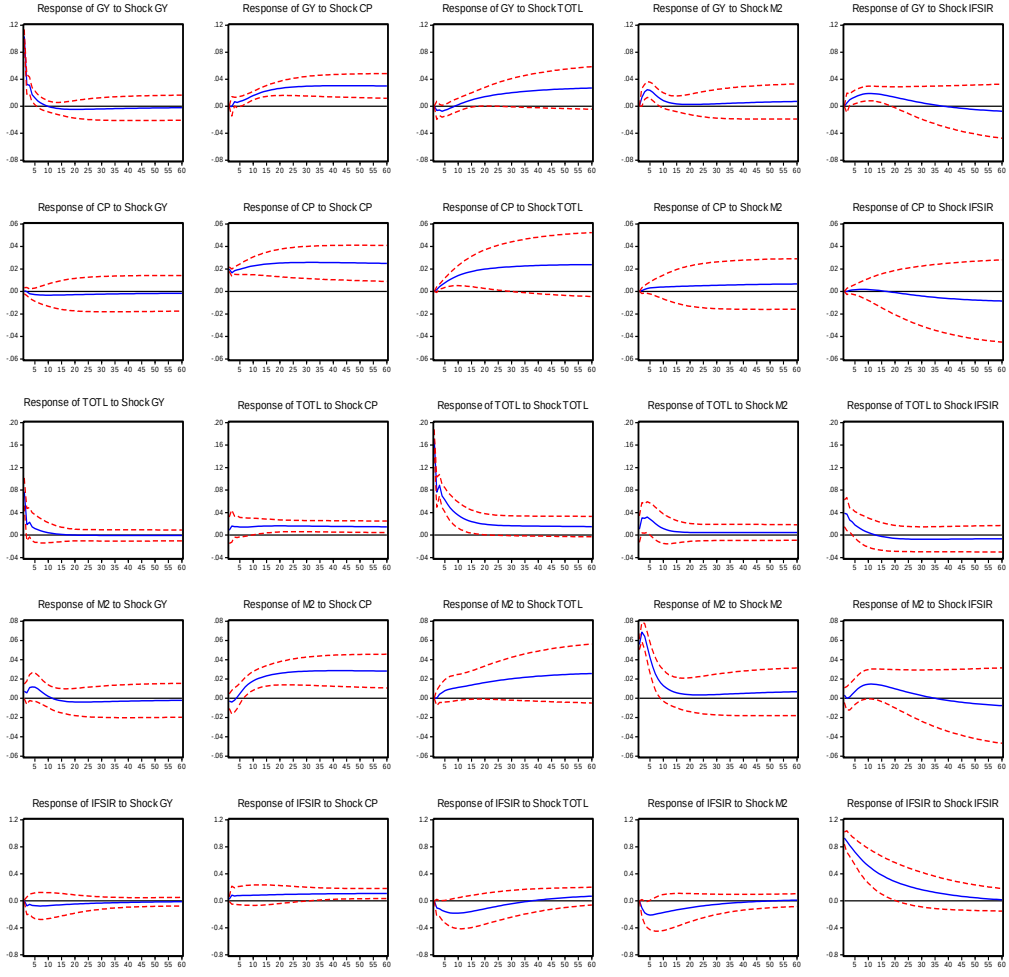
APPENDIX A

Figure A4: Impulse Responses with Aggregated FFS and IFS Loans



APPENDIX A

Figure A5: Impulse Responses with IFS Interest Rates and Total Credit (Aggregated Formal and Informal Financial Sector Credit)



APPENDIX B

INTERPOLATION OF INFORMAL SECTOR CREDIT AND INTEREST RATES TIME SERIES FOR MALAWI[2]

A.1. INTRODUCTION

Two survey datasets are used in the interpolation of informal financial sector (IFS) credit and interest rates for Malawi. These are: the Chipeta and Mkandawire Survey (hereafter the CM survey) of 1988/89, and the Second Integrated Household Survey for Malawi (hereafter IHS2) carried out in 2004/2005 by the Malawi National Statistical Office.

A.2. CONSTRUCTION OF IFS CREDIT TIME SERIES

Suppose economic agent *j* obtains credit $\left(c^{*}_{jt:i}\right)$ at time *t:i* (where *t* is a year counter and *i* is a month counter) in the IFS either for agricultural $\left(c^{A}_{jt:i}\right)$ or other non-agricultural activities $\left(c^{O}_{jt:i}\right)$. Further assume that data are available only for two end-points (c^{*}_{j1} and c^{*}_{jT}; c^{A}_{j1} and c^{A}_{jT}; and c^{O}_{j1} and c^{O}_{jT}, where *T* is the total number of observations including end-points). Let $\sum_{j=1}^{n} c^{*}_{jt:i} = C^{*}_{t:i}$; $\sum_{j=1}^{n} c^{A}_{jt:i} = C^{A}_{t:i}$; and $\sum_{j=1}^{n} c^{O}_{jt:i} = C^{O}_{t:i}$. The values $C^{*}_{1988:1}$ and $C^{*}_{2005:12}$ are calculated by taking informal financial sector credit allocated to individuals in the sample, and, assuming it is a representative sample, extrapolating it to the entire economically active age group (16-49 years). Effectively, this takes out children (those less than 16 years old, according to the United Nations definition) and the elderly (those aged 50 years and above). $C^{A}_{1988:1}$, $C^{O}_{1988:1}$, $C^{A}_{2005:12}$ and $C^{O}_{2005:12}$ are calculated analogously. A linear interpolation of $C^{*}_{t:i}$ is given by:

$$C^{*}_{t:i+1} = C^{*}_{t:i} + (C^{*}_{T} - C^{*}_{1})/T \qquad (A1)$$

and a linear interpolation of $C^{A}_{t:i}$ and $C^{O}_{t:i}$ are given by:

[2] This method is explained in detail in Ngalawa (2014).

$$C_{t:i}^{A} = \delta_{t:i} C_{t:i}^{*} \quad (A2A)$$

$$C_{t:i}^{O} = \varphi_{t:i} C_{t:i}^{*} \quad (A2B)$$

where $\delta_{t:i}$ is the share of IFS credit to the agricultural sector and $\varphi_{t:i}$ is the proportion of IFS credit allocated to non-agricultural activities at time *t:i*. The ratios $\delta_{t:i}$ and $\varphi_{t:i}$ are calculated by taking a linear trend from the known values δ_1, δ_T, $\varphi_1$and φ_T, as given by:

$$\delta_{t:i+1} = \delta_{t:i} + (\delta_T - \delta_1)/T \quad (A3A)$$

$$\varphi_{t:i+1} = \varphi_{t:i} + (\varphi_T - \varphi_1)/T \quad (A3B)$$

Agricultural activities are assumed to be influenced by the seasonal pattern of the agricultural sector, which is the mainstay of the Malawi economy. Therefore, rainfall data is used to construct weights for trending the agricultural component of the IFS credit. Monthly rainfall data collected at six weather stations (Bvumbwe and Ngabu in the Southern Region, Dedza and Nkhotakota in the Central Region, and Mzimba and Karonga in the Northern Region) are used. These weather stations were purposefully selected to cover a lowland and a highland in each region. Bvumbwe, Dedza and Mzimba represent the highlands, while Ngabu, Nkhotakota and Karonga represent the lowlands in the Southern, Central and Northern Regions of the country, respectively. Using average rainfall observations for the six weather stations, the rainfall weights $\left(\omega_{t:i}^{rf}\right)$ are calculated for each year, separately, according to the following formula:

$$\omega_{t:i}^{rf} = X_{t:i}^{rf} / \sum_{i=1}^{12} X_{t:i}^{rf} \quad (A4)$$

where $X_{t:i}^{rf}$, the weighting variable, is the amount of rainfall at time *t:i*. The weights enter the computation formula for trending the agricultural component of IFS credit with a

one month lag, on the premise that a decision to borrow for agricultural use is made to accommodate a one month time-lag for processing of the loan and purchasing of the agricultural inputs. The final interpolation of IFS agricultural loans computed separately for each year, therefore, is given by:

$$C'^{A}_{t:i} = \omega^{rf}_{t:i-1} \sum_{i=1}^{12} C^{A}_{t:i} \qquad (A5)$$

It is expected that borrowing and lending for non-agricultural use is influenced by agricultural activities in the rural areas, and industrial performance in the urban areas. For this reason, the non-agricultural component of IFS credit is trended using a weighted average of tobacco production *(tp)* as a proxy of total agricultural production, and the index of industrial production *(ip)* as a proxy for industrial performance. Calculated separately for each year, the tobacco production and index of industrial production weights, are given by the following formulae:

$$\omega^{tp}_{t:i} = X^{tp}_{t:i} / \sum_{i=1}^{12} X^{tp}_{t:i} \qquad (A6A)$$

$$\omega^{ip}_{t:i} = \Delta X^{ip}_{t:i} / \sum_{i=1}^{12} \Delta X^{ip}_{t:i} \qquad (A6B)$$

where $\omega^{tp}_{t:i}$ and $\omega^{ip}_{t:i}$ are tobacco production and index of industrial production weights; and $X^{tp}_{t:i}$ and $\Delta X^{ip}_{t:i}$ are the weighting variables, namely tobacco production and change in the index of industrial production, respectively. Realising that the ratio of industrial production to agricultural production may not have remained the same over the years, the annual proportions of tobacco production and manufacturing (as proxies for agricultural and industrial production, respectively) in GDP, $\left(S^{tp}_{t}\right)$ and $\left(S^{ip}_{t}\right)$ respectively, are used to calculate a weighted average of the two weighting variables over the sample period, as given by:

$$\omega^{O}_{t:i} = \left(S^{tp}_{t} / \left(S^{tp}_{t} + S^{ip}_{t}\right)\right)\omega^{tp}_{t:i} + \left(S^{ip}_{t} / \left(S^{tp}_{t} + S^{ip}_{t}\right)\right)\omega^{ip}_{t:i} \qquad (A7)$$

The final interpolation of IFS non-agricultural loans, accordingly, is calculated for each year separately, as given by:

$$C'^{O}_{t:i} = \omega^{O}_{t:i} \sum_{i=1}^{12} C^{O}_{t:i} \qquad (A8)$$

Summing up the credit for agricultural and non-agricultural activities, the final interpolation of aggregate IFS credit is obtained, as given by:

$$C'^{*}_{t:i} = C'^{A}_{t:i} + C'^{O}_{t:i} \qquad (A9)$$

The aggregate IFS credit series (sum of IFS agricultural and non-agricultural loans), is seasonally adjusted using TRAMO (Time Series Regression with Autoregressive Moving Average (ARIMA) Noise, Missing Observations, and Outliers) and SEATS (Signal Extraction in ARIMA Time Series) with a forecast horizon of 12 months.

A.3. CONSTRUCTION OF IFS INTEREST RATES

Prior to putting together informal sector interest rates for Malawi, it is imperative to acknowledge that the IFS operates within a framework of the following stylised facts:

(1) Lending rates in semi-formal and formal financial institutions change together in the same direction. The semi-formal financial institutions simply add a mark-up on the average base lending rates, to take into account lending risk.
(2) Lending rates charged by employers and estate owners also follow the pattern of FFS interest rates. The former, however, are set at a level that is lower than the latter, because employers and estate owners feel they have a social obligation to provide for certain needs to their employees/tenants.
(3) Interest rates on loans extended by money-lenders, friends, relatives, neighbours, traders/grocers/local merchants and grain millers are determined by custom and traditional values (see Chipeta and Mkandawire, 1991; Chimango, 1977), and they tend

to be rigid. Generally, friends, relatives, neighbours, traders/grocers/local merchants and grain millers, do not charge any interest on loans given out (see Chipeta and Mkandawire, 1991) as a way of promoting a *camaraderie* tradition (locally known as *achibale,* literally translated "relatives"). Malawi tradition holds that people that live close together in a society are effectively *achibale,* and each member of *achibale* feels bound by tradition to promote it. Moneylenders, on the other hand, charge 100 per cent interest per period of time, usually a month.

To compile the series of IFS interest rates, two further important simplifying assumptions are made. Firstly, it is assumed that total credit in the IFS varies according to the interpolation carried out in the previous section. Secondly, it is postulated that the proportion of credit attributed to each market segment changed from the position reported in the CM-survey to the case in IHS2 (see Table A1) following a linear trend. IHS3 data is included in the table for comparison purposes.

Table A1: IFS Credit Distribution by Market Segment and Interest Rates in Malawi

Credit Source	Interest rates (1988/89)	Proportion of IFS credit		
		CM-Survey	IHS2	IHS3
Friends, Relatives and Neighbours	0.00	21.55	37.08	45.24
Grocers/Traders/Local Merchants/Grain Millers/Other	0.00	2.16	2.15	2.27
Money-lenders	720.00	2.10	8.99	8.96
Community Funds/SCAs/SACCO/ Religious Institutions	137.40	9.63	6.64	4.54
Microfinance	20.00	38.00	42.59	37.19
Employers/Estate Owners	7.40	26.20	2.55	1.81

Source: Chipeta and Mkandawire (1991); Malawi National Statistical Office (2005); Malawi National Statistical Office (2012); author's calculations

From the known values of the proportions of total IFS credit attributed to each sub-market in the 1988/89 CM-Survey and the 2004/2005 IHS2, a linear interpolation of the proportions at monthly frequency is given by:

$$\phi^{j}_{t:i+1} = \phi^{j}_{t:i} + \left(\phi^{j}_{T} - \phi^{j}_{1}\right)/T \qquad (A10)$$

The proportion of total IFS loans attributed to sub-market *j* at time $t{:}\,i+1$ (where *t* is a year counter and *i* is a month counter) is ϕ. Suppose the price of loans (interest rate) for sub-market *j* at time *t:i* is given by $p^{j}_{t:i}$. Sector-wide interest rates for the IFS $(IR_{t:i})$ are given by:

$$IR_{t:i} = \sum_{j=1}^{n}\left(\phi^{j}_{t:i} p^{j}_{t:i}\right) \qquad (A11)$$

where *n* is the number of market segments.