# Interaction of Formal and Informal Financial Markets in Quasi-Emerging Market Economies

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**Abstract**

The primary objective of this paper is to investigate the interaction of formal and informal financial markets and their impact on economic activity in quasi-emerging market economies. Using a four-sector dynamic stochastic general equilibrium (DSGE) model with asymmetric information in the formal financial sector, we come up with three fundamental findings. First, we demonstrate that formal and informal financial sector loans are complementary in the aggregate, suggesting that an increase in the use of formal financial sector credit creates additional productive capacity that requires more informal financial sector credit to maintain equilibrium. Second, it is shown that interest rates in the formal and informal financial sectors do not always change together in the same direction. We demonstrate that in some instances, interest rates in the two sectors change in diametrically opposed directions with the implication that the informal financial sector may frustrate monetary policy, the extent of which depends on the size of the informal financial sector. Thus, the larger the size of the informal financial sector the lower the likely impact of monetary policy on economic activity. Thitrd, the model shows that the risk factor (probability of success) for both high and low risk borrowers plays an important role in determining the magnitude by which macroeconomic indicators respond to shocks.

## 1 Introduction

One of the fundamental distinguishing features of QEMEs is the co-existence of the FFS with a large IFS. Several studies have shown that the IFS in QEMEs is large (see for example African Development Bank, 1994; Chipeta and Mkandawire, 1991) and growing (see for example Chipeta, 1998; Soyibo, 1997; Bagachwa, 1995; Aryeetey, 1994; Chipeta and Mkandawire, 1991). According to the African Development Bank (1994), 70 percent of the total

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population in Cameroon and 80 percent in Zambia take part in informal financial activities. The African Development Bank (1994) study also showed that 85 percent of rural households in Niger and over 80 percent of smallholder farmers in Zimbabwe have access to informal credit, and 60 percent of the population in Ethiopia and 52 percent in Senegal participate in rotating savings and credit associations (ROSCAs). In Malawi, Chipeta and Mkandawire (1991) observed that in 1989, the IFS was larger than the FFS when measured in terms of credit extended to the private sector. They arrived at the same result by comparing savings mobilised by the formal and informal financial sectors. Field surveys carried out in Nigeria by Soyibo (1997), in Ghana by Aryeetey (1994), in Malawi by Chipeta and Mkandawire (1991) and in Tanzania by Bagachwa (1995) established that the IFS grew faster than the FFS in the reform years 1990-1992 (Chipeta, 1998).

Given its sheer size, the IFS's response to policy is expected to be non-trivial and the consequent effect on economic policy may not be obvious - it is likely to vary depending on whether informal financial markets are autonomous or reactive to formal financial markets (See Rahman, 1992; Acharya and Madhura, 1983; Sundaram and Pandit, 1984); whether the two markets are competitive or complementary; and whether the nature of their interaction frustrates or strengthens monetary policy. Unfortunately, nearly all QEMEs leave out informal financial transactions in official monetary data, effectively underestimating the volume of financial transactions and bringing into question the timing and effect of monetary policy on economic activity. This paper contributes to the literature by investigating these and other issues. Using a macromonetary model with microeconomic foundations, we study the interaction of formal and informal financial markets and analyse the resulting impact on economic activity in QEMEs.

For many years, informal financial markets have been perceived as an economic ill that has only succeeded in exploiting impoverished peasants in QEMEs (Bolnick, 1992). The policy prescription, as expected, has been to integrate the IFS in the FFS (see Aryeetey, 2008; Bolnick, 1992; Bell, 1990). Recent research, however, has shown an emerging change in opinion with the sector now being regarded more positively as an integral component of the whole financial sector. Chipeta and Mkandawire (1991), for instance, report that the IFS in Malawi plays an important role in alleviating economic hardships among low-income groups by enabling these groups to mobilise resources (savings effect), use the resources to earn income (investment effect) and obtain loans (credit effect). An account of similar findings is presented by Steel, Aryeetey, Hettige and Nissanke (1997) in a study of Ghana, Malawi, Nigeria and Tanzania. Steel et al. (1997) stress that informal financial institutions (IFIs) in the three countries are an important vehicle for mobilising household savings and financing small businesses, a function that is carried out using specialized techniques that address the problems of information, transaction costs and risks, which prevent banks from serving these market segments. In Kenya, Atieno (2001) observes that unlike commercial banks, informal credit sources provide easier access to credit facilities for small and micro-enterprises.

Against this background, it is clear that official monetary data grossly underestimates the volume of financial transactions in QEMEs; and that operating tools of monetary policy are targeted at only a portion of the financial sector though their impact may spread to the whole sector. On this point, important questions with profound policy implications ought to be asked. How do formal and informal financial markets interact? How does this interaction affect economic activity? How do informal financial markets respond to monetary policy and what is the impact on economic activity? This study contributes to the literature by providing answers to these and related questions using a four-sector dynamic stochastic general equilibrium (DSGE) model incorporating asymmetric information in the FFS.

The choice of a DSGE framework for analysis is motivated by a number of factors. First, DSGE models are derived from microeconomic foundations of constrained decision-making. That is, they describe the general equilibrium allocations and prices in the economy where all agents dynamically maximise their objectives subject to budget or resource constraints (Tovar, 2008). Following the estimation of deep parameters, therefore, it is possible to avoid the Lucas Critique, where only models in which the parameters that do not vary with policy interventions are suited to evaluate the impact of policy change (Ibid, 2008). Indeed, according to Woodford (2003), DSGE models should not, at least in principle, be vulnerable to the Lucas Critique, unlike the more traditional macroeconomic forecasting models. Second, DSGE models are structural, implying that each equation has an economic interpretation which allows clear identification of policy interventions and their transmission mechanisms (Peiris and Saxegaard, 2007). Third, DSGE models are forward looking in the sense that agents optimise model-consistent forecasts about the future evolution of the economy (Ibid, 2007). Fourth, DSGE models allow for a precise and an unambiguous examination of random disturbances. This is facilitated by the stochastic design of the models. To the best of our knowledge, there is no study that has examined the interaction of formal and informal financial sectors and their impact on economic activity in QEMEs using a macromonetary model developed within the context of a microfounded DSGE representation.

Following this introduction, the rest of the paper is structured as follows. A DSGE model for QEMEs is developed in Section 2. The model aims at building a quantitative macroeconomic representation from explicit optimising behaviour while allowing for a minimum amount possible of imperfections. Thus, the model is similar in many aspects to the Real Business Cycle (RBC) approach except on the monetary side (see Tovar, 2008; Mankiw, 2006). Calibrations of parameter and steady state values are presented in Section 3. Section 4 interprets simulation results of the model from three experiments, each illustrating impulse responses of selected macroeconomic indicators to a particular shock. The three shocks in the experiments include a positive production technology shock, a monetary policy shock and a risk factor shock. A summary and conclusions are presented in Section 5.

# 2 A DSGE Model for QEMEs

## 2.1 Basic Design

There are four sectors in the economy: households, firms, financial intermediaries and monetary authorities. The household maximises an intertemporal utility function separable in consumption, leisure, and real cash balances; and its financial resources are used for consumption or held as cash balances with the excess deposited in commercial banks or lent out to firms in the informal credit market. The financial system is segmented into formal and informal financial sectors. We generalise service providers in the FFS as commercial banks and in the IFS as moneylenders. While commercial banks are corporate institutions, moneylenders are usually individuals, each person operating as a business unit. In rare cases, moneylenders have been observed to hire agents (Bolnick, 1992).

Besides the fact that the business is run by individual persons, moneylending usually has no formal accounts and is often run without official registration. It is, therefore, difficult to isolate moneylending from the household as a completely separate institution. Accordingly, we consolidate the household and moneylending activities and assume that the behaviour of moneylenders is decribed within the household's utility maximisation problem. Nonetheless, we allow the moneylending function to operate distinctly within the household framework. We describe the household's credit function as 'moneylending' and we reserve the term 'moneylenders' for credit institutions in the IFS.

The firm produces its own capital by converting loans obtained from the formal or informal financial sectors, which are assumed to be perfect substitutes (see Dasgupta, 2004). Using capital and labour as the only factors of production, the firm produces final output using technology described by a Cobb Douglas production function. In the financial market, firms self-selectively seek loans either in the formal or informal credit markets.

While lenders in the IFS deal with local communities for which they are able to identify risk levels of individual potential borrowers, the same does not apply to commercial banks in the FFS. Commercial banks are unable to distinguish between high and low risk borrowers *ex-ante* because high risk borrowers disguise themselves as low risk borrowers in order to enhance their chances of obtaining credit in the FFS. We assume the commercial banks have a preference for low risk borrowers emmanating from the view that low risk borrowers are associated with a relatively higher rate of loan repayment, which translates into higher expected profits for the banks than is the case with high risk borrowers. At this point, we invoke the Stiglitz and Weiss (1981) hypothesis that banks may ration credit in equilibrium. The residual demand that is rationed out of the formal loan market spills over to the informal credit market. Accordingly, the IFS provides credit to this demand as well as the component of total credit demand which self selectively seeks loans in the IFS only. Finally, we assume that the population is constant so there is no aggregation bias with treating average quantities as aggregate quantities (see Dasgupta, 2004).

## 2.2 Household Sector

There is a continuum of identical households (with identical endowments and preferences). The objective of a representative household of constant size with a constant amount of time per period and an infinite planning horizon is to maximise the expected sum of a discounted stream of instantaneous utilities $U_t$ given by[1]:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t U_t \tag{1}$$

where $\beta \epsilon (0,1)$ is the consumer subjective intertemporal discount factor. The utility function is assumed to be separable in consumption $(C_t)$, leisure $(1 - N_t)$ and real cash balances $\left(\frac{M_t}{P_t}\right)$:

$$U_t = \ln C_t + \Phi \ln (1 - N_t) + \Gamma \ln \left(\frac{M_t}{P_t}\right) \tag{2}$$

where $N_t$ is time $t$ labour (the amount of time worked) and $\Phi, \Gamma > 0$ represent the importance of leisure and real cash balances, respectively, in utility. The utility function $U_t(.,.,.)$ satisfies $U_{t,C_t} > 0, U_{t,(1-N_t)} > 0, U_{t,\left(\frac{M_t}{P_t}\right)} > 0, U_{t,C_t,C_t} < 0, U_{t,(1-N_t),(1-N_t)} < 0$ and $U_{t,\left(\frac{M_t}{P_t}\right),\left(\frac{M_t}{P_t}\right)} < 0$. The household's financial resources are used for consumption, deposited in commercial banks, held in cash or lent out to firms. We assume the household lends money to firms or deposits funds in commercial banks from its own earnings. Maximisation of the household's objective function, therefore, is subject to the following intertemporal budget constraint:

$$C_t + L_t^i + D_t + \frac{M_t}{P_t} = \left(1 + R_{t-1}^{li}\right) q L_{t-1}^i + (1 + R_{t-1}^{df}) D_{t-1} + \frac{M_{t-1}}{P_{t-1}} + W_t N_t \tag{3}$$

[1] A summary of parameters and variable definitions is presented in Table 1.

where $L_t^i$ are loans to firms given by households (informal finance), which we generalise as moneylending, $D_t$ are the household's deposits in commercial banks, $R_t^{li}$ are interest rates on credit given by the households, $q_t$ is the probability of repayment on loans given by the moneylenders, $R_t^{df}$ are interest rates on deposits in commercial banks and $W_t$ is the wage rate. Maximising the objective function given in equation (1) subject to the budget constraint in equation (3) with respect to consumption, labour, cash balances, and the household's loans to firms and deposits in commercial banks, yields the following first order conditions:

$$\frac{1}{C_t} = \beta\left(1 + R_t^{df}\right) E_t\left(\frac{1}{C_{t+1}}\right) \tag{4}$$

$$N_t = 1 - \frac{\Phi C_t}{W_t} \tag{5}$$

$$\frac{M_t}{P_t} = \Gamma\beta E_t\left(\frac{C_{t+1}}{R_t^{df}}\right) \tag{6}$$

$$1 + R_t^{df} = \left(1 + R_t^{li}\right) q \tag{7}$$

Equation (4) is the Euler equation[2]. Equation (5) is a labour supply equation. It illustrates that consumption and labour supply are inversely related due to decreasing marginal utility of consumption. Equation (6) is a money demand equation. It states that the demand for real cash balances is negatively related to interest rates and positively related to future consumption. Equation (7) states that for the household in equilibrium, the effective return on deposits in commercial banks is equal to the return on loans given out on the informal financial market, taking into account the risk of default.

## 2.3 The Firm

Agriculture in low income countries often accounts for at least half of GDP and 60 to 80 percent of total employment (International Finance Corporation, 2009). In Malawi, the sector is responsible for nearly 80 percent (2006 estimate) of the country's exports, employs an estimated 84.5 percent of the labour force and generates 82.5 percent of foreign exchange earnings (Malawi Government, 2004). Smallholder agriculture in the country accounts for nearly 75 percent of total agricultural production (average for the period 1994-2006) while

[2] This is also referred to in the literature as the intertemporal consumption function. We can replace $\left(1 + R_t^{df}\right)$ with $\left(1 + R_t^{li}\right) q$ for the same result.

estate agriculture caters for the rest. For generality, therefore, it is safe to assume that a representative firm in a QEME is small and engaged in agricultural activities. The firm owns land and requires working capital, which it borrows at the beginning of the period from either the formal or informal financial sector and repays at the end of the period after selling its harvest[3]. We assume there are no adjustment costs and that the working capital is predetermined at time $t$ (Ambler and Paquet, 1994). The equation of motion for the capital stock is given by:

$$K_{t+1} = (1-\delta) K_t + I_t \tag{8}$$

where $K_t$ is capital, $I_t$ is investment and $\delta$ is depreciation. Since the working capital is used up in a single period, it is equivalent to $\delta = 1$, which reduces equation (8) to $K_{t+1} = I_t$. We assume the loan is converted into current investment (change in capital) using a linear function described as:

$$I_t = \vartheta_{\tau,t} \left( L_t^f + L_t^i \right) \tag{9}$$

where $\vartheta_\tau$ is a risk factor or probability of success ($\forall \tau = hr, lr$, where $hr$ denotes high risk (low probability of success) and $lr$ stands for low risk (high probability of success)); and $L_t^f$ and $L_t^i$ are formal and informal financial sector loans, respectively[4]. This is a case of a generic firm. A proportion ($\rho$) of all firms are high risk borrowers and the remaining proportion $(1-\rho)$ are low risk. Total lending, therefore, is described as:

$$I_t = \rho \vartheta_{hr,t} \left( L_t^f + L_t^i \right) + (1-\rho) \vartheta_{lr,t} \left( L_t^f + L_t^i \right)$$

$$I_t = \left[ \rho \vartheta_{hr,t} + (1-\rho) \vartheta_{lr,t} \right] \left( L_t^f + L_t^i \right) \tag{10}$$

The firm's production technology is assumed to be given by a Cobb-Douglas formulation of the following form:

$$Y_t = e^{A_t} K_t^{\alpha} N_t^{1-\alpha} \tag{11}$$

where $Y_t$ is output and $A_t > 0$ captures technology. The technology factor is assumed to evolve according to a first order autoregressive process given by:

$$A_t = \eta A_{t-1} + \varepsilon_t^A \tag{12}$$

where $\varepsilon_t^A$ is independently and identically distributed ($iid$) with a standard deviation of $\sigma_{\varepsilon^A}$.

[3] For simplicity, we assume that a firm cannot borrow from both sectors at any given time.

[4] We define high risk firms as those firms that have a lower probability of success in converting the loans into capital while low risk firms are defined analogously as those firms with a higher probability of success in converting their loans into capital (see Dasgupta, 2004)

The firm's cost minimisation problem subject to satisfying market demand, therefore, is given by:

$$\min_{K_t,\, N_t} W_t N_t + \left(1 + R_t^{lf}\right) L_t^f + \left(1 + R_t^{li}\right) q L_t^i + \phi_t \left(Y_t - e^{A_t} K_t^{\alpha} N_t^{1-\alpha}\right) \tag{13}$$

where $\phi_t$ is a Lagrangian multiplier. First order conditions with respect to labour, FFS loans and IFS loans yield demand functions for labour and formal and informal financial sector loans, in that order, given by:

$$W_t = \phi_t (1-\alpha) \frac{Y_t}{N_t} \tag{14}$$

$$L_t^{df} = \frac{1}{\vartheta_{\tau t}} E_t \left[ \frac{(1-\alpha)\left(1 + R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{\tau t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha - 1}} \tag{15}$$

$$L_t^{di} = \frac{1}{\vartheta_{\tau t}} E_t \left[ \frac{(1-\alpha)\left(1 + R_t^{li}\right) q K_{t+1}^{\alpha}}{\alpha \vartheta_{\tau t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha - 1}} \tag{16}$$

Equation (14) shows that wages increase with output but are inversely related to labour supply. Equations (15) and (16) show the self-selection of firms in seeking loans. While some firms approach the FFS first, others self-selectively approach the IFS for credit. Both demand functions show that the demand for loans increases with higher expected wages and employment, given that $\alpha < 0$.

## 2.4 Financial Intermediaries

An important distinguishing feature of low income economies is the segmentation of the financial system into formal and informal financial sectors. Within the two broad segments, there are several different types of operators that usually have very little contact with one another and whose clients often do not overlap; and even when they overlap, they are able to sort out clearly which aspects of their financial business will be handled by which financial arrangement (Aryeetey, 2008). To model the two sectors, we build on the ideas of Dasgupta (2004).

### 2.4.1 Formal Financial Sector

Base lending rates are set as a mark-up ($\zeta$) over the bank rate i.e. $R_t^{lf} = R_t^{nr} + \zeta$, where $R_t^{nr}$ is the bank rate. The size of the mark-up depends on a commercial bank's market power, reflecting its estimate of the interest elasticity of the demand for credit (King, 2003). For simplicity, we assume the mark-up is fixed. Aggregate self-selection demand for loans in the FFS is given by:

$$\begin{aligned} L_t^{adf} &= \frac{\rho}{\vartheta_{hr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{hr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} + \\ & \quad \frac{(1-\rho)}{\vartheta_{lr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{lr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \end{aligned} \tag{17}$$

We assume commercial banks are not keen to give out loans to high risk borrowers as these are associated with a high rate of default in loan repayment, which reduces the banks' expected profits. The banks, however, are not able to distinguish between the two types of borrowers *a priori* because high risk borrowers have the incentive to mimic the behaviour of low risk borrowers in order to enhance their chances of accessing the FFS loans. Against this behaviour among potential borrowers, therefore, total revealed demand for loans in the FFS is given by:

$$\begin{aligned} L_t^{adf} &= \frac{\rho}{\vartheta_{lr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{lr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \\ & \quad \frac{(1-\rho)}{\vartheta_{lr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{lr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \\ L_t^{adf} &= \frac{1}{\vartheta_{lr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{lr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \end{aligned} \tag{18}$$

In the absence of information that distinguishes the types, banks resort to credit rationing, turning down some loan applicants even if they are willing to pay a relatively high price (Stiglitz and Weiss, 1981). Indeed when formal credit markets are imperfect due to asymmetric information, credit rationing is the most common practice to minimise banks' exposure to risk (Dasgupta, 2004). We assume the commercial banks can only supply a fraction $\varpi$ of the revealed demand for FFS loans. We further assume $\varpi_t$ is endogenously determined within the banks' profit maximisation framework. Following the absence of information that identifies the types of potential borrowers, commercial banks decide to take a safe position by assuming the worst case scenario in which all potential borrowers are high risk. The supply function for FFS loans, therefore, is given by:

$$L_t^{sf} = \frac{\varpi_t}{\vartheta_{hr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{hr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \tag{19}$$

The loans given out by commercial banks to firms in the formal credit market $\left(L_t^f\right)$ are converted from household deposits $(D_t)$ and borrowing from the central bank $\left(L_t^{cb}\right)$. For simplicity, we assume there is no liquidity reserve requirement (LRR) i.e. all the deposits can be converted into loans. The intermediation technology, therefore, is assumed to be given by[5]:

$$L_t^{sf} = D_t + L_t^{cb} \tag{20}$$

The commercial banks' profit maximisation problem is described by:

$$\max_{L_t^{adf},\, \varpi_t} \varpi_t \left(1+R_t^{lf}\right) L_t^{adf} + D_t + L_t^{cb} - \varpi_t L_t^{adf} - \left(1+R_t^{df}\right) D_t - \left(1+R_t^{nr}\right) L_t^{cb}$$

subject to $L_t^{adf} \leq D_t + L_t^{cb}$, which reduces to:

$$\max_{L_t^{adf},\, \varpi_t} \varpi_t R_t^{lf} L_t^{adf} - R_t^{df} D_t - R_t^{nr} L_t^{cb} \text{ subject to } L_t^{adf} \leq D_t + L_t^{cb} \tag{21}$$

Taking FOCs with respect to $L_t^{adf}$, $D_t$ and $L_t^{cb}$ and solving for $\varpi_t$, we obtain:

$$\ell_t = \varpi_t R_t^{lf} = R_t^{nr} = R_t^{df} \tag{22}$$

$$\varpi_t = \frac{R_t^{df}}{R_t^{lf}} = \frac{R_t^{nr}}{R_t^{lf}} \tag{23}$$

where $\ell_t$ is a Lagrangian multiplier. Equation (22) states that in equilibrium, the cost of funds from the different sources (household deposits and borrowing from the central bank) will be equal $\left(\text{i.e. } R_t^{nr} = R_t^{df}\right)$ and they will be proportional to the return on loans $\left(\varpi R_t^{lf}\right)$. Alternatively, it can be inferred from equation (23) that the ratio of the cost of funds from the two identified sources defines the proportion of total demand for FFS loans that is satisfied by the commercial banks.

[5]This can also be seen as a simplified representation of the banks' balance sheets with assets on the left hand side and liabilities on the right.

### 2.4.2 Informal Financial Sector

Loans in the IFS are provided by moneylenders[6]. The self selection demand for IFS credit is given by:

$$L_t^{adi} = \frac{\rho}{\vartheta_{hr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{li}\right) qK_{t+1}^{\alpha}}{\alpha \vartheta_{hr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} + \frac{(1-\rho)}{\vartheta_{lr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{li}\right) qK_{t+1}^{\alpha}}{\alpha \vartheta_{lr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \tag{24}$$

Like commercial banks, moneylenders also face a pool of high and low risk borrowers. However, unlike the banks, the moneylenders are able to identify the risk levels of individual borrowers. Achievement of this feat owes to the localisation of moneylending to communities within the neighbourhood of the lenders, which makes risk-level information readily available.

The residual demand for credit in the FFS is defined by equation (25) as equal to the total self-selection demand for loans in the FFS (equation (17)) less the proportion of revealed demand for FFS loans that succeeds in getting loans from the commercial banks (equation (19)). This residual demand spills over to the IFS. Assuming moneylenders are able to correctly identify the risk level of each potential borrower, the FFS residual demand seeking loans in the IFS is given by:

$$\begin{aligned} L_t^{rf} &= \frac{\rho}{\vartheta_{hr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{hr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} + \frac{(1-\rho)}{\vartheta_{lr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{lr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} - \\ & \frac{\varpi_t \rho}{\vartheta_{hr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{hr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} - \frac{\varpi_t (1-\rho)}{\vartheta_{lr,t}} E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha \vartheta_{lr,t} W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \end{aligned}$$

$$\begin{aligned} L_t^{rf} &= \left[ \frac{\rho}{\vartheta_{hr,t}} \left( \frac{1}{\vartheta_{hr,t}} \right)^{\frac{1}{\alpha-1}} + \frac{(1-\rho)}{\vartheta_{lr,t}} \left( \frac{1}{\vartheta_{lr,t}} \right)^{\frac{1}{\alpha-1}} - \frac{\varpi_t \rho}{\vartheta_{hr,t}} \left( \frac{1}{\vartheta_{hr,t}} \right)^{\frac{1}{\alpha-1}} - \frac{\varpi_t (1-\rho)}{\vartheta_{lr,t}} \left( \frac{1}{\vartheta_{lr,t}} \right)^{\frac{1}{\alpha-1}} \right] \\ & E_t \left[ \frac{(1-\alpha)\left(1+R_t^{lf}\right) K_{t+1}^{\alpha}}{\alpha W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \end{aligned}$$

[6] We emphasize that the term 'moneylenders' is not used to distinctly refer to the usury market, but rather as a blanket reference to all creditors in the IFS, including the moneylenders themselves, traders, landlords, estate owners and grain millers, inter alia.

$$L_t^{rf} = \left[\left(\frac{1}{\vartheta_{hr,t}}\right)^{\frac{1}{\alpha-1}}\left(\frac{\rho\left(1-\varpi_t\right)}{\vartheta_{hr,t}}\right) + E_t\left(\frac{1}{\vartheta_{lr,t}}\right)^{\frac{1}{\alpha-1}}\left(\frac{\left(1-\rho\right)\left(1-\varpi_t\right)}{\vartheta_{lr,t}}\right)\right] \left[\frac{\left(1-\alpha\right)\left(1+R_t^{lf}\right)K_{t+1}^{\alpha}}{\alpha W_{t+1}N_{t+1}}\right]^{\frac{1}{\alpha-1}} \tag{25}$$

Aggregate demand for loans in the IFS, therefore, is given by the sum of equations (24) and (25):

$$L_t^{adi} = \frac{\rho}{\vartheta_{hr,t}}E_t\left[\frac{\left(1-\alpha\right)\left(1+R_t^{li}\right)qK_{t+1}^{\alpha}}{\alpha\vartheta_{hr,t}W_{t+1}N_{t+1}}\right]^{\frac{1}{\alpha-1}} + \frac{\left(1-\rho\right)}{\vartheta_{lr,t}}E_t\left[\frac{\left(1-\alpha\right)\left(1+R_t^{li}\right)qK_{t+1}^{\alpha}}{\alpha\vartheta_{lr,t}W_{t+1}N_{t+1}}\right]^{\frac{1}{\alpha-1}} + \left[\left(\frac{1}{\vartheta_{hr,t}}\right)^{\frac{1}{\alpha-1}}\left(\frac{\rho\left(1-\varpi_t\right)}{\vartheta_{hr,t}}\right) + \left(\frac{1}{\vartheta_{lr,t}}\right)^{\frac{1}{\alpha-1}}\left(\frac{\left(1-\rho\right)\left(1-\varpi_t\right)}{\vartheta_{lr,t}}\right)\right] \left[\frac{\left(1-\alpha\right)\left(1+R_t^{lf}\right)K_{t+1}^{\alpha}}{\alpha W_{t+1}N_{t+1}}\right]^{\frac{1}{\alpha-1}}$$

$$L_t^{adi} = \left[\frac{\left(1-\alpha\right)\left(1+R_t^{li}\right)qK_{t+1}^{\alpha}}{\alpha W_{t+1}N_{t+1}}\right]^{\frac{1}{\alpha-1}}\left[\frac{\rho}{\vartheta_{hr,t}}\left(\frac{1}{\vartheta_{hr,t}}\right)^{\frac{1}{\alpha-1}} + \frac{\left(1-\rho\right)}{\vartheta_{lr,t}}\left(\frac{1}{\vartheta_{lr,t}}\right)^{\frac{1}{\alpha-1}} + \left(\frac{1}{\vartheta_{hr,t}}\right)^{\frac{1}{\alpha-1}}\left(\frac{\rho\left(1-\varpi_t\right)}{\vartheta_{hr,t}}\right) + \left(\frac{1}{\vartheta_{lr,t}}\right)^{\frac{1}{\alpha-1}}\left(\frac{\left(1-\rho\right)\left(1-\varpi_t\right)}{\vartheta_{lr,t}}\right)\right]$$

$$L_t^{adi} = E_t\left[\frac{\left(1-\alpha\right)\left(1+R_t^{li}\right)qK_{t+1}^{\alpha}}{\alpha W_{t+1}N_{t+1}}\right]^{\frac{1}{\alpha-1}}\left[\left(\frac{\rho}{\vartheta_{hr,t}}\right)\left(\frac{1}{\vartheta_{hr,t}}\right)^{\frac{1}{\alpha-1}}\left(2-\varpi\right) + \left(\frac{\left(1-\rho\right)}{\vartheta_{lr,t}}\right)\left(\frac{1}{\vartheta_{lr,t}}\right)^{\frac{1}{\alpha-1}}\left(2-\varpi\right)\right]$$

$$
\begin{aligned}
L_t^{adi} &= (2-\varpi_t)\, E_t \left[ \frac{(1-\alpha)\left(1+R_t^{li}\right) qK_{t+1}^{\alpha}}{\alpha W_{t+1} N_{t+1}} \right]^{\frac{1}{\alpha-1}} \Bigg[ \left(\frac{\rho}{\vartheta_{hr,t}}\right)\left(\frac{1}{\vartheta_{hr,t}}\right)^{\frac{1}{\alpha-1}} + \\
&\quad \left(\frac{(1-\rho)}{\vartheta_{lr,t}}\right)\left(\frac{1}{\vartheta_{lr,t}}\right)^{\frac{1}{\alpha-1}} \Bigg] \qquad (26)
\end{aligned}
$$

## 2.5 Monetary Authorities

Monetary authorities in QEMEs generally have a choice among three different operating targets of monetary policy: money supply, interest rate and exchange rate targets[7]. With the wave of liberalisation in the 1980s and the 1990s, exchange rate targeting has become less popular, leaving money supply and interest rates in the fold of common monetary policy operating targets for QEMEs. Countries may target one or both instruments. We experiment with a forward-looking monetary policy rule that treats the bank rate ($R_t^{nr}$) as an operating tool of monetary policy to characterise how monetary authorities conduct policy in QEMEs. The forward-looking specification allows the central bank to consider a broad array of information to form beliefs about the future condition of the economy (Clarida, Gali and Gertler, 2000). The rule calls for adjustment of the bank rate based on the return on investment, the expected change in output and expected inflation:

$$
R_t^{nr} = \chi_1 R_t^{rr} + \chi_2 \Delta Y^e + (1-\chi_2)\,\pi^e + \mu_t \qquad (27)
$$

where $R_t^{rr}$ is the real rate of interest or return on investment, $\Delta Y^e$ is expected change in output i.e. $\Delta Y^e = E(Y_{t+1}) - Y_t$, $\pi^e$ is expected rate of inflation defined as the expected difference between real and nominal interest rates in the next period and $\mu_t$ is a disturbance term assumed to be *iid*. Since our model is in discreet time, we postulate that the marginal productivity of capital in the next period is equal to the rate of interest (see Carlstrom and Fuerst, 2003; Benhabib, Carlstrom and Fuerst, 2005) as given by:

$$
R_t^{rr} = \alpha e^{A_{t+1}} K_{t+1}^{\alpha-1} N_{t+1}^{1-\alpha} \qquad (28)
$$

[7] While inflation targeting is an alternative, it is an outside option for a majority of QEMEs. Most studies, for example Masson, Savastano and Sharma (1998; 1997), point out that preconditions for adopting an inflation targeting framework in QEMEs are not yet present. Very few low income countries have so far adopted inflation targeting as a monetary policy operating strategy. In a recent study of developing countries that have adopted the strategy, Lin and Ye (2009) use a pool of 13 countries, of which only the Philippines is low income.

## 2.6 Market Equilibrium

In equilibrium, clearing of the final goods market implies that aggregate production is equal to demand for household consumption and private investment:

$$Y_t = C_t + I_t \tag{29}$$

where $I_t = K_{t+1}$. We assume that money is required for all transactions in the goods market. In equilibrium, therefore, the following equality will hold:

$$P_t C_t = M_t \tag{30}$$

Equation (30) is an identity illustrating an ex-post equilibrium position connoting that prices operate only on the real side of the market. Since we have used $N_t$ to represent labour supply by the household as well as labour demand by the firm, we have implicitly assumed clearing of the labour market. The equilibrium wage is determined by the market according to equations (5) and (14). The bank rate is determined by the monetary policy reaction function in equation (27). Commercial bank deposit and IFS interest rates are endogenously determined. Base lending rates are determined by loading a fixed mark-up over the bank rate. Self-selection demand for FFS and IFS loans is given by equations (15) and (16), in that order. Equations (19) and (26) represent loans supplied by the formal and informal financial sectors, respectively. Equilibrium in the two markets follow the simultaneous equation solution of the two equations, which takes into account the spill-over of demand from the FFS satisfied by the supply in the IFS. The sum of equations (19) and (26) determines the level of capital accumulation in the economy.

We assume prices adjust to equate supply and demand in every market simultaneously (see Mankiw, 1989). We further assume that money supply is exogenous. Interest rates and the price level adjust to equate supply and demand in the money market.

# 3 Calibrations

Several parameter estimates are adopted from the literature where their values are fairly standard. Following Liu and Gupta (2007), Hartley, Salyer and Sheffrin (1997) and Hansen (1985), the share of labour in output is set at 0.63, implying a value of 0.37 for $\alpha$; economic agents are assumed to spend an estimated 21 percent of their time on work activities, suggesting a value of $\Phi$ equal to 3[8]; the autoregressive process for the technology factor, $\eta$, is approximated at 0.91; the consumer discount factor $\beta$ is assumed to be 0.99; and the depreciation rate, $\delta$ is 1 (see Table 1). Other parameter estimates and initial values are obtained directly from quarterly data for Malawi covering the period 1988:1-2005:4. These include parameter estimate for the mark-up over the bank rate to obtain base lending rate ($\zeta$) and initial value for commercial bank deposit rates $\left(R^{df}\right)$.

More parameter estimates are obtained from equilibrium relations within the framework of the model. These are consumption parameter characterising weight of real money balances in the utility function ($\Gamma$), the lagrangian multiplier in a firm's cost minimisation function ($\phi$), the factor of inertia in the base lending rate ($\chi_1$) and weight of expected change in output in the monetary policy rule ($\chi_2$). Initial values of some parameters are also obtained from the model's equilibrium relations. These include initial values of employment ($N$), capital stock ($K$), consumption ($C$), wage rate ($W$) and proportion of FFS loan demand that is satisfied ($\varpi$). From our knowledge of QEMEs, the probability of loan repayment in the IFS ($q$) is estimated at 0.85 and the proportion of high risk borrowers ($\rho$) is approximated at 0.15. The risk factor (probability of success) for high risk borrowers ($\vartheta_{hr}$) and the risk factor (probability of success) for low risk borrowers ($\vartheta_{lr}$) are adjusted in the model with the experiments.

# 4 Simulation Results and Inferences

The model is solved using DYNARE in MATLAB (see Juilliard, 1996). We focus our attention on three shocks namely, a positive production technology shock characterised by an unexpected improvement in production technology; a monetary policy shock identified by an unanticipated increase in the bank rate; and a risk factor shock represented by a sudden increase in the probability of success for high risk borrowers. Figure 1 shows the impact of a positive production technology shock on various macroeconomic indicators when the success rate for high risk borrowers is low ($\vartheta_{hr} = 0.275$) and when it is relatively high ($\vartheta_{hr} = 0.8$). Figure 2 repeats the experiment but for a monetary policy shock. Impulse responses of selected macroeconomic indicators following a shock on the probability of success for high risk borrowers with high and low probabilities of success for low risk borrowers ($\vartheta_{lr} = 0.95$ and $\vartheta_{lr} = 0.3$, respectively) are presented in Figure 3.

[8]According to Hartley et al. (1997), evidence from many countries shows that the time spent working (which determines $\Phi$) and capital's share in output ($\alpha$), while different, do not vary dramatically.

Table 1: Calibrated Parameter and Steady State Values

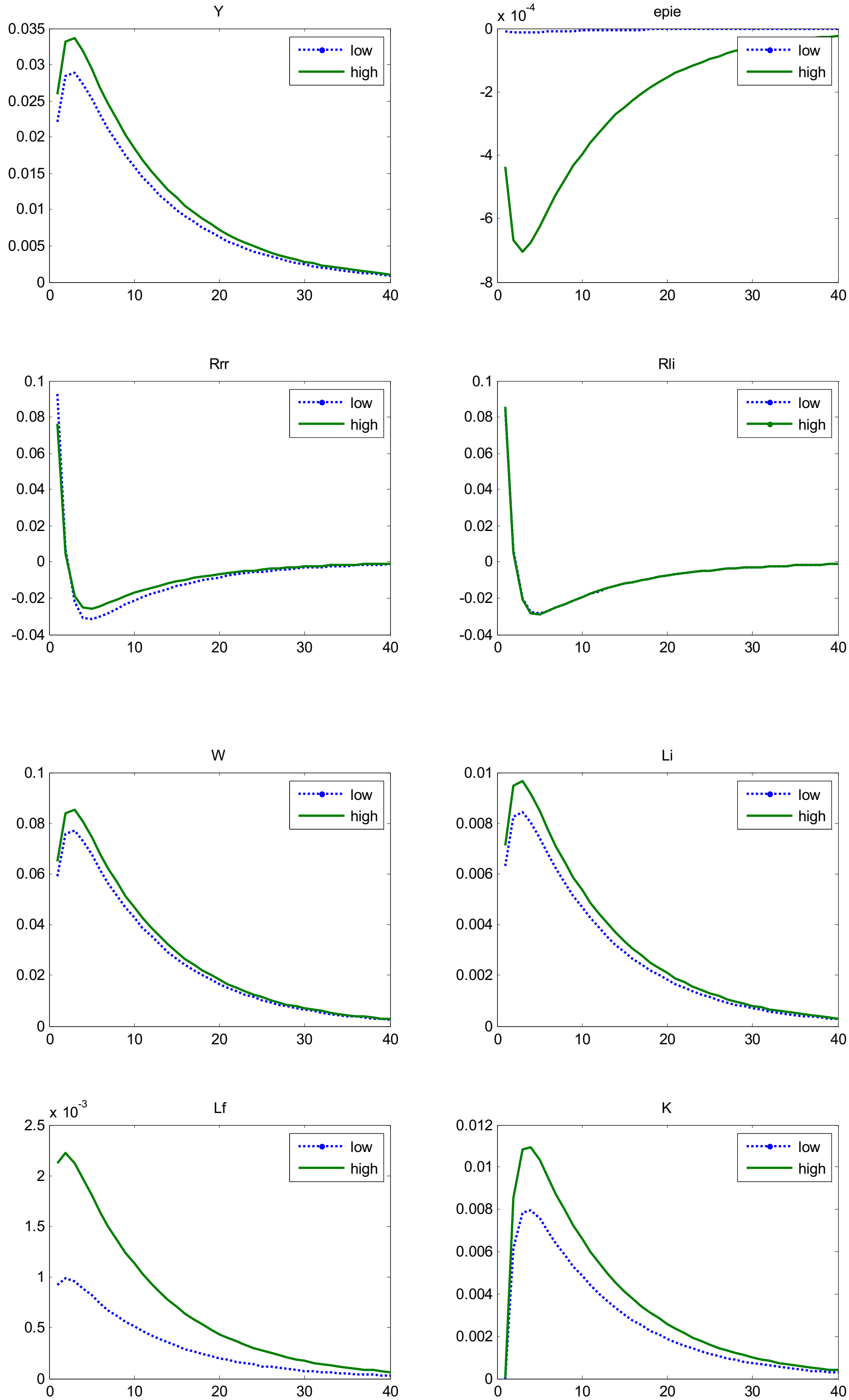
| Parameter | Description | Value |
|---|---|---|
| $\alpha$ | Output elasticity of capital | 0.37 |
| $\beta$ | Consumer subjective intertemporal discount factor | 0.99 |
| $\delta$ | Depreciation rate | 1 |
| $\eta$ | Autoregressive process for the technology factor | 0.91 |
| $\Gamma$ | Weight of real money balances in the utility function | 3 |
| $q$ | Probability of loan repayment in the IFS | 0.85 |
| $\Phi$ | Leisure parameter | 3 |
| $\phi$ | Lagrangian multiplier in a firm's cost minimisation function | 0.8 |
| $\rho$ | Proportion of high risk borrowers | 0.15 |
| $\vartheta_{hr}$ | Risk factor (rate of success) for high risk borrowers | 0.275/0.8 |
| $\vartheta_{lr}$ | Risk factor (rate of success) for low risk borrowers | 0.3/0.95 |
| $\zeta$ | Mark-up over the bank rate to obtain base lending rate | 0.1 |
| $\chi_1$ | Factor of inertia in the base lending rate | 0.98 |
| $\chi_2$ | Weight of expected change in output in the monetary policy rule | 0.3 |
| $C$ | Initial value of consumption | 0.8 |
| $K$ | Initial value of capital stock | 0.2 |
| $N$ | Initial value of employment | 0.3 |
| $\varpi$ | Initial value of proportion of FFS loan demand that is satisfied | 0.7 |
| $W$ | Initial value of wage rate | 0.3 |
| $R^{df}$ | Initial value of commercial bank deposit rates | 0.075 |

## 4.1 Production Technology Shock

Figure 1 shows the impact of a production technology shock when the rate of success for high risk borrowers is low (i.e. $\vartheta_{hr} = 0.275$) and when it is high (i.e. $\vartheta_{hr} = 0.8$). An unanticipated improvement in production technology when the rate of success for high risk borrowers is low (i.e. $\vartheta_{hr} = 0.275$), as illustrated in the figure, causes a decline in marginal costs across all firms leading to a jump in output and a decline in expected prices. Since the shock causes an improvement in the marginal productivity of capital, which is equal to the instantaneous interest rate (see Carlstrom and Fuerst, 2003; Benhabib et al., 2005), we observe that our measure of the real interest rate goes up together with all nominal interest rates in the FFS. Holding the risk of default constant, interest rates in the IFS adjust upwards as well, in line with the lenders' risk hypothesis (see Basu, 1997). Thus, it is observed that in this instance, interest rates in both the formal and informal financial sectors change together in the same direction.

As a direct consequence of the improvement in technology, labour productivity increases, consequently pushing wage rates upwards. Coupled with the increase in employment, the higher wage rates lead to a rise in households' financial resources, resulting in an increase in loans supplied by moneylenders in the IFS. Commercial banks respond to the higher output

Figure 1: Impulse Responses of a Production Technology Shock with High and Low Probabilities of Success for High Risk Borrowers



by expanding their customer base, leading to a rise in FFS loans, albeit marginally. Formal and informal financial sector loans, therefore, respond as complements. Since capital stock depends on the sum of formal and informal financial sector loans, *inter alia*, the increase in lending by commercial banks and moneylenders is followed by a rise in capital stock.

When the rate of success for high risk borrowers is increased to 0.8, a positive production technology shock causes a larger increase in loans extended by both formal and informal financial sectors as entrepreneurs are now encouraged to venture into new business establishments and expand existing ones to take advantage of the improvement in the success rate. Accordingly, capital stock and output increase by larger proportions and expected prices also decline by a larger margin. With larger amounts of capital and output, firms demand more labour and offer larger increases in wages than when the rate of success for high risk borrowers was low. The response of interest rates in both formal and informal financial sectors, however, does not change markedly.

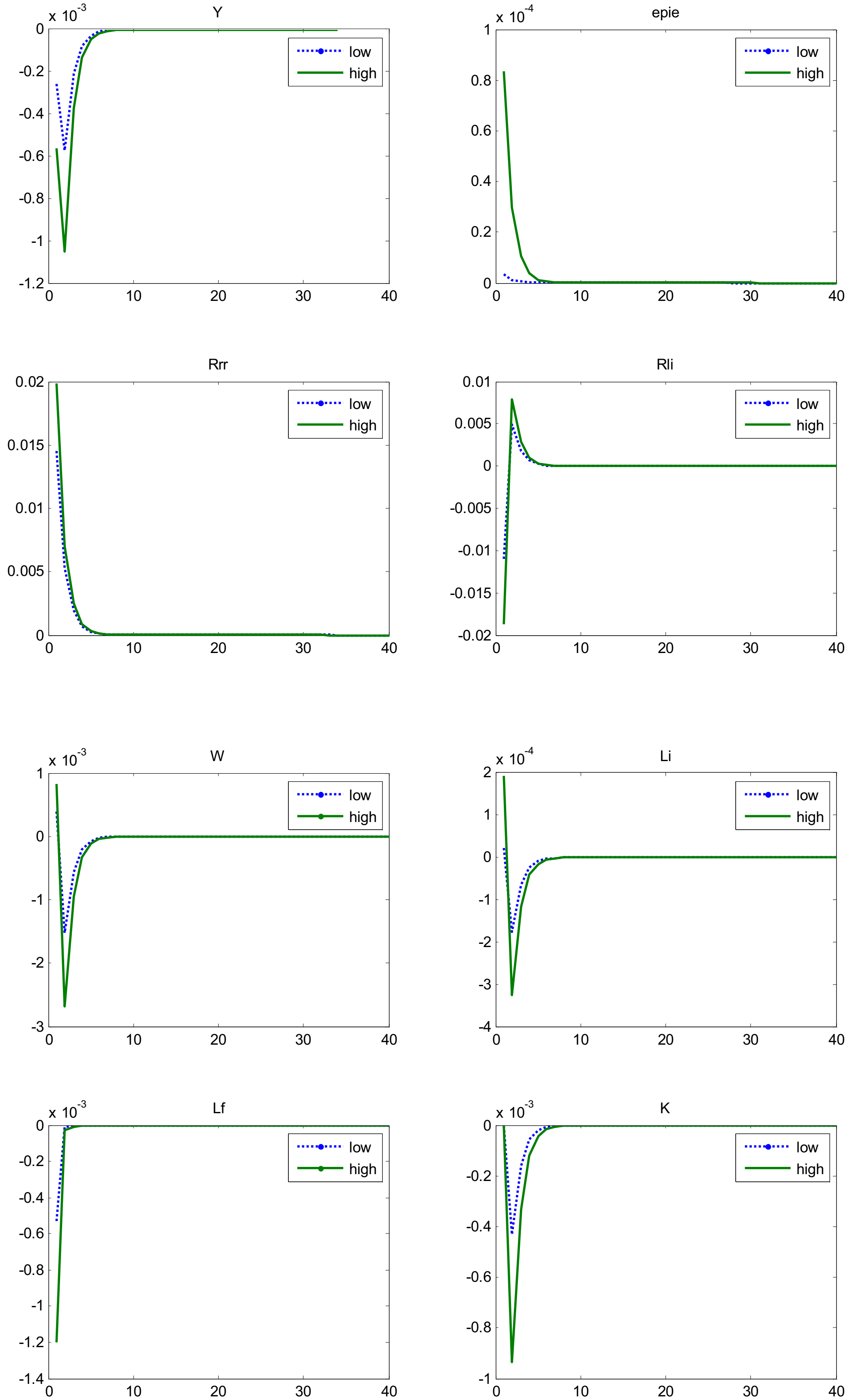
## 4.2 Monetary Policy Shock

Figure 2 shows the impact of a monetary policy shock when the rate of success for high risk borrowers is low (i.e. $\vartheta_{hr} = 0.275$) and when it is high ($\vartheta_{hr} = 0.8$). When the rate of success for high risk borrowers is low (i.e. $\vartheta_{hr} = 0.275$), an unanticipated increase in interest rates (monetary policy shock) causes an increase in base lending rates and expected forward inflation. Facing higher expected prices, households smooth their consumption by reducing their consumption expenditures. Firms respond to the expected lower sales by cutting down on production, employment and wage rates. Accordingly, capital formation and subsequently demand for both formal and informal financial sector loans decline. Thus, lending in the two sectors is complementary. The decline in IFS loans is reinforced by the lower wages and employment, which reduce households' financial resources, consequently lowering loanable funds for moneylenders.

Moneylenders initially reduce their lending rates, possibly because the reduction in their capacity to give out loans is proportionately lower than the decline in demand for IFS loans. Thus, at the pre-shock lending rates, moneylenders have excess supply of loans, *ceteris paribus*. Since IFS loans and commercial bank deposits are substitutes to households, the excess IFS loanable funds are deposited in commercial banks, leading to a decline in commercial bank deposit rates and a gradual increase in IFS interest rates until equilibrium is attained. In this instance, it is observed that formal and informal financial sector interest rates are changing in opposite directions unlike the case in Section 1.

When the rate of success for high risk borrowers is increased to 0.8, an unexpected increase

Figure 2: Impulse Responses of a Monetary Policy Shock with High and Low Probabilities of Success for High Risk Borrowers



in the bank rate causes a larger decline in the demand for loans, both in the formal and informal financial sectors, leading to a larger drop in capital stock and a correspondingly larger decline in employment and output. Expected forward prices also go up by a larger margin causing a larger decline in consumption, output, employment, wages rates, lending (in both formal and informal financial sectors) and capital formation. There is, however, no marked change in the response of interest rates in both formal and informal financial sectors.

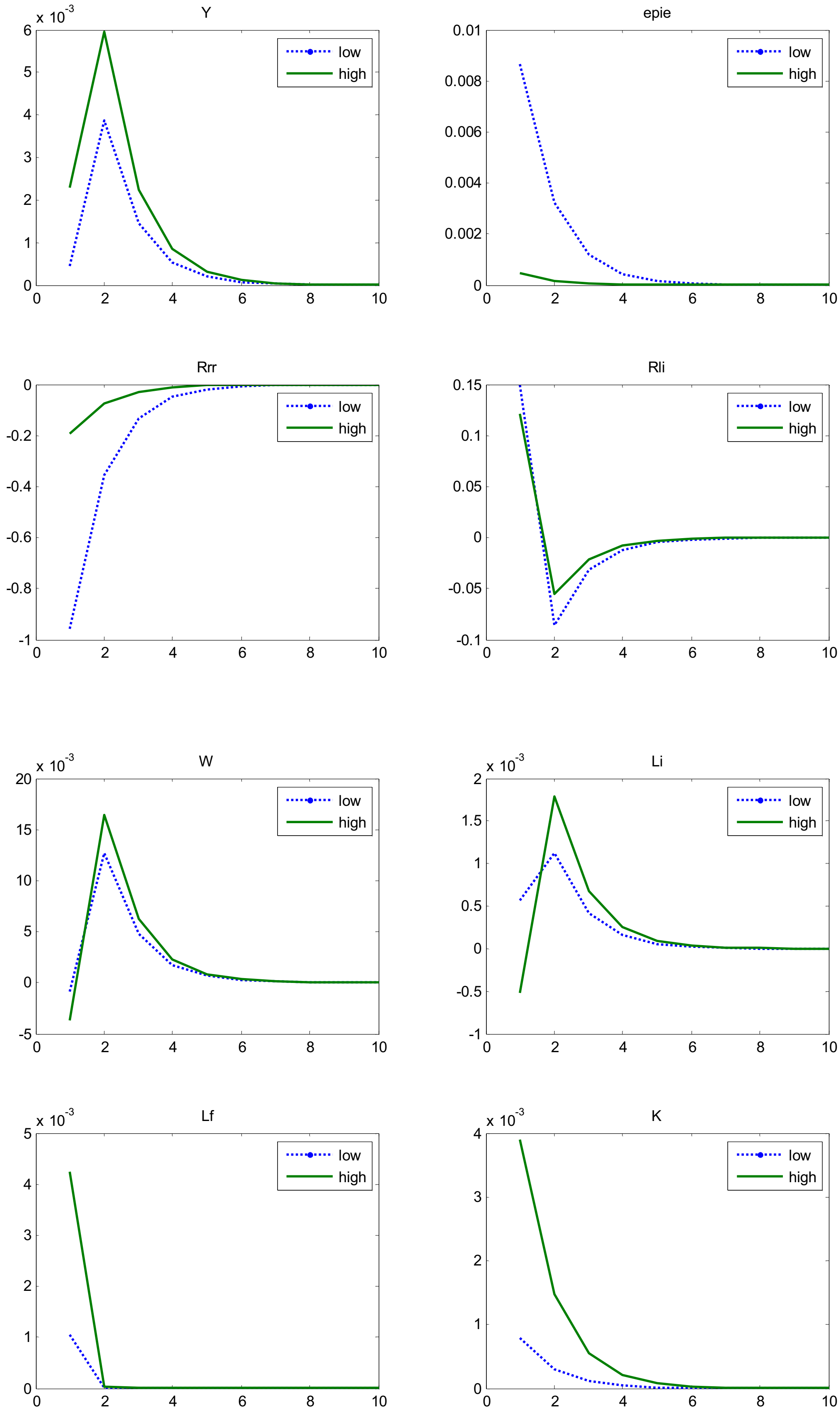
## 4.3 Risk Factor Shock

Figure 3 presents impulse response functions illustrating how various macroeconomic indicators respond to a shock on the probability of success (risk factor) for high risk borrowers. This experiment is evaluated against two scenarios: a high probability of success for low risk borrowers ($\vartheta_{lr} = 0.95$) in one instance and a low probability of success for the low risk borrowers ($\vartheta_{lr} = 0.3$) in another. Everything else remaining the same, an unexpected increase in the probability of success for high risk borrowers results in a rise in the proportion of borrowed funds that is turned into productive capital (see equations (9) and (10)). Consequently, capital, demand for labour, wage rates and output go up (see Figure 3). The expected higher wages translate into expected high costs of production, leading consumers to expect higher prices.

Banks perceive the unanticipated increase in the probability of success for high risk borrowers as a reduction in the risk of loans extended to this type of borrowers. Everything else being equal, overall risk on loans decreases and the banks respond by increasing their lending leading to further increases in capital, output, demand for labour, wage rates and expected prices. With the rise in employment and wage rates, households now have a larger capacity to lend. IFS lending, therefore, goes up as well. Thus, consistent with previous findings, formal and informal financial sector lending remain complementary.

Following the shock, high risk borrowers' capacity to repay their loans goes up, which motivates banks to reduce the risk premium on base lending rates as a way of attracting more borrowers. As a result, FFS interest rates decline. In the IFS, on the other hand, interest rates initially go up, reflecting the profit-sharing element that is typical in QEMEs. With higher anticipated output, the moneylender raises interest rates as a way of sharing the borrower's expected higher profits. The impact of the profit sharing element, however, is later offset by a reduction in the risk premium on lending rates necessitated by the increase in the probability of success for the high risk borrowers, causing IFS interest rates to decline. Thus, unlike the outcome in Section 1 and in agreement with findings in Section 2, we observe that interest rates in the formal and informal financial sectors are not changing together in the

Figure 3: Impulse Responses of a Shock on the Probability of Success for High Risk Borrowers with High and Low Probabilities of Success for Low Risk Borrowers



same direction.

Changing the risk factor (probability of success) for low risk borrowers (from 0.3 to 0.95 or vice versa), we observe that the impulse responses follow the same pattern with differences only in magnitudes. When the probability of success for low risk borrowers is increased from 0.3 to 0.95, the shock on the probability of success for high risk borrowers (characterised by an unexpected increase in the probability of success for the high risk borrowers) causes a larger increase in formal and informal financial sector loans and consequently a larger increase in capital and output. This result lends further support to previous findings that loans in the formal and informal financial sectors are complementary. A larger increase in FFS loans is followed by a larger increase in IFS loans. This occurence may be attributed to a decline in the average risk on loans following the increase in the probability of success for both types of borrowers, everything else remaining equal.

The higher rate of success for low risk borrowers ($\vartheta_{lr} = 0.95$) also leads to a larger reduction in FFS interest rates. This occurs for the same reason as outlined in the foregoing discussion. That is, a higher probability of success for low risk borrowers reduces the average risk on loans, which leads banks to respond by reducing interest rates with a relatively larger margin. The impulse responses of IFS interest rates, however, are observed to be nearly the same whenever the probability of success for low risk borrowers is high ($\vartheta_{lr} = 0.95$) and when it is low ($\vartheta_{lr} = 0.3$). Since we have assumed that there is no information asymmetry in the IFS, the reduction in the rate of success for low risk borrowers following an unexpected increase in the probability of success for high risk borrowers provides little additional information on the risk profile of potential borrowers. Accordingly, there is little justification to adjust IFS interest rates. Again, this finding is consistent with earlier results that changes in FFS interest rates are not necessarily followed by corresponding changes in IFS interest rates.

## 4.4 Inferences

We draw three important inferences from the experiments carried out in the DSGE model. First, the model reveals that although formal and informal financial sector loans may be substitutes in the borrowing firm's utility function, they are in effect complementary in the aggregate. A complementary credit link exists when growth in demand for credit from one sector is accompanied by an increase in demand for credit from the other sector (Chipeta and Mkandawire, 1991). This implies that an increase in capital formation 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 Aryeetey, 1992; Chipeta and Mkandawire, 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.

Second, the model shows that interest rates in the IFS are not necessarily driven by FFS interest rates. While interest rates in the two sectors are observed to change together in the same direction following a positive production technology shock, the same is not observed with either a monetary policy shock or a risk factor shock. In the case of a monetary policy shock, the response of IFS interest rates is diametrically opposed to the direction taken by FFS interest rates in response to the shock. The implication of this outcome is that the IFS may frustrate monetary policy. The experiment with a monetary policy shock illustrates this argument. The impact of a monetary policy shock (a sudden increase in the bank rate) is partly offset by a decline in interest rates in the IFS. Following the sudden increase in the bank rate, credit extended by both the formal and informal financial sectors decline. That is, lending in the formal and informal financial sectors remain complementary. The decline in IFS loans, however, is lessened by the drop in IFS interest rates. Clearly, where the size of the IFS is large, its effect in partly offsetting the outcome of monetary policy is likely to be large as well. Thus, countries with a very large IFS may be associated with a relatively lower impact of monetary policy on economic activity.

Third, the model illustrates that the risk factor (probability of success) for both high and low risk borrowers plays an important role in determining the magnitude by which macroeconomic indicators respond to shocks. In the experiments with a positive production technology shock and a monetary policy shock, it is shown that the response of both formal and informal financial sector loans is sensitive to the rate of success for high risk borrowers. The responses of capital stock, output, employment, wage rates and expected prices to each of the two shocks also show sensitivity to the risk factor of high risk borrowers. Similarly, in the experiment with a shock on the risk factor for high risk borrowers, changes in the risk factor of low risk borrowers determine the magnitude by which macroeconomic indicators respond to the shock. Lending in both the formal and informal financial sectors, capital stock, output, wage rates and expected prices respond to the shock on the risk factor for high risk borrowers with different magnitudes depending on whether or not the risk factor for low risk borrowers is low or high.

# 5 Summary and Conclusions

This paper set out to investigate the interaction of formal and informal financial sectors and to examine how economic activity is consequently affected. Commencing with the observation that the IFS in QEMEs is large and plays a non-trivial role in determining the direction of economic activity, we developed a four-sector macro-monetary DSGE model for analysis. The model demonstrates that while formal and informal sector loans may be substitutes in a borrower's utility function, they are in the aggregate complementary. Thus, increasing the use of FFS credit increases the demand for credit in the IFS. The observed behaviour of formal and informal financial sector interest rates presents another important finding. The model demonstartes that interest rates in the IFS are not necessarily driven by FFS interest rates. When experimenting with a positive production technology shock, interest rates in the two sectors were observed to move together in the same direction while in the experiments involving a monetary policy shock and a risk factor shock, they were not. In the monetary policy shock experiment, the two interest rates were in fact moving in opposite directions. The implication of this finding is that the IFS has the potential to frustrate monetary policy and its impact is likely to be more pronounced in countries where the sector is very large. Finally, the study shows that the risk factor of borrowers is an important determinant of the extent to which macroeconomic indicators respond to various shocks. In all the three experiments demonstrating how selected macroeconomic indicators respond to a positive production technology shock, a monetary policy shock and a shock on the probability of success for high risk borrowers, the model shows that changing the risk factors of either low or high risk borrowers results in most macroeconomic indicators responding with different magnitudes.

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