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Excess liquidity, oligopolistic loan markets and monetary policy in LDCs

Tarron Khemraj

Abstract

Evidence about commercial banks' liquidity preference says the following about the loan market in LDCs: (i) the loan interest rate is a minimum mark-up rate; (ii) the loan market is characterized by oligopoly power; and (iii) indirect monetary policy, a cornerstone of financial liberalization, can only be effective at very high interest rates that are likely to be deflationary. The minimum rate is a mark-up over an exogenous foreign interest rate, marginal transaction costs and a risk premium. The paper utilizes and extends the oligopoly model of the banking firm. A calibration exercise tends to replicate the observed stylized facts.

JEL Classification: O10, O16, E52, G21, L13

Keywords: excess bank liquidity, oligopoly loan market, monetary policy

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Excess liquidity, oligopolistic loan markets and monetary policy in LDCs

Tarron Khemraj

Introduction

The financial liberalization hypothesis holds that allowing the market determination of real interest rates would mobilize savings and increase deposits (Fry, 1997a). Commercial banks—that are able to select good from bad borrowers, diversify risks, minimize transaction costs, etc—would then channel these savings to the best investors who earn the highest rate of return. Performing such roles of intermediation, banks not only increase the rate of capital accumulation but also increase productivity, thereby boosting the economy's steady-state growth (Bencivenga and Smith, 1991).

However, in many less developed countries banks hold large quantities of excess liquidity—a large part of which is non-remunerated—in their asset portfolio (Saxegard, 2006; Khemraj, 2006; Fielding and Shorthand, 2005). For the remainder of this paper excess liquidity is defined as total bank liquidity minus required bank liquidity. The required liquidity (or reserve) ratio is set by the central bank in the individual country.

In spite of efforts to liberalize and modernize financial institutions, markets and instruments in LDCs, the banking sector is the most important source of financing in these economies and it is likely to continue to be that way indefinitely (Stiglitz, 1989; Singh, 1997). Therefore, the investment choice of banks can either retard finance's role in growth or augment that role. Hence, examining banks' liquidity preference in LDCs will emphasize important information regarding their behaviour in such economies.

This paper posits the hypothesis that banks in such economies require a minimum rate of interest in the loan market before they make a specific loan. A bank must receive a minimum loan rate that compensates for risks, marginal transaction costs and the rate of return on a safe foreign asset before it makes a loan to a particular borrower. If the marginal borrower is unwilling to pay the minimum rate, then the banks accumulate non-remunerative excess liquidity¹. This phenomenon is depicted by a liquidity preference curve that is flat at a very high loan rate. Therefore, non-remunerative excess liquidity and loans can become perfect substitutes at a very high rate of interest in the loan market. The paper will demonstrate that such behaviour is consistent with a loan market that is oligopolistic. Moreover, to present its case, the paper utilizes the industrial organization banking model of Klein (1971) and Freixas and Rochet (1999). The model will also be modified to suit the institutional characteristics of underdeveloped economies.

1 Why would commercial banks—operating under a liberalized financial environment—which take the safe foreign interest rate as given demand non-remunerated excess reserves? The main reason has to do with the fact that even under a liberalized setting a foreign currency constraint exists. The constraint is not induced by conscious policy—as in the days of financial repression—but emerges via the market. Even though rational banks would like to convert all non-remunerated excess reserves into foreign assets, they cannot do so at every moment because there might be a shortage of foreign currencies in the domestic foreign exchange market. At the same time commercial banks cannot starve their long established customers, who typically received loans and must also participate in international trade, of scarce foreign currencies. To do so would mean the banks are exposing their loan base to financial stress.

A key implication of this study for policy is the postulation that commercial banks set the loan rate exogenously via a mark-up over the marginal transaction costs and the exogenous safe rate of interest². It therefore means that a liquidity shock emanating from the central bank will not elicit a response in the interest rate over the flat section of the banks' liquidity preference curve. This is important for LDCs that have been implementing indirect (or market-based) monetary policy as a means of influencing bank credit—and ultimately consumption and investment decisions—by managing excess reserves and/or a short-term interest rate³.

Indirect monetary policy is often seen as a precondition for the adoption of inflation targeting—or at least a milder version of inflation targeting known as inflation targeting 'lite' (Stone, 2003)—in LDCs. Monetary policy shocks—characterized by shifts in the supply curve—are only likely to be effective at very high loan rates (above the minimum rate) when the liquidity preference curve is downward sloping. High interest rates, however, can contribute to economic stagnation even after significant efforts have been made in liberalizing and developing financial systems in developing countries.

The paper is structured as follows. Section 2 presents the stylized facts that depict the liquidity preference curves for nine developing countries. Section 3 develops the banking model that is used to derive the mark-up minimum interest rate. The model is also used to make theoretical statements regarding commercial banks' response to the central bank's open market operations (or monetary shocks). Section 4 uses the derived minimum rate to perform a calibration exercise that can be used to make international comparisons among countries. Section 5 concludes.

The stylized facts

This section utilizes the technique of locally weighted polynomial regressions (Loess) of degree one in order to extract bank liquidity preference curves for nine less developed countries. The local regressions are extremely useful for deciphering underlying nonlinear relationships. The technique was first proposed by Cleveland (1979) and further developed by Cleveland and Devlin (1988)⁴.

Initially eleven developing countries were analyzed. Only countries that have been known to be persistently inundated with excess liquidity were chosen. The Caribbean countries are all included in the work of Khemraj (2006), while the African countries were included in the sample of Saxegaard (2006). Egypt, which was eventually eliminated, was studied by Fielding and Shorthand (2005) who analyzed excess bank liquidity and political violence in that country. The other key factor determining the sample of countries is the availability of excess reserves or liquidity data. Data on non-remunerative excess reserves were obtained

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- 2 The same argument can be made about the deposit market and market for government bonds and Treasury bills. That issue, however, is beyond the scope of this paper and is the subject of further research.
 - 3 Alexander et al (1995, p. 2) define direct versus indirect monetary policy instruments. Direct instruments set or limit prices (interest rates) or quantity (credit). The quantity-based direct instruments often place restrictions on commercial banks' balance sheet. Hence, they are associated with financial repression. Indirect instruments, in contrast, operate through the market by influencing the demand and supply conditions of commercial bank reserves.
 - 4 Only a subset of observations within a neighbourhood of the point to fit the curve is used. The regression is weighted so that observations further from the given data point are given less weight. The subset of data used in each weighted least squares fit is αN , where α = the smoothing parameter and N = number of data points. A higher parameter, α , gives a smoother fit; but there also tends to be the lack of fit when α increases. If the chosen α is too low there can be a surplus of fit with many local wiggles occurring. Therefore, for the purpose of extracting the various non-linear liquidity preference curves a smoothing parameter of 0.4 is used. This choice follows closely the guidelines given by Cleveland (1993, p. 98).

for Barbados, The Bahamas, Trinidad and Tobago, and Mauritius⁵. A broader measure of excess liquidity—which adds both non-remunerative excess reserves and excess liquid assets—was used for Guyana and Jamaica. Excess liquid assets typically comprise of domestic government securities in excess of the secondary reserve ratio. This broader measure was only available for Guyana and Jamaica.

For Tanzania, Uganda and Zambia the excess reserves data had to be calculated using data from the respective country's central bank and from the *International Financial Statistics* (IFS). The required reserve ratio, which was obtained from the central banks, was used to calculate the required reserve series using deposit data from the IFS. The time-series of excess reserves was then calculated by subtracting the required reserves data from total reserves (the latter was obtained from the IFS). Unfortunately, excess reserves could not be found for Namibia or Egypt⁶. Nor could data on the required reserve ratio be obtained to enable the calculation of the excess reserves. Therefore, the data on total reserves, taken from the IFS, was used for these two countries. The period of analysis was chosen to maximize the sample size, but at the same time to enable to study post-liberalization liquidity preference. The data set for each country represents at least five years of post interest rate liberalization (see Appendix Table A, for dates of key financial reforms).

There are two clear tendencies in the figures: (i) the fitted liquidity preference curves tend to become flat⁷; and (ii) the flatness occurs at a very high rate of interest⁸. This means the demand elasticity for bank excess liquidity is perfectly elastic (or approaches perfect elasticity) at a high loan rate. Hence, commercial banks view loans and unproductive excess liquidity as perfect (or near perfect) substitutes at very high loan rates.

In the case of Guyana the bank's liquidity preference curve becomes flat at approximately 14.5 percent. This implies that a bank will not lend, on average, to the marginal borrower if that borrower cannot pay at least 14.5 percent. The same can be said for Barbados where the curve becomes flat at around 8.5 percent. In the case of Jamaica, commercial banks will not lend to the marginal borrower who wishes to pay a rate below 17 percent. The marginal borrower in Uganda will find credit difficult to come by if he or she is unwilling to borrow at around 19 percent. In Trinidad and Tobago the curve becomes flat at approximately 9 percent; while in Namibia the minimum rate seems to be approximately 11 percent. In the case of Tanzania the horizontal section occurs at around 15 percent. The Bahamas seem to have two minimum rate regimes at 6 percent and 5.6 percent. In the case of Zambia the curve tends to become less steep as the loan rate falls but never perfectly elastic.

Under a perfectly competitive loan market—an assumption that is implicitly made in the financial liberalization literature (see Arestis and Demetriades, 1999)—excess liquidity and bank loans should become substitutes at a zero loan rate. The fact that they are substitutes at a very high rate implies the banking sector

5 Mauritius was eliminated from the study. There was not significant variability in the loan rate for Mauritius to uncover a meaningful relationship.

6 Egypt was also eliminated because an unintuitive result emerged. The liquidity preference curve turned out to be an inverted U-shape.

7 It might be tempting to view the flat liquidity preference curves as indicative of a liquidity trap. However, that is not the case for two reasons: (i) the analysis uses the loan rate rather than the safe government bond/Treasury bill rate; and (ii) the curves tend to become flat at a very high rate of interest. There is a liquidity trap when money and bonds become perfect substitutes at zero bond/Treasury bill rate.

8 The nominal loan rate was used throughout the analysis. Use of the real interest rate does not change the conclusion. Moreover, the data for each country demonstrate a persistence of excess liquidity in spite of the inflation rate in the respective country.

Figure 1:
Guyana (Loess fit) bank liquidity and the loan rate (quarterly data: 1997:1 – 2007:2)

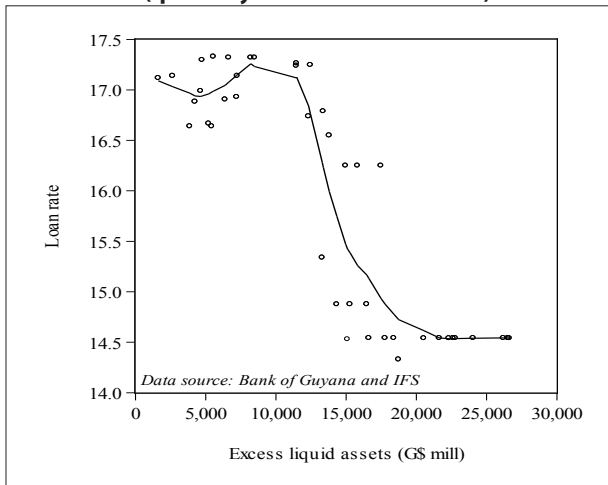


Figure 2:
Barbados (Loess fit) bank liquidity and the loan rate (quarterly data: 1997:1 – 2007:2)

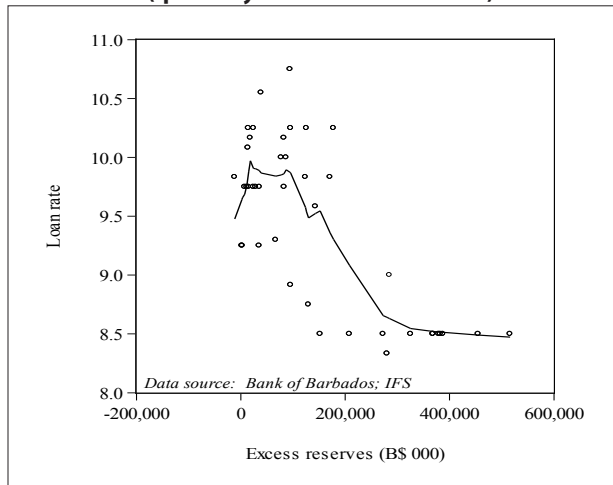


Figure 3:
Jamaica (Loess fit) bank liquidity and the loan rate (quarterly data: 1997:1 – 2007:1)

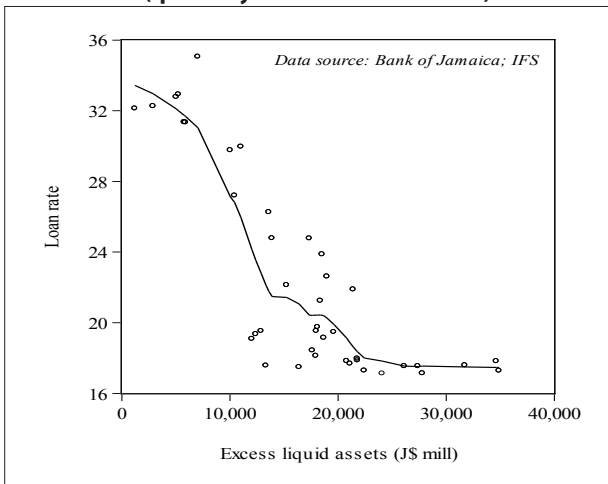


Figure 4:
The Bahamas (Loess fit) bank liquidity and the loan rate (quarterly data: 1997:1 – 2007:2)

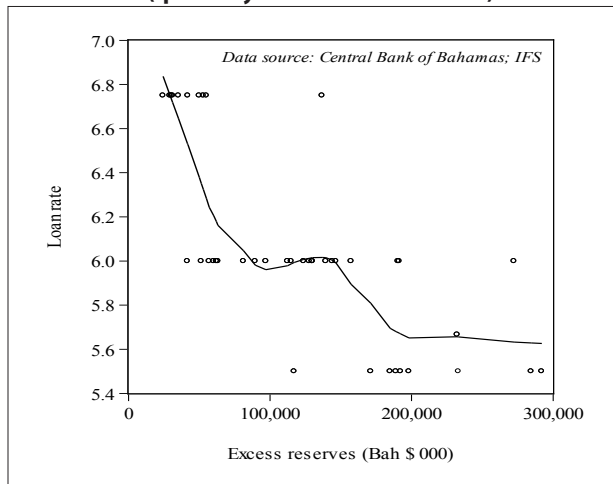


Figure 5:
Trinidad & Tobago (Loess fit) bank liquidity and the loan rate (quarterly data 1997:1 – 2007:1)

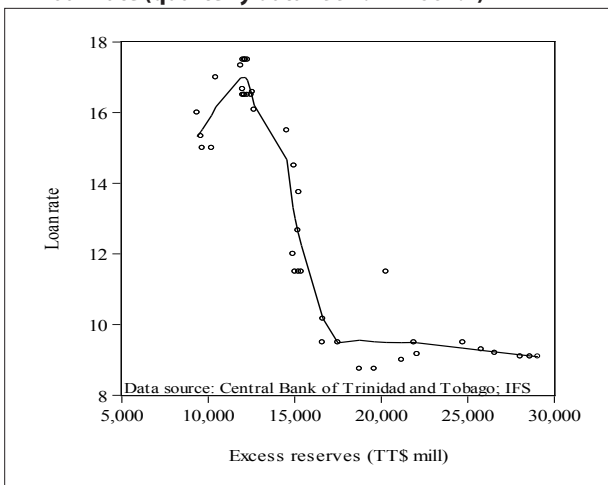


Figure 6:
Namibia (Loess fit) bank liquidity and the loan rate (monthly data: 1997:4 – 2007:1)

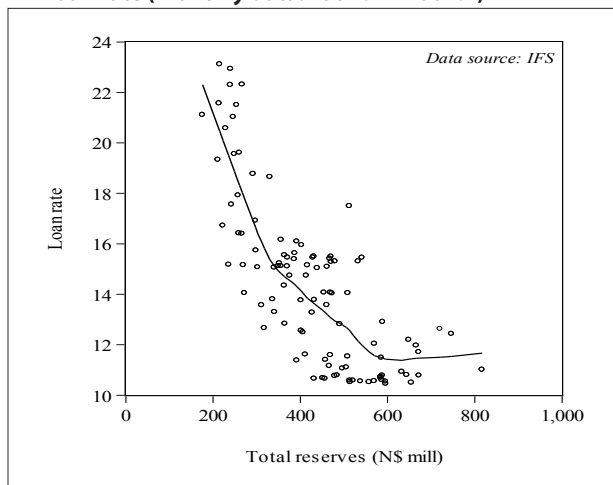


Figure 7:
Uganda (Loess fit) bank liquidity and the loan rate (monthly data 1999:1 – 2007:6)

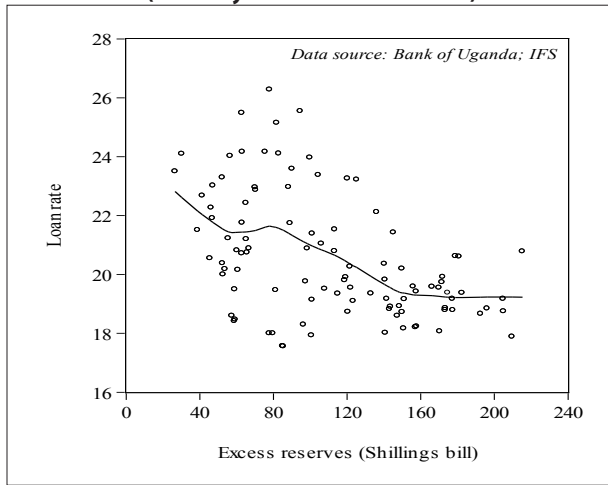


Figure 8:
Tanzania (Loess fit) bank liquidity and the loan rate (monthly data: 1998:1 – 2006:12)

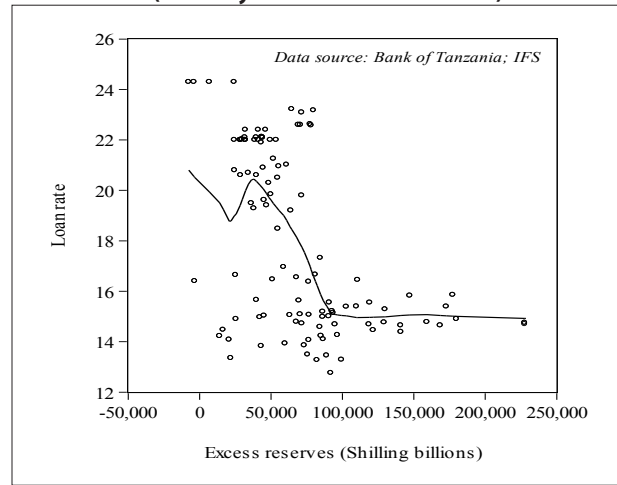
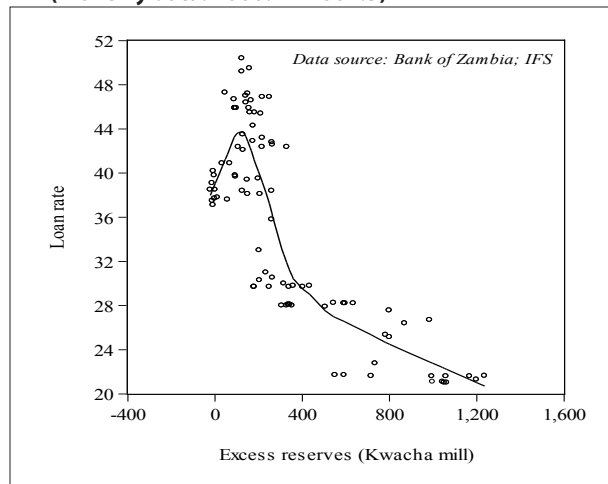


Figure 9:
Zambia (Loess fit) bank liquidity and the loan rate (monthly data: 2000:1 – 2007:5)



in our selected economies (and very likely other underdeveloped economies also) is far from the case of competition. This paper makes the realistic assumption that the banking sector is oligopolistic and not competitive. As oligopolies, banks are able to mark-up the loan rate over an exogenous benchmark rate, transaction costs, and also take into consideration any risk of default associated with a specific class of borrowers.

Oligopoly banking and monetary policy

This section of the paper has three objectives: (i) present an oligopolistic banking model from which the minimum loan rate can be derived; (ii) use the model to demonstrate to what extent indirect monetary policy influences the loan market for different market structures; and (iii) explain the implication of the minimum rate for monetary policy using a diagram which links the interbank money market with the loan market.

Banks are assumed to possess market power in the loan market and the government Treasury bill market. The monopoly banking model was first introduced by Klein (1971) and later applied to a liquidity management model under uncertainty by Prisman, Slovin and Sushka (1986). However, an important difference between the model in this paper and earlier banking models is the fact that the government bond (or Treasury bill) market is not perfectly competitive as was originally postulated by Klein (1971), Slovin and Sushka (1983), Prisman, Slovin and Sushka (1986), and Freixas and Rochet (1999). While the government security market is likely to be highly developed and liquid in the advanced economies—hence the individual bank accepts this rate as given—it is not the case in LDCs where few institutional investors, mainly banks, dominate the purchase of Treasury bills. Therefore, the individual bank faces an upward sloping Treasury bill supply curve, thus making the bank an oligopsonist. If the Treasury bill market is uncompetitive, then the Treasury bill yield cannot be used as the exogenous reference rate which pins down the domestic term structure (as was the case in the papers cited immediately above). The discount rate is another candidate rate that can serve as the exogenous reference rate since it is clearly exogenous and under the control of the central bank. However, given the persistence of excess liquidity, this rate has not been very useful to signal monetary policy stance since banks seldom borrow reserves from the central bank.

As noted earlier, a key aspect of financial liberalization is the development of the money market in which the “independent” central bank will implement indirect monetary policy (IMF/World Bank, 2001; Fry, 1997b, chapter 6). To achieve this objective a primary market is developed for government Treasury bills, which a central bank can use to pursue open market operations⁹. In some countries such as Jamaica (see Peart, 1995) the central bank creates its own open market instrument. However, in most cases the Treasury bill auction system is the principal way of controlling bank excess reserves. Steps are then taken to develop the secondary market for Treasury bills and the interbank market for excess bank reserves.

In light of the very open nature of the economies under study (and LDCs in general), bank managers must always be mindful, subject to suitable adjustments for real exchange rate risks, of the prevailing rate of interest on foreign assets (which can be represented by the US Treasury bill rate or the LIBOR). Bank managers need to compare the international rate (adjusted for real exchange rate movements) with the prevailing domestic Treasury bill rate and the loan rate (also adjusted for domestic risk scenarios and transaction costs).

The non-bank public must also consider the international safe rate and exchange rate movements when making investment decisions particularly in domestic deposit accounts. Banks will lose deposits and market share if the deposit rate becomes too low vis-à-vis the risk adjusted foreign rate. The existence of such an arbitrage mechanism in an unregulated open economy provides for a link between the asset and liability sides (of the bank's balance sheet) in a banking model even though domestic financial markets are subjected to market power. Therefore, the foreign interest rate, which is clearly exogenous to the domestic economy, can be used as the exogenous reference rate in the modelling exercise. Hence, the model is applied in an open economy environment, thereby accounting for another important difference between the approach of this paper and the traditional banking model that is mainly presented in a closed economy setting.

Equation 1 is the representative bank's profit function that is assumed to be concave in loans to the private sector (L); domestic government securities (G); foreign assets (F); and deposits (D). The i subscript attached to each variable signals the quantity of the respective variable held by the representative bank.

⁹ See Alexander et al (1995) for a detailed description of the various indirect monetary policy instruments that are available to policy makers.

Other key variables include r_L = the average loan rate; r_D = average deposit rate; r_F = rate of interest on the international security (the LIBOR for instance); $c_i(L)$ = transaction and monitoring costs associated with making loans to private agents; ρ = the proportion of borrowers (where $0 \leq \rho \leq 1$) who are likely to default on their loans; and ψ = the probability (where $0 \leq \psi \leq 1$) that the government would fail to meet its debt obligations. The latter probability, for instance, is a function of the debt-GDP ratio or some other measure of debt sustainability. The bank's balance sheet identity in which zD = required reserves (where z = ratio of total excess and required liquidity) is given by the identity equation 2.

$$\Pi_i = (1 - \rho)r_L(L)L_i + (1 - \psi)r_G(G)G_i + r_F F_i - r_D(D)D_i - c_i(L) \quad (1)$$

$$zD_i + G_i + F_i + L_i = D_i \quad (2)$$

After solving the balance sheet constraint for F_i and substituting into equation 2, the profit function (equation 3) is derived.

$$\Pi_i = [(1 - \rho)r_L(L) - r_F]L_i + [(1 - \psi)r_G(G) - r_F]G_i - [r_D(D) - r_F(1 - z)]D_i - c_i(L) \quad (3)$$

$$L = L_i + \sum_{i \neq j} L_j; \quad G = G_i + \sum_{i \neq j} G_j; \quad D = D_i + \sum_{i \neq j} D_j \quad (3a)$$

The paper follows Freixas and Rochet (1999) by assuming a Cournot oligopoly. In the Cournot equilibrium the i th bank maximizes profit by taking the volume of loans, Treasury bills, and deposits of other banks as given. In other words, for the i th bank, (L_i^*, G_i^*, D_i^*) , solves equation 3. Equation (3a) denotes the aggregate quantity of loans, Treasury bills and deposits demanded, respectively, by the entire banking sector.

The loan market

It is now possible to derive a pricing equation for the representative bank in the loan market. Equation 4 is the first order condition after maximizing the profit function with respect to L_i . The market demand curve the bank faces is downward sloping thus giving the elasticity of demand expression in equation (4b) in which ϵ_L denotes the banks' elasticity of demand. There is a unique equilibrium in which bank i assumes $L_i^* = L^* / N$, where N denotes the number of commercial banks that make up the banking sector. The expression $r_L'(L)$ represents the first derivative of the loan rate with respect to L . As demonstrated by (4a) it is simply the inverse of $L'(r_L)$.

$$\frac{d\Pi_i}{dL_i} = (1 - \rho)r_L(L) + (1 - \rho)r_L'(L)L_i - r_F - c_i'(L) = 0 \quad (4)$$

$$r_L'(L) = 1 / L'(r_L) \quad (4a)$$

$$\epsilon_L = r_L \cdot L'(r_L) / L \quad (4b)$$

Substituting 4a and 4b into the first order condition yields equation 5, which shows that the loan rate is a mark-up over the foreign rate and the marginal cost of transacting, $c_i'(L)$. The mark-up is dependent on the inverse of the product of N and the market elasticity of demand (ϵ_L). As $N \rightarrow 1$ there is the case of a monopoly and the mark-up is highest, while as $N \rightarrow \infty$ one bank has an infinitesimal share of the market; the equilibrium approaches the competitive state in which the mark-up approaches zero. The bank also increases the mark-up rate once the perceived probability of default increases (that is: $\rho \rightarrow 1$).

$$r_L \left(1 + \frac{1}{N\epsilon_L}\right) = [r_F + c'_i(L)] / (1 - \rho) \quad (5)$$

This equation helps to explain the existence of a minimum loan rate, at which point excess liquidity and private loans become perfect substitutes; hence, it explains the flattening of the empirical liquidity preference curve that was observed in the last section. Since the bank possesses the ability to choose a minimum rate, it will simply accumulate excess liquidity when the marginal borrower cannot pay the desired minimum loan rate. In other words, the bank accumulates excess liquidity because the marginal benefit from the additional unit of loan is less than the marginal cost of that same unit of loan. The minimum rate also implies that the removal of interest rate controls (or financial repression¹⁰) will result in very high loan rates as banks behave more like theoretical oligopolies. High loan rates, especially after the liberalization of financial systems, have been observed in many developing countries (see Chirwa and Mlachila, 2004).

The Treasury bill market

As noted earlier the commercial banks do not take the domestic Treasury bill rate as given. With only a few large institutional purchasers of government securities, it is reasonable to assume that buyers do exert influence over the Treasury bill rate when they place bids for the security. In other words, banks face an upward sloping supply curve rather than a flat curve as is typically assumed in the literature. It is also a reasonable assumption to make since banks usually demand excess liquid assets over the stipulated statutory secondary liquidity ratio. Banks do find these assets desirable (hence the excess amounts) since they can collude and control the rate at which they bid for Treasury bills. Therefore, the Treasury bill rate can also be derived as a mark-up over the international rate.

$$\frac{d\Pi_i}{dG_i} = (1 - \psi)r_G(G) + (1 - \psi)r'_G(G)G_i - r_F = 0 \quad (6)$$

Maximizing the profit function with respect to G_i gives the first order condition in equation 6. Substitute 6a and 6b into equation 6 to obtain the new pricing equation 7. (note: ϵ_G denotes the elasticity of demand for Treasury bills) There is a unique equilibrium in which bank i assumes $G_i^* = L^* / N$, where N denotes the number of commercial banks that make up the banking system. Equation 7 postulates that the minimum Treasury bill rate at which a bank will bid for the security is denoted by a mark-up over the exogenous foreign rate and market-specific risk. The minimum mark-up rate increases as $N \rightarrow 1$ and decreases as $N \rightarrow \infty$. The minimum rate also increases as $\psi \rightarrow 1$, hence the bank will bid at a higher rate once the likelihood of a government default increases. This result is also consistent with the notion that a market Treasury bill rate that is below the minimum stipulated by the mark-up rule will result in the bank accumulating excess reserves passively. However, this issue is beyond the scope of this paper and is left to further research. Another issue that is not taken up in this paper is the derivation of the deposit rate.

$$r'_G(G) = 1 / G'(r_G) \quad (6a)$$

$$\epsilon_G = r_G \cdot G'(r_G) / G \quad (6b)$$

$$r_G \left(1 + \frac{1}{N\epsilon_G}\right) = r_F / (1 - \psi) \quad (7)$$

¹⁰ Fry (1982) explains the main forms of financial repression as nominal interest rate ceilings for deposit and loan rates, directed credit to particular industries, and the expropriation by government of seigniorage by the use of high cash and liquid asset requirements and obligatory holding of government securities.

Indirect monetary policy and market structure

It is interesting to see the extent to which indirect monetary policy influences the loan market when banks use a mark-up pricing rule to determine both the loan rate and the rate of interest on the government security. The main task of indirect monetary policy in LDCs is the management of excess bank reserves through some form of open market operations using government Treasury bills, which the central bank holds as asset. The following arguments, however, are equally valid when the central bank invents its own open market instrument as in Jamaica (see Peart, 1995).

So far the paper has argued that excess liquidity is a structural phenomenon rooted in the oligopoly nature of banking. The task ahead is to now derive a theoretical equation to show the extent to which open market operations would influence the loan rate and hence bank credit and the real side of the economy. In particular, the objective is to analyze the effect on r_L when the central bank manages bank liquidity by varying the quantity of G . G is the policy variable; hence it is exogenous. The loan rate (r_L) is the endogenous variable in the model. An increase in the sale of Treasury bills (G) is indicative of monetary tightening and a concomitant increase in r_G (that is: $r'_G(G) > 0$); the opposite occurs when the sale of G declines.

It is possible to combine equations 5 and 7, which both have the common term r_F , to form equation 8. Taking the derivative dr_L/dG will produce the monetary policy impact equation (equation 9), which measures the pass-through effect of monetary intervention. The loan rate is affected positively by a monetary contraction (increased sales of G) and negatively by a monetary expansion (decrease sales of G). Equation 9, moreover, provides an opportunity to simulate the impact of monetary policy for various banking structures given certain scenarios for elasticity and the probability of government and private sector default. In other words, given plausible values for ϵ_L , ϵ_G , ψ and ρ , how does dr_L/dG change for various levels of N ? Where N is a proxy for market structure; $N=1$ denotes monopoly, while $N=\infty$ indicates perfect competition.

$$r_L \frac{(1 + \frac{1}{N\epsilon_L})(1 - \rho)}{(1 + \frac{1}{N\epsilon_G})(1 - \psi)} - \frac{c'(L)}{(1 + \frac{1}{\epsilon_G})(1 - \psi)} - r_G(G) = 0 \quad (8)$$

$$\frac{dr_L}{dG} = \frac{r'_G(G)(1 + \frac{1}{N\epsilon_G})(1 - \psi)}{(1 + \frac{1}{N\epsilon_L})(1 - \rho)} \geq 0 \quad (9)$$

In order to simplify the simulation analysis assume that $r'_G(G) = 1$. This does not distort the result in any way. The assumption is made that $\epsilon_L < \epsilon_G$. This is a plausible assumption for two reasons. Firstly, there are more buyers of government Treasury bills (bank and non-bank buyers) relative to the number of commercial banks. Secondly, the financial reform agenda has emphasized the development of money markets (of which the Treasury bill market is part) first as a launching pad for indirect monetary policy and the further development of capital markets. Hence, money markets tend to have more participants (thus the higher elasticity).

There are many possible values that can be chosen for ϵ_L , ϵ_G , ψ , ρ and N . However, the simulation is done for $N = 1, 2, \dots, 35$. None of the countries in this study has a banking system with thirty-five

commercial banks (see Appendix Table B). Figure 10 presents the simulation of equation 9 for the following values: $\epsilon_G = 1$, $\epsilon_L = 0.2$, $\rho = 0.1$, $\psi = (0.1, 0.2, 0.3, 0.4)$. The curves show different levels of values for dr_L/dG (for the four different values of ψ) over N . It is clear that the pass-through of monetary policy (dr_L/dG) gets larger as the degree of competition rises. However, monetary policy becomes less effective as the probability of government default rises. Since developing countries typically possess financial systems with few commercial, the simulation results would suggest very limited pass-through for such economies.

Figure 11 shows the simulation exercise for $\epsilon_G = 1$, $\epsilon_L = 0.2$, $\psi = 0.1$ and $\rho = (0.1, 0.2, 0.3, 0.4)$. Again the monetary policy impact increases as the banking sector becomes more competitive. However, an interesting but plausible result emerges. The monetary pass-through rises as the private sector probability of default (ρ) rises. The result implies that a central bank would be able to contract the economy with relative ease during a crisis. On the other hand, the model also suggests the central bank might be able to stimulate the economy during episodes of financial distress. These results, however, might be more relevant for competitive banking structures rather than the third world scenarios that we are studying.

Figure 12 reports the simulation exercise for the values $\epsilon_G = 1.5$, $\rho = 0.1$, $\psi = 0.1$ and $\epsilon_L = (0.2, 0.5, 0.8, 1.1)$. In general the pass-through increases with N ; however, as $\epsilon_L \rightarrow \epsilon_G$ the effect becomes constant for the relatively more competitive banking sectors. However, the extreme, but improbable, situation results whereby there is constant pass-through over any level of N when $\epsilon_L = \epsilon_G$.

It is also possible to use a novel diagram to clarify some of the issues emanating from equation 5. Figure 13 illustrates how the minimum loan rate affects both the loan market and the market for bank reserves simultaneously. A solution in the diagram gives three endogenous variables— r_L , the quantity of loans made to private agents (L), and the quantity of excess reserves (R). The excess reserves demand curve (R_D) is downward sloping and becomes flat at the minimum loan rate (r_L^{\min}). The reserve supply curve (R_S) is vertical. R_S shifts outward or inward when the central bank pursues open market operations (changes G). When $R_D = R_S$ the reserve market is in equilibrium and it results in an equilibrium solution (R^*, r_L^*).

The loan supply curve (L_S) is horizontal at the minimum rate. It is horizontal because the banks set the minimum rate exogenously and the public accepts the rate. Therefore, the minimum rate becomes the market's supply curve. The public's loan demand curve (L_D) is downward sloping as the typical demand curve. At the point where $L_S = L_D$, the loan market equilibrium gives a solution (L^*, r_L^*).

Assume both markets are in initial equilibrium at (R^*, r_L^*) and (L^*, r_L^*). An introduction of an expansionary monetary shock would shift the R_S curve outward along the flat liquidity preference curve. There is no change in the minimum rate (r_L^{\min}) or endogenous loan rate (r_L^*). The result is the accumulation of a larger quantity of excess reserves (R_1^*). However, a contraction in monetary policy has a more dramatic effect in the model. The reserve supply curve shifts inward to R_{S2} and the quantity of excess liquidity declines. If the contraction takes place over the downward sloping section of the R_S curve, both r_L^{\min} and r_L^* would increase. The higher r_L^{\min} shifts upward the L_S curve thereby diminishing the quantity of loans extended to the private sector. The conclusion, therefore, is an expansion of monetary policy in an oligopolistic banking sector would not be successful in stimulating private sector credit, but a contraction would tend to have debilitating effects on growth-augmenting credit to businesses.

Figure 10:
Monetary policy effectiveness for different values of N and Ψ

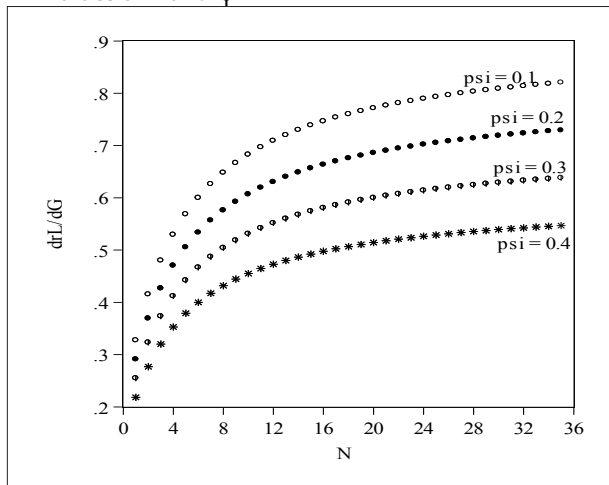


Figure 11:
Monetary policy effectiveness for different values of N and ρ

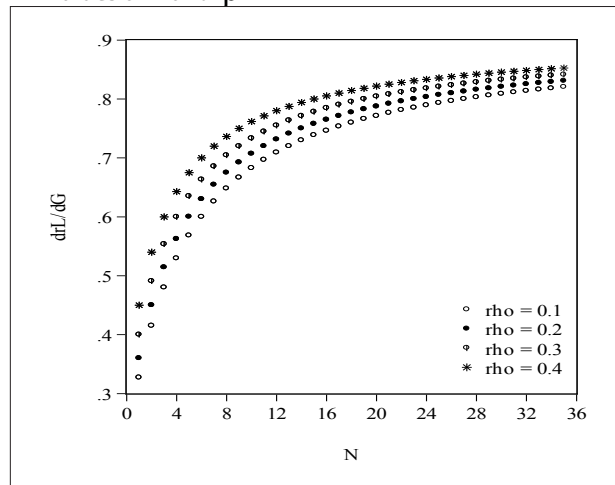


Figure 12:
Monetary policy effectiveness for different values of N and ϵ_L

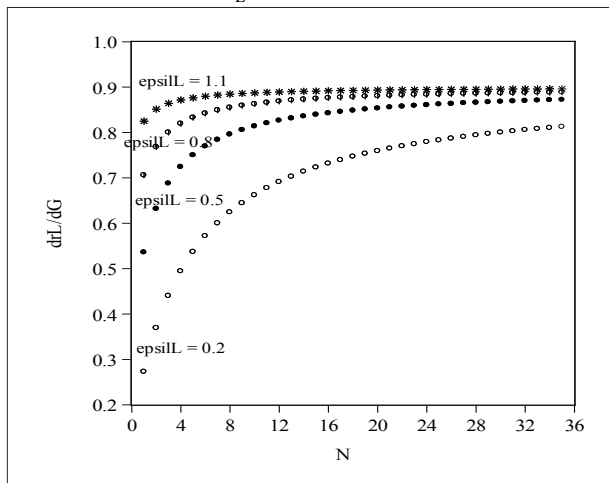
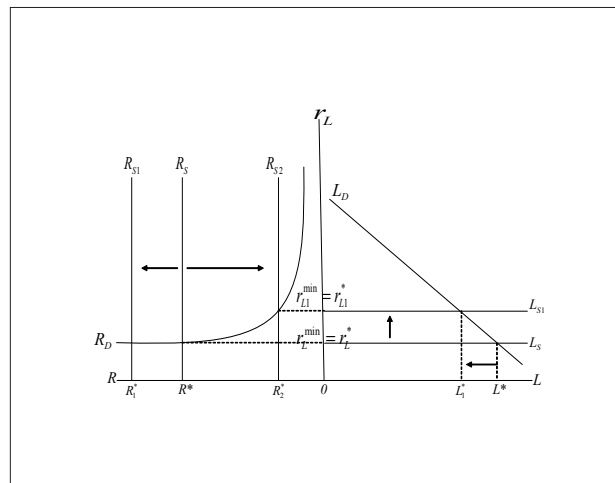


Figure 13:
Monetary policy and the minimum rate



A calibration exercise

An exercise in calibration—in the context of this paper—would involve obtaining estimates for marginal transaction costs and choosing values (or obtaining estimates) for the probability of default, bank concentration and elasticity of demand (given the foreign interest rate) in order to replicate the flat bank liquidity preference curves given by the stylized facts. This interpretation of calibration is in keeping with the outline given by Cooley (1996).

Given equation 5 a suitable proxy for each of the following— N , ϵ_L , r_F , $c'_i(L)$ and ρ —must be obtained. Fortunately, it is fairly straightforward to obtain a reasonable proxy for N and r_F . N refers to the number of commercial banks that make up the banking sector (see Appendix Table B), while r_F can be

approximated by the three month LIBOR. It is not so easy, however, to get suitable estimates for the other three unknowns. Surprisingly there is a lack of econometric estimates of ϵ_L for the countries under study. Hence, we have to make a reasonable assumption. Given the fact that the banking systems of Guyana, Jamaica, Barbados, Namibia and Trinidad and Tobago possess a very similar number of banks and very high asset concentration ratios, we can assume an elasticity parameter of below one. For the calibration exercise assume that $\epsilon_L = 0.5$. In the case of Tanzania, which has twenty-three banks and a slightly lower concentration ratio, assume $\epsilon_L = 1.5$.

Another key problem is obtaining a reasonable estimate for the marginal transaction cost [$c'_i(L)$]. Consequently, $c'_i(L)$ has to be approximated by the average overhead cost. That is, total overhead costs (taken from the World Bank's financial structure data set) divided by the quantity of credit extended to the private sector. The World Bank's data, however, presents overhead costs as a ratio of total bank asset. Therefore, the IMF's *International Financial Statistics* total commercial bank asset and credit to private sector data are used to estimate the average overhead cost vis-à-vis the quantity of loans. Since the World Bank's data on overhead costs for each country stops at 2004, the average is utilized for the purpose of calibration. Table 1 presents the assumed values, estimates and calibrated results.

Table 1:
Calibration results and assumed parameter values

	Barbados	Guyana	Jamaica	Trinidad & Tobago	Tanzania	The Bahamas	Namibia
Transaction costs (cost per one unit of local currency)	0.051	0.071	0.192	0.066	0.118	1.12	0.0563
Elasticity	0.5	0.5	0.5	0.5	1.5	0.5	0.5
Number of banks (N)	6	6 & 7	6	6	23	9	4 & 5
Probability – rho	0.16	0.39	0.02	0.011	0.000	0.000	0.36

Source: Author's estimates.

The calibration exercise, therefore, seeks to choose a given value for the probability of borrower default, given our estimates and assumptions, which can replicate the flat interest rate threshold. Table 1 also reports the probability—which should be seen as tentative—for seven countries. It was not possible to replicate a flat or near horizontal liquidity preference curves for two of the countries; instead of flat curves, U-shaped simulated liquidity preference curves were obtained.

Figures 14 to 20 represent the simulated liquidity preference curve using the Loess technique once more. The smoothing parameter of 0.4 was again utilized. The vertical axis in each figure represents the simulated or artificial loan rate, which uses the estimated values, assumed values, and the three month LIBOR. If the curve flattens it can be seen as being consistent with the minimum rate hypothesis. Unfortunately, since visual analysis is utilized it is not entirely possible to replicate the exact horizontal threshold of the original graph. The results should also be interpreted with care given the difficulties in obtaining good estimates for each of the true parameters.

In the case of The Bahamas an average operating cost of B\$ 1.12 was utilized—given the calculations and source of the pertinent data. It implies that on average every Bahamian dollar of loan extended cost Bah\$ 1.12. Therefore, in light of the very high average operating cost, even a zero probability was not sufficient to bring down the horizontal section of the curve to its prior level. A similar situation occurred with respect to Tanzania whereby a zero probability could barely replicate the 15 percent threshold. Overall,

Figure 14:
Jamaica calibration (quarterly data: 1997:1 – 2007:1)

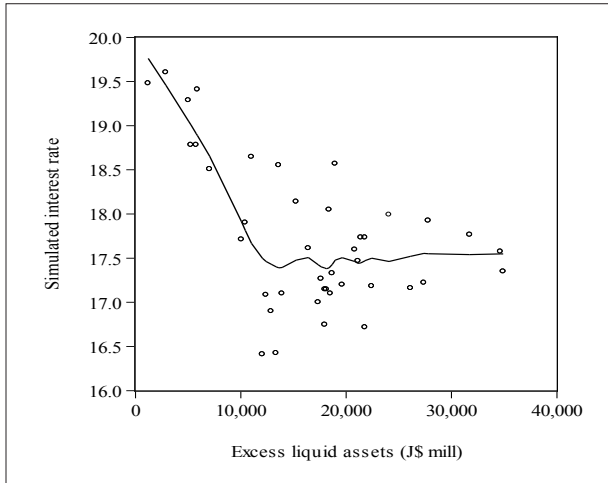


Figure 15:
Barbados calibration (quarterly data: 1997:1 – 2007:1)

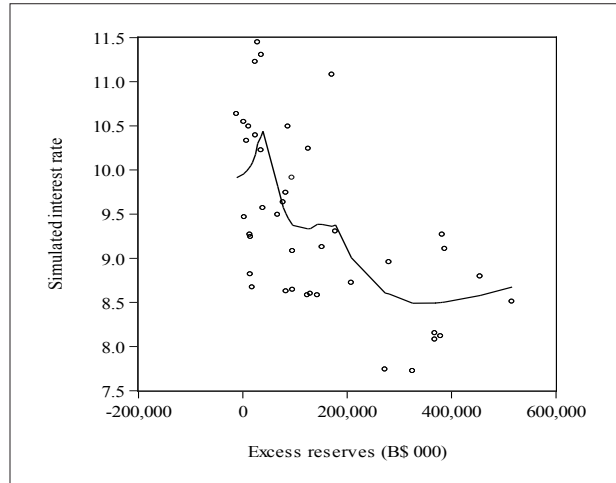


Figure 16:
Bahamas calibration (quarterly data: 1997:1 – 2007:1)

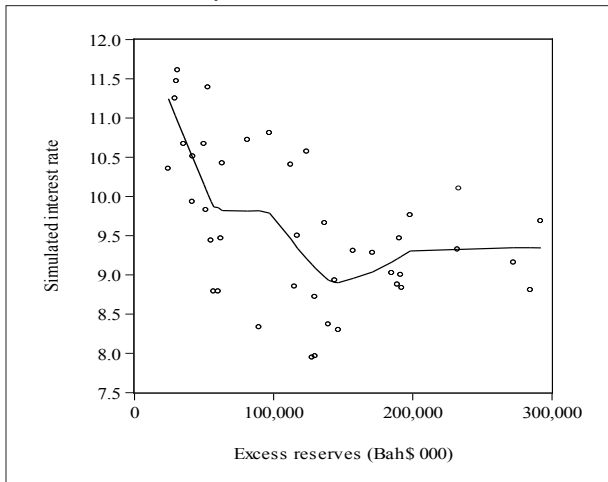


Figure 17:
Guyana calibration (quarterly data: 1997:1 – 2007:1)

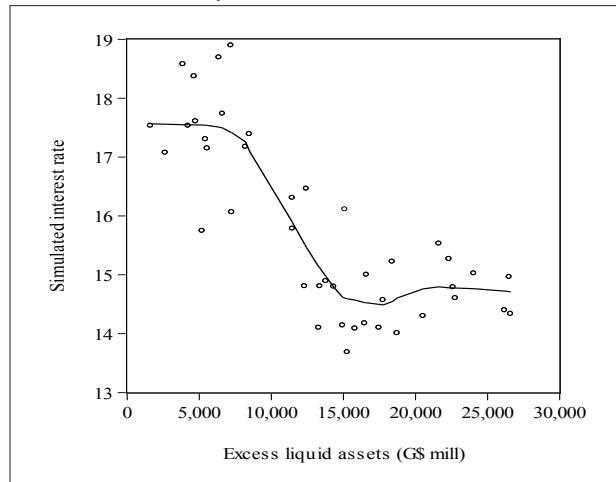


Figure 18:
Trinidad and Tobago calibration (quarterly data: 1997:1 – 2007:1)

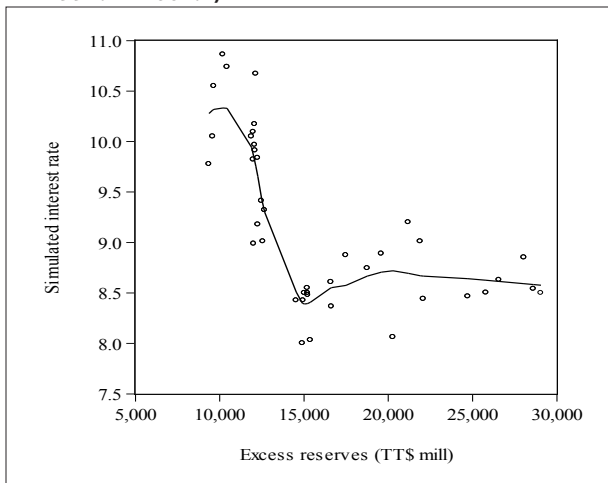


Figure 19:
Namibia calibration (quarterly data: 1997:1 – 2007:1)

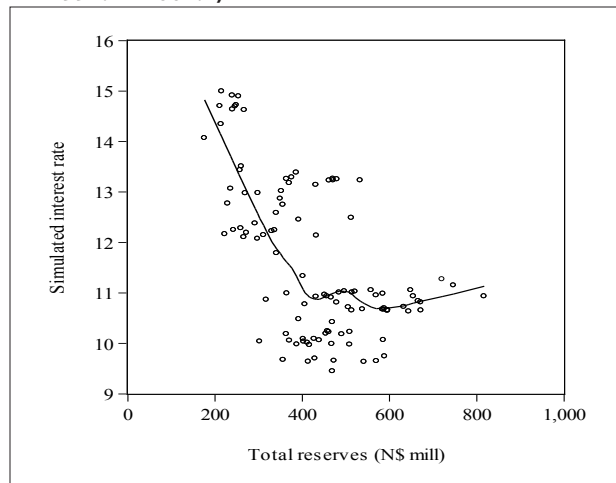
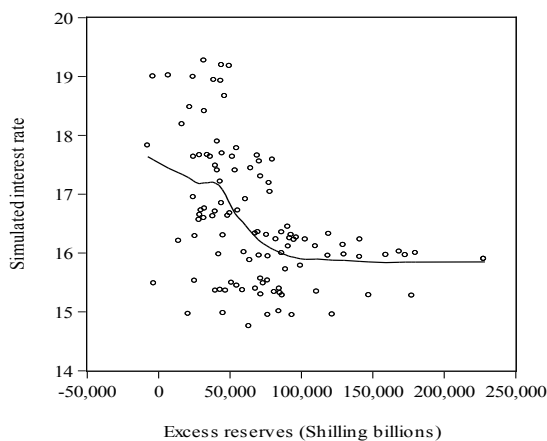


Figure 20:
**Tanzania calibration (quarterly data:
 1997:1 – 2007:1)**



however, the tendency for the calibrated liquidity preference curves to become horizontal could be interpreted as supportive of the minimum rate hypothesis.

Conclusion

The paper argued that the phenomenon of excess bank liquidity gives important insights as to the nature of the loan market in LDCs. Commercial banks require a minimum mark-up interest rate in the loan market before they lend to the marginal borrower. Such an interest rate stems from the oligopoly power banks possess in that market.

The paper also highlighted an important theoretical issue as it relates to the application of the theory of the banking firm to underdeveloped economies. It was noted that the banking model has to be modified to take into consideration the unique institutional characteristic of no exogenous domestic rate of interest that can serve as the benchmark rate as is the case in the advanced economies. Interest rates are determined by oligopolistic interactions. Consequently, a suitable foreign interest rate has to serve as the exogenous rate in any modelling exercise. Therefore, by introducing the foreign interest rate the paper pitches the banking model in an open economy context.

Two important policy implications result from the finding of the perfectly elastic liquidity preference curves. The first being the very high loan rate that is likely to occur after the loan market is liberalized. This follows from the fact that private oligopoly banks are free to set the loan rate at any level they might desire. As argued earlier, banks will mark-up the loan rate to compensate for marginal transaction costs, risks and the rate of interest on the safe external security.

The second policy implication is the ineffectiveness of indirect monetary policy over the flat range of the liquidity preference curve. As highlighted by the stylized facts, the downward sloping portion of the curves occurs at very high loan rates. Therefore, reserve shocks (that is shifts in the reserve supply curve owing to open market operations) emanating from the central bank can only have desirable effects on the loan rate (and hence alter consumption and investment decisions) when that rate is very high. This is because over the flat range of the liquidity preference curve commercial banks set interest rates exogenously of liquidity shocks emanating from the central bank. The high loan rate, moreover, is detrimental to output and employment creation in economies where the banking sector account for most business financing. Society and the policy makers, and the foreigners who advise the domestic policy makers, will have to decide whether indirect monetary policy is so important that it is worth the cost of persistent strangulation of domestic private investments in productive activities.

Two important issues that are the focus of future research projects have been omitted in this paper. The first one is the implications of persistent excess liquidity for money market development (and the operation of these markets) in LDCs. The second has to do with why banks operating in liberalized economies such as Guyana, Uganda and Jamaica, for instance, have been seemingly unwilling to invest all non-remunerative excess reserves in a safe foreign asset? Hence, what does excess liquidity say about the operation of the foreign exchange market in liberalized LDCs?

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Table A:
Key financial reforms

Countries	Key reforms
Guyana	<ol style="list-style-type: none"> 1. Indirect monetary policy adopted in mid-1991. Monetary policy focuses on managing excess reserves as a means of controlling bank credit and meeting stable inflation objectives. 2. Interest rate controls jettisoned in 1991. The bank rate and rediscount rate determined via a competitive bidding system for government Treasury bills. 3. Credit controls abandoned in 1991. 4. Cambio market system commissioned in 1990. Cambio system was used to unify the official exchange rate with the parallel foreign exchange market and create a floating exchange rate system. <p><i>Source: Egoume-Bossogo et al (2003).</i></p>
Jamaica	<ol style="list-style-type: none"> 1. Jamaica's first attempt at liberalization commenced in 1985. However, restrictions were soon reinstated. 2. Interest rates de-controlled in 1985. 3. Credit controls jettisoned in 1991. 4. Exchange control regime abandoned in 1991 and a flexible exchange rate adopted in that same year. 5. Indirect monetary policy, or open market operations, adopted in 1985. Monetary policy is focused on managing excess reserves to promote business credit and stable inflation. <p><i>Source: El Hadj (1997).</i></p>
Trinidad and Tobago	<ol style="list-style-type: none"> 1. Interest rate controls removed in 1993. 2. Exchange controls removed in 1991. 3. Exchange rate floated in 1993. <p><i>Source: El Hadj (1997).</i></p>
Barbados	<ol style="list-style-type: none"> 1. Interest rate deregulation in 1991. <p><i>Source: Haynes (1997).</i></p>
The Bahamas	<ol style="list-style-type: none"> 1. Deposit interest rate ceiling removed in 1994. <p><i>Source: Craigg (1997).</i></p>
Tanzania	<ol style="list-style-type: none"> 1. Interest rate controls removed in 1991. 2. Credit controls removed in 1992. 3. Indirect monetary policy introduced in 1991. Monetary policy utilizes Treasury bills as a means of managing excess reserves. <p><i>Source: Bank of Tanzania.</i></p>
Namibia	<ol style="list-style-type: none"> 1. Interest rate controls removed in 1991. 2. Sale of Treasury bills in 1992 for managing excess reserves and achieving monetary targets. 3. Credit controls eliminated in 1992. 4. Interbank money market established in 1993. <p><i>Source: Bank of Namibia Annual Report (2002).</i></p>
Zambia	<ol style="list-style-type: none"> 1. Comprehensive interest rate liberalization in 1992. 2. Indirect monetary policy adopted in 1992. <p><i>Source: Simatele (2004).</i></p>
Uganda	<ol style="list-style-type: none"> 1. A Treasury bill auction mechanism introduced to facilitate the market determination of interest rates. 2. Treasury bills are used for open market operations in order to manage excess reserves. 3. Market determination of the exchange rate in 1993. 4. Credit controls removed in 1993. <p><i>Source: Egesa and Abuka (2006).</i></p>

Table B:
The number of commercial banks

	The Bahamas	Barbados	Guyana	Jamaica	Namibia	Trinidad & Tobago	Tanzania	Uganda	Zambia
1997	9	na	7	6	5	6	na	na	na
1998	9	na	7	6	5	6	na	na	na
1999	9	na	7	6	5	6	na	na	na
2000	9	na	7	6	5	6	na	na	na
2001	9	na	7	6	4	6	na	na	na
2002	9	6	7	6	4	6	na	na	na
2003	9	6	6	6	4	6	23	14	13
2004	9	6	6	6	4	6	23	14	13
2005	9	6	6	6	4	6	23	14	13
2006	9	6	6	6	4	6	23	14	13

Source: Various central bank websites and Annual Reports.

Table C:
Asset concentration ratios—the share of three largest commercial banks

	The Bahamas	Barbados	Guyana	Jamaica	Namibia	Trinidad & Tobago	Tanzania	Uganda	Zambia
1995	0.95	1.00	1.00	na	1.00	0.70	1.00	0.76	0.86
1996	0.73	1.00	1.00	na	0.83	0.74	0.81	0.51	0.82
1997	0.69	0.98	1.00	na	0.82	0.73	0.72	0.52	0.93
1998	0.50	0.98	1.00	na	0.82	0.70	0.72	0.59	0.68
1999	0.50	0.98	1.00	na	0.78	0.72	0.72	0.64	0.69
2000	0.46	1.00	1.00	na	0.80	0.74	0.70	0.62	0.66
2001	0.66	na	1.00	na	0.83	0.75	0.68	0.57	0.62
2002	0.68	na	1.00	0.82	0.91	0.75	0.58	0.65	0.61
2003	0.61	na	1.00	0.86	0.86	0.83	0.62	0.65	0.58
2004	0.71	na	1.00	0.83	0.93	0.87	na	0.63	0.64

Source: World Bank's financial structure dataset.