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Testing for the Credit Crunch in Trinidad and Tobago Using an Alternative Method

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Abstract

This paper examines whether the decline in loans to the private sector in Trinidad and Tobago from mid-2009 was caused by a demand-induced or the credit crunch phenomenon. The study presents an alternative methodology for estimating the credit crunch. The new methodology emphasizes an aggregate banking model in which excess liquidity and interest rate spread are important stylized facts. The analytical framework is used to identify shocks to loans and deposits that are found to be empirically related to excess liquidity. Using Two-Stage Least Squares (TSLS), we estimate auxiliary regressions of random deposit and loan shocks. The results suggest that weak loan demand instead of a supply-induced credit crunch best explains the decline.

JEL Classifications: E51, G21.

Keywords: Credit Crunch, Excess Liquidity, Loanable Funds Model.

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1. Introduction

The level of non-remunerated excess liquidity in the banking system can signal a weakness in the demand for loans or a credit crunch in which banks prefer to hoard the non-remunerated asset instead of extending marginal quantities of loans.[1] This argument is also applicable in the case where excess reserves are remunerated at a very low interest rate as in the United States (US) since October 2008. However, in developing economies this asset typically pays no interest (Khemraj, 2010a). Other scholars have observed the phenomenon of excess liquidity in order to exploit information signal of a credit crunch (see Agénor et al. 2004; Poghosyan, 2011). The credit crunch can result from several supply related factors such as harsh bank supervision practices, decline in bank capital, and regulatory burden (Clair and Tucker, 1993). This paper adopts this convention and defines a credit crunch as a supply side problem emanating from the banks. Credit contraction can also result from weak demand for loans. The contribution of this paper is that it provides an alternative methodology for determining whether supply or demand is the binding constraint.

From a policy perspective, it is crucial to distinguish between a supply-driven or demand-determined slowdown in equilibrium lending. For example, if loan demand is weak the banks could either hoard excess reserves or invest in foreign assets providing there is no friction in the domestic foreign exchange market. Such a friction can result from a foreign currency constraint that causes a mismatch between the demand and supply of scarce foreign currency (Khemraj, 2009). Similarly, the build-up of excess liquidity could be reflective of a supply-side credit

[1] This paper uses the terms excess reserves and excess liquidity interchangeably. In modern parlance, these are essentially excess funding liquidity. The concept of funding liquidity has been a major preoccupation of researchers in recent years (see Drehmann and Nikolaou, 2010). Since the central bank provides the liquidity backstop, it is the ultimate source of funding liquidity that helps to maintain the market liquidity of financial assets. In most developing economies, however, the question of market liquidity is subdued because of the persistent excess bank liquidity and the virtual nonexistence of secondary money markets.

crunch by banks in which the market loan rate (marginal revenue of lending) falls to the risk-adjusted marginal cost of lending (Khemraj, 2010a). In this case further liquidity easing will not stimulate lending and actually cause commercial banks to invest the excess cash in foreign assets once the foreign exchange mismatch is eased.

This study presents an alternative test that is derived from a structural model of the oligopoly banking firm in developing economies. Khemraj (2010b) shows that the excess liquidity phenomenon could reflect the oligopoly mark-up interest rate of commercial banks. In developing economies, the phenomenon of excess liquidity has been persistent for decades and it precedes the relatively recent excess liquidity build-up in the United States owing to quantitative easing. This study goes further by showing that an intuitive test of the existence of a credit crunch can be derived from the oligopoly model of the banking firm. Trinidad and Tobago data are utilized to perform the empirical estimation, since this country was identified to be one in which credit contracted sharply during the global financial crisis (2007-2009). Furthermore, investigation of the data also shows that in recent years, the quantity of excess liquidity in Trinidad and Tobago's banking system has been growing rapidly (see Figure 1).[2] The method we develop can easily be applied to other economies given the prevalence of excess liquidity that coincides with a steep contraction in bank lending. Although excess reserves tend to diminish the money multiplier and weaken the link between deposits and loans, this work shows that estimating the demand for excess liquidity can yield useful information for practical central banking.

In the past, several studies have sought to explain the phenomenon of excess liquidity in developing economies. According to Khemraj (2010a), banks' desire to hoard excess liquidity

[2] The Central Bank of Trinidad and Tobago measures excess liquidity as total commercial bank reserves minus required reserves.

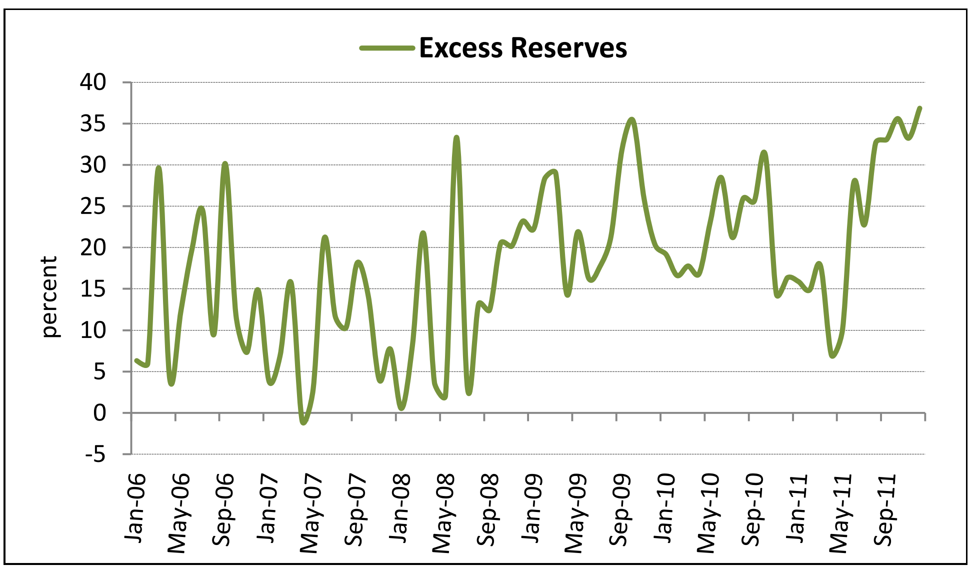
reflects the situation in which the market loan rate falls to equal the risk-adjusted marginal cost of lending. In this regime banks demand non-remunerated excess liquidity as a substitute for interest-earning loans as is evidenced by a flat liquidity preference curve. The phenomenon could also reflect a monetary overhang as rationing in the commodity market forces households to save in bank deposits (Caprio and Hanohan, 1993). Saxegaard (2006) estimated empirically several structural and risk factors determining the phenomenon in Sub-Saharan Africa. He found that excess liquidity can weaken the monetary transmission mechanism and affect the ability of the central bank to control inflation. Saxegaard's findings are however different to Jayaraman and Choong (2012) who found that a liquidity shock cannot explain changes in inflation in Fiji's banking system.

Furthermore, Maynard and Moore (2005) examined why Barbadian commercial banks demand excess liquid assets. Among other factors, the authors found that the build-up of excess bank reserves during 1974-2004 was mainly due to the volatility of bank deposits, interest rates and the government’s fiscal operations. The issue of excess reserves was also examined in Jamaica by Anderson-Reid (2011). Similar to the case of Barbados, Anderson-Reid found that the major determinants of excess reserves in Jamaica's banking system include the volatility of currency withdrawals and the actions of the government. Also, in The Bahamas, the economic decisions undertaken by the government led to the build-up of excess reserves in the banking system (see Jordan et al. 2012).

Moreover, Aikaeli (2006) used an Autoregressive Distributed Lag (ARDL) model to investigate the determinants of excess liquidity in Tanzania. The results from the empirical analysis show that the key factor responsible for the increase in excess liquidity in the long run was the reserve requirement ratio. In a recent study, Primus et al. (forthcoming) used

Generalized Method of Moments (GMM) estimation to investigate whether commercial banks in Trinidad and Tobago demand excess reserves for precautionary purposes. Further, using the results from the GMM estimation into a Vector Error Correction (VEC) model, the authors examined the dynamic effects of an increase in government expenditure on involuntary excess liquidity. The results from the study show that commercial banks demand excess reserves for precautionary purposes. Also, an increase in government spending leads to a persistent rise in involuntary excess liquidity. In addition, the issue of excess reserves has received attention in other developing countries, such as Egypt (see Fielding and Shortland, 2005), Mexico (see Jallath-Coria et al. 2005), Turkey (see Tabak and Bankasi, 2006), Cape Verde (see Pontes and Sol Murta, 2012), and Indonesia (see Bathaluddin et al. 2012).

Figure 1. Excess Reserves to Total Reserves in Trinidad and Tobago (2006-2011)



Using the idea that banks set the lending rate as a mark-up over the central bank's borrowing rate, Agénor and El Aynaoui (2010) examine the implications of excess liquidity for the effectiveness of monetary policy. They argue that excess liquidity causes banks to relax credit standards, thereby accounting for asymmetric interest rate formation. The model presented herein also utilizes the notion of oligopoly mark-up interest rate at the microeconomic level as the basis for the alternative model of a loanable funds market in a bank-dominated financial system.

The rest of the paper is organized as follows. Section 2 outlines the analytical framework, which inspires the identification of the credit crunch. In Section 3 we use Ordinary Least Squares (OLS) to estimate the excess liquidity model and Two-Stage Least Squares (TSLS) to obtain the auxiliary regression estimates. This section also presents the findings from the empirical estimation. The final section offers some concluding remarks.

2. The Analytical Framework

There is a large literature searching for the existence of a credit crunch in various economies given its importance for policy insights. Much of the theoretical underpinning comes from the notion of disequilibrium in the credit market because of asymmetric information problems. At the empirical level researchers assume market disequilibrium to decipher whether the observed slowdown of credit reflects deficient demand or a supply-induced credit crunch. The pioneering application of this approach can be found in the study by Laffont and Garcia (1977). This method has found wide applications at central banks and at international organizations. For example, the work by Pazarbaşioğlu (1997), Ikide (2003), Allain and Oulidi (2009) and Poghosyan (2011) – to cite just a few – have all tried to furnish an answer to this critical question using the disequilibrium method.

Agénor et al. (2004) proposed another approach that involved estimating an empirical model of excess bank liquidity. Once the model is estimated, dynamic forecasts of excess liquidity are generated over the period the loan market would be observed. The purpose of this method is to use the liquidity projection to determine voluntary versus involuntary excess liquid asset demand by commercial banks. Involuntary demand would indicate the slowdown of credit is demand-induced while voluntary demand signals a supply-induced reduction of loans. Poghosyan (2011) used the excess bank liquidity preference approach of Khemraj (2010a) as a robustness check to support his hypothesis of a credit crunch in Jordan. In this approach, a flat bank liquidity preference curve is an indication of a credit crunch at which point the market loan rate is equal to the risk-adjusted marginal cost of extending loans.

This paper develops an alternative approach that is based on observing how shocks to loans and deposits affect the level of excess bank liquidity. The approach develops a loanable funds model from which a structural excess liquidity demand equation can be derived within a model that takes into consideration loans, deposits and the persistent spread between the loan and deposit rates. The approach allows us to match up the loan and deposit shocks with excess liquidity over the sample period that shows a reduction in bank loans to the private sector. Therefore, we can see the transition from one regime to another. The disequilibrium model also does this but it requires using a sophisticated maximum likelihood estimation routine that is dependent on normally distributed regression residuals. The new approach can therefore be an intuitive complement for the other methods. Moreover, it can determine whether there is a strong credit crunch, weak credit crunch or no credit crunch in which case the build-up of bank liquidity is demand-induced. In each case the policy response ought to be different.

2.1 A Diagrammatic Exposition

The loanable funds model below is applicable to an economy in which banks form the dominant source of external finance – a situation which is known to be widespread in developing and some advanced economies. The model takes into consideration two stylized facts of the banking sector in developing economies – persistent excess liquidity and interest rate spread (Khemraj, 2010b). There is no single interest rate that clears the market for loanable funds. On the one hand, the loan rate – assumed to be a mark-up over the marginal cost of lending, a foreign interest rate and a probability of borrower default – clears the loan market. On the other hand, the deposit rate – assumed to be a mark-up over the foreign interest rate and the liquidity ratio – clears the deposit market. In the presence of persistent excess liquidity the foreign risk-free rate becomes the base rate and not a local money market rate akin to the US Federal funds rate. However, sometimes frictions in the local foreign exchange market will prevent all excess liquidity from being invested into a safe foreign asset. The notion of a foreign currency constraint creates these mismatches or frictions (Khemraj, 2009).

In keeping with the notion that the commercial banks possess the market power, the banks set the deposit and loan rates and the savers and borrowers, respectively, take these rates as given. Effectively therefore the banks supply loans at some minimum mark-up interest rate and accept deposits at a maximum interest rate. In this framework the spread is embedded into the loanable funds model and no single rate clears the market. The basic model from which excess liquidity can be derived to measure the credit crunch is presented below. To understand the mechanism by which the interest rates adjust consider the following equations.

Firstly, the loan rate is given by the following expression,

$$r_L^{\min} = (r_F + m(L)) / (1-\rho)(1+(aN)^{-1}) \tag{1}$$

and secondly the deposit rate is given by,

$$r_D^{\max} = r_F / (1-z)(1+(bN)^{-1}) \tag{2}$$

The loan rate is written as a minimum rate, $r_L^{\min}$, which the banks require for extending a marginal quantity of loans, while the deposit rate is the maximum, $r_D^{\max}$, banks will pay to encourage the public to place funds in the banks. r_F is the foreign interest rate, $m(L)$ denotes the marginal cost of loans, ρ is the probability that borrowers will default, *N* represents the number of banks in the oligopoly industry, *a* shows borrowers' elasticity of demand for loans, *b* denotes savers elasticity of supply of deposits, and *z* is the ratio of non-remunerated liquidity to total assets.

The demand for loans, L_D, and supply of deposits, D_S, are written in linear form to simplify the algebra and derivation of the excess liquidity projection function, as follows:

$$L_D = L_0 - ar_L + \varepsilon^L \quad (3)$$

$$D_S = D_0 + br_D + \varepsilon^D \quad (4)$$

where ε^L is the loan demand shocks assumed to be random $\varepsilon^L \sim N(0, \sigma_L^2)$, ε^D is the savings shocks assumed to be random $\varepsilon^D \sim N(0, \sigma_D^2)$, and L_0 and D_0 are constants. This basic system can be represented in a diagram as in Figure 2. $D*$ and $L*$ are equilibrium quantities of deposits and loans, respectively. These are projected by 45^0 lines in order to obtain the level of excess liquidity. The system determines the interest rate spread and excess liquidity endogenously. Excess liquidity is determined as $E^* = D - L$ or according to the following equation:

$$E^* = (D_0 - L_0) + ar_L + br_D + \theta(\varepsilon^D - \varepsilon^L) \quad (5)$$

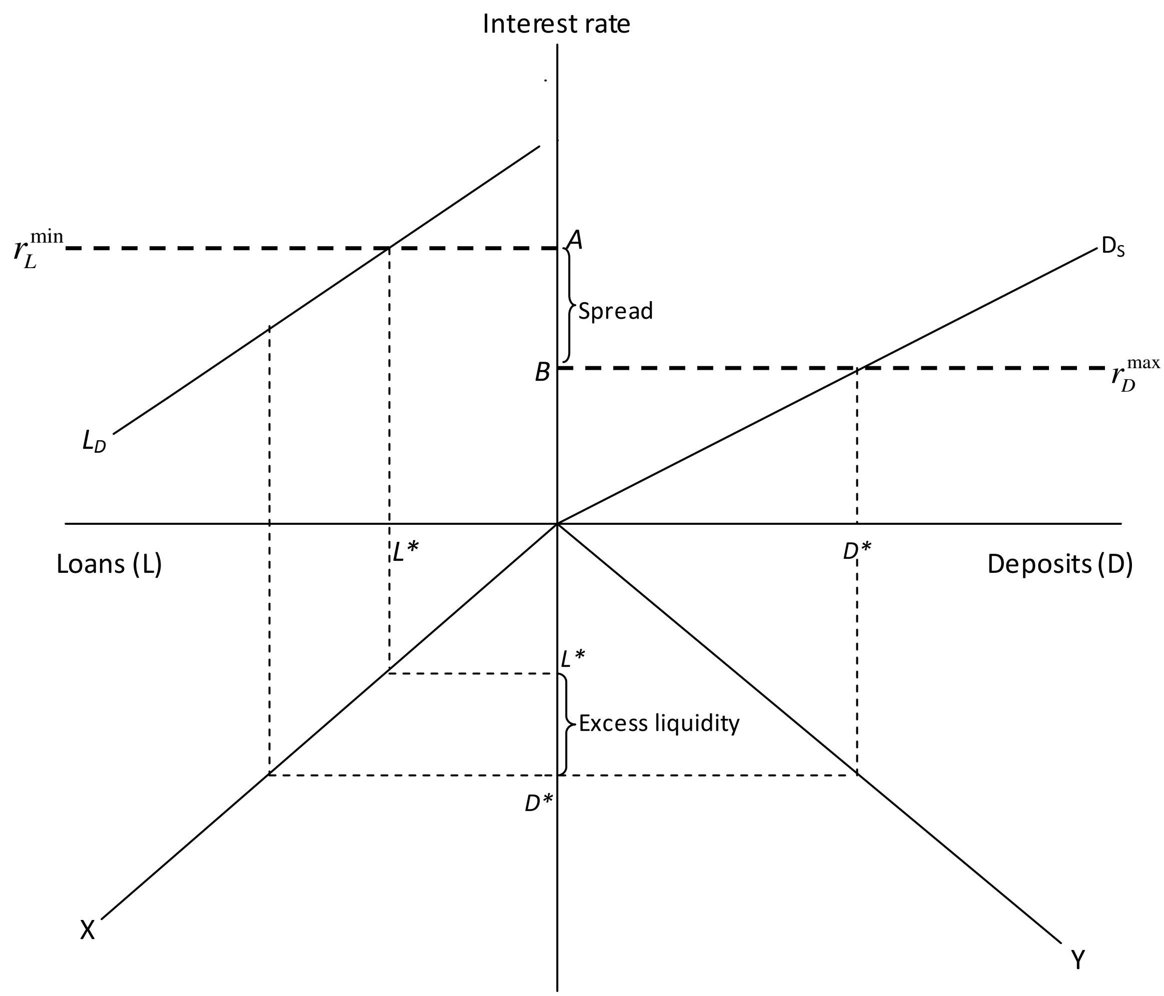
where θ measures the impact of the net shocks on excess liquidity[3].

It is obvious from the model that a positive shock to savings (outward shift in D_S) will cause an increase in excess liquidity, ceteris paribus; while a ceteris paribus positive shock in

[3] One way of estimating *E* is to solve the following minimization problem $e^2 = (E - E^*)^2$ for the four parameters *a*, *b*, $D_0 - L_0$ and θ. Where *E* is the realized excess liquidity and E^* is the structural solution above.

loan demand (outward shift in L_D) will decrease the level of excess liquidity. This fact is confirmed with the estimation of the reduced-form regression model later in the paper. However, there will be simultaneous shocks in loan demand and savings supply. A reduced-form regression will not be able to untangle the existence of a credit crunch. Therefore, a more structural approach has to be implemented whereby we must estimate the random deposit and loan shocks. However, equation (5) shows the important role the deposit and loan shocks play in the system determining liquidity. Below we outline the various types of credit crunch.

Figure 2. The Market for Loanable Funds



2.2 Identifying the Credit Crunch

The method used for identifying the credit crunch is motivated by Figure 2. The objective is to compare loan demand and deposit supply shocks. One of the other cited methods looks at estimating whether disequilibrium exists in the loanable funds market; however, our method does not require disequilibrium. The final method involves estimating an excess liquidity demand function. Figure 2 allows us to outline various scenarios pertaining to the existence or non-existence of the credit crunch.

In the case of a *strong credit crunch*, there is a positive shock to ε^L but excess liquidity rises because of a greater concomitant positive shock to ε^D. This is a sign that banks are hoarding excess liquidity at some threshold interest rate. In terms of Figure 2, the L_D curve shifts outward; the D_S curve also shifts outward but to a higher level that causes excess liquidity to rise. When there is a *weak credit crunch,* there is a positive shock to ε^L but excess liquidity falls either because of a negative shock to ε^D or the positive shock to ε^L is greater than a positive shock to ε^D. This implies the outward shift in L_D is greater than the outward shift in D_S. Finally, for the case when there is *no credit crunch*, a negative shock to ε^L indicates an inward shift in the demand for loans in spite of the nature of the deposit shocks. This implies the slowdown in credit is purely due to weakness in the demand for loans.

3. Empirical Estimation and Results

This section estimates a reduced-form regression using OLS, to measure whether the predictions of Figure 2 can be found in the actual data. It then presents graphical support to decide whether a credit crunch can account for the slowdown in credit to the private sector. Furthermore, using the method of TSLS, we estimate auxiliary regressions to obtain the results from the loan and deposit shocks. The sample comprises monthly data from January 1995 to September 2011.

3.1 Regression Estimates

The regression takes the following form:

$$E_t = \beta_0 + \beta_1 E_{t-1} + \beta_2 r_{Lt} + \beta_3 \varepsilon_t^D + \beta_4 \varepsilon_t^L + \gamma Z + \varepsilon_t \quad (6)$$

E_t, which represents excess reserves, is measured as total reserves divided by required reserves. The loan rate, r_{Lt}, is included in the empirical model because it measures the opportunity cost of holding excess liquidity. By demanding excess liquidity the banks are losing the return on lending at the said rate. The prime lending rate is used to proxy the opportunity cost variable. Z is a vector of other determinants of excess liquidity, namely volatility of demand deposits and macroeconomic volatility. These variables are used to measure the effect of uncertainty on banks' demand for excess liquidity (see Agénor et al. 2004).

Demand deposit and total deposit volatility are measured by a GARCH (1, 1) model of demand deposit, while macroeconomic uncertainty is approximated by a GARCH (1, 1) measure of the Trinidad and Tobago stock market index. From the auxiliary regressions (equations (7) and (8)), ε_t^L and ε_t^D are estimated using TSLS because of the endogenous relationship between the relevant interest rates, loans and deposits.

$$L_t = L_0 + a_0 r_{Lt} + a_1 L_{t-1} + \varepsilon_t^L \quad (7)$$

$$D_t = D_0 + b_0 r_{Dt} + b_1 D_{t-1} + \varepsilon_t^D \quad (8)$$

The following coefficient values are expected: $\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 > 0$ and $\beta_4 < 0$. The volatility measures are expected to have a positive effect on excess liquidity; therefore the vector γ includes parameters that are all positive. We estimated the auxiliary regressions with lagged dependent variables so as to make the residuals normally distributed and serially uncorrelated. These residuals are the proxy for loan and deposit shocks that are important for equation (6). Following Figure 2, the auxiliary regressions should have the following coefficient restrictions: $a_0 < 0$ and $b_0 > 0$.

Table 1 reports the regression results of equation (6). This is the final model that was obtained after a more general specification with up to four lags. The model was simplified using Wald F-tests. This model has an adjusted R^2 of 0.7 and all coefficients are statistically significant, expect the coefficient on the loan rate that turned out to be marginally significant with a p-value of 0.053. These estimates are all based on robust standard errors correcting for autocorrelation and heteroskedasticity. None of the volatility measures was found to be statistically significant, except aggregate deposit volatility. However, while this volatility measure had a low p-value – hence statistical significance – it does not reflect economic significance given the very small coefficient. The other coefficients, however, indicate economic significance and correct signs. In keeping with Figure 2, deposit supply shocks are positively related to excess liquidity, while loan demand shocks are negatively related. The loan interest rate exerts a negative influence on excess liquidity in keeping with the hypothesis that this rate reflects the opportunity costs of hoarding liquid assets.

Table 1. Results for Excess Liquidity Regression

Dependent Variable: Excess reserves
HAC Standard Errors & Covariance

Variable	Coefficient	Std. Error	T-statistics	P-value
Constant	72.1000	8.8200	8.1700	0.0000
Loan rate	-0.4760	0.2400	-1.9500	0.0530
Shock_loan	-0.0220	0.0000	-9.5600	0.0000
Shock_deposit	0.0530	0.0100	5.5800	0.0000
Volatility_deposit	0.0000	0.0000	6.8100	0.0000
Excess Reserves (-1)	0.3530	0.0800	4.4900	0.0000
Adj_R-square	0.7			

Table 2 presents the results for the two estimated auxiliary regressions. The estimated residual shocks were inserted into the second-stage estimation given in Table 1 above. The coefficient on the loan rate is statistically and economically significant with a low p-value and an estimated coefficient of -19.74. The deposit rate has a positive coefficient, 8.87, but is statistically insignificant given the p-value of 0.137. The standard errors are robust standard errors. The instruments used in each regression are reported in Table 2; they include lagged values of the variables, a seasonal dummy, and a linear time trend to reflect the trending nature of the loan and deposit series. This strategy is recommended when applying TSLS to time-series data (see Wooldridge, 2009). Furthermore, in the TSLS process, the first-stage estimates give very high F-statistic values, therefore suggesting that the existence of weak instruments is less of a problem. The very small J-statistic indicates the null hypothesis that the instruments are exogenous cannot be rejected.

Table 2. Results for Auxiliary Regressions

Dependent variable: Loans
HAC Standard Errors & Covariance
Instrument list: Constant, Loan(-1), Trend, Loan rate(-1)

Variable	Coefficient	Std. Error	T-statistics	P-value
Constant	398.3000	256.5400	1.5520	0.1220
Loan rate	-19.7400	4.5500	-4.3380	0.0000
Loan (-1)	0.9930	0.0070	141.0700	0.0000
Trend	2.1170	1.4890	1.4200	0.1570
J-statistic	0.0			
First stage F-statistic	1754.0			

Dependent Variable: Deposits
HAC Standard Errors & Covariance
Instrument list: Deposit rate(-1), Deposit(-1), Trend, Dummy12

Variable	Coefficient	Std. Error	T-statistics	P-value
Constant	-130.1000	493.4280	-0.2640	0.7920
Deposit rate	8.8700	5.7700	1.5370	0.1370
Deposit (-1)	1.0000	0.0100	100.5000	0.0000
Trend	5.6300	3.2990	1.7060	0.0900
Dummy12	591.8000	297.6000	1.9880	0.0480
J-statistic	0.0			
First stage F-statistic	890.0			

In estimating the auxiliary regressions in levels, we are faced with the conflict between econometric method and the structural relevance embedded in Figure 2. The trending nature of the loan and deposit series would suggest non-stationary time series. Figure 2 expresses the variables in levels so as to identify shocks in the level of the data. One possibility of correcting the trending data would be to difference the series. However, differencing will result in losing the essence of Figure 2. Therefore, we decided to proceed with the levels of the series. In estimating the regressions, we controlled for a time trend and incorporated a seasonal dummy variable to capture the end of year economic activities – that is dummy12. On theoretical grounds we expect the interest rate to revert to its long-term natural rate. In this case, given our small sample size, the interest rate may not fully adjust to its long-term equilibrium.

3.2 Deciphering a Credit Crunch

Although the empirical results given above show consistency between the analytical model and the data, they cannot say whether the build-up of excess liquidity reflects a credit crunch or weakness in demand for loans. This section proposes a method that looks at shocks in deposits and loans as the former are the main source of financing for loans in a bank-dominated economy in which there is virtually no money market funding of bank loans. Figure 3 shows a turning point in loans to the private sector from 2009. For the purpose of completeness we also present the level of deposits over the same period. The task of this paper is to figure out whether the flat lending reflects demand weakness or is supply-induced.

Figure 3. Loans and Deposits (2006-2011)

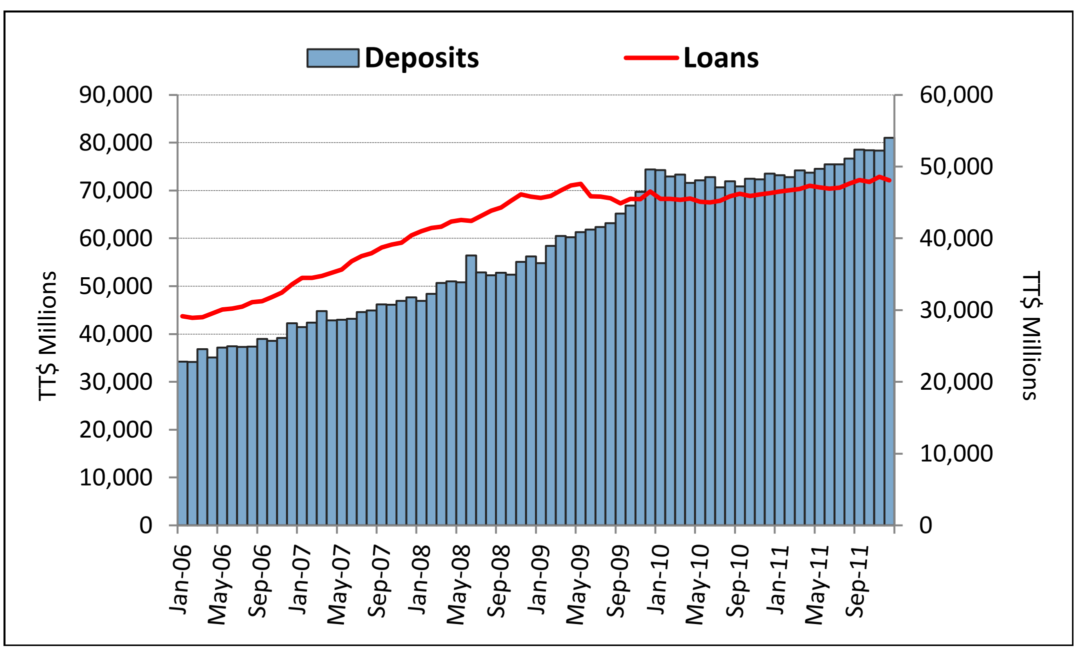
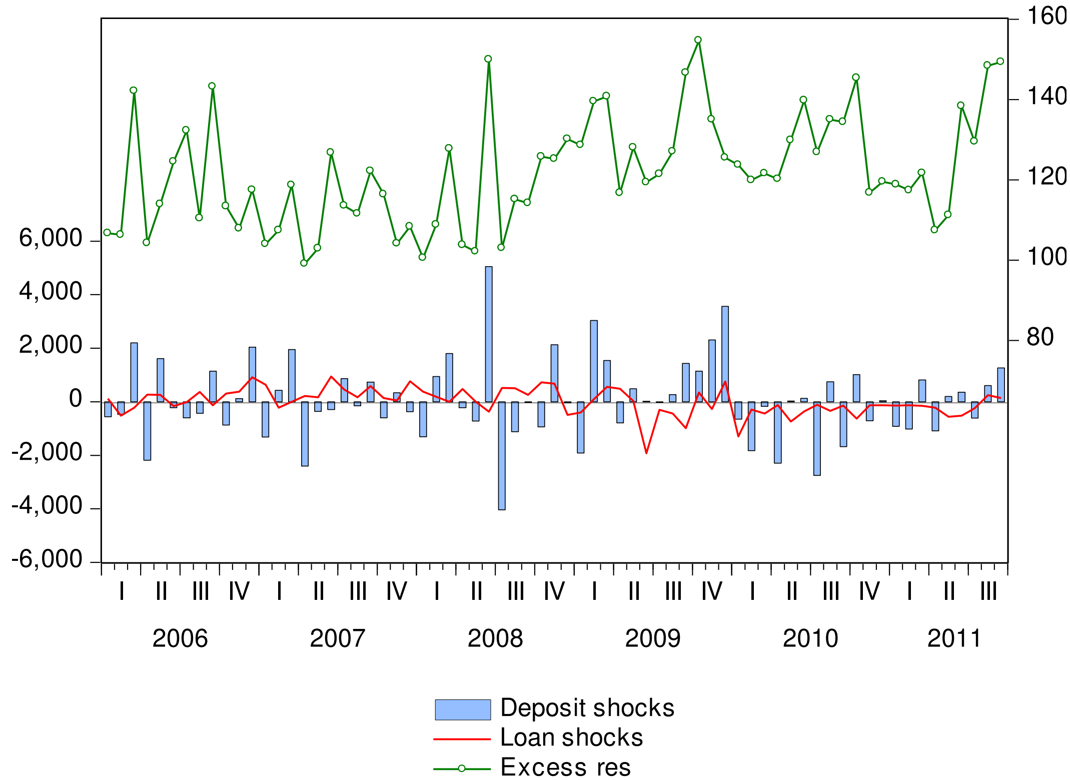


Figure 4 presents the shocks to deposits and loans (in millions of TT$) along with excess reserves, which is shown by a percentage above 100%. Given the observed facts in Figure 3, we are particularly interested in explaining the reason for the flatness in private sector loans from around mid-2009. The loan demand shocks are shown by the red line graph. Starting from mid-2009, September and December of that year saw positive demand shocks. In 2010 the loan demand shocks turned negative and persistent. While the negative demand shocks continued for 2011, there was a turnaround in August and September as the shocks turned positive. Therefore, we can conclude that the negative loan demand shocks were overwhelming as shown by the red line in the negative territory. This finding is more consistent with a demand-induced slowdown in private sector loans instead of a credit crunch. Another point to note is there was not a flat bank liquidity preference curve over the period of interest as Poghosyan (2011) found for Jordan when the credit crunch thesis held up. Instead of a flat curve it is downward sloping, thereby suggesting that banks are still willing to trade off non-remunerated excess liquidity for loans but are prevented from doing so because of the weak demand.

Figure 4. Deposit and Loan Shocks (Left-Axis) and Excess Reserves (Right -Axis)



4. Conclusion

This work presented an alternative method of identifying a credit crunch when there is a noticeable decline in loans to the private sector as occurred in Trinidad and Tobago from mid-2009. The method presented does not need to assume that the credit market is in disequilibrium nor do we need the maximum likelihood estimator to be deployed. Ordinary Least Squares (OLS) is enough to estimate the excess liquidity model (equation (6)) and Two-Stage Least Squares (TSLS) can estimate the auxiliary regressions with instruments coming from embedded trends in the data and ex post lags. The shocks or shifts in loans and deposits help us to identify whether the slowdown occurred because of a weakness in demand or a credit supply problem. The estimation strategy is based on an alternative specification of the loanable funds market in a bank dominated financial system, which has persistent excess liquidity and interest rate spread, two known features in many liberalized financial sectors of developing countries. The results from the empirical analysis suggest that the contraction in private sector loans from mid-2009 is best explained by a decline in demand for bank credit.

The technique developed in this paper can be helpful to policy makers who manage the excess liquidity on a weekly basis as part of a financial programming or reserve money program framework. If it is found that the forecast of loan demand shock is negative it makes little sense "mopping up" excess liquidity in the next period. However, the monetary authority still has to determine how elastic is the relationship between liquidity and commercial banks' demand for foreign assets (see Khemraj, 2009). Positive shocks to the demand for loans but an increase in excess liquidity would tend to signal a credit crunch and the policy response would need to be different compared with when there is weakness in the demand for bank loans.

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