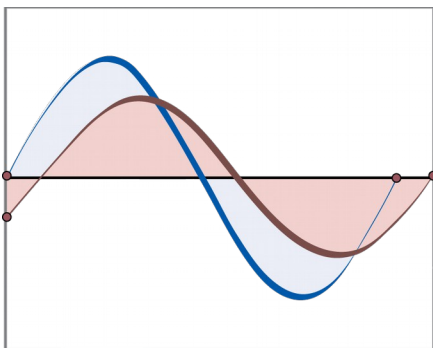


# Working Papers

WP 00/2015 July 2015

## Revisiting the Monetary Transmission Mechanism with External Shocks and High Liquidity

Stefan Edwards  
Research Department



Currently, open market operations (OMO's) and the Repo rate are the two major tools used by the Central Bank of Trinidad and Tobago in order to achieve its macroeconomic objectives. The aim of this paper is to introduce two new factors, i.e., externally driven fiscal shocks and active financial sector dynamics into the traditional monetary transmission mechanism framework to gauge their impacts on the financial system. The study uses a vector auto-regression (VAR) model in order to assess the impact of the Central Bank's management action on the subsequent agents of the monetary transmission channel. Specifically, the banking sector response to Central Bank management action through the buildup of excess liquidity and high banking spreads is assessed and taken into account. The result indicates that high banking spreads are driven by high excess liquidity, which in turn induces a financial attenuation mechanism. This financial attenuator is then posited as dampening the effect of monetary policy on the domestic economy.

JEL Classification Numbers: E42, E44, E52, E58

Keywords: Monetary Policy Transmission, SVAR, Excess Liquidity, Financial Attenuator, Open Petroleum Economy

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# Revisiting the Monetary Transmission Mechanism with External Shocks and High Liquidity

Stefan Edwards

## I. Introduction

This paper proposes to assess the degree to which monetary policy impacts the real economy subject to externally driven fiscal shocks, as well as to an active banking sector. Inherently, Central Banks in small open economies often tend to take a leadership role in buffering external economic effects. In these situations, the interest rate channel singularly may not be able to provide sufficient information about the efficacy of monetary policy. While standard monetary transmission theory dictate that the exchange rate is the main external sector variable, many small open economies often manage their exchange rates. Identifying the correct magnitude and effects of externally driven shocks therefore becomes an imperative in determining the variables that contain information about external sector conditions. In addition, since financial sector behavior management is a priority of monetary policy, assessing how the banking sector behaves in response to changes in policy adds another dimension to evaluate the effectiveness of monetary policy. The purpose of this paper is thus two-fold: Firstly, to identify the correct magnitude and effects of externally driven shocks. Secondly, to analyze Central Bank's policy action to banking spreads given that the spread is hypothesized to proxy the ability of the banking sector to dilute policy signals and are empirically related to high levels of liquidity<sup>1</sup>.

The paper is organized as follows: firstly, the seminal literature concerning studies as it relates to the monetary transmission mechanism will be reviewed, along with a general discussion regarding intersecting literature with respect to the monetary transmission mechanism in small open economies. Moreover, emphasis will be placed on the Trinidad and Tobago experience in order to account for the nature of an externalized, open petroleum economy and the dynamic nature of its financial sector. Additionally, the policy actions of the Central Bank will be represented by multiple variables representing its suite of management tools. Structural shocks will be utilized within a VAR system at different stages of the transmission sequence in order to identify where policy signals are amplified or attenuated, notably as pertains to the relationship between the Central Bank and the banking sector.

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<sup>1</sup>Khemraj (2010).

## II. Literature Review

While there has been a large body of work undertaken on monetary policy transmission stemming from groundbreaking developments in macroeconomic analysis and forecasting, there remains a relative lack of research that pertains to small, open, emerging economies. Suffice to say, the Trinidad and Tobago economy is a hydrocarbon exporter which has exhibited high levels of excess liquidity after the Financial Crisis of 2008. This section will trace the development of the seminal works of the monetary transmission discussion and make note of selected papers that describe less conventional characterizations of policy transmission, yet capture and categorize the experiences of small, open, emerging economies (including Trinidad & Tobago)..

In his seminal paper, Sims (1980) argued that using large structural frameworks were inappropriate for achieving identification i.e., where the reduced form of a model is able to derive the unique parameters of the structural model. In order to solve this problem, Sims (1980) purported a more practical approach of testing economic reasoning without a large 'burden of maintained hypotheses' usually required by large structural approaches. In this vein, the paper advocated the vector auto regression (VAR) approach, which emphasized the endogenous relationships between variables, rather than those imposed by structure. The author revealed that the methodology allowed for macroeconomic judgment hinging on a particular logical ordering when determining the effects of stabilization policy. Furthermore, exogenous relationships could be derived through causality tests to interpret the structural effects of shocks.

Bernanke and Gertler (1995) subsequently assessed the effectiveness of early generation VAR's designed to delineate the impact of monetary policy shocks and found that these models generally matched with reality. However, the paper also identified some extraneous factors associated with the magnitude, timing and composition of monetary policy (interest rate) shocks on the economy. In order to address these factors, the authors posited that the credit channel should be broken down into the balance sheet and bank lending channels in order to better discern the impacts of policy changes on the external finance premium, and its subsequent effects on these separate components of the credit channel.

Pesaran, Shin et al (2003) provided a long run modeling strategy for determining the impact of monetary policy shocks in the context of a requirement for 'transparent theoretical foundations'. The approach entailed estimating the linearized forms of the long run relationships derived from the theoretical framework, using the VAR method. An important feature of this approach was the imposition of restrictions based on the derived theoretical structure on an otherwise unrestricted approach, which provides an important strategy for testing exogenous shocks. Furthermore,

the approach also innovated upon past literature in providing an analytical framework specifically designed for small open economies which is accounted for from the stage of derivation of the long run relationships, and not simply added on as a postscript to closed economy models.

With special reference to the applications of these approaches to small open economies, Chow (2004) performed VAR analysis on the economy of Singapore, which explicitly targets exchange rates. Using the effective exchange rate as the policy variable, the author attempted to posit exchange rate shocks as policy stances of the monetary authority which allowed the examination of the responses of key macroeconomic variables to these policy shocks. Foreign variables were utilized and treated as exogenous, contextualizing domestic policy shocks relative to international shocks. The effects of policy shocks were found to be consistent with the conventional view of the monetary policy transmission mechanism. In the final analysis, the results of the model cast doubt on the role of interest rates as a reliable conduit of policy in a small, open, exchange rate managing economy.

In another study done by Catao, Laxston & Pagan (2008) the structural VAR (SVAR) approach was applied to data from Brazil in an attempt to delineate the impacts of monetary policy in a large emerging economy that targets inflation. The author revealed that there was a marked relationship between interest rates and inflation, and that the effects of a policy shock on inflation and output were much more pronounced in Brazil than in developed economies. Furthermore, the study revealed that increasing interest rates resulted in an appreciation of the exchange rate which impacted inflation as well as bank lending. This phenomenon can be explained by the fact that large volumes of foreign currency debt were held by the domestic business sector. The non-tradable sector was characterized as more bank-dependent than the tradable sector, which suggests that as demand for non-tradable goods increases (owing to the exchange rate appreciation) the demand for credit also rises. This balance-sheet style effect is seen as typical in emerging economies.

In yet another study, Chen, Huang and Wang (2009) in an attempt to account for the effects of foreign exchange interventions<sup>2</sup> on nominal policy rates employed the use of an SVAR framework to assess monetary policy transmission to extract information from a reconstruction of the overnight interbank loan rate (called the 'predicted policy rate,' for Taiwan. The results indicated that incompletely sterilized foreign exchange interventions by the Central Bank distort the effects of the policy rate through excess liquidity. Using a filtered overnight rate however, reproduces the expected policy impacts on macroeconomic variables which are omitted in the economic literature for the Taiwanese study, which uses the natural overnight rate.

Pertaining to policy transmission in Trinidad and Tobago, Watson (2003) used a vector error correction model (VECM) strategy to evaluate the efficacy of monetary policy measures in Trinidad & Tobago. The price of oil was

<sup>2</sup> Intervention in this case is regarded as purchases of foreign currency as Taiwan is subject to a conventional currency constraint.

established as the main driver of the economy, particularly concerning its effects on the exchange rate through foreign exchange accumulation facilitated by oil revenues. Monetary policy in this model is thus limited by oil prices. Watson indicated that the role of the Central Bank should be relegated to smoothing out minor oscillations and preserving environmental stability was outlined as the Central Bank's Act, but cannot 'forestall a change in macroeconomic fundamentals'.

Following the Central Bank of Trinidad and Tobago's transition from using open market operations to using the Repo rate as its primary policy tool, Boodoo and Cheong <sup>3</sup> (2010) used an unrestricted VAR strategy to test the strength of the interest rate channel of the monetary transmission mechanism, via an analysis of impulse response functions and variance decomposition. Despite the use of an unrestricted VAR, the results were placed in the context of the interest rate policy transmission channel. The study found a weak pass through relationship between policy rates and market rates, positing the presence of high excess liquidity as a damper on transmission.

**The aim of this paper is to extend the monetary transmission model based on what was utilized in Boodoo and Cheong (2010).** Using an SVAR approach, the extension of the model accommodates the inclusion of externally driven fiscal shocks and the identification of the effects of excess liquidity. The responses of the Central Bank to both external and internal developments should also be identified using policy variables conventionally outlined in transmission theory.

### III. The Model

#### III(i) Data

The model uses quarterly data spanning from June 2002 to December 2014. The following series are used in the model:

1. **NDFI**<sup>4</sup>: Quarterly average of Net Domestic Fiscal Injections.
2. **XSL**: Quarterly average of commercial bank excess reserves
3. **OMO**: Outstanding short term open market operations bills
4. **REPO**: Central bank repurchase facility rate
5. **SPREAD**: Commercial bank spread i.e., the weighted average lending rate less the weighted average deposit rate
6. **CREDIT**: End of quarter value for total credit issued
7. **CORE2**: Year-on-year core inflation rate (per quarter)

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<sup>3</sup>Both of whom worked at the Central Bank of Trinidad & Tobago at the time of the paper's publication.

<sup>4</sup>Level series shifted upward to eradicate negative values so as to facilitate log differencing.

## 8. **NEGDP**: End of quarter value for the non-energy GDP index

It should be noted that NDFI's are held exogenous in the model for two reasons. **Firstly**, net domestic fiscal injections represent the operations of the Government and reflect international commodity price levels which are externally driven. NDFI's are generated when the Government draws down on its account at the Central Bank of Trinidad & Tobago in order to facilitate expenditure. This account is credited with tax revenues, including those from the multinational energy companies operating in Trinidad. These companies pay taxes in foreign currency to the Central Bank, which in turn accumulates this foreign exchange as official reserves. In turn, the equivalent amount is credited to the Government account in local currency. As commodity prices and foreign growth generally reflect the status of medium to long term international economic conditions, the movements of the NDFI variable, driven by tax based foreign currency accumulation, are taken to relay information about the international economy. The general pro-cyclicality of fiscal policy in Trinidad and Tobago <sup>5</sup> implies that NDFI's should vary in response to these international conditions.

**Secondly**, this exogeneity of NDFI treats the Central Bank as having minimal direct effects on the spending behavior of the Government via its policy tools. This notion is important as it allows us to contextualize the actions of the Central Bank as a response to a fiscally driven buildup of excess liquidity, in addition to its more generally accepted role in managing the financial sector, inflation and the real economy. The financial sector and the non-energy economy are taken to have little or no effect on the process by which NDFI's are generated. A caveat concerning the relationship between the real economy and NDFI's however is that growth in the non-energy GDP (NEGDP) should decrease the size of the NDFI impulse, particularly through reducing the non-energy fiscal deficit (NEFD) <sup>6</sup>. The NEFD has however historically been in a deficit position, which allows the postulation concerning NDFI's in the model to hold true <sup>7</sup>. The endogenous set of variables in the model i.e., all except the NDFI's, are therefore taken to be subjected to its exogenous effects. This framework therefore invokes the theory that NDFI's capture the information necessary to consider it generally representative of the relevant external conditions that affect the economy of Trinidad & Tobago.

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<sup>5</sup>Cotton, Finch & Sookraj (2013).

<sup>6</sup>The Non-energy fiscal deficit is defined as the net of tax revenue less subsidy expenditure generated by the non-energy sector. A deficit obviously implies the non-energy sector is an absorber of subsidies rather than a generator of tax revenue.

<sup>7</sup>See Appendix B for a chart showing the trend of the Non-Energy Fiscal Deficit.

Furthermore, the analysis considers excess liquidity to be generated largely by NDFI's. In Trinidad and Tobago, payments to the public originating from the government's account at the Central Bank will emerge mainly as deposits within the banking system. This increase in deposits increases the level of prescribed liabilities in the banking system. Excess liquidity (XSL) occurs when commercial banks hold reserves in excess of the statutory requirement, which is expressed as a percentage of prescribed liabilities<sup>8</sup>. Therefore, fiscal impulses (NDFI) are taken to drive the creation of deposits in the financial sector, as the public receives payments, wages and transfers from the Government. The excess of these deposits over the reserve requirement is defined as excess liquidity<sup>9</sup>. The postulation in this model is that excess liquidity is the major implication originating from NDFI's for the rest of the economy. Open market operations (OMO) represents the level of outstanding short term Treasury bills<sup>10</sup> and directly represents the Central Bank's main liquidity management tool. One notable caveat concerning OMO's is that between late 2008 and early 2014, statutory limits on OMO's were exhausted, with movements in the variable dependent solely on space created by maturing bills. The repurchase rate (REPO) is the Central Bank policy rate and its main policy tool. Under ideal conditions it governs the overnight and short term liquidity markets, using this conduit to signal policy to the commercial banking sector. Under conditions of high excess liquidity however, short term borrowing within the financial sector has collapsed<sup>11</sup>.

The commercial bank spread (SPREAD) represents the difference between the weighted average commercial bank lending and deposit rates. This is generally taken to mean the difference between bank costs and earnings, and thus assumes that this variable is managed by commercial banks to maintain desired levels of profit. (The commercial bank spread has other dynamic implications for the economy which will be outlined subsequently). The levels of total credit (CREDIT), core inflation (CORE2) and non-energy sector GDP (NEGDP) are taken to respond to the aggregate effects of the preceding macroeconomic variables. The NEGDP variable is singularly used to measure the real economy as the tax revenues that drive NDFI's are derived from changes in the energy sector GDP. Thus including energy GDP might interfere with the exogenous setup of NDFI's in the model.

The model was estimated in log-differences for purposes of inducing stationarity and the optimal lag length of four was chosen by comparing the test statistics from the likelihood-ratio, final prediction error, Akaike information

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<sup>8</sup>The current primary reserve requirement in Trinidad and Tobago stands at 17 per cent of prescribed liabilities.

<sup>9</sup>See Appendix B for Kernel Fit charts comparing the relations between NDFI's deposits and Excess Liquidity.

<sup>10</sup>Bills up to a tenor of one year were used in the model.

<sup>11</sup>See Appendix B for chart comparing excess liquidity to repo market volumes



criterion, Schwarz information criterion and the Hannan-Quinn information criterion <sup>12</sup>. The short length of the sample series i.e., 46 points after lagging is a potential drawback particularly considering the large number of variables that were used in designing the model,. The alternative of extrapolating or interpolating quarterly data into higher frequencies however was not too feasible. The objective of the model is to obtain the impulse response functions (IRF's) to delineate the effects of liquidity shocks as well as policy shocks. In this scenario, shocks to the Repo rate are considered policy shocks. Historical decompositions were generated in order to decompose particular variables into their contributing factors.

### III(ii). Methodology

An  $m$  variable SVAR system is developed <sup>13</sup> in order to model the interactions between the Trinidad & Tobago macro-economy subject to fiscal impulses from NDFI's. In equation (1) below,  $y_t$  is an  $m \times 1$  vector,  $A_i$  through  $A_p$  are  $m \times m$  matrices,  $\mu_0$  is an  $m \times 1$  matrix of constants,  $L^i$  is the lag operator and  $\varepsilon_t$  is the vector of residuals.

$$Ay_t = \mu_0 + \sum A_i L^i y_t + \varepsilon_t \quad (i=1 \dots p) \tag{1}$$

The specification of this system assumes the economy can be described by the linear dynamic stochastic structural form in equation (2):

$$A(L)y(t) = \varepsilon(t) \tag{2}$$

In this equation,  $A(L)$  is the  $m \times m$  polynomial matrix of lag operators,  $y(t)$  is the  $m \times 1$  vector of observations, and  $\varepsilon(t)$  is the vector of serially uncorrelated structural shocks<sup>14</sup>.

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<sup>12</sup> See Appendix A for relevant output for adequacy checks concerning causality, stationarity, lag-length, autocorrelation, and model stability.

<sup>13</sup> The methodology follows mainly from Horvath & Rusnak (2008).

<sup>14</sup> That is, the variance of  $\varepsilon(t)$  can be represented as a purely diagonal matrix with the diagonal elements representing the variances of the structural disturbances. Formally, this can be represented as  $E[\varepsilon(t)\varepsilon(t)' | y(t-s), s>0] = I, E[\varepsilon(t)\varepsilon(t)' | y(t-s), s>0] = 0$

The system must be divided into separate blocks for the macroeconomic and policy variables firstly and NDFI's subsequently, if the interaction between the external conditions captured by NDFI's and the economy is to be identified. Representing the structural form in matrix notation in equation (3) we get:

$$A(L) = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{bmatrix}, y(t) = \begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix}, \varepsilon(t) = \begin{bmatrix} \varepsilon_1(t) \\ \varepsilon_2(t) \end{bmatrix} \quad (3)$$

The dimension of  $A_{ij}(L)$  is  $m_i \times m_j$  whereas the dimensions of both  $y_i(t)$  and  $\varepsilon_i(t)$  would be  $m_i \times 1$ . The model would contain  $m_1$  macroeconomy variables and  $m_2$  external variables (NDFI) in vectors  $y_1(t)$  and  $y_2(t)$  respectively. The vectors  $y_1(t)$  and  $y_2(t)$  would be of the following form:

$$\text{ENDOVector} = Y_1(t)' = (\text{XSL}_t, \text{OMO}_t, \text{REPO}_t, \text{SPREAD}_t, \text{CREDIT}_t, \text{CORE2}_t, \text{NEGDP}_t)$$

$$\text{EXOVector} = Y_2(t)' = (\text{NDFI}_t)$$

where the  $m_t$  elements represent the observed values of the variables from the domestic macroeconomy and NDFI respectively. In order to accommodate the scenario that the neither the Central Bank nor the macroeconomic variables used directly affects the evolution of the externally driven fiscal shock, we may impose the block exogeneity restriction on the structural form. From the above matrices in equation (3), the restriction would take the form of the ensuring  $A_{21}(L) = 0$ , which computes as the vector of policy and macroeconomic variables  $y_1(t)$  having no effect on  $\varepsilon_2(t)$ , the vector of structural shocks originating from NDFI's.

Estimation requires the use of a reduced form equation, of the form outlined in equation (4):

$$Y(t) = B(L)y(t-1) + u(t) \quad (4)$$

In the reduced form,  $B(L)$  is the polynomial matrix in the lag operators and  $\text{var}(u(t))=\Sigma$ . The structural innovations can be recovered by rewriting  $A(L)$  as  $A(L) = A_0 + A^0(L)$ , where  $A_0$  is the contemporaneous coefficient matrix on  $L^0$  in  $A(L)$  i.e.,  $A_0$  is the impact matrix. With this in mind,  $A^0(L)$  can be defined simply as the coefficient matrix in  $A(L)$ , without the contemporaneous coefficient  $A_0$ . The structural equation can thus be re-cast as  $y(t)[A_0 + A^0(L)] = \varepsilon(t)$ . Premultiplying throughout by  $A_0^{-1}$  and rearranging gives us a structural representation of  $y(t) = -A_0^{-1}A^0(L)y(t) + A_0^{-1}\varepsilon(t)$ . The analog between the reduced form residuals and the structural shocks can be therefore denoted as  $u(t) = A_0^{-1}\varepsilon(t)$ .

Identifying responses to structural shocks may be problematic as there are less parameters to be estimated in the reduced form than the structural form. In order to identify the responses to the structural shocks, a necessary condition is imposing restrictions numbering  $m(m-1)/2$  on the matrix of coefficients that contains  $m(m+1)/2$  restrictable elements. Imposing any more than  $m(m-1)/2$  restrictions results in overidentification, which complicates the interpretation of responses<sup>15</sup>. The following Choleski factorisation of  $A_0^{-1}$ , i.e., imposing a lower triangular structure on the the inverted matrix of coefficients allows this requirement to be satisfied. The recursive scheme can therefore be generalised as follows in equation 5:

$$\begin{matrix} u_t^1 \\ u_t^2 \\ u_t^3 \\ u_t^4 \\ u_t^5 \\ u_t^6 \\ u_t^7 \\ u_t^8 \end{matrix} = A_0^{-1} \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{31} & \alpha_{32} & 1 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & 1 & 0 & 0 & 0 & 0 \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & 1 & 0 & 0 & 0 \\ \alpha_{61} & \alpha_{62} & \alpha_{63} & \alpha_{64} & \alpha_{65} & 1 & 0 & 0 \\ \alpha_{71} & \alpha_{72} & \alpha_{73} & \alpha_{74} & \alpha_{75} & \alpha_{76} & 1 & 0 \\ \alpha_{81} & \alpha_{82} & \alpha_{83} & \alpha_{84} & \alpha_{85} & \alpha_{86} & \alpha_{87} & 1 \end{bmatrix} \cdot \varepsilon_t \begin{bmatrix} NDFI_t \\ XSL_t \\ OMO_t \\ REPO_t \\ SPREAD_t \\ CREDIT_t \\ CORE2_t \\ NEGDP_t \end{bmatrix} \tag{5}$$

Block exogeneity conditions would be satisfied as long as the vector of shocks places NDFI at the head of the order i.e., at the top of the column, followed by the other endogenous macroeconomic and policy variables subsequently. The ordering of the endogenous variables was determined by their expected directions of impact, as well as, the accounting conventions determining the flow of funds. The implication of this approach is that the positions of the  $\alpha_{ij}$  coefficients in  $A_0^{-1}$  above can be altered in order to change the impact of the shocks in the vector  $\varepsilon(t)$  on the residuals in vector  $u(t)$ . This can be useful as the Choleski decomposition is often restrictive owing to its non-theoretical nature. Closer application of economic theory on the model can therefore occur through manipulation of the elements of the

<sup>15</sup>As noted in Canova (2012), which compares the results of over-identified and just-identified VAR models.

impact matrix, within the bounds of being 'just-identified'. This may be considered more appealing concerning identification than the Choleski recursion scheme for small open economies are often idiosyncratic, rather than conventional. Seeking identification in this manner particularly for large systems however, can be tedious, and a simple exogenisation of external variables faced by small open economies can serve as an adequate framework for identification within the Choleski schematic <sup>16</sup>. In general, this notion serves as part of the rationale for treating NDFI as exogenous in the model, as it is taken to reflect external sector information. In the present case, the Choleski recursion scheme is sufficient to satisfy the need for identification.

#### **IV. Results**

##### **IV(i). Response of the Economy to a Liquidity Shock**

The cumulative IRF's are presented in order to observe the net effects of the shocks on the respective variable over the time horizon. Figure 1 displays the responses of the model's policy and macroeconomic variables to a standard deviation shock in excess liquidity. Firstly we recall that we hold NDFI's exogenous to the rest of the model, but that these fiscal impulses drive the buildup of bank deposits, and subsequently, excess liquidity. The response of OMO bills remains stagnant in the early periods of response then decreases over the time horizon relative to the excess liquidity shock. This represents the effect of the statutory limits on the variable. A similar effect can be said to be observed on the Repo rate as it declines over the time horizon.

The liquidity shock however, leads to an increase in the commercial bank spread. This effect is of potential importance as the positive profile of the IRF of the banking spread implies there is some difference in the reactions of the deposit and lending rates to the liquidity shock. Driven by the creation of bank deposits stemming from fiscal impulses, this positive shock to excess liquidity leads to an increase in the banking spread which is driven mainly by decreasing deposit rates, i.e., loan rates decrease more slowly than deposit rates. The implication of this phenomenon is that the cost of credit does not decrease proportionally to the return on deposits over the time horizon. The bank lending channel of monetary policy transmission postulates the necessity for policy rates to have an effect on the interest rates of bank liabilities (deposits) for this channel to be considered robust in influencing the supply of credit, indicating that expansionary monetary policy should increase credit <sup>17</sup>. A decreasing Repo rate as observed in response to the liquidity shock, should lead to an increase in the credit supply. However, an increase in excess liquidity implies an increasing money supply, which in turn can potentially increase credit supply, sending

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<sup>16</sup>Cushman and Zha (1997)

<sup>17</sup>Mishkin, (1995)

deposit rates downwards. The direction of the response of credit to both policy rates and liquidity should therefore be expansionary in the present theoretical context. The response of credit to a positive excess liquidity shock, as well as a decreasing Repo rate in this scenario is however negative, and must be contextualized.

#### **IV(ii). The Financial Attenuator**

The response functions for credit, core inflation and non-energy GDP in relation to an excess liquidity shock, all register seemingly permanent decreases over the time horizon. In the previous section, it was revealed that the profile of the excess liquidity shock, and the subsequent response of the Repo rate observed in this model, should result in increased credit. What then accounts for the negative response of credit? The downshift of credit in response to a liquidity shock can be at least partly understood as a result of an increasing external finance premium (EFP.) The EFP is generally understood within the context of responses of market interest rates to policy rate shifts, and can be essentially be defined as the differential between the costs of utilizing external sources of finance versus internal sources of finance<sup>18</sup>. An increasing EFP represents a divergence in the expected returns of lenders and costs of borrowers, which can distort the effect that a lower policy rate<sup>19</sup> should have on credit in the economy. Changes in policy rates are generally taken to affect the EFP in the same direction as the movement of said policy rates. For example, a lower Repo rate should lower the EFP by allowing the differential between the costs of internal and external finance to decrease, hence stimulating the economy's appetite for credit. These changes should have an effect on the borrowers balance sheet i.e., through net worth, cash flow and liquid assets and implies that the balance sheet value of the firm and the external finance premium are inversely related.

This notion is the essential description of a financial accelerator<sup>20</sup> and has implications for the analysis in this paper. In this case, the fiscally driven shock to excess liquidity has been shown to also affect the balance sheets of potential borrowers, particularly by providing them with increased assets in the form of the liquidity-creating deposits they hold at commercial banks. In addition to these increased deposits, increasing the net worth of the private sector, we recall the previous postulation as to how the banking spread simultaneously originates through the lowering of deposit rates owing to this increased deposit availability. The implication here is that an increased banking spread portrays different adjustment elasticities in lending and deposit rates in response to the liquidity shock. In the case of Trinidad and

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18<sup>l</sup> Bernanke & Gertler (1995)

19<sup>l</sup> In this case, the Repo rate, but can be applied to other expansionary shocks.

20<sup>l</sup> Bernanke, Gertler and Gilchrist (1996), who derive the EFP as a result of generalising the lender-borrower relationship into a macroeconomic model. In this paper, it is simply assumed that the spread is evidence of an EFP, given the only semi-theoretical nature of this model.

Tobago therefore, it can be interpreted that the increase in the balance sheet value of the private sector through increased deposits, **increases** the external finance premium via increasing the banking spread. If we subsequently interpret the lending rate as the cost of utilizing external finance and the deposit rate as the *opportunity cost* of utilizing internal funds, we can understand the increased banking spread as a proxy to the EFP.

As proxy to the EFP, the increased spread therefore represents a divergence in the expected returns of lenders and costs faced by potential borrowers. This divergence can have the effect of decreasing financial intermediation as firms are more inclined to limit financing new investment activity to what is available on the firms balance sheet i.e. through retained earnings, or simply to abandon investment activity altogether <sup>21</sup>. This can ultimately result in lowered credit demand. The downward movement of the Repo rate's response function can then be explained as an action to stave off losses from this negative shock to economic activity originating from the attenuator. The culmination of these effects implies that the excess liquidity shock drives an increased banking spread, revealing an increased external finance premium resulting in lower financial intermediation. Ultimately, this translates into the observed negative effect on credit, and contributes to the subsequent negative effects of liquidity on inflation and growth. **The increased spread can therefore be said to induce a financial attenuator effect through an EFP that moves in a countercyclical fashion to the policy rate, dampening its effect on the economy<sup>22</sup>.**

### Figure 1

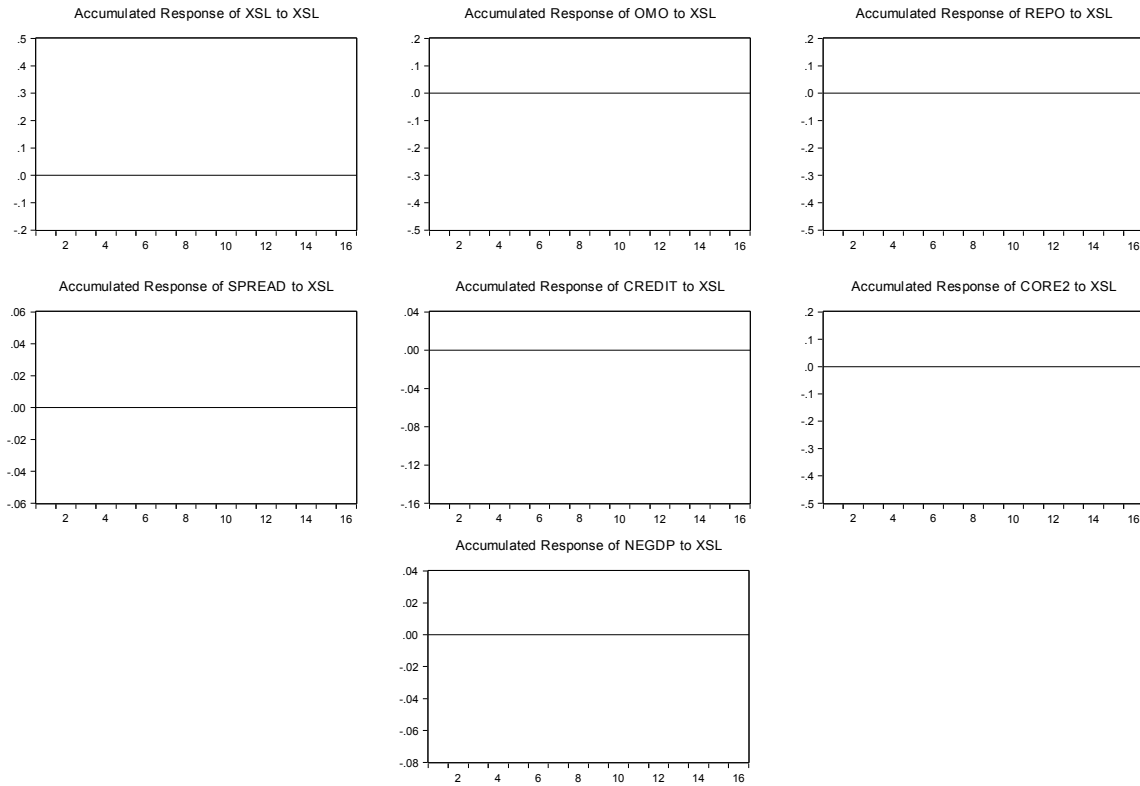
#### Responses to a shock to Excess Liquidity

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<sup>21</sup>Goh & Tan (2007). This mirrors the idea of an investment demand constraint.

<sup>22</sup>This is a similar attenuation effect to what is described in Aslam and Santoro, (2008), though they use a highly structural approach to outline what they call the 'endogenous steady state spread generated between lending and borrowing rates'.

Accumulated Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



Source: E-views 7 generated output.

### IV(iii). Policy Shock

This section presents the responses of the economy to a shock in the main policy tool of the Central Bank.

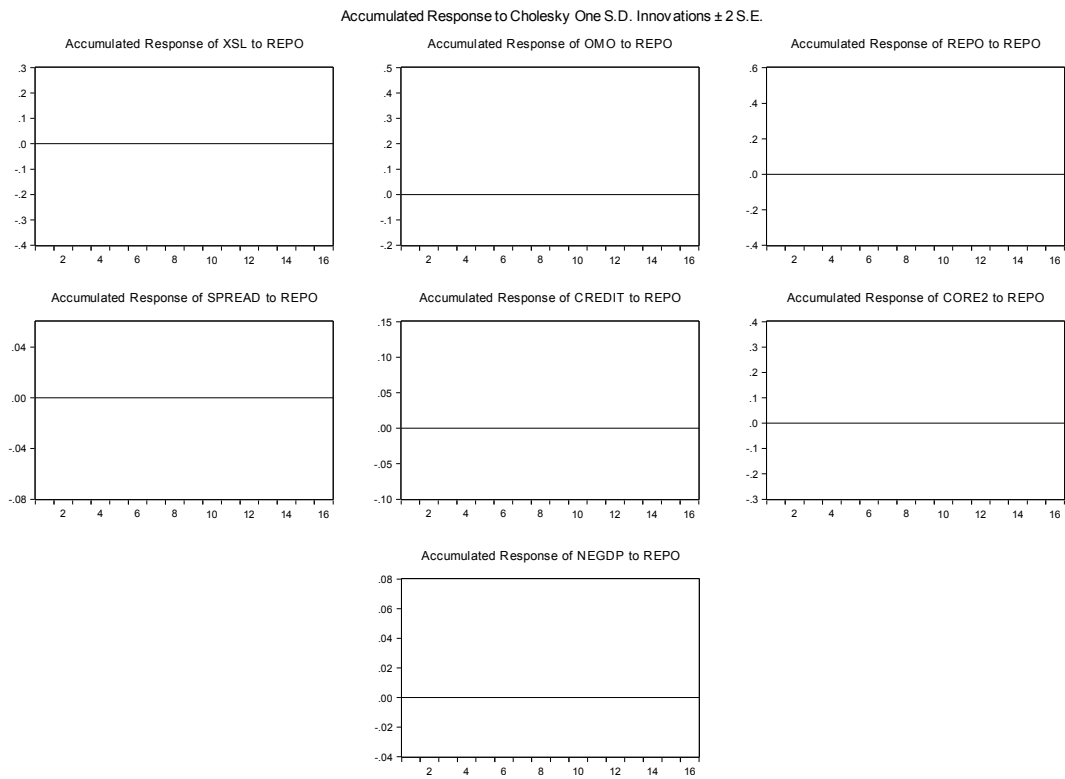
#### a) Repo Rate Shock

In the scenario of Figure 2, a one standard deviation shock in the Repo rate is delivered to the rest of the economy, resulting in a permanent leveling up of the Repo rate. Outstanding open market operations follow a similar path after the third quarter, which can be interpreted as a change in the level of the management tool as part of a phase of generally tightening policy by the Central Bank. Additionally, increased demand for short term bills by the financial sector may result from an environment of increasing interest rates. Holders of short term bills have more of an incentive to switch to higher interest bills as long as interest rates keep increasing in order to mitigate interest rate risk, thus driving demand for OMO's. The effect of an increase in outstanding OMO's is reflected by a corresponding downshift in the response function of excess liquidity over the time horizon. The response of the banking spread to the Repo shock therefore becomes negative, implying that decreasing liquidity raises the opportunity cost of agents

utilising internal funds for investment activity, thus reducing the external finance premium <sup>23</sup>. The effects of the reduction of the EFP become evident in the response of credit to a shock in the Repo rate from the fifth quarter onwards. The lowered EFP also results in generally positive responses in inflation and growth to a Repo shock over the time horizon.

**Figure 2**

**Responses to a shock to the Repo Rate**



Source: E-views 7 generated output.

**IV(iv). Historical Decomposition**

<sup>23</sup>The assumption here is of course that lowered liquidity encourages banks to increase deposit rates to attract capital.



In this section the historical decomposition of the banking spread is investigated. This is undertaken to determine which variables drive it, given its critical function in the model as the manifestation of a financial attenuator. The historical decomposition is similar to the forecast error variance decomposition in that it allows the variables of the system to be decomposed as weighted sums of the system's structural shocks<sup>24</sup>. Historical decompositions also produce a forecast<sup>25</sup> of the endogenous variable being decomposed. They express the endogenous variable as a sum of the forecast plus the structural shocks. This characteristic enables the investigation of the effects these shocks have on any particular variable in the decomposition over the time horizon of the model. A four period moving average of the structural shocks as well as the banking spread is presented in order to show the fundamental movements in the shocks versus the spread. It is acceptable to present the shocks in this manner as it mitigates the impacts of starting values, which may be large even for stationary series<sup>26</sup>. The shocks that were observed to be important to the spread were excess liquidity, open market operations, credit and the autonomous shock from the spread itself. Figure 3 shows that these combined shocks account for much of the variation in the endogenous spread<sup>27</sup>.

**Figure 3**

**Decomposition of Endogenous Spread relative to Combined Structural Shocks**

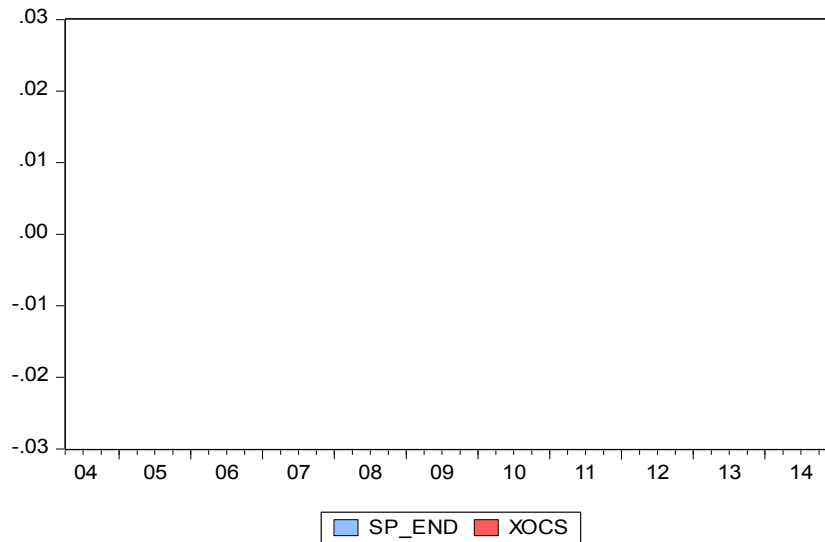
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24<sup>l</sup>Dungey & Fry (2007)

25<sup>l</sup>See Appendix 2 for a comparison of the endogenous spread and its forecast

26<sup>l</sup>Lutkehpoh (2011).

27<sup>l</sup>The XOCS variable represents the sum of structural shocks from excess liquidity, open market operations, credit, and autonomous shocks from the spread. See Appendix 2 for individual XOSC shocks to the spread.

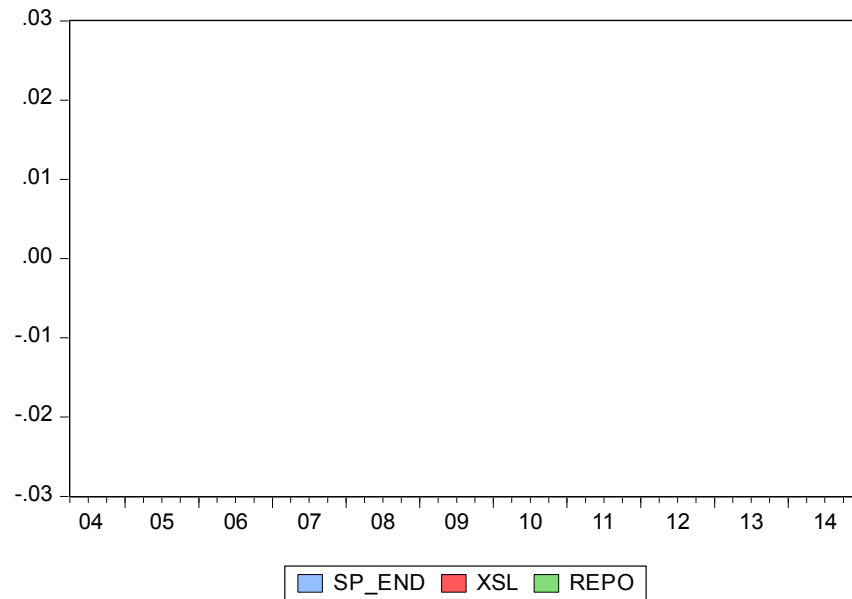


Source: E-views 7 generated output.

Of interest to the analysis however is the relationship of the banking spread to excess liquidity as well as the Repo rate. The levels of influence these respective shocks exert upon the spread can yield further information about the existence of a financial attenuator within the setup of this model. The EFP and financial attenuator mechanisms derived from the impulse response functions in above sections depend on **the notion that the spread is driven more by excess liquidity than the Repo rate.** Figure 4 compares the evolution of the endogenous spread to shocks from the Repo and excess liquidity. Notably, the period between 2008 and 2010, where both the spread and the excess liquidity shocks increase dramatically, corresponds with the first major accommodative moves by the Central Bank in response to the onset of the Financial Crisis via decreasing the Repo rate by 500 basis points between September 2008 and December 2010. Given the way the financial attenuator is developed as a consequence of deposit driven excess liquidity which increases the spread, it becomes clear that structural shocks from excess liquidity account for much more historical variation in the spread than do structural shocks from the Repo rate, particularly in the post-2008 era. We can indeed conclude that the historical shocks tell us that the fiscally driven buildup of excess liquidity concurrent with an increasing banking spread was the major driver of the financial attenuator over the reference period.

**Figure 4**

**Decomposition of Endogenous Spread relative to Excess Liquidity and the Repo Rate**



Source: E-views 7 generated output.

## V. Conclusion and Recommendations

**The paper attempted to delineate the nature of monetary policy transmission subject to fiscal shocks driven by external sector conditions. The Central Bank of Trinidad and Tobago was characterized in the model as one that attempts to manage the financial sector and real economy in the context of these externally driven fiscal shocks.** The variable NDFI was also assumed to contain information about the external conditions affecting the macro-economy as it is driven generally by repatriation to the Government of the local currency value of foreign currency tax payments originating from transnational energy companies. Additionally, the foreign currency tax payments are accumulated by the Central Bank as reserves. NDFI's therefore are exogenised in the model to capture the unilateral direction of impact of external conditions on the domestic economy of Trinidad and Tobago. Excess liquidity was characterized as the direct consequence of these fiscally driven external shocks, and postulated as having effects that the Central Bank tries to manage. The results of the model adequately describe a financial attenuation process underpinned by a fiscally driven liquidity buildup in Trinidad and Tobago between 2002 and 2014. The main tool of the Central Bank, the Repo rate, has been shown to be subject to excess liquidity in affecting the banking spread, which represents this attenuation since about the year 2008. **The implication is that government spending has driven a wedge between monetary policy and the rest of the economy.**

Future work should aim to validate or invalidate whether or not this model structure holds for different economic conditions, which are not necessarily bound to be defined by conditions that engender financial attenuation. Additionally, the strength of the relationships derived in the paper must be properly contextualized in future work,

even if the model is at least adequate in revealing them. More true open economy variables such as the exchange rate or various elements of the balance of payments could be utilized to more resolutely identify the channels via which international shocks transmit to the domestic economy, as well as the way in which the Central Bank must respond to them.

The main implication for monetary policy comes from the scenario of the Repo rate shock in which the commercial bank spread is brought down by a combination of increasing the level of policy rates, as well as the level of outstanding open market operations which causes a seemingly permanent downshift in the levels of excess liquidity. This scenario closely resembles the approach that the Central Bank of Trinidad and Tobago has adopted since 2014. In April 2014, increased statutory limits on the levels of Treasury Bills and Treasury Notes geared toward liquidity management began to be deployed as OMO's by the Central Bank. Additionally, in September 2014, the Bank started withdrawing from the accommodative policy position it adopted after the Financial Crisis by beginning a round of Repo rate increases that continued into 2015. **Future work could also focus on using the modeling framework to determine whether this policy course was successful or not.** Finally, the paper presents a scenario which postulates that indirect monetary management tools can be relied upon by a Central Bank in a small open economy to manage the issue of financial attenuation arising from excess liquidity generated by fiscal impulses. The scenario also shows that the use of these tools is consistent with the eventual improvement of macroeconomic performance.

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## Appendix A - Adequacy Checks

**Table A1**  
**Unit Root Tests**

Group unit root test: Summary				
Series: NDFI, XSL, OMO, REPO, SPREAD, CREDIT, CORE2, NEGDP				
Date: 07/06/15 Time: 11:09				
Sample: 2002Q3 2014Q4				
Exogenous variables: Individual effects				
Automatic selection of maximum lags				
Automatic lag length selection based on SIC: 0 to 5				
Newey-West automatic bandwidth selection and Bartlett kernel				
Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.48384	0.0000	8	380
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-12.9025	0.0000	8	380
ADF - Fisher Chi-square	169.510	0.0000	8	380
PP - Fisher Chi-square	181.826	0.0000	8	392
** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.				
Source: E-views 7 generated output.				

**Table A2**  
**Autocorrelation Tests**

VAR Residual Serial Correlation LM Tests		
Null Hypothesis: no serial correlation at lag order h		
Date: 07/06/15 Time: 11:10		
Sample: 2002Q3 2014Q4		
Included observations: 46		
Lags	LM-Stat	Prob
1	46.13417	0.5900
2	85.63139	0.0009
3	47.10654	0.5502
4	50.83230	0.4013
Probs from chi-square with 49 df.		

Source: E-views 7 generated output.

**Table A3**  
**Lag Order Criteria**

VAR Lag Order Selection Criteria						
Endogenous variables: XSL OMO REPO SPREAD CREDIT CORE2 NEGDP						
Exogenous variables: C NDFI						
Date: 07/06/15 Time: 11:11						
Sample: 2002Q3 2014Q4						
Included observations: 46						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	636.5478	NA	4.15e-21	-27.06730	-26.51075*	-26.85881*
1	686.3984	80.19441*	4.14e-21	-27.10428	-24.59984	-26.16610
2	729.2078	55.83826	6.46e-21	-26.83512	-22.38278	-25.16724
3	791.9280	62.72020	5.74e-21	-27.43165	-21.03141	-25.03408
4	886.1874	65.57179	2.38e-21*	-29.39945*	-21.05131	-26.27219
* indicates lag order selected by the criterion						

Source: E-views 7 generated output.

**Table A4**  
**Causality Tests**

VAR Granger Causality/Block Exogeneity Wald Tests  
Date: 07/06/15 Time: 11:13



Sample: 2002Q3 2014Q4  
 Included observations: 46

Dependent variable: XSL

Excluded	Chi-sq	df	Prob.
OMO	1.021092	4	0.9066
REPO	4.132186	4	0.3884
SPREAD	3.811164	4	0.4322
CREDIT	2.629629	4	0.6216
CORE2	2.352472	4	0.6712
NEGDP	2.295855	4	0.6815
All	20.80228	24	0.6504

Dependent variable: OMO

Excluded	Chi-sq	df	Prob.
XSL	3.825775	4	0.4301
REPO	8.985264	4	0.0615
SPREAD	8.041667	4	0.0901
CREDIT	1.597270	4	0.8093
CORE2	4.487541	4	0.3440
NEGDP	3.679578	4	0.4511
All	30.93344	24	0.1557

Dependent variable: REPO

Excluded	Chi-sq	df	Prob.
XSL	6.154120	4	0.1879
OMO	8.638516	4	0.0708
SPREAD	4.702911	4	0.3192
CREDIT	3.405991	4	0.4923
CORE2	4.793780	4	0.3091
NEGDP	4.690397	4	0.3206
All	39.52910	24	0.0240

Dependent variable: SPREAD

Excluded	Chi-sq	df	Prob.
XSL	11.19130	4	0.0245
OMO	8.359449	4	0.0793
REPO	3.939188	4	0.4143
CREDIT	11.57306	4	0.0208
CORE2	2.246181	4	0.6906
NEGDP	1.263840	4	0.8675

All	44.91861	24	0.0060
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Dependent variable: CREDIT

Excluded	Chi-sq	df	Prob.
XSL	1.891887	4	0.7556
OMO	1.693802	4	0.7918
REPO	0.300457	4	0.9898
SPREAD	1.111852	4	0.8924
CORE2	1.194855	4	0.8789
NEGDP	4.638191	4	0.3265
All	19.61106	24	0.7187

Dependent variable: CORE2

Excluded	Chi-sq	df	Prob.
XSL	1.317823	4	0.8583
OMO	1.990035	4	0.7376
REPO	4.220178	4	0.3770
SPREAD	2.560213	4	0.6339
CREDIT	3.205274	4	0.5241
NEGDP	2.769076	4	0.5972
All	15.92049	24	0.8909

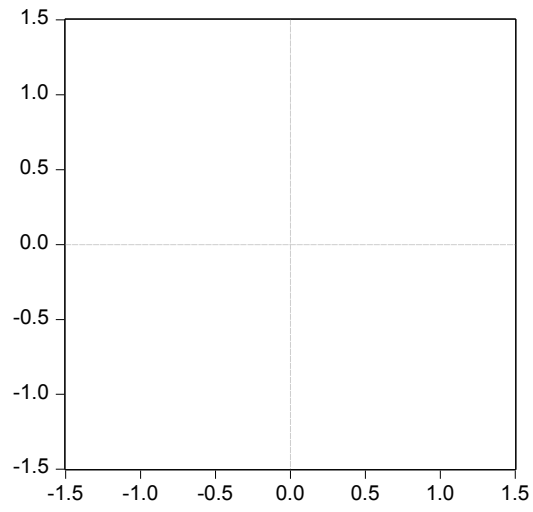
Dependent variable: NEGDP

Excluded	Chi-sq	df	Prob.
XSL	7.050079	4	0.1333
OMO	11.91725	4	0.0180
REPO	12.79427	4	0.0123
SPREAD	8.870816	4	0.0644
CREDIT	5.583919	4	0.2325
CORE2	6.020372	4	0.1976
All	26.77028	24	0.3153

Source: E-views 7 generated output.

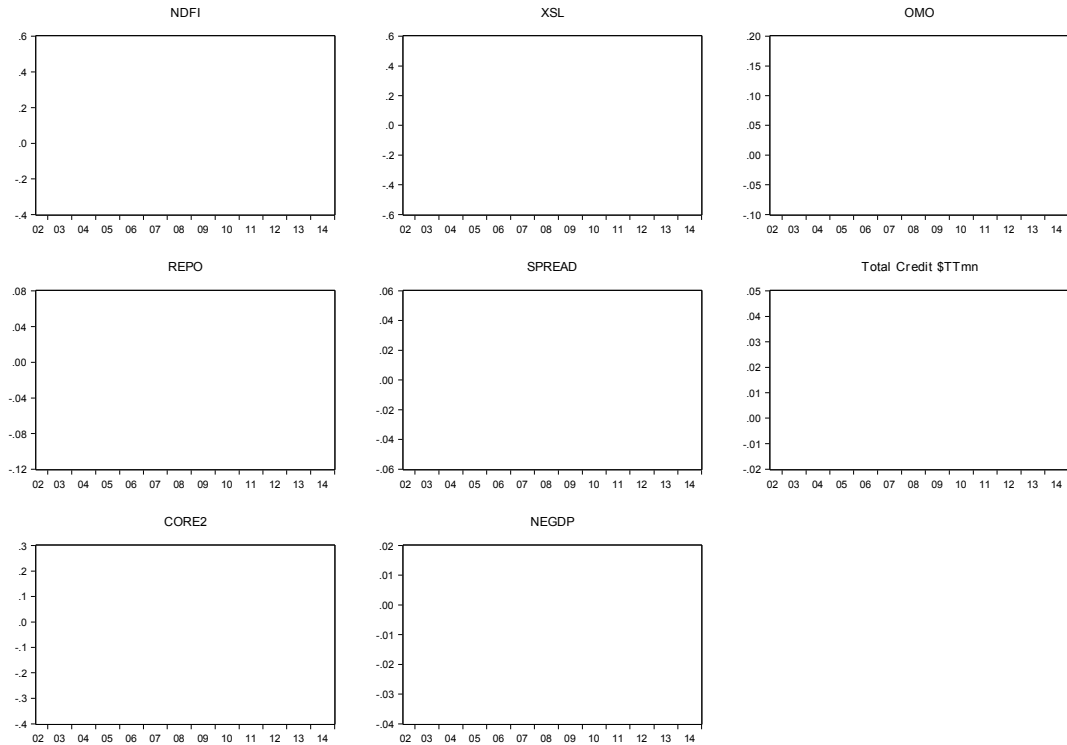
**Figure A1**  
**Stability Tests**

Inverse Roots of AR Characteristic Polynomial



Source: E-views 7 generated output.

**Figure A2**  
**List of Endogenous Variables**

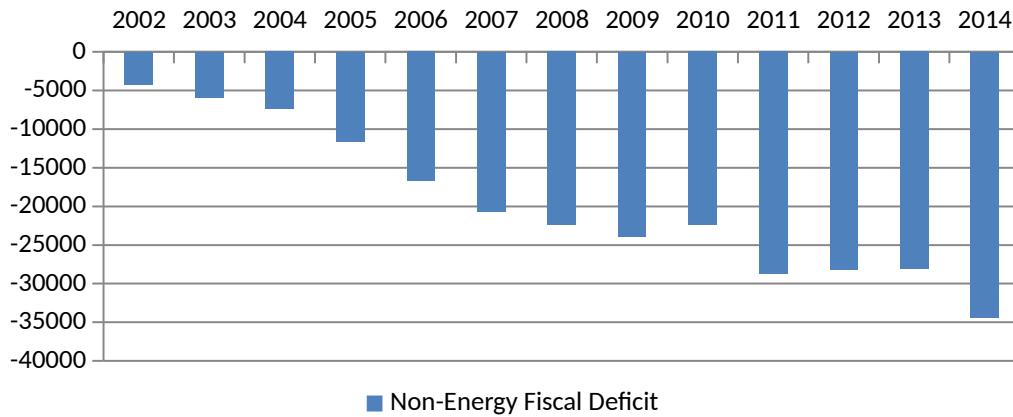


Source: E-views 7 generated output.

### Appendix B

**Figure B1**  
Non-Energy Fiscal Deficit (TT\$m)

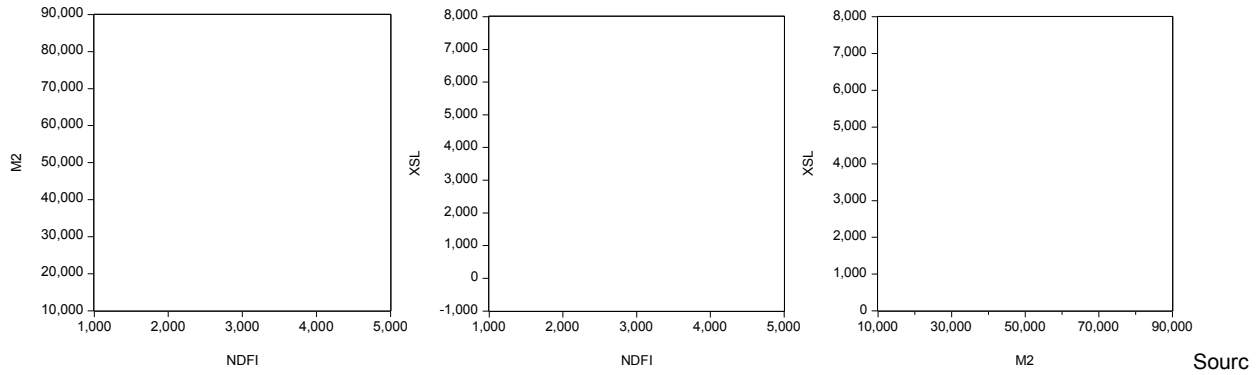
## Non-Energy Fiscal Deficit



Source: Central Bank of Trinidad & Tobago

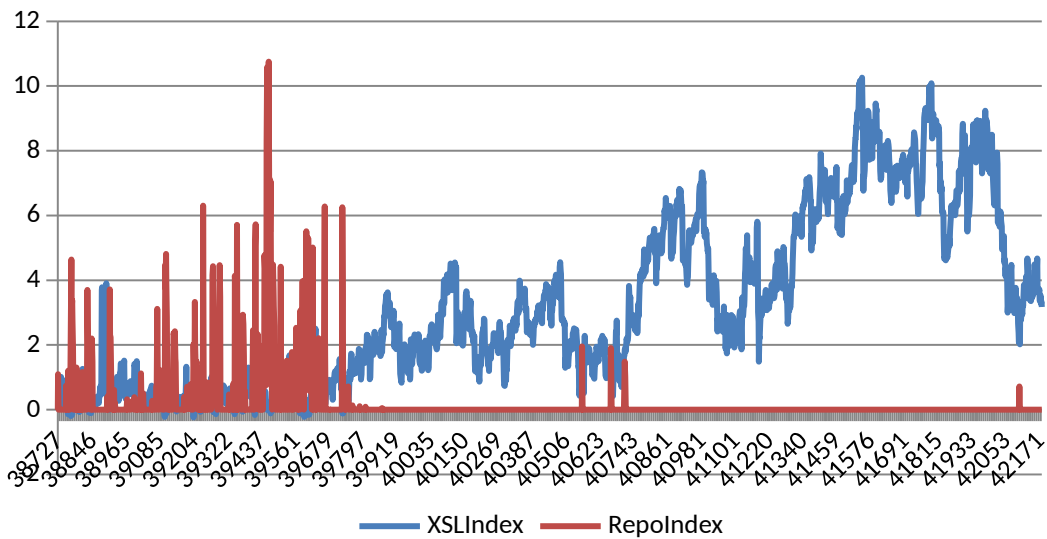
**Figure B2**

**Kernel Fits of NDFI, M2 measure of money supply (as proxy to prescribed liabilities) and excess liquidity**



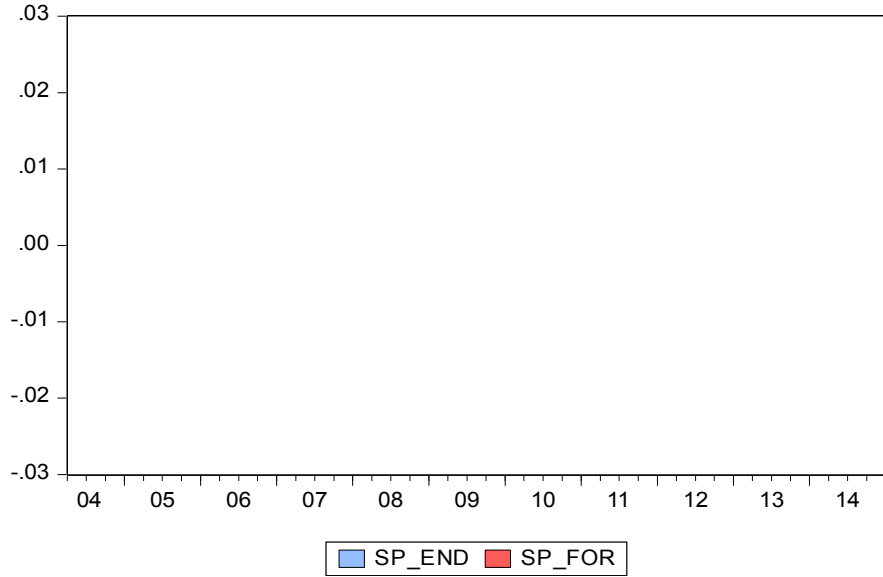
e: E-views 7 generated output.

**Figure B3**  
**Repo Market and Interbank Market Index Volumes, 2002-2015**



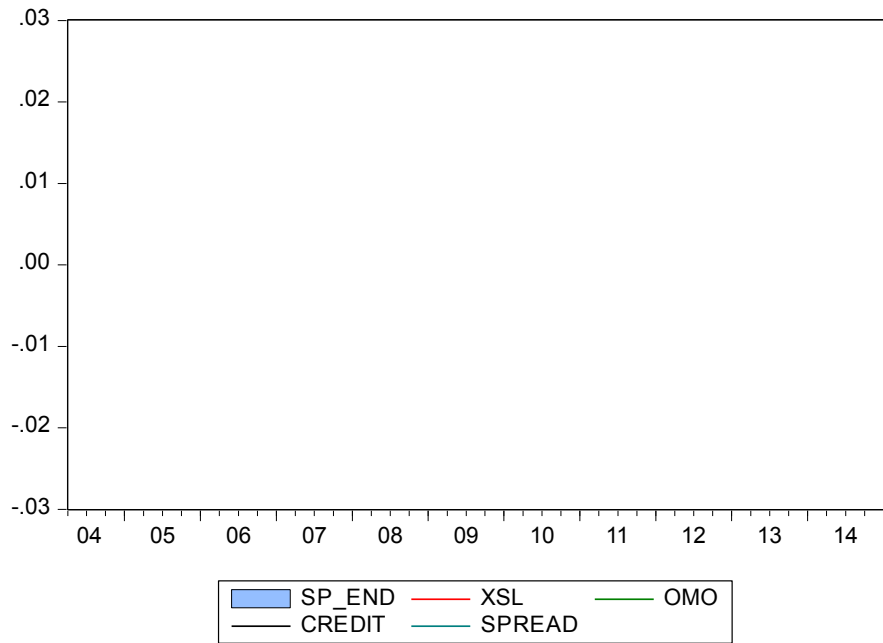
Source: Central Bank of Trinidad and Tobago

**Figure B4**  
**Historical Decomposition of the Spread and its Forecast**



Source: E-views 7 generated output.

**Figure B5**  
**Individual Shocks to the Spread**



Source: E-views 7 generated output.