EVALUATING MONETARY POLICY MEASURES IN A SMALL PRIMARY-EXPORTING ECONOMY[1]

THE CASE OF TRINIDAD & TOBAGO

by

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ABSTRACT

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In this paper, an attempt is made to determine whether and to what extent monetary policy impacts the real sector in Trinidad & Tobago given the great dependence of the latter on oil. Two potential instruments of monetary policy - the Required Reserves Ratio and the rate on Treasury Bills - are considered and only the Treasury Bill Rate is established as a true policy instrument. The exchange rate is established as the most important transmission mechanism of monetary policy to the real sector.

The principal methodological tool used is a quarterly VAR model applied to quarterly data spanning the period 1971-1998 and incorporating a deterministic/exogenous component to account for peculiarities of the monetary policy history of Trinidad & Tobago as well as the price of oil. The extent of the impact of monetary policy measures on real activity is measured through Pesaran and Shin's generalised impulse response function and the nature of the transmission mechanism through the corresponding generalised forecast error decomposition.

Keywords: monetary policy, VAR modelling, impulse responses, transmission mechanism.

JEL Classification: C51, E52

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L'évaluation de la politique monétaire dans une petite économie exportatrice de produits primaires:

le cas de Trinidad & Tobago

Cet article tente de déterminer si, compte tenu de sa dépendence du secteur pétrolier, la politique monétaire à Trinidad & Tobago influe sur l'activité de son secteur réel et, si oui, jusqu'à quel point. Sont identifiés deux instruments possibles de la politique monétaire, soient le taux des réserves obligatoirement détenues par la Banque Centrale et le taux d'intérêt sur les bons de trésor à court terme. Seul ce dernier se révèle comme étant un véritable instrument de la politique monétaire. Le taux de change se révèle comme le moyen de la transmission monétaire le plus important.

Un modèle VAR, appliqué aux données trimestrielles allant de 1971 à 1998, est utilize. Celui-ci incorpore des variables déterministes/exogènes introduites pour capter l'histoire de la politique monétaire ainsi que le prix du pétrole. L'impact de la politique monétaire se mesure à travers la fonction d'impulsion généralisée de Pesaran et Shin alors que la nature du mécanisme de la transmission monétaire s'évalue à travers la décomposition généralisée de l'erreur de prévision correspondante.

Mots clés: politique monétaire, modelisation VAR, fonctions d'impulsion, mécanisme de transmission monétaire.

Classification JEL: C51, E52

Introduction

Since the seminal work of Friedman and Schwartz (1963) economists generally agree that monetary policy can and does affect the real economy. In small, highly open, primary-exporting economies like that of Trinidad and Tobago, the nature and extent of the effect remain an empirical question. This is so largely because the effect on economic activity of other variables, notably, in this instance, the price of oil (over which monetary policy exercises no influence whatever), may very well have an attenuating effect and indeed may result in outcomes totally unanticipated by any policy measure. The effects of monetary policy on the real sector are likely to be uncertain since economic activity is so responsive to external factors that the outcome for the real sector may instead be a reflection of disturbances from this source rather than of monetary policy.

Even where economists agree that the real sector responds to monetary shocks, they generally do not agree upon the mechanism through which monetary policy measures are transmitted through the economy to the real sector and the nature and extent of the effects. This is why the transmission mechanism is referred to as a "black box" by Bernanke and Gertler (1995). Sims (1992) sums up the dilemma as follows:

> … the (economics) profession as a whole has no clear answer to the question of the size and nature of the effects of monetary policy on aggregate activity p. 975

This paper represents an attempt, firstly, to determine empirically whether and to what extent monetary policy impacts the real sector in Trinidad & Tobago given the great dependence of the latter on oil (and in particular movements in the price of oil). Over the period of this study, two potential instruments of monetary policy may be identified: the Required Reserves Ratio (RRR) and the rate on Treasury Bills (TBR). We will be evaluating the relative effectiveness of the TBR and the RRR as tools of monetary policy and, indeed, we will consider whether they ought to be considered as policy tools at all. Secondly, there is the question of the nature of the transmission mechanism in Trinidad and Tobago and, in particular, the relative importance of the different transmission channels from monetary policy to real activity.

The principal methodological tool will be a quarterly VAR model applied to quarterly data spanning the period 1971-1998 and incorporating a deterministic/exogenous component to account for peculiarities of the monetary policy history of Trinidad & Tobago as well as the price of oil. The extent of the impact of monetary policy measures on real activity will be measured through Pesaran and Shin's (1998) generalised impulse response function and the nature of the transmission mechanism through the corresponding generalised forecast error decomposition. On theoretical grounds, we prefer the use of generalised to the more popular orthogonalised errors, based on the Choleski decomposition, which is found in most of the applied work to date. In this paper we empirically compare the two approaches.

The rest of this paper is organized as follows: in the next section, the salient theoretical points are reviewed and discussed with particular reference to monetary policy in an oil-based economy like Trinidad & Tobago. There follows a historical/analytical review of monetary policy measures in Trinidad and Tobago from 1971 to the present time. The modeling methodology and data used in the empirical study are then considered, followed by specification of the model and an analysis of the empirical results obtained on the monetary policy issues. We then conclude the paper.

Theoretical considerations

There is a voluminous literature on the subject of monetary policy and its transmission to the real sector. There is considerable debate, in particular, on whether "money" or "credit" or some other transmission mechanism like the exchange rate is the conduit of choice of monetary policy measures. See Bernanke and Blinder (1988, 1992), Bernanke and Gertler (1995), Dale and Haldane (1995), Sims (1992) and De Fiore (1998).

The "money" view emphasises the role of the "open market operations" of the monetary authority and, by extension, the existence of a vibrant market for bonds. It is difficult on *a priori* theoretical grounds to justify consideration of this view in the case of Trinidad & Tobago since there is no organised market for bonds in that country and open market operations, as they are traditionally conducted, are still very much in embryonic form. Over the period covered by this study, the monetary policy instruments of choice in Trinidad & Tobago were the RRR and the TBR. The application of the RRR results in some fixed percentage of deposits being withdrawn from circulation. This restricts the ability of the commercial banks to "create" money and this may theoretically result in higher interest rates and a consequent fall in aggregate demand (and other effects on the real sector). This is very much the path predicted by the "money" school. The public may also hold real (physical) assets as an alternative to cash in the absence of a bond market. Treasury Bills are used to entice banks and other financial entities to hold an interest bearing asset as part of the reserves held with the Central Bank. In more recent times there has been some attempt to use them in open market operations.

The alternative "credit" view lays emphasis on commercial bank loans as the transmission mechanism. Restrictive monetary policy measures (such as an increase in the RRR or in the Treasury Bill Rate) adversely affect the commercial banks' ability to make loans. Aggregate expenditure falls because borrowers face a credit crunch. Many have argued that the money channel and the credit channel are independent of each other but the opposite view is gaining ground. Bernanke and Gertler (1995) argue that the term "credit channel" is a misnomer and such a channel is in fact an enhancement of the money channel. They also argue very cogently that the credit channel is really two distinct channels – the balance sheet channel and the bank-lending channel. The first is in evidence when rising interest rates result in lower value of a firm's net worth and the consequent difficulty in raising funds by borrowing. The second (bank-lending) channel is in evidence when monetary contraction results in a fall in deposits that constrains the banks' ability to make loans.

In a highly open economy like Trinidad & Tobago, other transmission channels may be considered. Following De Fiore (1998), we will consider in particular the rate of exchange as a potential channel. It was not until April 1993, however, that Trinidad & Tobago moved from a fixed to a floating rate of exchange. During the period of the fixed rate regime, it would seem that monetary impulses would not be transmitted through the exchange rate. However, during that entire period, there was a lively black market where the "real" rate of exchange was likely to be more truly reflected. Indeed pressures in this market led to successive devaluations and eventually the liberalisation of the exchange rate regime. It is for this reason that, in this paper, we will consider a measure of the real exchange rate as a possible transmission channel. A contractionary monetary policy measure ought, *ceteris paribus*, to lead to an appreciation of the value of the local currency for at least two reasons. Firstly, liquidity shortages would curb the demand for imported goods so strengthening the balance of payments position. This is all the more likely in a petroleum based economy like Trinidad & Tobago where total exports are dominated by oil exports whose price is denominated in US dollars and not in the national currency. Secondly, rising interest rates may slow down capital outflows and even encourage capital inflows. This second feature is not extremely likely since there is no real market, financial and otherwise, for assets denominated in Trinidad and Tobago dollars.

Whatever the nature of the transmission mechanism, and whether or not monetary measures will impact the real sector as it is expected to do in more developed economies, it is more than likely to be attenuated by the peculiarities of the Trinidad & Tobago economy. The most likely attenuating factor will be the price of oil that is determined by considerations that lie outside the control of the local economy. Montiel (1991) presents an interesting set of stylized facts about the typical developing economy, some of which apply to the Trinidad & Tobago case, that can result in totally unanticipated effects of monetary policy measures.

Monetary policy initiatives in Trinidad & Tobago: 1970-1999

The evolution of monetary policy in Trinidad and Tobago can be divided into four broad periods: 1970-1974, 1975-1985, 1986-1992 and 1993-1999. Each phase represents a fundamental shift in not only policy objectives but also in the strategies and typology of instruments. See Farrell et al. (1994) for further details.

<u>1970-1974</u>

Although the Central Bank of Trinidad and Tobago was established in 1964 the conduct of monetary policy actually began two years later in 1966 as the relevant sections of the legislation required proclamation. During this period the Trinidad and Tobago (TT) dollar was pegged to the pound sterling and the monetary authorities sought to move domestic interest rates in line with international sterling interest rates by varying the rediscount rate. Free convertibility of TT dollars into pound sterling meant that local investors could move funds abroad and back again in response to large interest rate differentials. Changes in the rediscount rate were influenced by changes in the UK bank rate and served as a signal to commercial banks to alter their interest rate structure. However, by 1970, the pound sterling was declared foreign exchange and, as such, the Central Bank no longer needed this instrument since foreign exchange was now under its control. The rediscount rate became an inactive instrument after 1973.

Apart from the rediscount rate, the other main instrument of policy was the reserve requirement. Commercial banks were required to hold and maintain reserves with the Central Bank in two basic forms:

- Non-interest bearing cash reserves which took the form of a statutory minimum ratio (primary reserve);
- A voluntary reserve in the form of Treasury Bills and special deposits (secondary reserves). These secondary reserves facilitated banks in that they could hold excess reserves which were highly liquid and interest-bearing, while at the same time broaden their portfolio of assets.

The statutory reserve requirement was intended to control the monetary base and thus control the expansion of credit. The desired effects of increasing the reserve requirement would therefore be to reduce the money multiplier, and as such reduce the money supply with a consequent contractionary effect on the economy. However, the actual effects of such actions would also depend on the demand for money balances by the non-bank private sector and the demand for excess reserves by the banking system. Moreover, a restrictive or contractionary monetary stance results in higher interest rates that serve to attract deposits. An increase in deposits would ultimately raise the money supply, the extent to which is uncertain. Thus, in determining the impact on the real sector, the monetary transmission mechanism must be properly identified.

1975-1985

The year 1975 marked the start of a boom period resulting from the skyrocketing of oil prices. Trinidad & Tobago experienced rapid economic growth, a sharp build-up of foreign reserves and increased government revenue. As a result, the Central Bank took a somewhat passive stance towards monetary policy, generally accommodating the expenditure and resource demands associated with the oil boom. Nonetheless, the following measures were implemented to keep the economy in check:

- Selective credit controls were imposed under which banks were required to restrict non-business loans to no more than 25% of incremental credit;
- Commercial banks were subject to a marginal reserve requirement of 15% in 1980;
- Non-bank financial institutions were required to hold reserves ranging from 3% to 5% of their deposit liabilities with the Central Bank.

This period also marked the end of the link between the pound sterling and the TT dollar which was instead pegged to the US dollar. In 1979, limits were increased on the amount of foreign exchange commercial banks could release for imports of services. However, given the high marginal propensity to import in Trinidad & Tobago and the external debt build-up associated with the construction of a new industrial capacity, the effects were such that, by 1983, there was a rapid decline in the country’s foreign exchange reserves. The Central Bank responded by introducing direct measures to control the purchase of foreign exchange for imports.

1986-1992

By 1986 oil prices had collapsed, leading to fiscal and balance of payments deficits, rising inflation and unemployment, and weak economic growth. The monetary authorities, wary of rapid and incipient inflationary pressures, undertook cautious expansionary monetary policy actions in an effort to slow the rate of economic decline. The idea was to lower the level of interest rates by reducing the reserve requirement so as to facilitate investment and encourage economic revival. However, the commercial banks had large credit exposures to cyclically sensitive sectors such as manufacturing and construction that at this time could not afford to repay their loans. Consequently, commercial banks wound up with deteriorating asset positions – two indigenous banks were restructured and eventually merged with a third - while the non-bank sector experienced severe financial distress as evidenced by the failure of six Finance Houses. Lax regulations on the part of the non-bank sector led to unsound business and investment decisions that, in turn, further deteriorated the quality of asset portfolios. In 1986 a deposit insurance scheme managed by the Deposit Insurance Corporation (DIC) became compulsory for all licensed financial institutions.

The primary reserve requirement was further reduced and the secondary reserve requirement was increased, so keeping the overall reserve ratio fixed but altering the portfolio of the banks' assets. Commercial banks now held less of their deposits as primary reserves, and more in the form of secondary reserves (largely Treasury Bills) which were interest bearing.

By 1989, the authorities turned to the IMF to help put the economy back on a stable path. The country entered into two back-to-back stand-by arrangements with the Fund whose conditionalities inevitably shaped the policy arena, including the future thrust of monetary policy. The IMF required Government to reduce its budgetary deficits which inevitably meant wage restraint (and in some cases wage cuts) in the public sector and state enterprises. This was a period of considerable unrest that culminated in an attempted coup d'état by a fringe Muslim organisation and the electoral defeat of the government in power.

During this turbulent period, monetary targets were established, limits put on commercial bank lending to state enterprises and statutory authorities, and on Central Bank lending to central government.

1993-1999

The process of economic liberalization following the Fund programme was hastened in this period. The IMF encouraged the Government to liberalize trade and to dismantle controls on current and capital transactions, ostensibly to help arrest the decline in international reserves. The negative list was removed leading to the collapse of many "screw-driver" type industries that were no longer protected from foreign competition. Those that could not survive in such an environment were forced either to lay off workers or close down completely, resulting in increased unemployment.

Additionally, the country was faced with a serious problem of debt servicing. A great proportion of the government's income was used to service these debts, and more so, the interest incurred. Thus, less funds could be used for developmental purposes and in such areas as the health and social sectors. The standard of living of many fell during this period but the economy also began to show signs of sustainable recovery.

The Central Bank, in these circumstances, moved to defend domestic interest rates so as to minimize short-term capital movements that appeared to be quite responsive to US/TT interest rate differentials. In doing so, and at the same time preserving the exchange rate, the Bank increased the required reserves ratio and made active use of moral suasion. The Bank also increased its Open Market Operations through the sale of treasury bills to commercial banks, in response to sustained high levels of liquidity in the system.

Modelling and data framework

In this section we develop the basic modelling framework to be used in the empirical study. The point of departure is a structural VAR model of the Trinidad & Tobago economy of the form:

$$\sum_{j=0}^{p} \mathbf{\Phi}_j \mathbf{y}_{t-j} - \sum_{j=0}^{q} \mathbf{\Gamma}_j \mathbf{x}_{t-j} - \boldsymbol{\mu}_0 - \boldsymbol{\mu}_1 t - \mathbf{\Psi} \mathbf{d}_t - \mathbf{\Theta} \mathbf{f}_t = \mathbf{u}_t, \; t = 1,2, .., T \qquad (1)$$

where

- $\mathbf{\Phi}_j$, j=1,2, .., n, are G×G matrices and $\mathbf{\Gamma}_j$, j=0,2, .., q are G×K matrices.
- $\mathbf{y}_t$ is a (G×1) vector of endogenous variables
- $\mathbf{x}_t$ is a (K×1) vector of exogenous variables
- $\boldsymbol{\mu}_0$ is the (G×1) constant term vector
- $\boldsymbol{\mu}_1$ is a (G×1)vector of fixed coefficients
- t is the trend variable (used also as the time subscript)
- $\mathbf{d}_t$ is a (k×1) vector of "intervention" dummies
- $\mathbf{f}_t$ is a (s×1) vector of seasonal dummies (s+1 is the number of "seasons")
- $\mathbf{\Psi}$ is a (G×k) matrix of fixed coefficients
- $\mathbf{\Theta}$ is a (G×s) matrix of fixed coefficients
- $\mathbf{u}_t$ is the (G×1) error vector of independently, identically distributed random variables with mean zero and covariance matrix $\mathbf{\Omega}$.

The **y** vector must comprise the monetary policy instruments, potential channels of transmission of monetary policy and target real variables. Monetary policy in the context of the VAR model considered in this paper is partly exogenous and partly endogenous. It is exogenous because the policy instruments are, in the final analysis, perfectly controllable by the monetary authority and innovations to an instrument are generated autonomously. But it is endogenous because there are also "within-period" feedbacks so that unpredictable movements in the monetary policy variable are generated in part by disturbances originating elsewhere in the economy. This endogenous response occurs through the monetary authority's reaction function which is likely to be influenced by movements in the (short-term) rate of interest which must therefore also appear among the endogenous variables.

The policy instruments already identified are the Required Reserves Ratio that the Central Bank imposes on the commercial banking sector, and the Treasury Bill Rate. The potential channels of transmission are bank deposits (the money channel), bank loans (the credit channel) and the exchange rate. In order to keep the VAR to manageable proportions, we target only one real variable – real GDP – while short-term interest rates are represented by the rate on bank loans. There are thus, initially, seven (7) endogenous variables in the system.

We are also hypothesising that effects of the monetary measures will be affected by the price of oil which enters into the system as the only exogenous variable. We also believe that, in the tradition of the "narrative" approach of Romer and Romer (1989), the model should incorporate the historical record of monetary policy measures (discussed in the previous section). This will be done using a series of dummy variables (defined below). Seasonal dummies and a time trend are also included among the deterministic variables.

There are some issues to be resolved in applying the general framework defined by (1). There is, in the first instance, the fact that the innovations, $\mathbf{u}_t$, are unobservable and are observed only indirectly across the reduced form innovations $\mathbf{v}_t = \mathbf{\Phi}_0^{-1}\mathbf{u}_t$. This introduces an identification problem which Sims (1980) resolves using the Choleski decomposition. This decomposition, however, requires the triangularisation of $\mathbf{\Phi}_0$ which results in the orthogonalisation of the reduced form innovations and transforms (1) into a recursive system. The ordering of the variables therefore becomes of crucial importance to the analysis. This shortcoming is usually overcome in monetary policy studies by assuming that there is no contemporaneous feedback from the non-policy variables to the policy variable. This is tantamount to putting the monetary policy instruments at the top of a recursively ordered system. In the words of Dale and Haldane (1995) "the recursive mapping between the policy and non policy variables then constitutes a valid representation of the monetary transmission process".

This ordering, however, is quite restrictive. Even if we buy the plausible argument that the policy instruments should be first in the causal chain, there may be no theoretical justification for assuming that there is no contemporaneous feedback from the non-policy variables to the policy variables. This is especially true if the model employs, as it does in this paper, quarterly data as opposed to higher frequency data like monthly data. Furthermore, it does not solve the problem of the ordering of the non-policy variables. Even in a relatively small VAR, there may be several possible parameterizations that could be employed and there is no clear guidance about which one to use. In addition, each one is likely to lead to quite different conclusions about the nature and extent of the impact of monetary measures.

Pesaran and Shin (1998) propose a more general alternative to the Choleski decomposition which is unaffected by the ordering of the variables and which does not require the orthogonalisation of the reduced form innovations. The resulting responses are unique "and fully take account of the historical patterns of correlations observed amongst the different shocks" (Pesaran and Shin (1998), p.20). Furthermore, they allow for the possibility of contemporaneous feedback from the non-policy variables to the policy variables. It is this procedure that will be employed in this paper and will be compared to some results obtained from using the Choleski decomposition.

A second issue is the measurement of variables already identified for incorporation into the model and the periodicity of the data. Relatively reliable monthly data, dating back to 1971 and even earlier, exist for the required reserves ratio, the Treasury bill rate, the (nominal) exchange rate, the loan rate (on bank loans), the volume of bank loans, commercial bank deposits[2] and the oil price. GDP, however, is available only in annual format. However, since 1982, the Central Bank has been publishing a quarterly real GDP index. Otherwise, all GDP data are available only in annual format. Given the importance of GDP to the study, we adopted a procedure to obtain quarterly data for the entire period. We explain this procedure below. Data sources are provided in the appendix.

Some of the data had to be transformed in order to be used in the model. We first had to calculate a real exchange rate using the nominal rates. This was done using the formula:

$$\text{RER} = \text{NER}\ \frac{\text{USCPI}}{\text{RPI}}$$

where RER and NER are, respectively, the real and nominal exchange rates (expressed in TT dollars per US dollar), USCPI the US consumer price index and RPI the Retail Price Index of Trinidad and Tobago.

A quarterly series for real GDP is computed in two steps. In a first step, annual constant price data for the period 1971 to 1981 are converted to quarterly data using a procedure proposed by Goldstein and Khan (1976). Secondly, GDP growth rates derived from the Central Bank Quarterly (real) GDP index were applied from 1982, first quarter, to 1998, fourth quarter (using the value for 1981, fourth quarter, as an initial value) to generate quarterly GDP series from 1982 to 1998.

The dummy variables used are defined in such a way as to account for the monetary policy history of Trinidad & Tobago. In summary, four such variables are defined as follows:

D_1= 1 if observation is made in the period 1971-1974, 0 if not.

D_2= 1 if observation made in the period 1975-1985, 0 if not.

D_3= 1 if observation made in the period 1986-1993, 0 if not.

[2] A "total deposits" figure was used representing the sum of demand, savings, time deposits and foreign deposits. The latter became available only from April 1993 when the floating rate regime was introduced.

D_4= 1 if observation made in the period 1994-1998, 0 if not.

All variables enter into the model in logarithmic form. In the case of the required reserves ratio RRR_t, the treasury bill rate and the loan rate of interest, the logarithmic form is calculated as follows:

$$0.25 \log (1 + x_t/100)$$

where x is the relevant variable expressed in percentage form.

The variables used in the exercise were tested for unit roots and, as shown in Table 1 below, they all appeared to be I(1).

Table 1

Dickey-Fuller Tests

Variable	Required Reserves	Treasury Bill Rate	Exchange rate	Loan Rate	Loans	Deposits	GDP
ADF level	-2.7986	-1.7902	-2.1583	-2.1663	-1.2270	-1.8841	-2.1027
ADF 1^{st} diff	-10.416	-6.4058	-9.7746	-9.6390	-5.4793	-3.6103	-2.8963

95% critical value for the Dickey-Fuller statistic (level) = -3.4504
95% critical value for the Dickey-Fuller statistic (1^{st} diff) = -2.8877
90% critical value for the Dickey-Fuller statistic (level) = -3.15
90% critical value for the augmented Dickey-Fuller statistic (1^{st} diff) = -2.58

The test for variables in levels includes a constant and a trend term while the test in first differences includes only a constant term. The order of the ADF is chosen on the basis of the AIC criterion and only the statistic satisfying that criterion is shown here. In the presence of these non stationary series, we tested for the presence of cointegrating vectors using the procedure suggested by Johansen (1988) and determined the existence of long-run relationships. It was therefore decided to use "levels" rather than first differences. This makes our system equivalent to a VAR error correction system.

Model Specification

We applied a series of tests in order to arrive at a final specification of the model. In the first place, we attempted to establish the appropriate lag length of the VAR defined in the previous section using the Likelihood Ratio test described in Enders (1995), p. 312-5 as well as the "multivariate" AIC and SBC criteria. Mindful of the loss of efficiency that might result from the estimation of too many parameters, we limited consideration to a maximum lag length of 4 (the unrestricted model). This was compared to VARs of orders 3, 2 and 1 (restricted models). The values of the AIC, SBC, the value of the χ^2 (corresponding degrees of freedom, for testing the alternative of 4 lags against the null, are shown in parentheses) and the p-value associated with this statistic are displayed in Table 2 below:

Table 2

Statistics used in determining appropriate lag length for 7-variable VAR

Unrestricted model: lag length = 4

Order of VAR	4	3	2	1
AIC	-7235.15	-7273.13	-7260.55	-7246.76
SBC	-6465.38	-6653.56	-6791.17	-6927.59
χ^2		45.92 (56)	123.21 (112)	201.24 (168)
p-value		0.8296	0.221	0.04076

The lowest AIC value is obtained in the 3 variable case and, furthermore, the Likelihood Ratio test does not reject the null that there are only 3 lags (rather than 4). It also does not reject the null that there are only 2 lags while the SBC value associated with the 2 variable case is smaller than that of the 3 and 4 variable case. We therefore decided to make the 3 variable the unrestricted model and compare it to the 2 variable and 1 variable cases. The relevant statistics are shown in Table 3 below:

Table 3

Statistics used in determining appropriate lag length for 7-variable VAR

Unrestricted model: lag length = 3

Order of VAR	3	2	1
AIC	-7341.32	-7316.80	-7246.76
SBC	-6719.61	-6856.32	-6996.53
χ^2		83.24 (56)	209.76 (112)
p-value		0.0105	0.0000

The evidence seems to favour the lag of order 3 and this specification is retained initially.

As a next step, and as an initial step to establishing whether or not RRR and TBR were valid policy instruments, we tested the relevance of both the RRR and TBR variables for "causality" (a bloc causality test was used). Surprisingly, the null of non causality was NOT rejected in the case of the RRR variable (χ^2 (24) = 23.1, p-value = 0.5153). It was, however, soundly rejected in the case of the TBR variable (χ^2 (24) = 53.5, p-value = 0.0005).

We decided to discontinue consideration of RRR and to drop it from the system entirely. This resulted in a much more manageable 6 variable VAR and we proceeded, as we did in the 7 variable case, to determine the optimum lag length. Once again we used a maximum of 4 lags (alternative hypothesis) which we compared to the 3, 2 and 1 variable cases (null hypotheses). The relevant statistics are shown in Table 4 below:

Table 4

Statistics used in determining appropriate lag length for 6-variable VAR

Unrestricted model: lag length = 4

Order of VAR	**4**	**3**	**2**	**1**
AIC	-5997.43	-6021.90	-6013.90	-5984.21
SBC	-5402.00	-5539.11	-5643.76	-5726.73
χ^2		39.14 (42)	99.62 (84)	390.24 (126)
p-value		0.59735	0.1174	0.00000

The results seem to favour a lag length of order 3 but there is some evidence that it might be 2. Using the 3-lag case as the unrestricted model, we compared it to the 2-lag case. The relevant statistics are shown in Table 5 below:

Table 5

Statistics used in determining appropriate lag length for 6-variable VAR

Unrestricted model: lag length = 3

Order of VAR	**3**	**2**
AIC	-6076.54	-6067.38
SBC	-5592.094	-5695.97
χ^2		83.24 (56)
p-value		0.00751

The null is soundly rejected and we retain the 3 lag VAR specification.

We then performed a series of bloc causality tests on the endogenous variables in the system. Only in the case of the deposits variable was the null of non-causality not convincingly rejected with p-values in all cases zero to three decimal places. In the case of the deposits variable, the p-value was 0.235. This is an interesting result in that it suggests, in particular, that the money variable does not affect the real variable in the system so that the money channel is either weak or non-existent. More will be said on this later.

We then carried out variable deletion tests on the exogenous oil price and dummy variables. In the case of the dummies, both individually and collectively, the null was rejected with p-values of zero to three places of decimal. In the case of the oil price, when they were individually tested, all showed p-values close to zero except the lag 3 value which displayed a p-value of 0.172. We decided nevertheless to use all three lags even though the third appeared to be not significant.

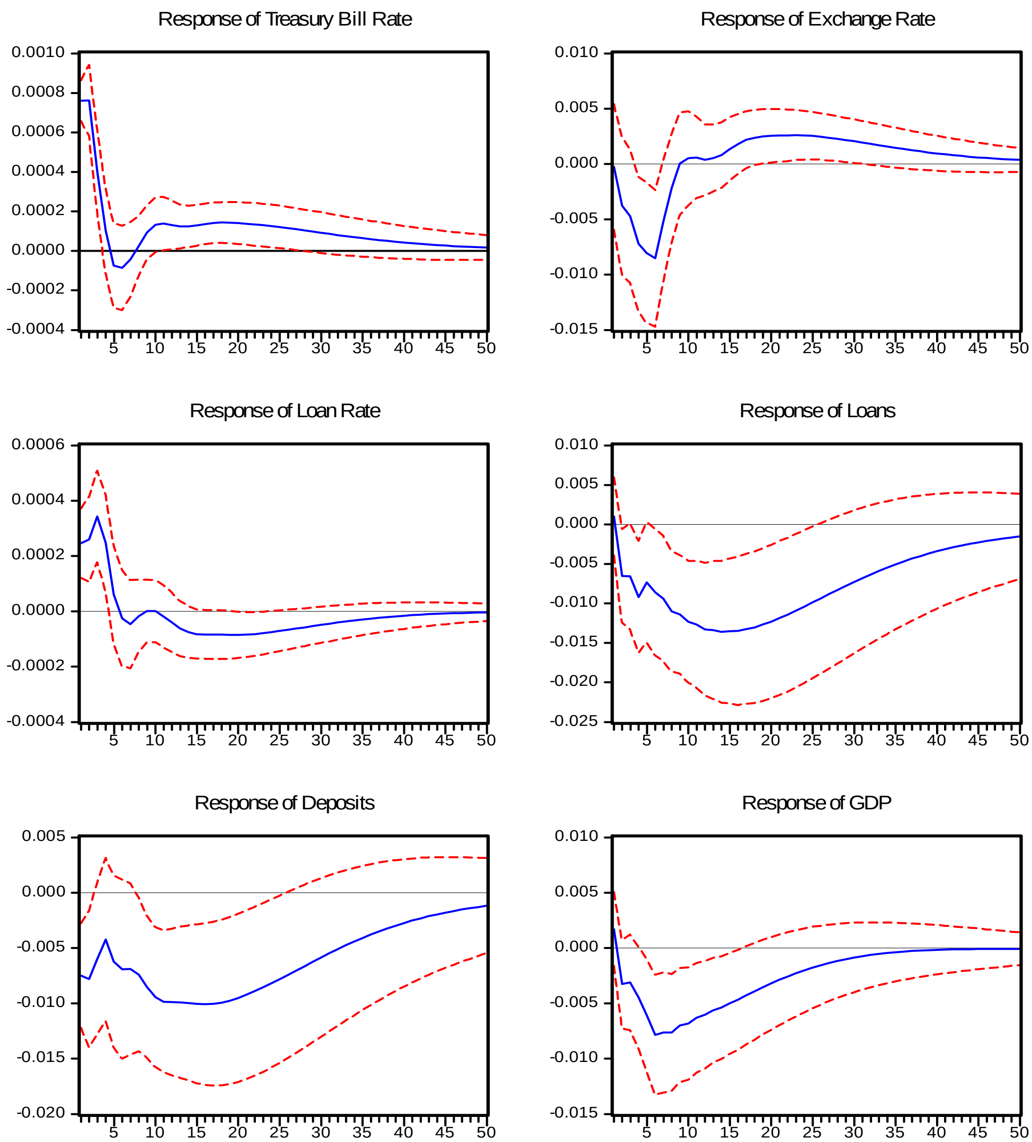
The model retained may be considered the best fit available from the data. The statistical significance of the intervention dummies shows clearly that the various monetary policy regimes must be taken into account in order to carry out the analysis effectively. The statistical significance of the oil-price variable, an exogenous variable in the system, means that exogenous monetary policy shocks can be “tainted” by movements in this variable so clouding the effects of such measures.

Analysis of results

In Figure 1 below, we display Pesaran and Shin’s generalized impulse responses (50 quarters) to a one-standard-error shock to the treasury bill rate.

Figure 1

Graph of Generalised Impulse Responses to one-standard-error shock in the Treasury Bill Rate (95% confidence bands are shown)



Let us begin by looking at the responses over the first two years (8 quarters) which are likely to be the most important for the policy makers. The results generally support the predictions of the theory. They indicate that a tight money policy results generally in higher interest rates. This in turn is accompanied by an appreciation of the exchange rate. In the mean time, loans decline in response to the rising interest rates. Deposits also fall and this is not necessarily contrary to theory. Indeed, economic agents may respond to the initial rising rates by drawing down on accumulated deposits rather than through raising loans although this may not be what the policy makers intended. As is expected in conditions of tight money, GDP declines as well.

There is a marked tendency for the policy instrument to return to base following the initial shock. It does so after four quarters and, indeed, overshoots the mark, going below the base for a few periods. The decline in deposits may be a cause of some concern to the policy makers at this point and they force an increase in the policy instrument above the base line, hoping that this will result in higher rates and an improvement in the level of deposits. But this does not happen as the loan rate does not follow the upward movement in the policy instrument. Both loans and deposits remain below the base line scenario case for a considerable period of time and there is but a slow response to the incentive. In the meantime, the national currency also depreciates. What is a possible explanation of this phenomenon which is not predicted by the theory?

The answer has probably to do with the nature and structure of a primary exporting small island economy like that of Trinidad & Tobago. There may be other unseen factors at work that are responsible for some of the consequences of a tight money policy. One of the main features of a primary exporting country like Trinidad & Tobago is the high propensity to import, especially intermediate and capital goods which have a direct impact on levels of production. The major exporters, like the oil companies, earn and often deposit large amounts of their earnings abroad (in foreign banks). A tight money policy, especially a sustained one, may encourage such tendencies further (and may even encourage capital flight) as it jeopardises the smooth financing of business activity. This is especially true in situations where tight money policies follow on the heels of rising oil prices and the resulting inflow of revenue.

It is for this reason that loan rates do not respond to movements in the Treasury Bill Rate: other (external) sources of finance are available and, in the absence of a demand for loans, the loan rate does not rise. In fact, the banks may now be willing to attract lenders by keeping the rate relatively low (and being satisfied with a smaller mark-up rather than nothing at all).

The monetary policy measure, then, appears at best to be effective in the short run but, in the long run, economic agents take action to counter the desired consequences of the policy.

What are the relative strengths of the three channels of transmission discussed at the beginning of this paper viz. the money, credit and exchange rate channels. A study of the Forecast Error Variance Decomposition will help to elucidate that. Such a decomposition provides information about the relative influence on any one variable of the random innovations of the rest of the variables making up the system.

Since we are interested in the effect of the monetary policy on the real sector, consider the forecast error variance decomposition of GDP shown in Table 6 below. This is the generalised forecast error variance decomposition due to Pesaran and Shin (1998). One minor drawback in using this rather than one based on orthogonalised responses is that the row totals do not sum to unity. This makes their interpretation over time somewhat clumsy but not at all impossible. To facilitate this comparison, we have standardized the entries so that the row totals equal unity. The standardised entries are shown in italics in Table 6.

Table 6

Pesaran and Shin's Generalised Forecast Error Variance Decomposition for variable GDP

	Pesaran & Shin						Standardised					
Horizon	**Treasury Bill**	**Exchange Rate**	**Loan Rate**	**Loans**	**Deposits**	**GDP**	***Treasury Bill***	***Exchange Rate***	***Loan Rate***	***Loans***	***Deposits***	***GDP***
0	0.009524	0.004048	0.000518	0.004994	0.009505	1	*0.009259*	*0.003936*	*0.000504*	*0.004855*	*0.009241*	*0.972206*
1	0.028409	0.024165	0.007779	0.037219	0.00638	0.900885	*0.028272*	*0.024049*	*0.007742*	*0.03704*	*0.006349*	*0.896548*
2	0.037247	0.048735	0.018647	0.028776	0.009007	0.869038	*0.036826*	*0.048184*	*0.018436*	*0.02845*	*0.008905*	*0.8592*
3	0.057985	0.087764	0.021695	0.027771	0.008941	0.814527	*0.056922*	*0.086154*	*0.021297*	*0.027262*	*0.008777*	*0.799589*
4	0.08644	0.102941	0.036347	0.022514	0.00839	0.767267	*0.084422*	*0.100538*	*0.035498*	*0.021989*	*0.008194*	*0.749358*
5	0.12903	0.115111	0.047286	0.025064	0.009248	0.709949	*0.124584*	*0.111144*	*0.045657*	*0.024201*	*0.008929*	*0.685486*
6	0.157653	0.122377	0.063619	0.025551	0.010456	0.669112	*0.150322*	*0.116687*	*0.06066*	*0.024363*	*0.00997*	*0.637998*
7	0.182017	0.130345	0.076509	0.0297	0.012361	0.631313	*0.171351*	*0.122707*	*0.072026*	*0.02796*	*0.011637*	*0.59432*
8	0.196923	0.137494	0.090127	0.030677	0.015187	0.603621	*0.18335*	*0.128017*	*0.083915*	*0.028563*	*0.01414*	*0.562015*
9	0.210126	0.145165	0.100461	0.032345	0.01936	0.577763	*0.193625*	*0.133765*	*0.092572*	*0.029805*	*0.01784*	*0.532393*
10	0.219073	0.151944	0.110857	0.032319	0.02463	0.556274	*0.200049*	*0.138749*	*0.10123*	*0.029513*	*0.022491*	*0.507968*
11	0.226925	0.158431	0.119487	0.032421	0.030672	0.536331	*0.205499*	*0.143471*	*0.108205*	*0.02936*	*0.027776*	*0.48569*
12	0.232632	0.16387	0.127802	0.03186	0.037028	0.519054	*0.209155*	*0.147332*	*0.114904*	*0.028644*	*0.033291*	*0.466672*
13	0.237765	0.168668	0.134736	0.031429	0.043485	0.503419	*0.212384*	*0.150664*	*0.120354*	*0.028074*	*0.038843*	*0.449681*
14	0.241651	0.172603	0.141041	0.03083	0.049777	0.489859	*0.214655*	*0.153321*	*0.125285*	*0.027386*	*0.044217*	*0.435136*
15	0.244925	0.175976	0.146233	0.03035	0.055802	0.477974	*0.216506*	*0.155557*	*0.129266*	*0.026829*	*0.049327*	*0.422515*
16	0.247281	0.178735	0.150752	0.029842	0.061452	0.467817	*0.2177*	*0.157354*	*0.132719*	*0.026272*	*0.054101*	*0.411855*
17	0.249112	0.181045	0.154412	0.029411	0.066714	0.459116	*0.218556*	*0.158838*	*0.135472*	*0.025803*	*0.058531*	*0.4028*
18	0.250357	0.182901	0.157495	0.028998	0.071548	0.451756	*0.219025*	*0.160011*	*0.137784*	*0.025369*	*0.062593*	*0.395218*
19	0.251255	0.184405	0.159958	0.028643	0.075947	0.445551	*0.219291*	*0.160946*	*0.139608*	*0.024999*	*0.066285*	*0.38887*
20	0.251813	0.185581	0.161977	0.028327	0.079894	0.440367	*0.219357*	*0.161662*	*0.1411*	*0.024676*	*0.069596*	*0.383609*

It will be noticed that, over time, GDP plays a relatively important role in its own forecasting. Other, perhaps more important, conclusions may be drawn from inspection of this table. We notice, firstly, that the treasury bill rate also plays a very influential role, confirming that the policy instrument does have an impact on the real sector. In fact after by the end of the 8th quarter, it is already accounting for 18% of the total variation which is the largest influence on GDP after GDP itself. This confirms the statement of Bernanke and Gertler (1995), p. 29, that " although an unanticipated tightening of monetary policy typically has only *transitory* effects on interest rates, a monetary tightening is followed by *sustained* declines in real GDP and the price level".

What about the relative importance of the various transmission channels? It is clear that the strongest of the channels is the exchange rate channel. In fact the exchange rate variable has the strongest influence after GDP itself and the treasury bill rate while the influence of both the loans and deposit variables is weak, even negligible. After the 8th quarter, it accounts for just over 12% of the total variation while the loan variable (the credit channel) accounts for about 3% and the deposit variable (the money channel) for about 1%. Eventually the money channel becomes relatively stronger but neither the money or the credit ever exercises any great influence compared to the exchange rate channel.

It is interesting to compare Pesaran and Shin's generalised impulse responses studied in the previous section with the results based on orthoganalised residuals (Choleski decomposition). The two responses are expected to differ since, firstly, the orthogonalisation required by the Choleski decomposition imposes the restriction that there be no contemporaneous feedback from the non-policy variables to the policy variable and, secondly, the results obtained by application of the Choleski decomposition depend crucially on the ordering imposed.

As we argued previously, we have no *a priori* way of knowing the order in which the variables are to be placed and, in the final analysis, the ordering chosen was arbitrary. The one possible exception to this is the policy variable (TBR) which on *a priori* grounds may logically be placed first in the system. Even then, we have no *a priori* reason to accept this restriction especially when using low frequency data like quarterly data.

The general impulse responses shown in Figure 1 will result from any ordering of the variables. They will be identical to the orthogonalised responses provided that TBR is first in the ordering, whatever the ordering of the other variables. But they will usually be different if TBR appears in any other position than first. See Pesaran and Shin's (1998) proposition 3.1, p.20.

The orthoganalised forecast error variances, however, are different even if the ordering is the same and, consequently, the analytical conclusions to be drawn may be quite different. Table 7 below shows the orthogonalised forecast error variance decomposition for GDP using the order: treasury bill rate, exchange rate, loan rate, loans, deposits and GDP (which is the same ordering used in the generalised case) and the order: exchange rate, loan rate, loans, deposits, GDP and treasury bill rate.

Table 7

Orthoganalised Forecast Error Variance Decomposition for variable GDP

Order: treasury bill rate, exchange rate, loan rate, loans, deposits and GDP — Order: exchange rate, loan rate, loans, deposits, GDP and treasury bill rate

Horizon	Treasury Bill	Exchange Rate	Loan Rate	Loans	Deposits	GDP	*Treasury Bill*	*Exchange Rate*	*Loan Rate*	*Loans*	*Deposits*	*GDP*
0	0.009524	0.004156	0.004298	0.005141	0.004791	0.972089	*0*	*0.004048*	*0.000645*	*0.00421*	*0.010111*	*0.980986*
1	0.028409	0.023858	0.023497	0.026959	0.00724	0.890038	*0.058317*	*0.024165*	*0.006864*	*0.029819*	*0.006491*	*0.874344*
2	0.037247	0.048131	0.024533	0.020693	0.005891	0.863505	*0.058292*	*0.048735*	*0.019629*	*0.022866*	*0.006753*	*0.843724*
3	0.057985	0.086652	0.02145	0.018312	0.005427	0.810174	*0.0763*	*0.087764*	*0.023999*	*0.020705*	*0.005986*	*0.785246*
4	0.08644	0.101435	0.023459	0.015051	0.005818	0.767797	*0.098401*	*0.102941*	*0.040315*	*0.016784*	*0.004914*	*0.736645*
5	0.12903	0.113161	0.022737	0.015564	0.005831	0.713678	*0.131466*	*0.115111*	*0.052492*	*0.018387*	*0.004903*	*0.677641*
6	0.157653	0.120138	0.026955	0.015272	0.005425	0.674558	*0.148163*	*0.122377*	*0.070073*	*0.01863*	*0.005063*	*0.635693*
7	0.182017	0.127842	0.030236	0.017757	0.004917	0.637231	*0.160632*	*0.130345*	*0.084017*	*0.022015*	*0.005887*	*0.597104*
8	0.196923	0.134802	0.035853	0.018105	0.004524	0.609793	*0.164717*	*0.137494*	*0.098647*	*0.022698*	*0.007257*	*0.569187*
9	0.210126	0.142292	0.039829	0.018943	0.004646	0.584165	*0.167711*	*0.145165*	*0.109843*	*0.023916*	*0.009783*	*0.543583*
10	0.219073	0.148931	0.044854	0.018678	0.005517	0.562948	*0.16745*	*0.151944*	*0.121047*	*0.023748*	*0.013092*	*0.52272*
11	0.226925	0.15529	0.04899	0.018518	0.007051	0.543225	*0.166796*	*0.158431*	*0.130381*	*0.023683*	*0.017154*	*0.503554*
12	0.232632	0.160629	0.05347	0.017994	0.009101	0.526175	*0.165057*	*0.16387*	*0.139331*	*0.023129*	*0.02147*	*0.487143*
13	0.237765	0.165339	0.057133	0.017573	0.011472	0.510718	*0.163464*	*0.168668*	*0.146806*	*0.022691*	*0.026019*	*0.472352*
14	0.241651	0.169203	0.060682	0.017099	0.014052	0.497313	*0.16157*	*0.172603*	*0.153579*	*0.022155*	*0.030493*	*0.459599*
15	0.244925	0.172516	0.063594	0.016714	0.016727	0.485524	*0.159818*	*0.175976*	*0.159163*	*0.021721*	*0.034884*	*0.448438*
16	0.247281	0.175228	0.066269	0.016348	0.01944	0.475434	*0.157995*	*0.178735*	*0.164014*	*0.021288*	*0.039038*	*0.438929*
17	0.249112	0.177501	0.068457	0.016042	0.022126	0.466761	*0.156318*	*0.181045*	*0.167946*	*0.020924*	*0.042979*	*0.430788*
18	0.250357	0.179328	0.070387	0.015773	0.024744	0.45941	*0.154711*	*0.182901*	*0.171254*	*0.020591*	*0.04663*	*0.423914*
19	0.251255	0.18081	0.071953	0.01555	0.027241	0.453191	*0.153271*	*0.184405*	*0.173898*	*0.02031*	*0.05*	*0.418116*
20	0.251813	0.18197	0.073288	0.015368	0.029582	0.447981	*0.151966*	*0.185581*	*0.176063*	*0.02007*	*0.053047*	*0.413273*

These entries are to be compared with each other and with the standardised generalised error variances shown in Table 6 above. As expected, the different orderings result in notable differences in the orthogonalised case. At first view, there is some similarity in the orthogonalised and the generalised cases when the same order is maintained. But when we look at the detail there are some remarkable differences in the policy conclusions that may be drawn. For instance, after 8 quarters, the orthogonalised case has the exchange rate, loans and deposits accounting, respectively, for 13.5%, 1.8% and 0.4% of the total error while the generalised case gives us 12.8%, 2.8% and 1.4%. By the end of the 20^{th} quarter, the orthogonalised case yields 18.2%, 1.5% and 2.9% while the generalised case yields 16.2%, 2.5% and 6.9%. In fact, in the generalised case, the credit channel has a fairly constant effect on GDP while the money channel is increasing remarkably. The money and credit channels are even less significant as transmission mechanisms if the orthoganalised errors are used and the exchange rate channel even more important.

Conclusion

There is ample evidence from this study that monetary policy measures do have an impact on the real sector. In particular, the treasury bill rate is useful as an instrument of monetary policy. There also emerges the conclusion that, of the three channels of transmission - money, credit and the exchange rate – the exchange rate channel is the most influential. But there are limitations.

Firstly there are limitations imposed by the peculiarities of an economy like that of Trinidad & Tobago. It is clear that activity in the petroleum sector, dominated as it is by the price of oil, colours these conclusions somewhat. Secondly, there are problems inherent in the data employed. Some data, like GDP, are not available as required. Then the model uses aggregates and, in particular, it aggregates all sectors of the economy. Dale and Haldane (1995) have found that, in the United Kingdom, the monetary transmission process in the "personal" sector may differ from that of the "corporate" sector. In particular, they found that the players in the personal sector increased their holdings of bank deposits following an increase in interest rates while those in the corporate sector hold less. It is possible that the Trinidad & Tobago data used in this paper are dominated by the corporate sector but it may also mean that the personal sector responds differently in Trinidad & Tobago from the United Kingdom.

It is, however, an interesting start to a debate on a well known subject within the framework of a small open economy where the endogeneity of money and monetary policy is often taken for granted. The next step will be to look at similar economies where data scarcity may be an even greater constraint. But the questions posed need to be answered as there are obvious implications for monetary and more, general economic policy in countries like these.

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Appendix

Data Sources

Data Capture

The data collected for this exercise are from three (relatively reliable) sources. These are:

(i) The Quarterly Statistical Digest (QSD) of the Central Bank of Trinidad and Tobago.

(ii) The Retail Price Index Bulletin of the Central Statistical Office.

(iii) The International Financial Statistics (a monthly publication of the International Monetary Fund).

The Table A1 below lists the raw series as they were "captured" from the above publications. All the data are quarterly and cover the period 1971, first quarter to 1998, fourth quarter.

Table A1
Raw data series: sources and description

Data Item	Source
Total Deposits	QSD, Table A2, TT$/Mn.
Gross Domestic Product	The original series in annual format is drawn form the CSO publication "The National Income Accounts of Trinidad & Tobago". It is converted into quarterly data following the Goldstein-Khan procedure.
Commercial Bank Loans	QSD, Table C9, TT$ Mn.
Interest Rate (Weighted Average Loan Rate)	QSD, Table G1.
Exchange Rate	The nominal rate (TT$/US$) is sourced from IFS, 369 rf (quarterly average).
Retail Price Index	CSO: Retail Price Index Bulletin.
Treasury Bill Rate	QSD
US Consumer Price Index	IFS, 111, 64.
Index of real GDP	QSD

QSD = Quarterly Statistical Digest of the Central Bank of Trinidad & Tobago

IFS = International Financial Statistics

CSO = Central Statistical Office of Trinidad & Tobago