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Foreword

Central Banks perform many functions. While their roles may vary depending on development levels and financial systems, most central banks ensure that the local currency retains its value in both domestic and external terms - they ensure that inflation is controlled and the foreign exchange rate remains relatively stable. A lesser-known and rarely celebrated role of central banks is their mandate to conduct economic research. This research is intended to inform policy and should, therefore, be relevant to the economy's circumstances and therefore assist policymakers in understanding how the economy is wired.

Since the Bank's establishment in 1964, conducting relevant research has been one of its enduring roles, one which has been steadfastly championed by our Research Department since 1968. Our research can be seen on the Bank's website as working papers. These working papers are intended to engage the public – especially policymakers and the academic community – in considering the day's economic challenges and possible responses. Sometimes, however, the Bank publishes research as special publications to mark historic milestones. Such is the case with this publication.

This compilation is one of two special research publications to mark the Bank's 55th anniversary. It brings together five previously published works highlighting issues of relevance to the Bank, specifically in the broad area of monetary policy. A subsequent publication will address the field of financial stability. If perchance, you ever wondered about the things that keep a central banker awake at night, this publication should assuage your curiosity!

Sandra Sookram

Preface

While the mandates of central banks are generally well-defined and most times very narrow, the economic issues that they must consider to achieve these mandates are wide-ranging. This compilation highlights many of those issues. The opening paper by the late Daryl Cheong reviews the role and performance of the Bank in its first five decades, broadly surveying how the institution exercised its mandate in distinct periods and circumstances. The paper reveals how an increasingly confident institution managed capricious international and domestic conditions to secure monetary and financial stability, while appropriating lessons for the future.

The second paper by Stephan Edwards and Alon Dhanessar provides more in-depth, technical insight into the Bank's work in the modern era. All central banks employ tools to accomplish their purposes, but these must be effective in the environment in which they operate, or their "operational sphere". To test the Bank's effectiveness in its operational sphere, which they identify as short-term financial markets, the authors examine how these markets respond to monetary policy following a sizeable fall in energy prices. They find that though the Bank's tools are effective, their effectiveness is limited by some of the economy's innate characteristics.

Sandra Sookram and Avinash Ramlogan examine the coordination of policies by two key macroeconomic agents: the Central Bank and the government. Ostensibly, policy coordination is necessary to avoid policy clashes which could be counter-productive for the economy as a whole. However, coordination may not occur because the institutions pursue different objectives or have dissimilar expectations of economic conditions. In this paper the authors test for coordination of fiscal and monetary policies over 1993-2016 and find that while there has been policy coordination, there is room for improvement.

Ashley Bobb and Lauren Sonnylal examine (for the period 1995 to 2016) the exchange rate pass-through to prices paid by local consumers and producers. This is important for Trinidad and Tobago given our very open nature and dependency on imports. The authors observed that an exchange rate change did not pass through entirely to domestic inflation, and that the contribution to inflation was less persistent than in previous periods. They conclude that monetary policy could be improved by actively considering exchange rate changes.

Interest in the relationship between price stability and financial stability has resurged following the Global Financial Crisis of 2008/2009. Reshma Mahabir and Akeem Rahaman in the final paper investigate this relationship for Trinidad and Tobago from 2000 to 2015. The perceptive reader may ask to what end, given that central banks often prioritize price stability over financial stability. Importantly, this knowledge could help the Bank avoid any fallout of monetary policy actions on financial stability or vice versa. It may even allow the Bank to develop tools or structures for affecting both monetary and financial stability simultaneously and thus improve its efficiency. However, all told, the authors find little relationship between the two objectives but provide insightful recommendations for improving monetary and financial stability.

The Bank is extremely grateful to those professionals who took the time to read the articles in this compilation and provide thoughtful comments. They include Professor Paul Mizen, Dr. Keyra Primus, Dr. Ann Marie Mohammed, Dr. Selvon Hazel, Dr. Penelope Forde and Dr. Darren Conrad. We indeed value their scholarly insights.

In closing, I hope you enjoy reading the compilation, and that each reader will find some nugget of enlightenment that deepens their understanding of our economy. The central bank continues to value high-quality research, not for its own sake, but ultimately, for improving the quality of life of all our citizens.

Garnett Samuel

The Central Bank of Trinidad and Tobago's Monetary Policy Operations Over the Last Five Decades[1]

Daryl Cheong[2]
Research Department

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Abstract

Since its establishment in 1964, the Central Bank has been an integral part of Trinidad and Tobago's economic and financial landscape. Throughout the country's post-independence history, the Bank has acted to engender and promote macroeconomic stability, which was sometimes complicated by periods of economic volatility. As the Central Bank celebrates its 55th anniversary in 2019, this paper retraces monetary policy operations during the varying economic episodes over the past five decades. It is hoped that key lessons from the past can help the Central Bank chart its future.

1. Introduction

Two years after Trinidad and Tobago gained independence in 1962, the government, recognising the importance of a monetary authority, established the Central Bank of Trinidad and Tobago (the Bank). As the Bank celebrates its 55th anniversary in 2019, it is opportune to reflect on the institution's contribution to Trinidad and Tobago's economic and financial landscape over the decades. This contribution has involved, inter alia, fostering macroeconomic stability, capital market development, safeguarding financial stability, maintaining a sound payments system as well as championing financial literacy and promoting local art and culture. While these are all important contributions, this paper focuses on a historical review of the Bank's monetary policy – one of its primary mandates – in the context of the economic environment and the Bank's objectives over time.

As a small open and energy-based economy, Trinidad and Tobago has experienced episodes of economic volatility and has undergone significant structural changes over the years. These spanned the oil boom and bust cycles of the 1970s and 1980s, structural adjustment and liberalisation of the late 1980s to early 1990s and the robust growth cycle of the mid-1990s into the 2000s. Meanwhile, the international monetary and financial environment also evolved markedly over the past six decades. For instance, the end of the exchange rate component of the Bretton Woods system in the early 1970s saw many advanced economies implement managed float regimes in the immediate aftermath (Garber, 1993); central banks began to adopt inflation targeting in the 1990s (Miskin & Posen, 1997) and more lately; amidst the Global Financial Crisis central banks resorted to 'unconventional' monetary policy tools. Likewise, the Bank's monetary policy over its 55-year history adapted to the economic environment at the time.

[1] This paper draws heavily from the unpublished paper "The Efficiency of Monetary Policy" which was presented by Daryl Cheong at the Central Bank of Trinidad and Tobago's Research Review Seminar, October 2005.

[2] The author worked as a Senior Economist at the Central Bank of Trinidad and Tobago before his untimely passing in 2019. The views expressed do not necessarily represent those of the Central Bank.

The paper is divided into five sections. The next briefly discusses how this study was approached, information sources and provides some caveats to the reader while the third section briefly discusses the evolution of monetary policy internationally. The fourth section, which is broken down into different sub-periods, delves directly into the discussion of the Bank's monetary policy. The fifth section ends the paper by distilling lessons for the Bank as it forges forward in the information and technological age.

2. Approach

This paper provides an account of the Bank's monetary policy actions over the period 1970–2018. It takes inspiration and draws heavily from the work of Farrell (1990). However, it does not explicitly attempt to assess the efficiency or effectiveness of the Bank's monetary policy. Nevertheless, a useful starting point for this discussion would be to frame the Bank's actions in the context of its given objectives. For this, the Central Bank Act 1964 (the Act) defines the purpose of the Bank and, in so doing, lays the foundation for monetary policy. Precisely, Section 3.(3) of the Act states 'The Bank shall have as its purpose the promotion of such monetary, credit and exchange conditions as are most favourable to the development of the economy of Trinidad and Tobago.' Further, Subsection 3.3(c) mandates the Bank to 'maintain, influence and regulate the volume and conditions of supply of credit and currency in the best interest of the economic life of Trinidad and Tobago.' Against the very broad mandate provided by the Act, the paper will attempt to identify the key objectives at various points while it retraces the Bank's monetary policy actions.

Owing to data and informational constraints, this paper does not cover the entire 55-year history of the Bank. However, these factors are less limiting for the period 1970 to 2018. The paper draws from Central Bank publications, such as Annual Reports, Economic Bulletins, Annual Economic Surveys, Monetary Policy Reports and other special publications. Most of the data used in the study can be sourced from the Bank's website, including from the 'Handbook of Key Economic and Financial Statistics'[3]. To adequately capture the unique economic circumstances throughout the country's post-independence history, the discussion is broken down into six sub-periods: 1970–1973; 1974–1982; 1983–1988; 1989–1993; 1994–2008; and 2009–2018. These periods reflect boom and bust cycles, the country's structural adjustment period (1989–1993)[4] and marked shifts in monetary policy for example, the intention to rely more heavily on indirect monetary policy instruments in the 1994–2008 era.

Although the approach is relatively straightforward, some caution to the reader is still warranted. One weakness in this study is that the influences of the socio-political environment on the Bank's decision making may not be adequately captured. The author acknowledges that though the Bank ideally sought to conduct its affairs based on objective economic and financial realities at all times, the socio-political environment could have influenced (to varying degrees) its decisions at different periods. Secondly, while the objectives of monetary policy at the time were identified, these objectives were not routinely numerically defined. Hence, some caution may be necessary when trying to assess whether monetary policy was achieving its objectives. More so, an assessment of monetary policy should be framed within the context of a country's overall macroeconomic policy. At various times throughout the Bank's history, monetary policy had to be carefully calibrated so as not to be overwhelmed by other policies. In practice, this has proven to be a key challenge over the years. Thirdly, as noted earlier, the study draws heavily from Central Bank publications. While these provided an invaluable account of the Bank's operations over the years, one may argue that as a consequence the discussions contained within may be skewed towards the Bank's perspective.

[3] https://www.central-bank.org.tt/statistics/handbook-key-economic-and-financial-statistics
[4] See section 4, sub-section iv.

3. The Evolution of Monetary Policy Frameworks Internationally

Before getting into the evolution of monetary policy in Trinidad and Tobago, it may be useful to briefly discuss the changes to monetary policy globally to provide some international context. The conduct of monetary policy internationally has undergone significant changes over the last six decades. In the post-World War II era, major industrialised countries formed the Bretton Woods international monetary system (IMS) to stabilise global trade and financial systems. Monetary policy under the Bretton Woods system was designed to maintain fixed currency pegs to gold, which was deemed the primary international reserve asset under this system (Truman 2017). The US committed to maintain the Dollar's par value to gold and many other countries simply pegged to the US dollar. By the mid to late 1960s, the needs of the global economy had evolved from those of the immediate post-war era. More so, the US faced the dilemma of falling gold reserves (Garber 1993) and the simultaneous need to ensure a certain level of US dollar liquidity domestically and abroad. With the US dollar facing speculative attacks and some countries such as Canada and West Germany breaking off from the G-10 by deciding to float their currencies, the fixed exchange rate element of the Bretton Woods system was abandoned in the early 1970s.

Following the collapse of the gold peg, many advanced industrialised economies began to introduce greater currency flexibility; and monetary policy in these countries began to focus on macroeconomic outcomes, such as inflation and output. Based in part on the monetarist ideology, central banks in advanced economies during the 1970s and 1980s implemented monetary aggregate targeting. Under this framework, central banks would use tools such as reserve requirements, open market operations and interest rates to meet predetermined growth levels in one or more monetary aggregate/s. However, by the late 1980s, central banks in major advanced economies found increasing evidence that the relationship between the money supply, output, inflation and interest rates was becoming less reliable (Estrella and Mishkin 1996, and Mishkin 2000). Some attributed this in part to financial innovations such as bankcard services and money market mutual funds, which had implications for the stability in the demand for money – a key tenet of monetary aggregate targeting.

With the demise of monetary aggregate targeting, central banks turned to inflation targeting as a monetary policy framework. First adopted in the 1990s, inflation targeting is common throughout developed and developing countries. As the name suggests, this involves setting predetermined paths for inflation and using monetary policy instruments to achieve the desired result. Under this framework, central bank monetary policy became much more transparent and accountable than in prior periods. Strong communication with the public is viewed as just as important as conventional tools in inflation targeting frameworks – in contrast to the cryptic communication styles of bygone eras. The adoption of inflation targeting has coincided with relatively steady rates of global inflation (particularly among developed countries), leading many to proclaim the framework's success.

However, inflation targeting is not a 'magic bullet' and there is no one-size-fits-all monetary policy. Many small developing states still utilise fixed exchange rate regimes and monetary targeting is used in several sub-Saharan African countries. Additionally, the success of the inflation targeting framework has been called into question given the challenges major central banks have faced to bring inflation up to target following the Global Financial Crisis, particularly as interest rates reached the zero lower bound. This has led some economists to advance alternative monetary policy frameworks such as price level targeting, nominal GDP growth and nominal GDP level targeting. While these have not gained traction, history will argue that monetary policy will continue to evolve. Just as financial innovations such as Automatic Banking Machines and credit cards influenced monetary policy in the 1980s, crypto assets and blockchain technologies may be the structural shift in the modern era.

4. Monetary Policy in Trinidad and Tobago

i. Monetary Policy in the Pre-B Period (1970-1973)

At the turn of the 1970s, Trinidad and Tobago found itself in a difficult economic and socio-political environment. Although real GDP growth remained positive, oil production plummeted in the early 1970s when compared with output levels achieved at the end of the previous decade. Concurrently, disenchanted with the social and economic status quo, the labour movement engaged in strike action and protests which disrupted productivity and created some concern for national security. To ease tensions the government introduced social programmes, the Unemployment Levy in 1970, and ramped up expenditure to boost employment. With total government expenditure rising sharply, the fiscal deficit ballooned from 1.1 per cent of GDP in 1969 to 6.5 per cent of GDP in 1972.

One of the more immediate concerns facing the Bank in the early 1970s was the rapid decline in external reserves. In addition to lower oil production and higher government spending which may have fuelled import demand, the Bank observed a growing trend in the access of credit by non-residents in the domestic banking system during the late 1960s and early 1970s. These developments coincided with the import cover ratio reaching 1.6 months at the end of 1972 compared with 3.2 months in 1970. To counter these developments, the Bank implemented two major policies that would remain in effect throughout the 1970s: exchange controls through the Exchange Control Act (1970)[5] and the regulation of foreign borrowers in 1970.

The challenging landscape called for some degree of fluidity in the Bank's policy actions. The Bank's main policy tools at the time were the rediscount rate[6], the primary (cash) and secondary reserve requirements and moral suasion. As Farrell (1990) noted, the Bank attempted to use these instruments to influence the term structure of short-term treasuries and commercial banks' interest rates. The rediscount rate was kept at 6 per cent and both the primary and secondary reserve requirements were maintained at 5 per cent in 1970. In response to a build-up of liquidity in the banking system resulting from strong government expenditure and lower international interest rates, the Bank reduced the rediscount rate to 5 per cent in the last quarter of 1971.

However, the Bank had to reverse this course in 1973 as the external position became untenable and inflationary pressures emerged. Lower interest rates along with a greater supply of loanable funds to the domestic economy led to rapid credit expansion in 1972 and 1973, with domestic private sector credit growing by 38.9 per cent and 9.1 per cent, respectively. This placed additional pressures on the external accounts and contributed to double-digit inflation. In response, the Bank raised the primary reserve requirement to 7 per cent, and took the rediscount rate up to 6 per cent. By the end of the year, commercial banks' median prime lending rate had risen to 9.1 per cent from around 6.9 per cent in 1972. The Bank also reduced the level of access to foreign exchange for travelling purposes and the government drew down its reserve (gold) tranche position with the IMF to shore up reserves (Farrell 1990).

ii. The Oil Boom (1974-1982)

Trinidad and Tobago's economic fortunes improved significantly with the onset of rising international oil prices and higher domestic oil production during 1974 to 1982. Real GDP growth averaged just under 6 percent annually between 1974 and 1982, international reserves measured over 12 months of import cover for much of the period and the fiscal accounts swung into surplus. However, buoyant economic activity, strong credit expansion and a decline in the value of the TT dollar vis-à-vis the US dollar gave rise to high inflation, which averaged around 14.5 per cent annually between 1974 and 1982. Accordingly, the Bank had two main objectives at the time: (1) to mitigate inflationary effects; and (2) to allocate credit to the productive sectors of the economy. In the medium to long run, the latter objective could aid with the first.

[5] The Exchange Control Act (1970) gave the Central Bank wide-ranging authority over external transactions, including the holding, allocation and uses of FX.
[6] The rate at which it provided short-term uncollateralised lending to commercial banks.

To dampen price pressures, the Bank continued the monetary policy tightening cycle which began in 1973. In 1974 the Bank increased the primary reserve requirement to 9 per cent and introduced a marginal reserve requirement of 15 per cent on new deposits in 1980. At end-December 1980, the effective statutory reserve requirement had risen to 10.9 per cent of total deposit liabilities. Interestingly, the Bank chose not to adjust the rediscount rate or the secondary reserve requirement. In general, despite elevated inflation, the Bank used its main policy instruments during 1975 and 1980 sparingly, perhaps not wanting to jeopardize the development thrust of the government. Farrell (1990) postulated that the Bank may have been hesitant to *'lean against the wind'* of the fiscal stimulus.

Instead, and in keeping with the developmental agenda at the time, the Bank sought to allocate credit to the productive sectors of the economy. During the period 1974 to 1978 the Bank's main tool to achieve its credit allocation objective was moral suasion, whereby it attempted to persuade the commercial banks to limit the level of consumer lending. An added benefit of limiting consumer lending would have been its potential to constrain spending and mitigate inflation. However, with moral suasion proving somewhat unreliable, the Bank resorted to selective credit controls. Effective November 5, 1979 under section 42 of the Act, commercial banks were instructed to limit personal, non-business lending to a maximum of 25 per cent of new lending. The Bank's strategy did yield some success, in that there was a slowdown in consumer lending and when scaled against nominal GDP, the gap between consumer and business lending widened 1979 **(Appendix II, Figure 1)**.

During this period significant developments were transpiring in the international monetary and exchange system. The British pound (sterling) was losing its dominance as a major reserve currency to the US dollar. In June 1972, the sterling was allowed to float and subsequently depreciated against the US dollar. Being pegged to the sterling, the TT dollar also lost value against the US dollar, moving from TT$1.92/US$ in 1972 to TT$2.44/US$ in 1976. Due to the depreciation of the sterling, imports from the US, now Trinidad and Tobago's major trading partner, became more expensive resulting in an acceleration in domestic inflation. In 1977, Trinidad and Tobago abandoned its peg to the sterling and instead fixed the TT dollar against the US dollar at TT$2.40/US$.

iii. The Economic Depression (1983-1988)

With the price of oil retreating from its peak, there was a sharp turnaround in Trinidad and Tobago's economic fortunes. In 1983 real GDP declined by 10.3 per cent, beginning a seven-year recessionary episode. The unemployment rate doubled from 11.1 per cent in 1983 to 22 per cent in 1988, and import cover declined to 1.1 months of prospective imports by 1988 from the lofty heights earlier in the decade. The fiscal position deteriorated and, along with the country having limited savings[7] and a dramatic fall in GDP, total central government debt to GDP increased from 10.9 per cent in 1982 to 55.5 per cent in 1988. As Farrell (1990) also noted, amidst the deteriorated conditions, the Bank began to state its objectives more clearly in its routine reporting than it had done in the past. During the period 1983 to 1988, the Bank's major concerns were: 1) the sharp loss in foreign exchange reserves; and 2) the continued expansion of bank credit and its implications for financial stability in the context of the difficult economic environment.

The Bank introduced several measures to address the leakage of international reserves. One of the most notable was the system of import budgeting in October 1983 which, in addition to stemming the loss of reserves, was aimed at achieving a better allocation of foreign exchange to productive sectors and building a comprehensive database on imports and importers. The system involved importers applying to the Bank for foreign exchange before placing orders for the importation of goods. The Bank also sought to realign the exchange rate with market conditions and devalued

[7] The Special Funds device was established to save a portion of the oil revenues in the 1970s. However, the savings mechanism was not formalized by legislation and without proper controls, Special Funds appropriations were subsumed as part of expenditure (Farrell 1990).

the TT dollar to TT$3.60/US$ in 1986. Conscious of the need to rein in inflation, the government adopted a two-tiered exchange rate, whereby essential food and medicine would be imported at the previous rate. However, this system proved difficult to administer effectively and, with reserves continuing to decline, the authorities disbanded the two-tiered system in January 1987 and further devalued the currency to TT$3.63/US$.

The Bank also made active use of its domestic monetary policy instruments and selective credit control guidelines. In November 1984, the Bank abolished the 15 per cent marginal reserve requirement on commercial banks' deposit liabilities and, to prevent any immediate surge in credit expansion, simultaneously increased the statutory reserve requirement to 17 per cent from 9 per cent. By 1986, it had become clear that the country was in the midst of a deep recession and the authorities were of the opinion that the time was right for 'careful and selective stimulation of economic activity, led by private sector investment'. In July 1986, the Bank reduced the commercial banks' cash reserve requirement from 17 per cent to 15 per cent of deposit liabilities. To ensure that credit would be channelled to more productive uses, in September 1986, the Bank introduced a new selective credit control guideline instructing commercial banks to limit loans for non-business purposes to, on average, a maximum of 30 per cent of total loans and advances.

However, subsequent economic developments coerced the Bank to limit its economic stimulation policy. Liquidity in the financial system had tightened significantly during the sub-period, prompting banks to borrow heavily from the Central Bank to finance their lending. To discourage heavy commercial bank borrowing, the Bank increased its rediscount rate by 200 basis points to 9.5 per cent in 1988 following the previous hike in 1983. In December 1987, the Bank's 'autonomy' came under question (in the opinion of the author), as the Minister of Finance under Section 50 of the Central Bank Act directed the Bank to reduce the cash reserve requirement of commercial banks to 9 per cent from 15 per cent and simultaneously raise the secondary reserve requirement to 11 per cent, leaving the overall reserve requirement at 20 per cent. With short-term treasuries being eligible assets to be held as part of the secondary reserve requirement, the resources released were immediately absorbed by a $450 million six-month treasury bill, allowing the government access to much-needed funding.

iv. The IMF and Structural Adjustment (1989-1993)

The recession left a legacy of high government debt and exhausted the country's savings. Further, much of the debt profile was short- to medium-term and by 1988 the external debt service ratio was around 22 per cent. Facing increasing challenges to meet its obligations and with just over one month of import cover, the government sort to reschedule its debt and turned to the IMF and the World Bank for assistance. In January 1989, the government entered into a 14-month Stand-by-Arrangement (SBA) with the IMF, beginning the structural adjustment period. The principal objectives outlined in the letter of intent of November 1988 were to: (1) reduce the external current account deficit; (2) lower the public sector deficit; (3) achieve an accumulation of foreign exchange reserves; and (4) restore economic growth.

Monetary policy during this era played a supporting role to the structural adjustment programme. Farrell (1989) highlighted two objectives of monetary policy during the structural adjustment period: (1) eliminating the subsidy on government short-term domestic borrowing; and (2) reducing commercial bank borrowings from the Central Bank. With regards to the former, the Bank sought to rebalance the composition between the primary and secondary reserve requirements. Initially, in 1989 the secondary reserve requirement was lowered to 5 per cent, while the primary reserve requirement was increased to 12 per cent. In January of 1991, the Bank reduced the secondary reserve requirement to zero, and took the primary reserve requirement up to 16 per cent. The lower demand for government paper saw the three-month treasury bill rate jump from 5.1 per cent in 1988 to 9.5 per cent in 1993 – effectively removing the subsidy **(Appendix II Figure 3)**.

The Bank was also decisive in reducing commercial bank advances on its balance sheet. Between October 1991 and January 1992, the rediscount rate was increased on three occasions to 13 per cent. Also in January 1992, commercial banks were instructed to reduce advances outstanding from the Bank and, in November, the Bank announced that it would no longer provide advances to commercial banks. At the end of 1992, the level of Central Bank advances to commercial banks was brought to zero.

A major objective of the structural adjustment programme was to correct external imbalances and accumulate foreign reserves. The authorities' main measures to restore the external balance were the realignment of the exchange rate, restructuring of the external debt and trade liberalization. Prior to the start of the SBA, the Bank devalued the exchange rate to TT$4.29/US$ in 1988. Of significance was the liberalisation of the foreign exchange market in April 1993. This entailed the floatation of the TT dollar and the removal of all exchange controls, which allowed residents to hold foreign currency assets and liabilities in local banks. The guidelines established in 1970 limiting loans to 'regulated borrowers' were annulled in 1993. The floatation of the TT dollar resulted in it losing approximately a third of its value as it ended 1993 at TT$5.73/US$.

v. Maturing Monetary Policy (1994-2008)

After the structural adjustment in the early 1990s, the economy entered into a new age of prosperity during the period 1994 to 2008. This was a transformational era for the economy as well as for the Bank's monetary policy. The country's decisions to invest in natural gas and establish a world-class petrochemical industry in the late 1970s and early 1980s began to reap dividends[8]. As such, Trinidad and Tobago became one of the leading global producers (and exporters) of liquefied natural gas (LNG), ammonia and methanol. These prices were benchmarked to the price of oil, which rose to new heights during the period. As a result, international reserves rebounded to 11.5 months of import cover by 2008 and, learning from the experience of the Special Funds device of the 1970s, the country formalised into legislation a sovereign wealth fund in which significant savings were accumulated. Meanwhile, GDP per capita increased five-fold between 1993 and 2008 and the unemployment rate fell to a historic low of under 5.0 per cent in 2008. Notably during this period and particularly at the turn of the century, high government spending was driven in part by an aggressive capital programme.

As the economy and society developed, the Bank began modernizing its monetary policy framework (Williams, et al., 2005). This involved, inter alia, liberalizing the financial sector and transitioning towards more market-based instruments. As a first step towards this, the Bank repealed all selective credit control guidelines in 1994. Open market operations (OMOs) of treasury bills were introduced in 1996 and two years later the repurchase agreement facility, which provided short-term funding to the commercial banks (collateralized by treasury securities) was established. Treasury notes were added to the OMOs in 2000, and the repurchase agreement rate (Repo-rate) – initially set at 5.75 per cent – was adopted as the Bank's main policy rate in 2002.

The Bank also began to align its policy framework with new international best practices in central banking transparency and accountability. The Bank formalized its monetary policy decision-making framework by establishing the Monetary Policy Committee (MPC) which comprised members of the Bank's senior management team and was chaired by the Governor. Initially, the MPC met and deliberated on the Repo rate and other monetary policy instruments on a monthly basis. Each Repo rate decision was accompanied by a media release which provided insights into the Bank's deliberations. Technical support to the MPC was provided by a Monetary Policy Support Committee[9] (MPSC). Another major accomplishment was the launch of the Monetary Policy Report (MPR) in August 2001. The MPR stated the Bank's monetary policy objectives,

[8] See http://www.energy.gov.tt/our-business/lng-petrochemicals/petrochemicals/

[9] The MPSC comprises senior and technical members of staff across several departments, including from the Research, Statistics and Reserves and Domestic Market Management Departments.

and provided context and insight into the Bank's policy decisions.

Although the non-inflationary economic expansion during 1994 to 2004 created a benign environment for monetary policy operations, excess banking sector liquidity emerged as one of the main challenges for the Bank in the modern era. This build-up in liquidity could be mainly attributed to the sharp rise in government expenditure and the country's income levels while the economy lacked the necessary financial and structural absorptive capacity. As such, the Bank became concerned of the potential inflationary impact that this build-up of excess liquidity could entail and during 1994 to 1997 raised the banks' primary reserve requirement from 16 to 24 per cent, while that of non-bank financial institutions (NFIs) was increased from 6 to 9 per cent. In 1998, the Bank changed the list of liabilities to which the reserve requirement is applied to prescribed liabilities from deposit liabilities, which effectively increased the quantity of reserves banks were required to hold.

With the introduction of OMOs in 1996, the Bank began to gradually reduce its reliance on the reserve requirement as its primary liquidity management tool. In 1998, the Bank reduced banks' reserve requirement ratio to 21 per cent and in 2001 reduced it further to 18 per cent. To prevent regulatory arbitrage, the Bank announced its plan to equate the reserve requirements of banks and non-banks at 9 per cent. As such in 2003 and 2004, two further reductions were undertaken, bringing the banks' requirement ratio down to 11 per cent. In the latter two instances, reserve sterilisation bonds were issued to mop up the resulting liquidity that would have otherwise been released into the system. Meanwhile, the Bank made active use of OMOs to manage liquidity, with outstanding bills and notes increasing from $967 million in 2000 to just over $5 billion by end-2004. However, despite the increased use of OMOs, liquidity averaged $321 million daily during 2001 to 2004 compared with roughly $130 million between 1994 and 2000.
The Bank's new monetary policy framework was put to the test as inflationary pressures emerged during 2005 and 2008. With the economy continuing to expand, there was little doubt that containing inflation was the Bank's primary focus during this period. To signal its more contractionary posture and influence interest rates upwards, the Bank increased the Repo rate from 5 per cent[10] in 2005 to 8.75 per cent by the end of 2008. To support the Repo rate increases and strengthen the monetary transmission mechanism, the Bank also aggressively moved to reduce excess liquidity. However, high government spending as well as constraints imposed when the balances of treasury bills and notes outstanding were at their statutory limits, proved very challenging to successful liquidity management.

Accordingly, the Bank had to be innovative with its approach to liquidity management. During the period 2005 and 2008 an array of liquidity management instruments were utilised, including liquidity sterilization bonds, requested commercial banks' special deposits (remunerated), and a one-time issue of a $500 million Central Bank bill **(Appendix I)**. The Bank also resorted to reintroducing the secondary reserve requirement (remunerated) at 2 per cent of prescribed liabilities in 2006, and increasing the primary reserve requirement by 6 percentage points to 17 per cent in 2008 (Nicholls, et al., 2009). Additionally, though not a liquidity management measure, the Bank would have also sterilized liquidity via the sale of foreign exchange to authorised dealers.

Despite the Bank's efforts, liquidity in general remained high, impeding the monetary transmission mechanism and limiting the impact of monetary policy. While the Bank was relatively successful in increasing short-term treasuries and commercial banks' interest rates, there was limited ultimate impact on key intermediate targets such as private sector credit **(Appendix II, Figure 2)** and ultimately final objectives. Although the Bank did have some success in bringing liquidity levels lower in 2007, between 2005 and 2008 liquidity averaged $474 million daily. As in the past, the Bank's liquidity management was overwhelmed by government spending. Further,

[9] After initially setting the Repo rate at 5.75 per cent in May 2002, the Bank reduced the rate on two occasions, the first by 50 basis points in August 2002 and then by 25 basis points to 5.00 in September 2003.

fiscal policy continued to provide the major catalyst and signal to the rest of the economy, boosting consumer and business confidence and aggregate demand. Accordingly, the Bank found it challenging to contain inflationary pressures, with year-on-year headline inflation averaging 8.8 per cent monthly during this period. While the price increases were mainly driven by food inflation, by the end of 2008, core inflation had also risen to around 7 per cent.

Meanwhile, according to the Bank's MPRs during this period, monetary policy was also geared towards achieving stability in the foreign exchange market. A large portion of foreign exchange (FX) inflows into the economy are derived from energy companies, and tend to be somewhat lumpy. The lumpy nature of these inflows and steady demand over time, create intermittent periods of tightness in the domestic FX market. To smooth these fluctuations and thereby maintain stability in the FX market, the Bank 'intervenes' in the market by typically selling FX to authorised dealers. The Bank's FX strategy kept the TT dollar relatively stable, with it depreciating by around 10 per cent relative to the US dollar between 1993 and 2008.

vi. The Global Financial Crisis (GFC) and Stabilisation Era (2009-2018)

The GFC of 2008 plunged the world economy, particularly advanced economies, into recession and ushered in an era of low global growth which would characterise most of the next ten years. To support their economies, central banks in advanced countries cut interest rates to the zero lower bound and engaged in quantitative easing – what economists now call 'unconventional' monetary policy (Dell'Ariccia, Rabanal and Sandri 2018, and Rudebusch 2018). This coordinated ultra-accommodative policy stance among major central banks remained in force to address the European sovereign debt crisis which emerged around 2012. At the end of 2018, a few central banks were still in the early stages of monetary policy 'normalisation', while others were still providing 'unconventional' support. The weak global economy also had spill-overs to Trinidad and Tobago, with the authorities having to avert a potential financial crisis in the face of CLICO's collapse at the start of 2009.

The global and domestic developments in 2009 saw the Bank reverse its tightening cycle which it began roughly four years before. With international energy prices plummeting and increasing uncertainty in the aftermath of the CLICO fall-out, the Bank judged that the most appropriate course of action for monetary policy was to ease financial conditions. In early 2009 the Bank began to reduce the Repo rate, taking it down cumulatively by 350 basis points during the year. This easing cycle would continue, with the Bank lowering the rate on a gradual basis to a historic low of 2.75 per cent by September 2012 and then holding it at this level for the next 24 months. As a result, interest rates in the banking system fell to record lows **(Appendix II, Figure 3)**. In hindsight, the data would justify the Bank's policy action. The domestic economy contracted by around 4.5 per cent in 2009 and growth would remain sluggish over the next ten years despite accommodative financial conditions. Meanwhile, inflation fell off significantly in 2009, only to rebound again driven by sharp food price increases between 2010 and 2013. However, for much of this period (2009–2014), core inflation (measured on a year-on-year basis) was steady, averaging just over 2.5 per cent monthly.

During this sub-period the Bank also had to contend with excessively high levels of liquidity in the commercial banking system **(Appendix II, Figure 4)**. Although comfortable liquidity levels would aid the accommodative policy stance, at the same time, the Bank was wary of the negative implications and the difficulty to subsequently contain liquidity if it got too high. Once again, liquidity was driven by government expenditure, which increased from around 27 per cent of GDP in fiscal year 2007/08 to 35 per cent of GDP in 2013/14. Further complicating liquidity management

were the statutory limits on treasury bills and notes, which were reached around 2008 after previously being increased in 2006. As in the past, the Bank employed a mix of liquidity sterilisation bonds[11] and commercial banks' requested fixed deposits to help contain liquidity **(Appendix I)**. It is notable that the Bank did not adjust the primary and secondary reserve requirements.

International and domestic factors began to warrant a review of the Bank's monetary policy stance in 2014. Internationally, the US Federal Reserve (Fed) signalled that a shift away from its ultra-accommodative policy position was on the near-term horizon, prompting the 'taper tantrum' in mid-2013. While this knee-jerk market reaction may have been unwarranted, the key message from the Fed was that the era of easy financial conditions in the US would eventually come to an end. Meanwhile, signs emerged that a recovery was taking hold domestically, with key indicators of non-energy sector activity showing favourable performances over 15 consecutive quarters between Q2:2011 and Q4: 2014. These factors combined with a pick-up in inflationary pressures (largely food driven) prompted the Bank to increase the Repo rate by a cumulative 50 basis points in the latter half of 2014.

However, precipitated by another sharp decline in energy prices, a shift in the domestic economic environment was beginning to take shape by the end of 2014. Compounding the drop in energy prices, which unlike the previous shock remained at relatively low levels for much longer, was a steady decline in domestic energy production. As such, economic activity weakened and inflation became very benign between 2015 and 2018. At the same time, the supply of FX to the domestic market fell considerably while demand held steady, prompting the Bank to increase its sales of FX to the domestic market by drawing down on its foreign exchange reserves. With international interest rates expected to increase and cognizant of additional pressures on the foreign exchange market (and foreign reserves) if TT-US interest rate differentials dropped too low, the Bank decided it most appropriate to continue the cycle of policy rate increases into 2015, with the Repo ending the year at 4.75 per cent.

With it becoming apparent that economic conditions had deteriorated and that the energy price shock was not transitory, the Bank had to pause its cycle of Repo rate increases during the better part of the next three years (2016–2018)[12]. It must be noted that with the Repo rate at 4.75 per cent, the Bank did not consider monetary policy as tight, but rather as neutral. Meanwhile, during 2014 to 2018, liquidity management was aided by an increase in the limits on the net issue of treasury bills (from $15 billion to $30 billion) and notes (from $5 billion to $15 billion)[13] as well as lower government spending due to the fiscal consolidation effort following the energy price shock. Government spending was reduced by 18.5 per cent between fiscal year 2014/15 and 2017/18. Accordingly, liquidity was brought down to more manageable levels during 2015 to 2018 **(Appendix II, Figure 4)**. The Bank was also able to let commercial banks' requested deposits, which at peak totalled $6 billion, to mature without roll over and dropped the secondary reserve requirement to zero **(Appendix I)**.

There were also notable changes to the Bank's monetary policy decision making process during 2013 and 2018. In 2013, the Bank moved from monthly Repo rate deliberations to bi-monthly deliberations and the MPC began to meet according to this cycle. This shift allowed the MPC to base its monetary policy decisions on a wider array of information, since updates to many economic indicators critical to the decision making process were not available on a monthly basis. Two external members (non-Bank employees) from the private sector and academia were also added to the Committee in 2013, but

[11] The Treasury Bonds Act was passed in 2008. Bonds under this Act are for the sole purpose of liquidity sterilization and there are no statutory limits to the issue of bonds under this Act. Before the passage of the Treasury Bonds Act (2008), liquidity sterilization bonds were issued under the Development Loans Act.

[12] The Bank raised the Repo rate by 25 basis points to 5.00 per cent in September 2018, citing concerns over TT-US interest rate differentials, which had turned negative on short-term (three-month) government securities.

[13] Parliament approved the increases in access limits in December 2013, but only until they were gazetted in 2014, could they be operationalized.

the Bank reverted to internal membership of the MPC in 2017. Additionally, from 2018, Repo rate decisions were made on a quarterly basis.

The Bank's foreign exchange policy remained consistent with the past. Facing increasing tightness in the FX market, the Bank moved to increase the transparency and predictability of its interventions. This action would provide market participants with some degree of comfort that a certain level of FX would be made available on a regular basis. Additionally, following a directive from the Minister of Finance, the exchange rate was allowed to depreciate by around 7 per cent vis-à-vis the US dollar in 2016.

5. Preparing for the Future

It is reasonable to attest that the Bank has been an active contributor to Trinidad and Tobago's economic landscape over the past five decades. This review of the Bank's monetary policy operations showed the Bank's willingness and ability to respond and adapt to the economic environment of the day. Further, for most of its history, the Bank has implemented monetary policy in an attempt to smooth economic fluctuations and address whatever it deemed as the major threat to the economy at the time, be it low growth, high inflation or a deterioration in the country's foreign reserves.

As the Bank celebrates its 55th anniversary in 2019, this introspection of its monetary policy operations reveals some issues that may require careful deliberation going forward. Two of the more readily identifiable issues involve re-examining the Bank's core objectives and the conduct of monetary policy in an environment where the government plays an important economic role. With regards to the former, at certain points over the last 50 years, the Bank seemed pulled in different directions, which could have limited its overall effectiveness. In retrospect, during the boom period of the 1970s, the Bank appeared torn between trying to address high inflation and the country's development agenda. More recently, in 2014–2018, the Bank's deliberations were also split between supporting the domestic economy on one hand and mitigating pressures on the external accounts on the other. With the Central Bank Act laying the foundation for this broad mandate, one obvious question is whether the Bank's monetary policy could benefit from a narrower and better defined focus.

Throughout its post-independence history, the central government has been a key force behind Trinidad and Tobago's economic development. Although this has resulted in economic gains over the years, fiscal policy has sometimes hampered the effectiveness of the Bank's monetary policy. This has wide-ranging implications for the Bank's toolkit as well as the monetary transmission mechanism. The most obvious example is the Bank's struggles to contain liquidity in the face of government spending. OMOs have been consistently overwhelmed by net domestic fiscal injections, resulting in the Bank frequently seeking increases to the statutory limits on the net issue of treasury bills and notes. Hence a review of the Bank's liquidity management tools with perhaps an assessment of the benefits to removing the statutory limit on the issue of short-term treasuries may be warranted. Additionally, consistent with findings from more detailed studies (Cheong & Boodoo, 2008) on the topic, this review has illustrated that private sector credit (one of the Bank's key intermediate target variables) has often proved unresponsive to domestic interest rates. At this time, the Bank may wish to re-examine its choices of intermediate variables and more broadly identify the channels of monetary transmission that may be the most appropriate for the domestic economy. In this context, the Bank's role in exchange rate policy should also be clearly defined.

As the Central Bank prepares to chart the next 55 years, these and other issues are high on its strategic agenda. Under the Bank's five-year strategic plan 2016/17–2020/21[14], efforts to enhance the monetary policy framework including strengthening liquidity management will be undertaken. The Bank is also working towards modernising its communication strategy in the information age. It is paying close attention to new and exciting financial technologies which hold tremendous opportunities, but may also pose challenges for monetary policy. While the future is always uncertain, as in the past, the Bank stands ready to contribute positively to the economic and financial landscape of Trinidad and Tobago.

[13] https://www.central-bank.org.tt/about/strategic-plan

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Appendix I

Key Liquidity Management Tools[1], 2005–2018

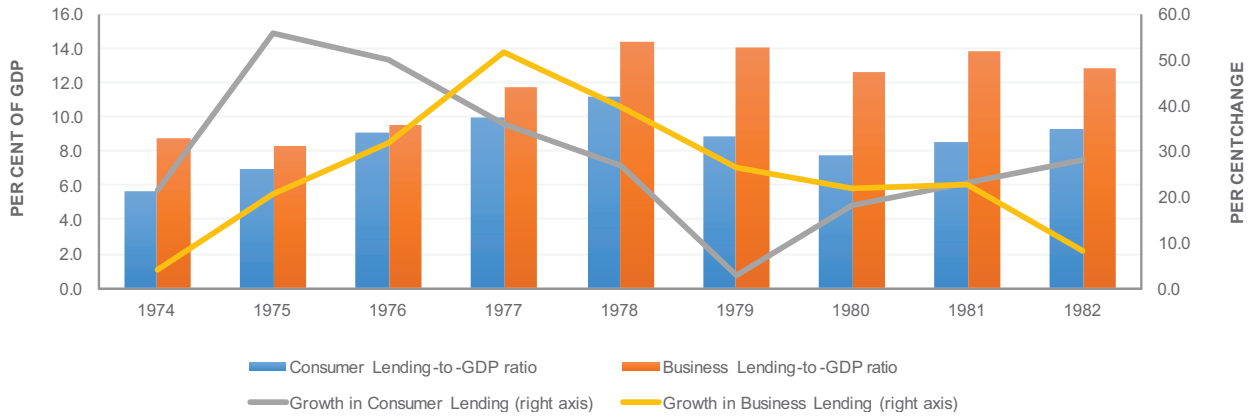
End of Period	Primary Reserve Requirement Ratio (%)	Secondary Reserve Requirement Ratio (%)	Net OMOs Outstanding (TT$ Mn)	Liquidity Sterilizations Bonds (Issues, TT$ Mn)	Requested Commercial Banks' Deposits (Balances, TT$ Mn)
2005	11	0	6,428.4	-	1,000.0
2006	11	2	7,054.7	700.0	1,500.0
2007	11	2	13,934.5	1,692.3	1,500.0
2008	17	2	19,200.0	1,200.0	1,500.0
2009	17	2	18,740.0	-	3,500.0
2010	17	2	18,543.2	-	4,500.0
2011	17	2	19,200.0	-	4,500.0
2012	17	2	18,939.9	-	5,990.0
2013	17	2	19,200.0	1,559.3	5,990.0
2014	17	2	30,634.6	1,000.0	6,000.0
2015	17	2	28,302.4	-	2,500.0
2016	17	2	29,259.5	-	1,500.0
2017	17	2	22,134.3	-	0.0
2018	17	0	23,085.4	-	0.0

Source: Central Bank of Trinidad and Tobago

[1] Excludes a $500 million Central Bank Bill issued in November 2008.

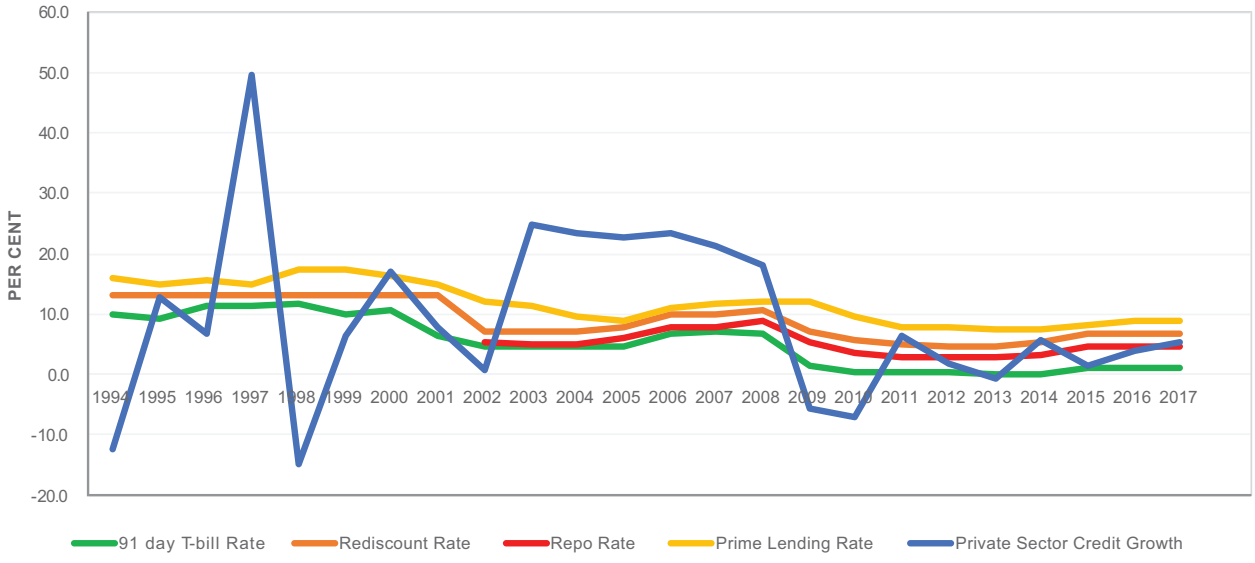
Appendix II

Figure 1: Commercial Banks' Lending to the Private Sector



Source: Central Bank of Trinidad and Tobago

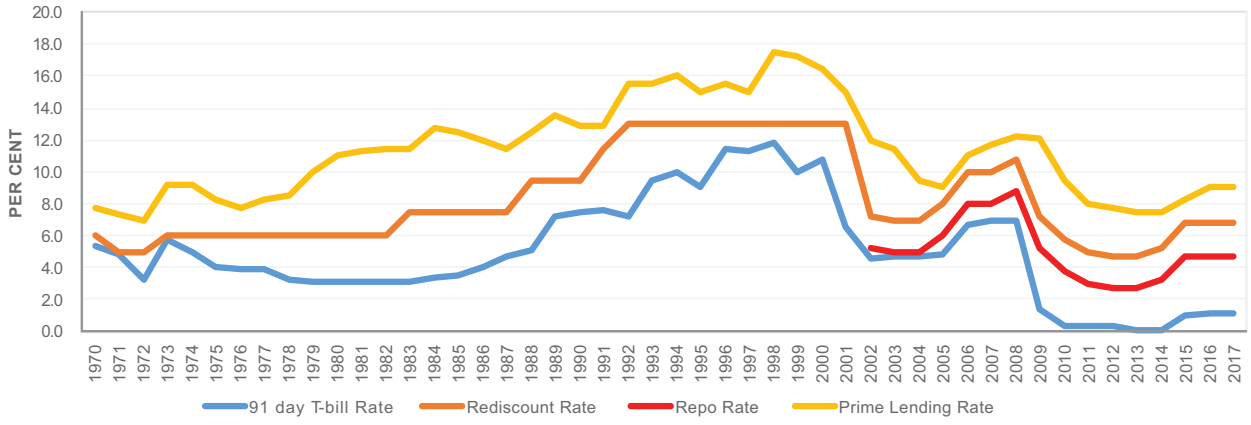
Figure 2: Policy Rates, Market Interest Rates and Private Sector Credit Growth



Source: Central Bank of Trinidad and Tobago

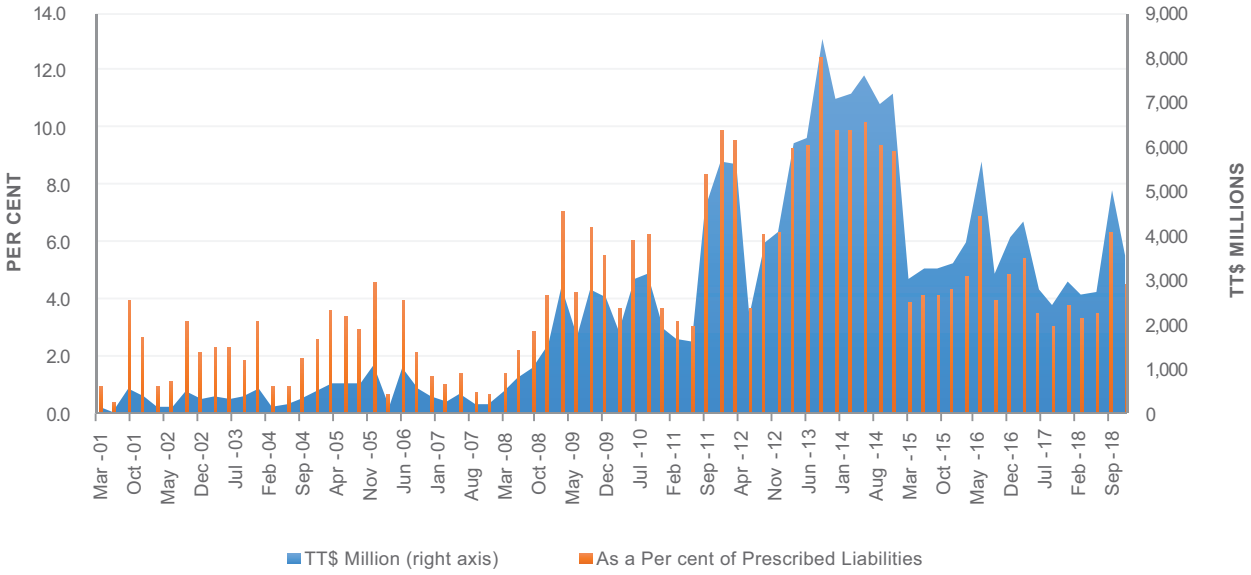
Appendix II (Continued)

Figure 3: Selected Domestic Interest Rates



Source: Central Bank of Trinidad and Tobago

Figure 4: Commercial Banks' Excess Reserves



Source: Central Bank of Trinidad and Tobago

Energy Price Shocks and Monetary Policy Responses: The Central Bank of Trinidad and Tobago and Its Operational Sphere

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Abstract

The objective of this paper is to investigate if the Central Bank of Trinidad and Tobago (CBTT) wields significant influence in its operational sphere i.e., short-term financial markets where the CBTT can affect Bank conditions via its operational tools. Determining the influence of the CBTT is done by assessing the extent to and manner in which the CBTT's operational tools mitigate the pass-through of a large negative energy price disturbance to short-term financial markets. The study applies a Bayesian VAR model to daily financial data over the period January 2007 to December 2017 in order to identify the very short-run effects that energy price and monetary policy variables have on short-term financial markets in Trinidad and Tobago. Overall the model demonstrated that the CBTT has substantial influence on the domestic financial market in response to an energy price shock, but also that the response is limited by some traditional small open economy constraints.

1. Introduction

Small economies are characterized by their vulnerability to exogenous shocks. Economic disturbances generated by the actions of larger economies are transmitted through various channels, impacting smaller economies, often with severe consequences. The concern of monetary authorities in many small economies often centres on managing the impacts of various exogenous shocks, especially since these shocks tend to have an effect on the external accounts of the smaller country. One category of exogenous shocks originates from changes in economic policy in other countries, particularly those which issue reserve currencies. Other shocks can originate in the financial sectors of larger countries and can severely impact smaller economies which hold foreign reserves. Finally, shocks to international commodity prices, or terms of trade (TOT) shocks, can adversely affect commodity producers, some of which are small open economies.

The Trinidad and Tobago economy experienced three major TOT shocks over the past four decades. Each was characterized by large adverse changes to energy prices. The first TOT shock occurred in the mid-1980s following the nation's first oil boom in the mid-1970s to early-1980s; the second accompanied the 2008 global financial crisis; and the third and most recent in 2014-2015 resulted from global oversupply and declining demand in crude oil markets. Large changes in oil prices have been historically difficult to forecast (Beckers and Beidas-Strom, 2015), and each price shock can have differing effects on financial markets and macroeconomic conditions, depending on the underlying monetary and

fiscal arrangements of the economy. For example, oil-exporting countries with flexible exchange rate regimes can undergo currency depreciations when oil prices fall. If the depreciations are steep and uncontrolled they can result in substantial inflation. On the other hand, in oil-exporting countries with fixed or managed exchange rate regimes, monetary policy may be constrained in responding to external shocks and fiscal policy may be required to partially or wholly absorb the shock by reducing expenditure or running budget deficits.

A central bank's goal is widely accepted as maintaining stable macroeconomic conditions by taking actions within its operational sphere. The operational sphere of a central bank is defined in this study as markets where the bank acts as a participant, and can affect conditions in those markets via the use of direct or indirect tools. Most central banks manipulate some monetary policy instrument to achieve macroeconomic outcomes – as measured by an inflation level or output growth – and financial stability, which can be measured by a range of financial stability indicators. Additionally, in small open economies, external conditions are often reflected by some indicator of foreign currency market or interest parity condition. In the post-Liberalisation era[1] many central banks adopted indirect instruments to achieve this goal. The operational sphere of a central bank in this scenario allows it to influence interest rates, banking system liquidity, and foreign exchange market conditions, through its role as the primary issuer of the instruments used to govern behaviour in the relevant markets.

In 1998, the CBTT began to use Open Market Operations (OMOs), through the sale of Treasury Bills (an indirect instrument), as its primary monetary policy tool to manage liquidity levels while it de-emphasised the use of Reserve Requirements (a direct instrument). Subsequently, in 2002 the Bank introduced a short-term Repurchase facility to influence short-term interest rates. These are therefore the tools the Central Bank has to address the effects of exogenous shocks. In responding to such shocks the Central Bank would adjust its operations in the markets associated with these instruments, in a direction that is expected to maintain macroeconomic stability. This implies that these policy instruments operate through influencing the behaviour of the financial sector. Thus, the use of indirect instruments by the Central Bank must affect the behaviour of the financial sector before transmitting to any other economic sector. Mishkin (1996) outlined several channels via which monetary policy can affect the financial sector and pass through to the rest of the economy.

Numerous studies have assessed the impact of oil price shocks on financial markets and macroeconomic conditions in small open energy-exporting economies. However, few have examined the short-run effects of central bank monetary policy actions in response to declining oil price shocks in such economies. This paper, therefore, investigates whether the CBTT wields significant influence in its operational sphere – short term financial markets – by assessing the effects of an energy price shock and evaluating the responses of monetary policy to these changes. Specifically, the paper examines the very short-run effects of an exogenous oil price shock and assesses the effectiveness of monetary policy using a Bayesian VAR model with the following variables: West Texas Intermediate spot oil price (WTI), net sales of foreign exchange, government balances, the level of excess reserves, open market operations, the domestic treasury term spread, trading volumes of the All T&T Stock Market Index (ATI), foreign currency interventions by the Central Bank, the Repo Rate, and TT-US exchange rate. The paper does not, however, assess pass-through to the rest of the macroeconomy. This was, however, treated with in Edwards (2015).

The remainder of the paper is organised as follows: Section 2 surveys the literature on exogenous oil price

[1] The era from the mid-1970'\s to the mid-1980s following the end of the Bretton Woods currency arrangement, and including the Debt Crisis period that affected many small open economies.

shocks and monetary policy. Section 3 examines the trends in the indicators employed. Section 4 explains the methodology and defines the indicators used. Section 5 describes the empirical results while Section 6 discusses them. Finally, section 7 concludes the paper and provides some policy recommendations.

2. Literature Review

Numerous studies have explored the effects of oil price shocks on energy exporters and importers, and on monetary and financial conditions; however, there is limited research on small open economies that feature a managed exchange rate system similar to Trinidad and Tobago. There are even fewer studies on the short-run financial sector impacts from world oil price shocks. The literature reviewed below provides an understanding of the dynamic relationship between energy price shocks and changing economic conditions, with a focus on monetary conditions and capital markets.

Taking off from the widespread debate surrounding the effects of oil prices on the macroeconomy in the early 1990s, Bernanke et al (1997) hypothesised that the large effects of oil price shocks on the economy were actually largely due to the effects of monetary policy responses to these shocks in most cases. The paper disaggregates this identification problem with a battery of Vector Auto-regression (VAR) models. However, the focus was on the United States, an oil-importing economy. For resource-exporting countries, Ferrero and Seneca (2015) evaluated an optimal monetary policy framework and concluded that a fall in oil prices will slow the economy; however, a sharp depreciation of the exchange rate will trigger inflation forcing a central bank to counter by increasing the key policy rate at the cost of deepening the economic slowdown.

Using a panel VAR technique to examine 40 oil-exporting countries, Koh (2016) determined that in response to a fall in oil prices, output and government consumption declined. However, the response was smaller and smoother in countries with flexible exchange rates as an immediate depreciation offsets the fall in fiscal expenditure. On the other hand, oil-exporting countries with fixed exchange rates experience small and delayed real exchange rate depreciations with the majority of adjustments occurring through fiscal contractions. The study further highlighted that there is some statistical evidence, albeit weak, that "a fall in output and government consumption in countries with oil-based sovereign wealth funds is more muted as these funds provide fiscal space to finance budget deficits".

Examining the channel through which monetary policy operates, and its connection to equity markets, Degiannakis, Filis and Arora (2017) concluded that increasing oil prices push up inflation and short-term interest rates, which directly impact stock market returns via two effects. The first is by increasing borrowing costs for firms, resulting in the second, namely, fewer profitable or feasible projects. On the other hand, for oil-exporting economies, Degiannakis, Filis and Arora (2017) determine that through the fiscal channel, "increased oil prices tend to lead to a transfer of wealth from oil-importing economies to oil-exporting ones", stimulating government expenditure in countries which benefit from oil price increases. This can have either of two effects: if government spending and consumption are complements, household expenditure and firm profitability will increase, driving up stock prices. However, if government spending and consumption are substitutes productive private capital may be "crowded out", and stock prices may be depressed.

Examinations of oil price shocks on the stock markets of oil-exporting Gulf Corporation Council (GCC)[2] nations reveal differing results. Using Wavelet analysis, Rizvi and Masih (2014) cautiously deduce that "being

[2] The Gulf Corporation Council (GCC), now known as the Corporation Council for the Arab States of the Gulf, is a regional, intergovernmental, political and economic union consisting of the United Arab Emirates (UAE), Qatar, Saudi Arabia, Kuwait, Oman and Bahrain.

heavily reliant on one commodity for a country does not expose its stock markets blindly to price shocks of that commodity". Their analysis found that for Saudi Arabia and Oman, there were no definitive impacts on the stock market in short or longer lag periods while Kuwait exhibited a longer-term impact. On the other hand, the shock impacted the UAE over a lag of 128 days, while Qatar and Bahrain experienced impacts over lags shorter than 30 days. However, employing a simple linear and non-linear examination, Arouri and Fouquau (2009) found that the stock markets in Qatar, Oman, and UAE reacted positively to oil price increases while those in Bahrain, Kuwait, and Saudi Arabia were minimally affected. A further study by Arouri, Lahiani, and Nguyen (2011) using a VAR-GARCH model confirmed the "existence of significant volatility spill-overs" from oil to stock markets in three out of six GCC countries.

Further examination in the Middle East and North Africa (MENA) region by Hesse and Poghosyan (2009) revealed through a panel GMM model that oil price shocks affected commercial bank profitability. Profitability in this case was boosted through improved capitalisation (ratio of equity to total assets) and liquidity (ratio of liquid assets to deposits), but it was undermined by lower bank efficiency[3] owing to oil price shocks. These effects are, however, indirect and pass through to banks via the effect of the oil price on inflation and the fiscal balance. Studies on the impact of energy price shocks on emerging economies also cover a number of macroeconomic and related monetary policy implications. Tang, Wu, and Zhang (2009) apply a structural VAR model to determine that positive oil price shocks negatively impact output and investment in China, while inflation and interest rates are positively affected. Their paper then highlights that flexible exchange rates and oil fund reserves have shock-absorbing properties and act as "macroeconomic stabilisation tools to insulate oil exporters from adverse oil price shocks".

Using a VAR framework, Riman, Akpan, and Offiong (2013) revealed that the Nigerian economy suffered from the "Dutch Disease", whereby an oil price shock positively and immediately impacted government expenditure; however, public investment, private investment and industrial production all responded negatively to the oil price shock, declining further through the year. Despite an increase in oil revenue, the economy did display an increase in domestic growth. On the other hand, using VAR and Vector Error Correction (VECM) models, Nchor, Klepáč, and Adamec (2016) concluded that in Ghana, a negative oil price shock resulted in a weaker long-run effect on government expenditure compared to a positive shock, while imports did not respond in the short run, but did in the long run. This suggests that Ghana's demand for imports had a delayed reaction to a fall in energy revenue, similar to the situation in the Trinidad and Tobago economy which manifested in persistent demand for foreign currency following the oil price declines over 2014 and 2015. This effect is explained in the study by Jbir and Zouari-Ghorbel (2009) who employed a VAR model and determined that an oil price shock on the Tunisian economy affects economic activity indirectly as it can be transmitted largely through government spending and subsidies. Their study infers that during a negative oil price shock, maintaining a certain level of government expenditure and supporting the domestic economy through frequent foreign exchange interventions may provide short-term support to the import industry.

With respect to the Latin American and Caribbean region, Bejarano, Hamann and Rodriguez (2015) found that for Colombia, a negative and permanent oil shock reduces disposable income permanently, causing a permanent fall in demand for non-tradable goods. They indicate that this should result in permanent real exchange rate depreciation, while nominal exchange rate depreciation will partially compensate for the fall in value of exports.

[3] Bank efficiency in this context is used as a proxy measure indicating how well banks manage their total costs relative to their income (Hesse and Poghosyan 2009).

However, the pass-through of nominal depreciation to inflation calls for a monetary policy response, which in the presence of nominal rigidities in non-tradable sector intensifies the fall in economic activity. Furthermore, Bejarano, Hamann and Rodriguez (2016) demonstrate that macroeconomic effects vary according to the degree of persistence of oil price shocks in oil-exporting economies. This is especially true where the main channels through which oil price shocks pass to the economy stem from the "real exchange rate, the country risk premium, and sluggish price adjustments". They explain that a sudden reversal in oil prices results in the reallocation of resources with asset prices and currency being negatively affected. With a more permanent decline in oil prices, long-term changes would have different macroeconomic consequences.

An important study on the Trinidad and Tobago economy by Watson (2003) explained that domestic monetary policy has limited applicability with respect to fostering macroeconomic stability in the context of the effect of energy price fluctuations. Considering that the economy is dependent on energy sector revenue, "monetary policy may be used to do fine tuning" where it will "smooth out minor fluctuations and maintain an environment of stability conducive to the conduct of economic activity".

In summary, the literature generally speaks to a decline in output and government expenditure following a negative shock to oil prices. Additionally, some studies suggest that imports tend to react to such shocks with a lag, while the impact on equity markets appears to be varied. The studies also show that the choice of foreign exchange regime can be very influential in the country's reaction to oil price shocks, and the availability of oil-funds, or accumulated reserves can have beneficial shock-absorbing properties.

3. Stylised Facts

In this section some of the variables identified as part of the operational sphere of the Central Bank, and how they historically relate to energy prices, are reviewed.

In the run-up to the global financial crisis, rising global demand and numerous supply disruptions resulted in oil prices increasing dramatically, to over US$145 per barrel WTI in July 2008. However, the substantial fall in global economic activity and tighter credit conditions during the crisis weakened commodity prices resulting in the WTI price per barrel plummeting to US$34 in February 2009. Following the global financial crisis, the aggressive stimulus packages employed by governments pushed economies into recovery. As inflation expectations grew and credit conditions improved, energy prices increased and crude prices averaged just under US$100 per barrel over 2011 to 2014. By the second half of 2014, however, oil prices began to tumble once more. The main driver in this instance was the Organisation of Petroleum Exporting Countries' (OPEC) decision not to cut production resulting in rising oil inventories and a substantial oversupply. Subsequently, WTI prices plunged to as low as US$26 in early 2016 and averaged under US$50 over 2015 to 2017.

Government spending, of course, is not part of the operational sphere, but it plays an important part in determining behaviour in the domestic financial sector. Domestic central government balances are generally a function of energy prices and energy sector revenue. Central Government balances, given by net domestic fiscal injections (NDFI[4]) fluctuated around a constant level between 2007 and 2014, suggesting that despite changes to the oil price, fundamental fiscal behaviour was consistent. NDFIs veered into the territory of 'net

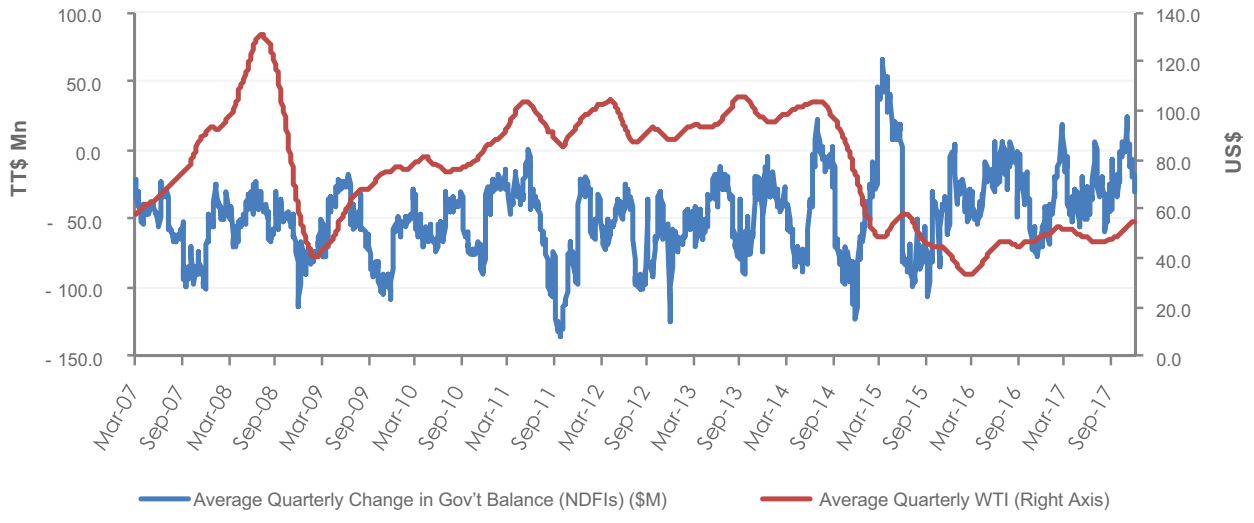
[4] NDFIs are the net of domestic fiscal expenditure and domestic revenue raised plus the net of bond redemptions. When domestic expenditure exceeds domestic revenue, there are 'fiscal injections'. When revenue exceeds expenditure domestically, there are 'fiscal withdrawals' from the financial system.

withdrawals' after mid-2014, as lower energy sector revenues restricted government expenditure, reducing fiscal injections into the system.

Following foreign exchange market liberalisation[5] and subsequent floating of the exchange rate in 1993, the Bank's main objectives were modified to: achieving domestic price stability and a stable local foreign exchange market. Foreign exchange stability would be achieved through the effective timing of foreign exchange interventions by the Central Bank **(Chart 2)**. Conditions in the foreign exchange market are related to energy price developments. As the price of oil increased before the financial crisis, net sales of foreign exchange by authorised foreign exchange dealers fell sharply while interventions by the Central Bank remained relatively low, suggesting that domestic demand was met mainly by inflows from the energy sector. However, during the 2008/09 crisis as oil prices plunged, net sales increased substantially and foreign currency interventions by the Central Bank increased in an effort to cover the market's shortfall. This pattern was repeated after the 2014 decline in oil prices. Net Sales of foreign exchange to the public are generally positive, meaning that authorised dealers' outflows to the public exceed inflows from the public in most conditions, implying the state of the forex market is permanently tight and will remain sensitive to energy price shocks.

Given the influential nature of the energy sector on the

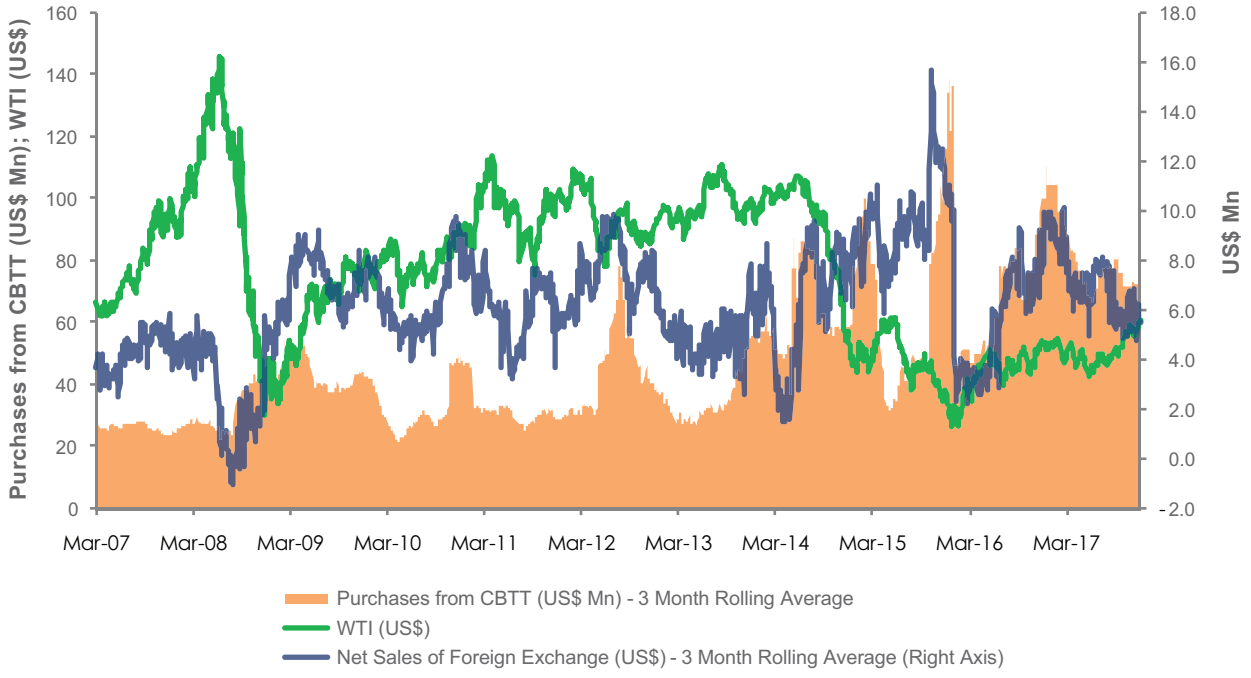
Chart 1: Trends in NDFIs and WTI



Source: Central Bank of Trinidad and Tobago

[5] The Monetary and Financial Market Chronology states that "on 12th April, 1993, the President of Trinidad and Tobago made an Order under Section 23(1) of the Central Bank Act proclaiming that the par value of the Trinidad and Tobago dollar in terms of the United States dollar would be based on prevailing market rates" (CBTT, 2005).

Chart 2: Trends in the Foreign Exchange Market



Source: Central Bank of Trinidad and Tobago

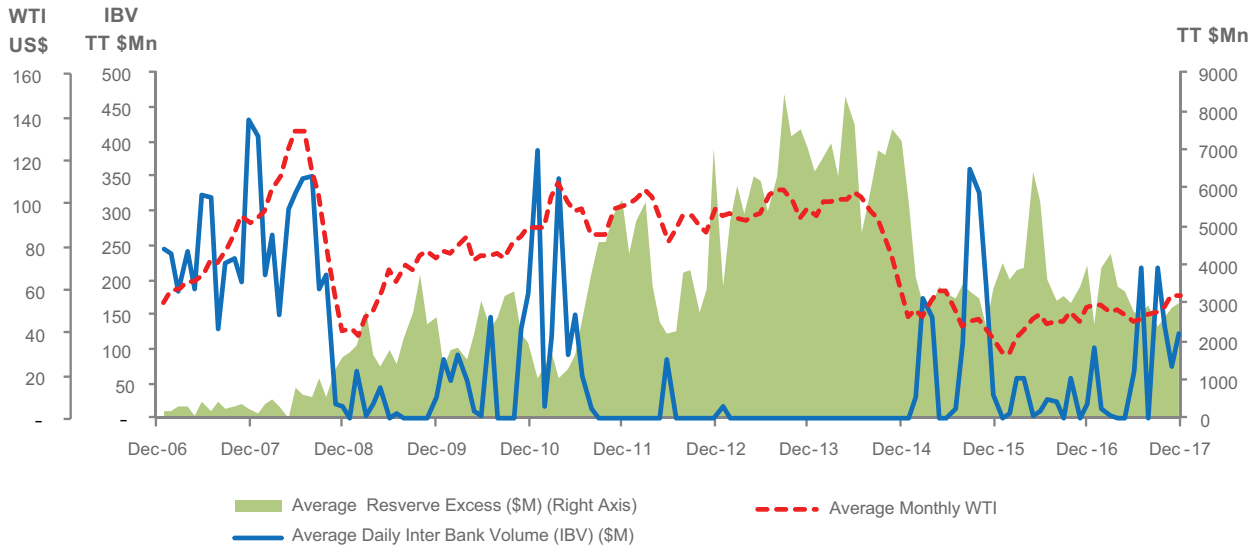
domestic economy, the Bank relies on its major policy and operational tools to keep price and foreign exchange market stability in line with domestic economic objectives. The main policy instrument, the Repo rate[6], is used to signal the direction of interest rates. Open Market Operations[7] is a major tool in absorbing excess liquidity from the system. The inter-bank market for overnight funding is where commercial banks can access short-term finance from each other, and its activity levels are reflective of liquidity conditions. Before the financial crisis, rising oil prices and robust economic growth induced inflation, which influenced the Central Bank to curb inflationary pressures by maintaining the Repo rate at around 8 per cent, and also by maintaining low excess system liquidity which generated the need for inter-bank borrowing **(Chart 3)**.

Eventually economic activity fell substantially, and the Central Bank adopted a more accommodative position by reducing the key policy rate, and by allowing excess liquidity to increase, which reduced inter-bank activity. Once global economic recovery set in, rising energy

[6] The Monetary and Financial Market Chronology states that "in May 2002, the Central Bank introduced a new framework to implement monetary policy which featured an announced overnight interest rate for Central Bank repurchase operations. The Central Bank would routinely conduct open market operations at these rates, in an attempt to keep money market yields, such as overnight inter-bank interest rates, close to the repo rate" (CBTT, 2005).

[7] The Monetary and Financial Market Chronology indicated that in November 1998, the Central Bank enhanced the efficiency of open market operations by establishing a system of primary dealers who would be guided by an Agreed Minute for the Operation of Primary Dealers (CBTT, 2005).

Chart 3: Trends in Inter-Bank Activity and Commercial Bank Excess Reserves



Source: Central Bank of Trinidad and Tobago

prices resulted in increasing foreign currency inflows and growing excess liquidity. However, domestic economic conditions did not improve as anticipated and growth remained sluggish. As such, the Central Bank further maintained its accommodative interest rate and liquidity position until 2014 when the decision was taken to move from accommodation to policy neutrality. Unexpectedly, in 2014, the fall in energy prices once again sent the domestic economy into a decline. The Central Bank kept the Repo rate neutral while maintaining excess reserves within a target range through OMO[8] operations.

Over the period examined, the local equity market exhibited various changes **(Chart 4)**. Following its formation in 1981, the domestic stock market experienced numerous swings; however, overall the market grew substantially. Before the financial crisis, the ATI[9] volume displayed upward volatility, possibly due to increasing energy prices fuelling trading activity in addition to the absence of major institutional investors stemming from a regulatory impact[10] in 2005. Conversely, during this period, the Central Government term spread[11] remained relatively stable, supported by low interest rates and excess system liquidity. During the crisis, while energy prices were plummeting, the term spread displayed a declining trend, suggesting a flattening of the yield curve. Simultaneously, trading volume on the domestic exchange fell off substantially. After the crisis, as the economy was entering a slow recovery mode, the Central Bank adopted an accommodative position, resulting in falling short-term rates.

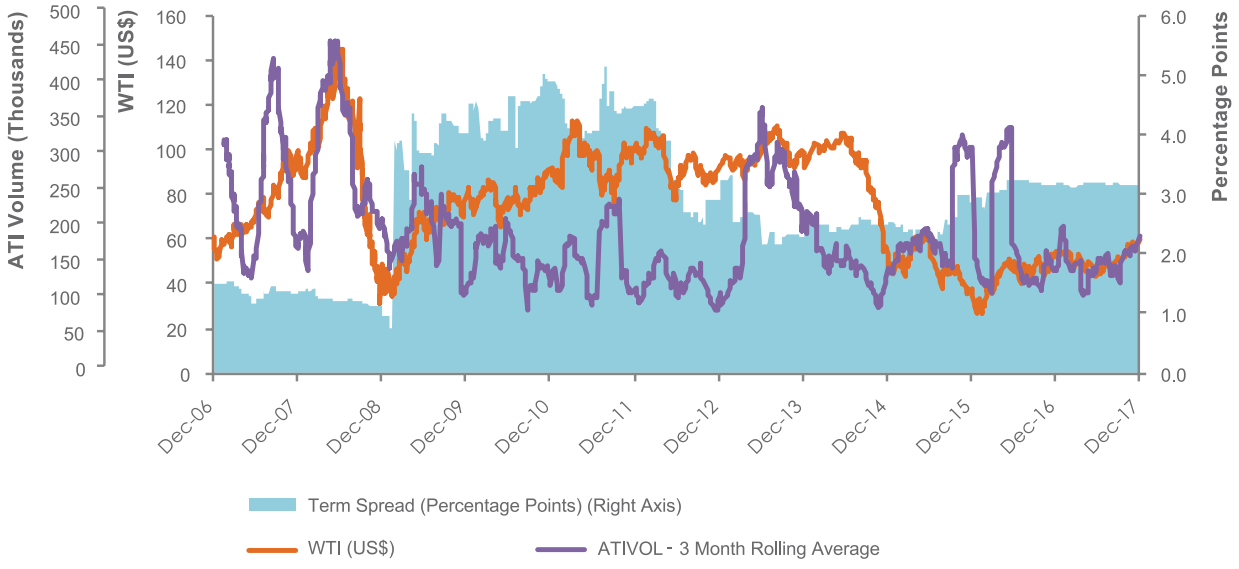
[8] Legislative limits on the issuing of Treasury Bills and Notes were increased in 2013 and the additional operational space started to be deployed by 2014.

[9] The All T&T (ATI) index represents ordinary shares on the domestic exchange that are domiciled in Trinidad and Tobago.

[10] A new regulatory requirement for pension funds which exceeded the 50 per cent limit on equity assets resulted in the funds reducing their equity holdings to within the statutory limits. In the 2005 Stock Exchange Annual Report, then Chairman Mc Eachrane mentioned that, "the limits were exceeded mainly (but not only) by robust increases in market values in recent years. The effect is dramatic, because institutional investors represent some 80 per cent of the investor market, who are now sellers rather than buyers" (2005).

[11] The domestic term spread refers to the difference between the 3-month Treasury rate and 10-year Central Government bond yield.

Chart 4: Trends in the Sovereign Term Spread and Stock Market Trading



Sources: Central Bank of Trinidad and Tobago and Trinidad and Tobago Stock Exchange

At the same time, inflationary expectations stemming from increasing energy prices buoyed longer-term rates, allowing the term spread to expand. Eventually, the low interest rate environment and sluggish economic activity resulted in a narrowing of the term spread. During this time and, despite the jumps in volume traded in 2013 and 2015 due to some public share offerings, the ATI volume traded remained relatively low due to subdued economic conditions. Following the 2014 energy price shock, the Bank adopted its neutral policy position while inflationary expectations seemed to be restrained allowing the term spread to remain stable.

4. Methodology and Dataset

Methodology

As outlined in Sims (1980), the VAR approach to determining the relationships between economic variables would take the following form:

$$Y_t = c + A_1 Y_{t-1} + \ldots + A_i Y_{t-1} + \varepsilon_t \qquad \text{(eq.1)}$$

In the above equation, Y_t is an n x 1 vector of observable economic variables, $A_1 \ldots A_i$ are n x n matrices of coefficients, c is an n-dimensional vector of constants, i is the maximum lag length, and ε_t is the mean-zero error term. However, VAR models are subject to the risk of overfitting when estimated via the classical regression approach, given that the number of parameters required for estimation increases quickly per additional variable or lag included (Lutkehpohl, 2005). This phenomenon has resulted in the application of VAR models using a small, usually single digit number of variables. This gives rise to the further problem of omitted variable bias (Banbura, Giannone and Reichlin, 2010).

To overcome these hurdles, the literature on factor-based VAR models, spearheaded by Bernanke, Boivin and Eliasz (2004) and Stock and Watson (2005), emerged with the aim of compressing information from large numbers of variables in order to limit the required

parameters for estimation. The Bayesian proposition, however, rests on the idea that the overfitting problem can be mitigated without the use of restrictions on the covariance structure of models through the use of a prior i.e., a pre-evidence belief about a variable, as seminally outlined by Litterman (1986). Solving Bayesian models was impractical before the advent of low-cost, high-volume computing power in recent times. This has, however, led to the widespread application of Bayesian VAR models compared with earlier periods.

The Bayesian approach identifies the prior as a probability density function g, of some parameter α. Economic information would be summarized in a probability density function associated with the sample information i.e., $f(y \mid \alpha)$. Bayes' theorem can produce a posterior (predictive) density function, $g(\alpha \mid y)$, by combining the two as follows: $g(\alpha \mid y) = [f(y \mid \alpha)\, g(\alpha)]/ f(y)$, where $f(y)$ is the normalizing unconditional sample density. This means the prior distribution α is summarised by $g(\alpha \mid y)$, given the sample information contained in y. With respect to VAR models, the posterior density can be generalized as the derived density of a multivariate normal distribution characterised by the mean and variance of the prior i.e., $g(\alpha \mid y) \sim N(\bar{\alpha}, \bar{\Sigma}\alpha)$ (Lutkehpol, 2005). The VAR model in equation 1 can thus be represented probabilistically as $f(y_t \mid Y_{t-1}, \alpha) = N(y_t\ ;\ \Sigma A_p y_{t-p}, \psi)$[12], where ψ is the covariance matrix (Karlsson, 2012).

A common prior employed is the Minnesota-Litterman (M-L) prior developed in Litterman (1979). Its construction, as described in Litterman (1986) was based on three stylised facts about macroeconomic time series in that i) they are mainly characterised by trends, ii) the lags nearest to the present time affect the variable most, and iii) a variable's own lags affect it more than lags of other variables. The presence of unit roots in particular is implied, and the M-L prior suggests dealing with this by imputing 'Bayesian shrinkage' toward a univariate random walk for each variable in the VAR.

Shrinkage is applied through the M-L prior to the coefficient of the first lag of the 'dependent' variable to reflect how tightly it is believed to be concentrated around zero i.e., 'overall tightness'. It is also applied to the lag coefficients of other variables to reflect that most movement in a variable is accounted for in its own lags i.e., 'relative tightness'. It is also applied to the coefficients of higher order lags to account for the idea that the lags nearest to the present state of a variable are the most relevant i.e., 'lag decay'. The use of the M-L prior means that no sign, equality or zero restrictions are imposed on the parameters of the VAR equation. This avoids the problem of 'incredible' restrictions as described by Sims (1980), in dealing with the overfitting problems described before.

Dataset

A dataset of 10 variables is used in populating Y_t, reflecting the main aspects of the financial sector of Trinidad and Tobago, as well as the external shocks they are subject to. The period spanned by the data is January 2007–December 2017, reflecting a total of 2709 daily observations per series. The data series were individually subject to transforms and scaling in order to minimize model instability. They are presented here in an order that represents our interpretation of the sequence in which they are affected by an external shock.

At the head of the model order, the WTI spot oil price was used as the main external shock to the financial sector in the model. The data was subject to first differencing. Net Sales of Foreign Exchange (NETSALE) is the difference between purchases and sales of foreign currency between authorised dealers and the public, and is expected to respond quickly to changes in the oil price. It is represented as a daily flow volume and was kept at its level profile, but scaled down. Government balances (GOVBAL), the net of Government's domestic payments and receipts, is also represented as a daily volume and was only scaled down and not differenced. It is expected to respond to conversions of foreign currency tax revenue into local currency. The level of excess reserves (XSL) is reported as a daily stock and was thus subject to first differencing and scaled down.

[12] Normality is taken to be asymptotic. Typical tests become overpowered with large datasets leading to failure, even with Box-Cox transforms of the data or bootstrapping. Nevertheless, maximum likelihood estimation gives consistent estimates of coefficients and covariances asymptotically, and standard errors for coefficients can be based on OLS (Hamilton, 1994 pp. 298-299).

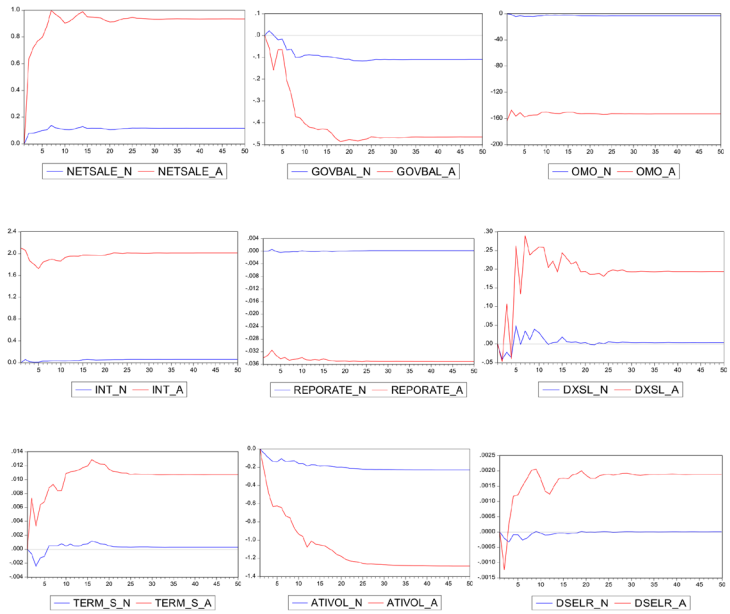
Open market operations is one of the Bank's instruments and the one that is able to respond particularly quickly to market developments, especially with regard to liquidity levels. It reflects its level figure as it is a daily flow volume. The term spread (TERM_S) is the difference between the benchmark 3-month Treasury rate and 10-year Treasury rate. It can be directly affected by liquidity and OMO activity, but contains information about an economy's yield curve. It was subject to first differencing. The trading volumes of the All T&T Index (ATI) of the Trinidad and Tobago Stock Exchange (TTSE) were taken as a proxy for capital market conditions, and were simply scaled down as they represent daily volumes.

The Central Bank uses foreign currency interventions (INT) to maintain market conditions it deems acceptable. INT represents a daily flow volume and its level value was scaled down. The interest rate on the short-term repurchase facility (REPORATE) is the Bank's main policy tool. It occurs at a lower frequency than other Bank instruments, however, mainly because in addition to its role in affecting the balance of short-term money market conditions, it has a longer term signalling role. It was represented in its first difference. The TT-US Selling rate (SELR) is the market rate that responds to the balance of supply and demand in the foreign exchange market. It does, however, reflect the intervention activity of the Central Bank. It is represented in first differences.

5. Econometric Results

The unrestricted model was estimated with 25 lags and provided satisfactory results pertaining to stationarity and autocorrelation[13]. The lag length was based on the idea that 25 days approximates a month of business days. Using the Cholesky decomposition and applying the M-L priors[14] to execute the Bayesian VAR provided the following cumulative impulse response functions (IRFs) shown in **Figure 1**.

Figure 1: Accommodative response of Central Bank to a negative Commodity Price Shock



Source: Authors Calculations

[13] See Appendix A

[14] The hyperparameters of the priors are set up to reflect that i) the effect of the prior dominates the effect of sample information, ii) the relative cross variable weights are low but existent and iii) lag decay is linear.

The impulse response functions with the suffix 'N' represent the responses of the variables solely to a negative two standard deviation shock in the WTI oil price. The impulse response functions with the suffix 'A' represent the responses of the variables to shocks that describe an additional 'accommodative' formulation of responses by the Central Bank. What this means is that in addition to the negative shock from oil prices, the variables representing the operational tools of the Bank were manipulated into statistically significant accommodative positions. This was done by applying a one standard deviation shock in a conventionally accommodative direction to these variables i.e., a negative one standard deviation shock to OMOs to represent increasing maturities, a positive one standard deviation shock representing increased forex interventions, and an expansionary negative one standard deviation shock applied to the Repo rate.

In the scenario solely depicting the negative shock associated with oil prices, Net Sales of Foreign Currency (NETSALE_N) increases, as lowered oil prices should result in lower purchases of foreign exchange from the public by authorised dealers, even in the short run. Government balances (GOVBAL_N) decline in response to the shock, reflecting that lowered receipts in the short run do not translate into lowered expenditure by the Central Government. Open Market Operations (OMO_N) by the Central Bank decline over the reference period, i.e., maturities of OMOs are allowed[15]. Furthermore, foreign currency interventions by the Bank (INT_N) also increase, likely in response to the increased Net Sales position as per the Bank's objective of maintaining an orderly foreign currency market. The Repo rate (REPORATE_N) increases slightly over the reference period.

This change should be interpreted carefully as the Repo is generally not altered as frequently as other operational tools, and the direction of the change is counterintuitive. Excess liquidity (DXSL_N) increases slightly, as does the term spread (TERM_S_N) over the reference period, possibly owing to falling short-term OMO instrument rates. The stock market volume (ATIVOL_N) declines in response to the WTI shock, and this is interpreted in part as a shift away from equity markets, as investors switch away from equities to compete for foreign currency under constrained forex market conditions. The exchange rate (DSELR_N) seems to return to very near its original equilibrium after appreciating slightly in the early part of the reference period.

The sole negative two standard deviation WTI shock seems to induce a natural, if very small, accommodative response in the operational variables of the Central Bank (i.e., not the Repo rate). To assess the impact of the Central Bank's actions, a statistically significant accommodative configuration is applied to the OMO, forex intervention and Repo variables. In this scenario, Net Sales (NETSALE_A) is observed to recursively increase to a much higher level than the alternative scenario, and government balances (GOVBAL_A) decreases to a much lower level, implying that increased monetary accommodation is associated with a deep worsening of the domestic fiscal balance. Amongst the operational variables, changes to outstanding OMOs (OMO_A) are shown to decline by one standard deviation, representing a one standard deviation increase in maturities, which are equivalent to injections of local currency into the financial system. Forex interventions by the Bank (INT_A) are shown to increase by one standard deviation and the Repo rate (REPO_A) is shown to decline by one standard deviation.

The shifts applied to the operational variables had significant effects on the short-term financial market variables. Excess liquidity (DXSL_A) was shown to increase significantly relative to the previous scenario following increased OMO maturities, which is a standard accommodative expectation. The term spread (TERM_S_A) increases more than in the alternate scenario since it can be expected that short-term OMO instrument rates will decline further following large

[15] In the suffix-'N' scenarios, the reactions of the operational variables seem quite small relative to the suffix-'A' scenarios, which result in large shifts of the operational variable IRF's. The IRF's for suffix-'N' scenarios for policy variables should still be regarded as significantly different from zero. The IRF's for the 'N' scenario can be better observed in Appendix A.

maturities. Stock market trading volumes (ATIVOL_A) declined further relative to the first scenario, and the US dollar selling rate (DSELR_A) responded to these conditions with a depreciation. This is consistent with higher liquidity which may have driven demand for foreign currency, resulting in the higher IRF for Net Sales, and is consistent with how the stock market variable is interpreted. The IRFs show that action by the Central Bank was effective enough to increase liquidity and shift the yield curve via the term spread. It also implies, however, that accommodation seems to encourage the Government balances to deteriorate, and that the magnitude of the foreign currency intervention by the Central Bank was not large enough to stave off depreciation.

6. Discussion

Regarding the effect of a negative oil price shock without any accommodative monetary policy adjustment, the model suggests that net sales of foreign exchange by authorised dealers increases, reflecting reduced inflows of foreign currency as domestic demand remains elevated. Government balances decline in response to the shock, suggesting that lower receipts do not translate into reduced expenditure as the Central Government maintains its budgeted programme of spending. This is different from what was outlined in Degiannakis, Filis and Arora (2017), who observed that expenditure was positively linked to energy prices. The results also depict increased net maturities of OMOs, likely due to the Central Bank facilitating higher liquidity to bolster financial market activity, in addition to supporting the government's short-run financing needs. Furthermore, foreign currency interventions by the Central Bank rise in response to the increased net sales of authorised dealers; this seems related to the Central Bank's objective of maintaining an orderly foreign currency market. As a result, following a slight appreciation in the exchange rate in the immediate periods after a fall in oil prices, the exchange rate eventually returns to near its original equilibrium.

Interestingly, the Repo rate rose slightly in response to the shock. This change is indeed counterintuitive, even if small. One possible reason could be to manage or limit the effect of a higher international interest rate differential, which can place additional pressures on flows of portfolio capital. This is conceivable considering the large increase in excess reserves and the implied drop-off in short-term Treasury rates. The size of the change does not, however, suggest that it is meant to operationally target outflows. In this case the Repo rate increase would not necessarily induce the 'portfolio-balance' effect required to stave off immediate capital outflows, but may serve as an invocation of the 'signalling' effect concerning the future path of domestic short-term rates. In terms of the equity market, the stock market ATI volume declines in response to the negative energy price shock. These results move in the opposite direction but follow the same logic of Arouri and Fouquau (2009) for Qatar, Oman and the UAE. This movement is interpreted in part as a shift away from domestic equities by investors, which can be negatively impacted by the shock. The assumption made is that despite increased liquidity, this shift reflects a switch towards the foreign exchange market by local equity investors.

Following the sole energy price shock analysis, a statistically significant accommodative configuration is applied to the open market operations, foreign exchange intervention and Repo variables. Summarily, the magnitudes of the responses were exacerbated, although the direction of responses remained essentially the same. This scenario is associated with larger net sales of foreign exchange by authorised dealers in response to an increase in Central Bank interventions, in addition to reduced demand for domestic equities via the ATI Volume variable. Furthermore, government balances are shown to substantially worsen in response to an accommodative monetary policy adjustment. This effect is likely due to additional OMO maturities and a build-up of system liquidity providing the Central Government with available funds at reduced rates to finance its expenditure programmes. The implication is that the level of government spending is more 'sticky' than levels

of government revenue, even in the very short run. This result was in line with Jbir and Zouari-Ghorbel (2009) who suggested that maintaining government expenditure in light of a negative oil price shock can provide short-term support to the economy. It should be noted in this case, that increasingly negative government balances are here interpreted as an increasing ratio of domestic expenditure relative to domestic revenue by the central government.

The accommodative shifts applied to the Central Bank's operational variables also had significant effects on the short-term financial market variables. Excess liquidity in the system was shown to increase significantly following increased OMO maturities and an extended fiscal position. The domestic term spread expanded more than in the original scenario, likely in response to falling short-term treasury rates following increasing maturities. Similar to the initial scenario, the stock market trading volume for domestic securities declined further, likely due to reduced demand for local equities in addition to the move towards greater foreign currency demand. Lastly, the US dollar selling rate exhibits depreciation, implying forex interventions could not prevent an exchange rate shift under statistically significant accommodative conditions.

The model shows that deliberate monetary policy action by the Central Bank can significantly affect short-term financial markets under the conditions of a large negative commodity price shock. This means the Central Bank seems to have the ability to coordinate an appropriate policy response, even under adverse conditions. Managing liquidity conditions and interest rate expectations are conventional macroeconomic functions of a monetary authority and cannot be called 'fine tuning'. Nevertheless, the actions of the Bank are not without consequence and, in the accommodative scenario, the operations of the Bank resulted in a currency depreciation. In the context of the model, a trade-off emerges between domestic currency accommodation and stability in the market for foreign currency. This is not unlike the prediction of the 'Keynesian Trilemma' for small open economies (Obstfeld and Taylor, 1997).

The Trilemma states that a central bank can choose two of the following options while forgoing the third: i) an open capital account, ii) a fixed exchange rate and iii) independent monetary policy. In this case, the capital account is accepted as open and also exogenous to the model, thus the Bank has the choice between exchange rate stability and independent monetary policy. Recall that in the first scenario, the exchange rate returned to its equilibrium rather quickly after the commodity price shock, as well as the fact that the changes to the operational variables of the Central Bank were statistically small. Furthermore, the goal of exchange rate stability in the Trilemma is compatible with the slight increase in the Repo rate observed in the first scenario, in the context of mitigating portfolio flows. In the second scenario, the changes to the operational tools of the Bank were statistically large, representing a change in the choice of the Bank from exchange rate stability to independent monetary policy under an open capital account. When this change was adopted, control over the exchange rate in the model was ceded and depreciation occurred.

7. Conclusion and Recommendations

The objective of this paper is to determine if the Central Bank of Trinidad and Tobago wields significant influence in its main operational sphere (short-term financial markets) by assessing the effects of an energy price shock, and evaluating the responses of monetary policy to these changes. The paper applies a shock from energy prices through a Bayesian VAR model to variables that characterize the domestic short-term financial market, utilising daily data over the period January 2007 to December 2017 to identify the very short-run effects of exogenous shocks and determine the effectiveness of policy actions used to respond to the effects of the shock. Overall the model demonstrated that the CBTT has substantial influence on the domestic financial market in the short term through the imposition of an accommodative monetary response configuration following an energy price shock.

There are several limitations to be considered, particularly concerning the adequacy of the data. While the dataset was large, many asymptotic arguments concerning adequacy, particularly pertaining to normality, were made. In fact the main justification for 'interpretability' of the model's impulse response functions comes from the fact that the Bayesian VAR provided mean zero errors. The problem of asymptotically overpowered adequacy tests is, however, interesting, and certainly a future application of nonparametric estimation to this or other similar models would be warranted[16]. Another particularly interesting relationship that emerged from the model was that of the stock market's response to the oil price shock, which can potentially explain some of the difficulties that abound in properly establishing capital markets in small economies. Certainly there is scope for future work to more resolutely validate whether the relationship outlined in this study holds under further scrutiny.

The important consideration for the policymaker is that significant accommodative action by a monetary authority can sow the seeds of depreciation of its own currency, a situation shown in Ferrerro and Seneca (2015) above as one that is best avoided. It is yet conceivable that there exists some level of domestic accommodation that does not interfere significantly with exchange rate stability. This must, however, be understood within the context of the Bank's role in underpinning overarching macroeconomic stability. The monetary authority in the model is interpreted to have attempted to maintain its exchange rate policy while undertaking domestic monetary accommodation. Accommodation in this model resulted in much larger foreign currency interventions by the Bank, to no avail as a depreciation still occurred. While the original scenario resulted in exchange rate stability, foreign currency interventions were also required. Those interventions were crucially smaller. Considering the main small open economy constraint, i.e., that the official reserves of a central bank are always and everywhere finite, the model suggests stability of the market for foreign currency seems to be an appropriate operational choice in the very short run, in that it is the less costly alternative. In summary, the fine tuning argument may miss the point that the Central Bank chooses a path it interprets to be less disruptive and more sustainable. This, however, does not preclude the need for longer-run flexibility in the foreign exchange market (Rodrik, 2008).

[16] See Appendix A for LOESS-filtered impulse response functions of the model used in the study.

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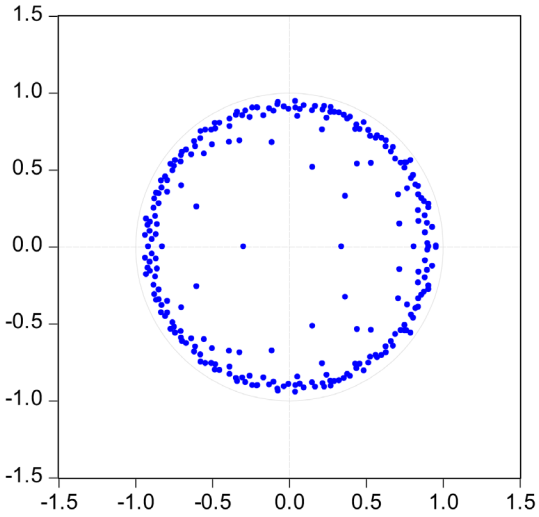
Appendix I

Inverse Roots of AR Characteristic Polynomial



Autocorrelation

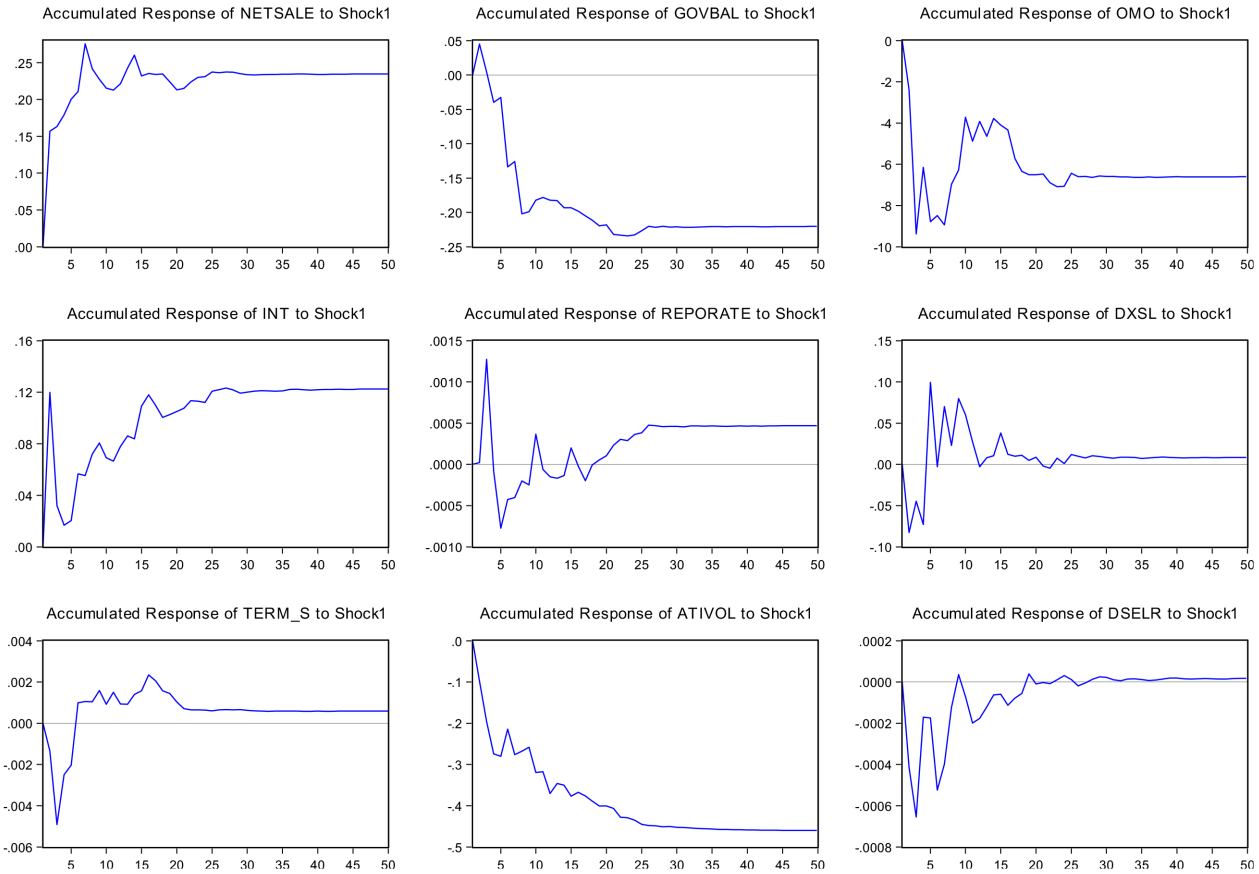
VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 03/09/18 Time: 11:33
Sample: 1/03/2007 12/29/2017
Included observations: 2684

Lags	LM-Stat	Prob	Lags	LM-Stat	Prob
1	121.4988	0.0708	16	104.8713	0.3498
2	88.57024	0.7863	17	104.5113	0.3589
3	96.86539	0.5701	18	102.7618	0.4049
4	92.47525	0.6910	19	114.8839	0.1466
5	111.6161	0.2009	20	130.1347	0.0231
6	104.0598	0.3706	21	148.5324	0.0012
7	101.0039	0.4531	22	139.6501	0.0054
8	91.38994	0.7189	23	127.2684	0.0342
9	105.3017	0.3389	24	87.24214	0.8149
10	77.09969	0.9568	25	113.8464	0.1626
11	112.4434	0.1861			
12	130.4769	0.0220			
13	102.0022	0.4255			
14	103.2882	0.3909			
15	100.1022	0.4783			

Probs from chi-square with 100 df.

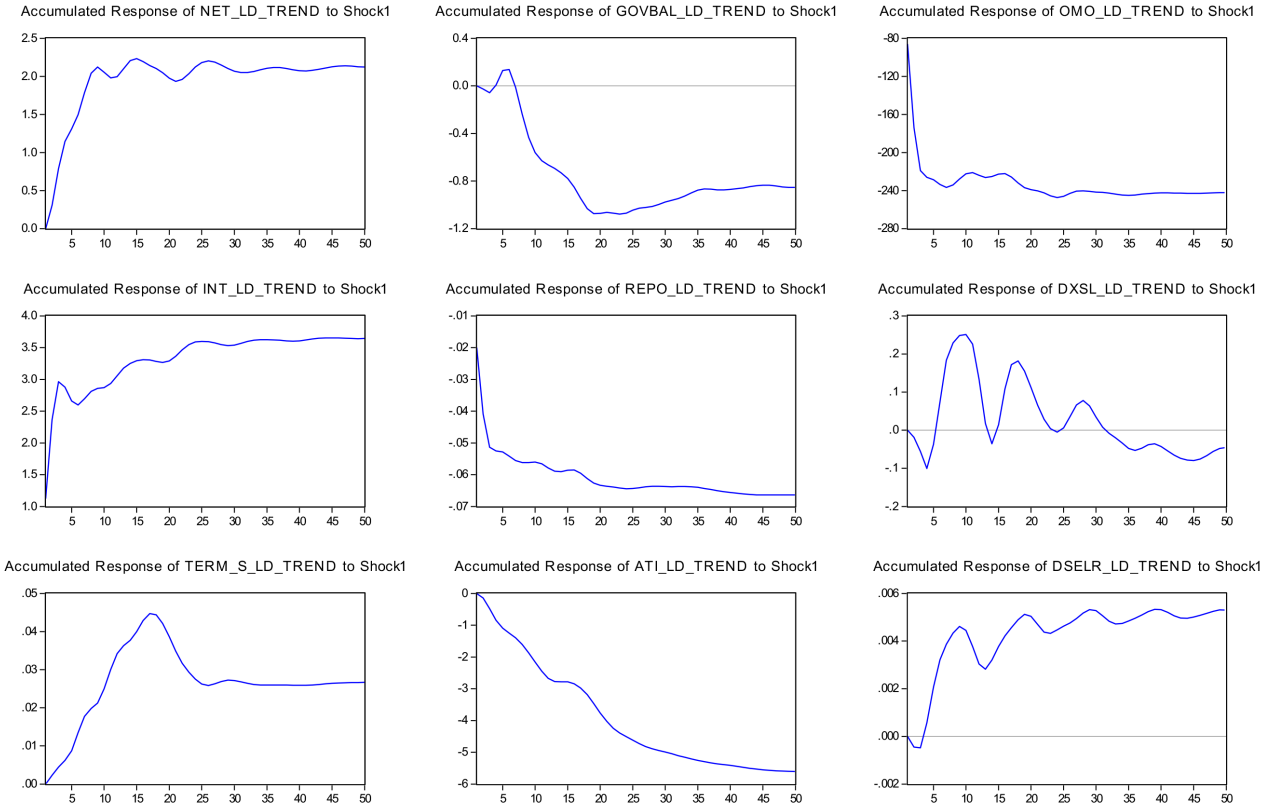
One-Standard Deviation Shock

Accumulated Response to User Specified Innovations



LOESS Filtered Impulse Responses Responding to Negative WTI Shock

Accumulated Response to User Specified Innovations



Coordination of Monetary and Fiscal Policies in Trinidad and Tobago

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JEL Classification: E61, H30
Keywords: Monetary Policy, Fiscal Policy, Coordination, Low Inflation, Sustainable Growth

Abstract

This paper investigates the extent of coordination between monetary and fiscal policies in Trinidad and Tobago from 1993 to 2016. To achieve this objective, the paper first adopts the Granger causality/Block Exogeneity Wald test (and cointegration test if necessary) to determine whether these policies are implemented independently. Testing for independence is necessary since only independent institutions are in a position to engage in economic policy coordination. If independence is observed, the extent of coordination is then estimated using: (i) the Set-Theoretic Approach (STA); and (ii) the vector autoregressive (VAR) modelling framework. The analysis reveals that policy coordination has been weak throughout the review period. Coordination improved following the 2008/09 global financial crisis as both fiscal and monetary authorities aimed to revive the economy. The results point to the need for the policy-making authorities to improve coordination to achieve sustainable long-term growth with low inflation.

1. Introduction

Policy coordination is an often-overlooked element of macroeconomic management. Yet developments occurring internationally frequently highlight its importance for countries and regions. One such event was the 2008/09 global financial crisis. The crisis, which began in the United States (US) 'subprime' mortgage market, was quickly transmitted to the rest of the world. The crisis left policymakers in many countries struggling to foster growth and price stability. Research has shown that many of them engaged in some degree of coordination between monetary and fiscal policies to revive their economies (Gomes da Silva and Vieira, 2014). Across the globe, central banks adopted highly accommodative monetary policies (including unconventional monetary policies in the case of the United States Federal Reserve, the Bank of England, the Bank of Japan and the European Central Bank) to stabilise financial markets while fiscal policies became expansionary with the aim of stimulating aggregate demand.

Policy coordination is a timely and relevant topic from the perspective of the economic challenges facing Trinidad and Tobago (TT) in recent years. It is clear that the domestic economy has been experiencing a negative terms of trade shock as a result of the substantial decline in international energy prices since mid-2014. This shock also coincided with a fall-off in local energy production. The impact of these developments is already evident in terms of the challenges facing government's revenue and the deterioration in the country's balance of payments. Since energy revenue is a major source of government's

expenditure – which stimulates the non-energy sector – the spillover effects have been felt throughout the non-energy sector. There is also a high degree of uncertainty surrounding when energy prices are likely to recover from their current levels.

In TT, macroeconomic management is carried out using two key types of policies. One is fiscal policy, which involves the Central Government adjusting spending levels (through taxation and public spending) to influence aggregate demand and the level of activity in the economy. National budgets prepared by the fiscal authority (Ministry of Finance of Trinidad and Tobago) reflect the fiscal policy stance of the government. The main aim of fiscal policy is to achieve high growth with low unemployment. Monetary policy, on the other hand, involves controlling the country's financial resources (such as foreign exchange reserves and credit) by operating on the monetary aggregates or interest rates. This is the function of the monetary authority i.e. the Central Bank of Trinidad and Tobago (CBTT). The main aim of monetary policy is to ensure low and stable inflation. Given the uncertainty surrounding energy prices, it is crucial that the country's macroeconomic policies (in particular monetary and fiscal policies) be geared to achieving the greatest possible success in terms of output and inflation by ensuring that resources are allocated in the most efficient manner.

The theoretical literature has produced a number of studies on the benefits of greater policy coordination. High levels of coordination can reduce the potential for policy conflicts that could: result in the economy operating at a lower-than-optimal level; increase the ability to respond to adverse external shock; provide a sustainable growth path alongside low inflation, and an overall improvement in the economic well-being of citizens of the country. However, coordination may not always be desirable and might also be extremely difficult to achieve in practice according to Blinder (1982). Blinder (1982) noted that a lack of coordination may be due to three main reasons: (i) different objectives of monetary and fiscal authorities on the economy; (ii) different opinions on the implications of policy actions on the economy; and (iii) different forecasts on the state of the economy used by the two authorities.

Since a high degree of policy coordination can provide better prospects for sustainable economic growth and low inflation, improving this aspect of macroeconomic management can be beneficial to TT. There are only a few prior studies related to the issue of monetary and fiscal coordination as it relates to the Caribbean region and TT in particular. Measuring policy coordination and understanding the interaction is a key step in addressing potential problems of weak policy coordination in the economy. This paper attempts to quantify the extent of the coordination over the period 1993-2016. The rest of the paper is organised as follows: Section 2 provides a review of related theoretical and empirical literature. Section 3 describes some of the stylised facts focusing on issues relating to recent policy behaviours in TT. Section 4 describes the methodology used to assess the extent of the relation between the monetary and fiscal policies. Section 5 is a presentation of the results along with an analysis of the findings. Finally, Section 6 will conclude with some brief policy implications.

2. Literature Review

Coordination refers to the necessary arrangements between the monetary and fiscal authorities that ensure policy actions are taken in a consistent manner (Haleim, 2016). The issue of policy coordination has been given much attention in the economic literature over the years. Below is a review of the important theoretical and empirical literature on this issue.

The interactions and potential conflicts associated with these two types of policies can be found in the traditional Mundell-Fleming model which requires both internal and external balance to be met (Fleming, 1962, Mundell, 1962). Later, Sargent and Wallace (1981) described the interaction of these policies as a game of chicken which requires coordination in order to achieve Pareto efficiency in an economy. According to Sargent and Wallace (1981), the fiscal authority being the agent for fiscal

policy, dominates the policy environment and makes the first move, which effectively dictates the actions of the monetary authority – like a game of chicken. The authors noted that when fiscal policy operates in a dominant way the ability to effectively carry out monetary policy is compromised and inflation objectives are unable to be met. The potential for policy dominance was also noted in Togo (2007) who pointed out the need to have these two policies coordinated and carried out independently so as to avoid an inappropriate mix of policies.

Other studies viewed the interaction between monetary and fiscal policies as a game between the monetary and fiscal authorities. For example, Tabellini (1985) found that coordination of policies in response to shocks increases the economy's speed of convergence to the steady state and planned target outcomes. Further, Nordhaus (1994) explained that non-cooperative policies played by monetary and fiscal authorities will result in a Nash equilibrium with higher interest rates and lower economic growth, but a strategy that involves coordination between authorities can yield a Pareto outcome with low inflation and higher economic growth. Dahan (1998), studying the budgetary implications of central bank actions and monetary implications of fiscal actions, also stressed the need for coordination of both polices. Recently, Bianchi and Milosi (2017) studied the effects of the lack of policy coordination with particular emphasis on the zero-bound period. They found that the lack of coordination can lead to an explosive dynamic of inflation and large output losses.

Policy coordination is also viewed as crucial for macroeconomic management within a monetary union. In a monetary union whereby monetary policy is carried out by a single central bank but fiscal policy is the work of individual member countries, fiscal policies (e.g. government deficits) in one country can have adverse spillover effects on other member countries and lead to inefficient outcomes for the monetary union (Cabral and Diaz, 2015). The possibility of spillover implications justifies the need for all members to engage in fiscal policy coordination in the European Monetary Union (EMU) (Ferre, 2008).

Several empirical studies devoted to policy interaction found that, in practice, there is evidence of a lack of strong coordination in many economies. This is especially so in small open economies, emerging markets and developing economies (EMDEs), including oil-producing economies. There are several reasons for the lack of policy coordination in these economies. Some of these can be found in Worrell (2000) where a high degree of coordination is often absent in small open economies due to: (i) the limited effectiveness of monetary policies; (ii) fiscal indiscipline; (iii) the lack of well-developed financial markets; (iv) uncertainty about monetary policy transmission; and (v) potential conflicts between monetary policy and other central bank objectives. Jayaraman (2016) also explained that small open economies are particularly vulnerable to external shocks such as commodity prices (e.g. energy and food prices). In some oil-producing countries, governments often display fiscal indiscipline (or adopt highly pro-cyclical spending behaviours). These economies are also plagued by budgetary planning challenges including issues relating to inter-generational equity and fiscal sustainability. These issues may contribute to the lack of policy coordination which results in weak long-run growth performances and high inflation among oil producers (Sturm et al. 2009).

Muscatelli et al. (2002) investigated the response of monetary and fiscal policy to macroeconomic targets in G7 countries, using a VAR modelling technique. The results showed that monetary and fiscal policies were used as strategic complements. The form of interaction is asymmetric and differs across countries. In the US and UK, monetary policy reacted (through a decline in the interest rate) significantly to a fiscal expansion. In the case of Italy, Germany, and France, the study did not find any clear monetary policy reaction.

In terms of developing economies, the degree of policy coordination was investigated in Tarawalie et al. (2013) for the West African Monetary Zone (WAMZ) countries. The study employed a Set Theoretic Approach (STA) and VAR modelling technique using data covering the

period 1980–2011. The study revealed the existence of weak policy coordination in all the WAMZ countries over the period, contributing to the non-compliance with respect to inflation and fiscal deficit criteria of the WAMZ. The STA results showed a policy coordination of less than 50%, with Gambia attaining a score of 41.6%, Ghana 35.4%, Guinea 31.8%, Liberia 37.9%, Nigeria 46.6% and Sierra Leone 41.3%.

Also, Arby and Hanif (2010) studied the extent of policy coordination for Pakistan. The sample period covered by the study is 1965–2009. The methodology involved the Granger causality test and cointegration analysis to determine the independence of both monetary and fiscal authorities. The STA approach was used to calculate the extent of policy coordination. The STA was calculated at 27% which suggests weak policy coordination. Andlib et al. (2012) also empirically analyzed this issue for Pakistan. The approach adopted was the unrestricted VAR model and data utilised covered the period 1980–2011. The results of the VAR test showed evidence of weak policy coordination and that shocks to monetary and fiscal variables have an insignificant impact on each other.

Policy coordination was also explored in Haleim (2016) for Egypt. The study covered the period 1974-2015, and adopted the approach of Arby and Hanif (2010). The results showed that policy coordination was weak over the period. The weak coordination was due to high fiscal deficits that put pressure on monetary policy to conduct its objective in stabilising prices. The study indicated that there was further room to improve coordination between policies.

The interaction between monetary and fiscal policies in India was examined in Sethi (2016). The study used the VAR/VECM modelling technique and monthly data covering the period April 2010 to March 2015. The study found that fiscal policy responds well to changes in monetary policy but the reverse did not take place. The study indicated that coordination of monetary and fiscal policies is a sufficient condition to achieve financial stability in the Indian economy.

Valdivia and Perez (2013) studied monetary and fiscal policy coordination in the Latin American region (Bolivia, Brazil, Chile, Colombia, Peru, Uruguay, Venezuela) during the periods 2007–2008 and 2009-2010, through the application of a dynamic stochastic, general equilibrium model specified in parameters for each country and comparable in structure to each other. The results showed that there is effectiveness in the implementation of coordinated policies. The results also revealed that the degrees of policy coordination are very important in explaining the fundamentals of the economies.

In light of the dearth of research in this area, our study will be a meaningful addition to the existing literature particularly in relation to the Caribbean region. One improvement to the analysis in this paper could be the use of a more reliable measure of the fiscal policy stance of the central government. Several empirical studies reviewed utilised the conventional measure which is the overall fiscal balance to GDP ratio. However, more reliable measures of fiscal stance could include the cyclically adjusted fiscal balance or structurally adjusted balance. These measures can provide a clearer understanding of the underlying fiscal position of the government. Unfortunately, data are not available for the entire sample period at the time of conducting this research for Trinidad and Tobago.

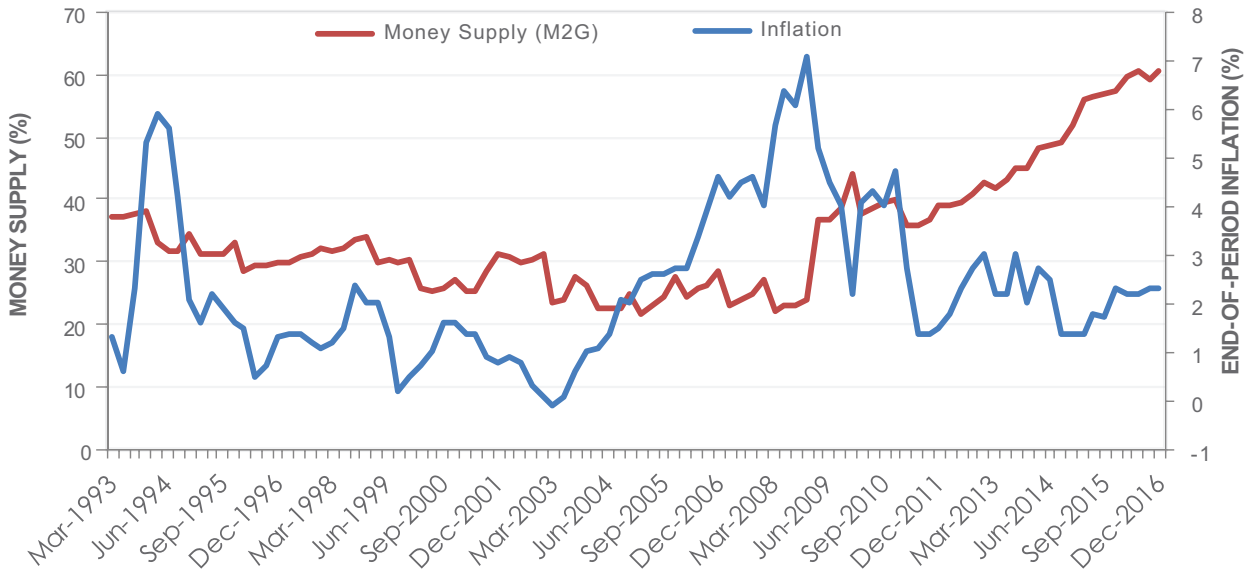
3. Stylised Facts

Trinidad and Tobago is a small open energy-based economy with a managed float exchange rate regime and free capital flows. This latter characteristic has applied to the economy since April 1993 when the country embarked on financial liberalization measures. The economic characteristics play an important role in the context of possibilities for policy coordination since there is more room for monetary and fiscal policies to achieve their desired goals without one compromising the other.

The main objective of monetary policy in TT is price stability. Achieving price stability is essential to achieving low and stable inflation. Under the current arrangement, price stability is achieved through changes in the Central Bank's policy interest rate, the Repo rate, but also through ensuring exchange rate stability.

Figure 1 shows the trends in inflation (core) and the money supply over the period 1993–2016. It can be seen from the graph that inflation increased moderately between 2003 and 2008, although the Central Bank took measures to tighten monetary policy by increasing interest rates and mopping up excess liquidity. The Central Bank, however, was unable to fully address the excess liquidity in the system which came from high government fiscal injections at the time. Over this period the money supply did not contract but remained relatively stable. With the advent of the 2008/09 global financial crisis, the Central Bank moved to ease monetary policy by lowering its policy interest rate. This monetary stance was adopted within the context of relatively low domestic inflation and the need to stimulate non-energy sector growth. This period also saw a substantial increase in the money supply.

Figure 1: The Money Supply and Inflation Link (1993-2016)



Note: M2G refers to the money supply-to-GDP ratio

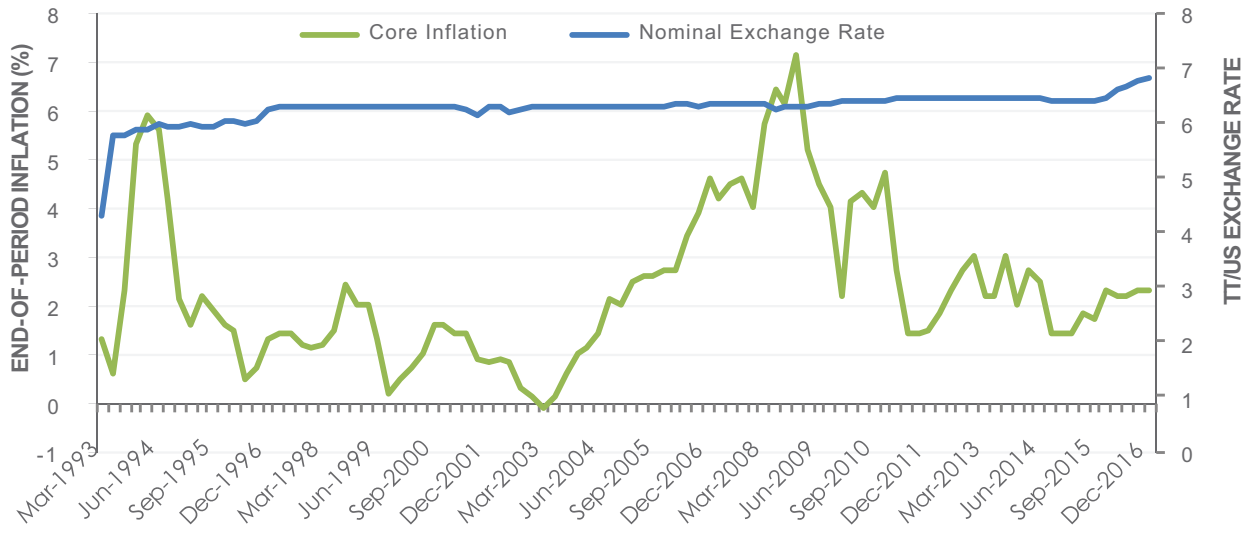
Sources: Central Bank of Trinidad and Tobago and the Central Statistical Office

Exchange rate stability is an important element of monetary policy formulation in TT given the high degree of openness of the domestic economy. Significant depreciations can potentially lead to increasing prices for imports which form a major part of local consumption. Significant exchange rate depreciations can also trigger speculative demand for foreign exchange which can put pressure on the country's gross official reserves. **Figure 2** shows the trends in the nominal exchange rate, which depreciated significantly soon after floatation in April 1993, but remained relatively stable throughout most of the review period. Meanwhile, core inflation, which excludes the more volatile food component fluctuated over the period. For instance, from a rate of 0.1 per cent in Q4: 2002, core inflation accelerated to 7.1 per cent by Q4: 2008. In the period of the global financial crisis, core inflation decelerated drastically to reach 1.4 per cent by Q2: 2011. Thereafter, core inflation fluctuated but generally remained below 3 per cent.

Since the decline in energy prices in mid-2014 and the fall in foreign exchange inflows, maintaining the exchange rate at the current level has become a topical issue on both the economic and political fronts. From an economic standpoint, there is much debate as to whether the exchange rate should be allowed to depreciate to relieve the frequent build-up of demand pressures in the local foreign exchange market. The excess demand, which cannot be met by market purchases, has been met thus far by heightened Central Bank interventions, which have led to a downward trend in the country's gross official reserves in recent years. The depreciation of the exchange rate has potential economic benefits in terms of improving the balance of payments position and curtailing the drawdown of the foreign exchange reserves. However, from a political perspective, the government would tend to be cautious of the potential adverse consequences of a depreciation on the economy, especially on domestic inflation, living standards, and the potential political fall-out.

Fiscal policy, on the other hand, plays a major role in

Figure 2: Core Inflation and Nominal Exchange Rate (1993-2016)

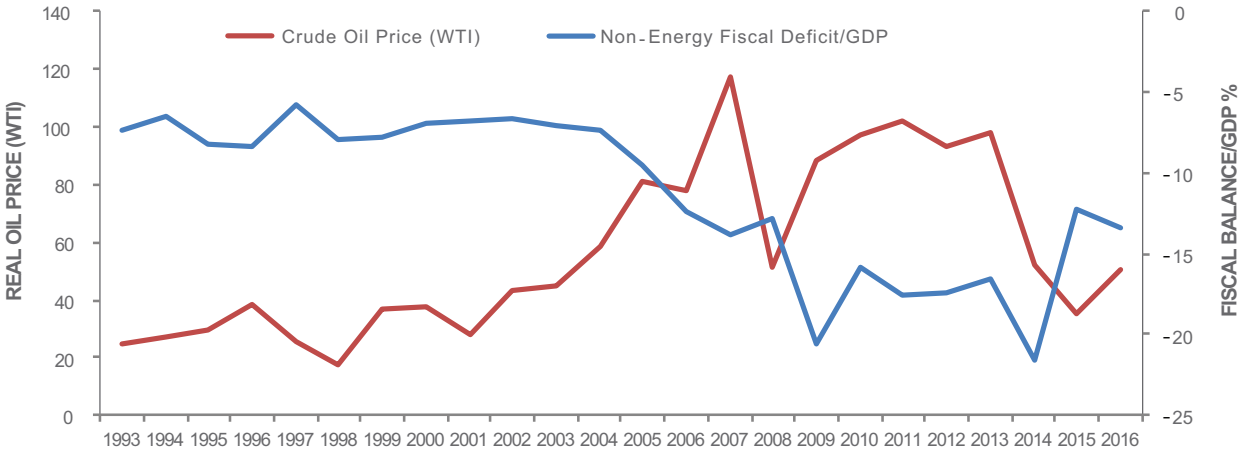


Sources: Central Bank of Trinidad and Tobago and the Central Statistical Office

the economy since it has a direct impact on economic activity, especially through public sector capital spending on infrastructure such as bridges, highways, hospitals and other public goods. Capital spending has spillover effects on the non-energy sectors such as construction, distribution, and finance, insurance and real estate. Various industries thrive on contracts issued by the government either through ministries or the large number of state enterprises. Also, the government is the single largest employer, accounting for 26 per cent of the labour force in 2016. Further, the local energy sector has traditionally been a major source of government's revenue. Therefore, a major share of government spending comes from revenue derived from the energy sector. Over the last 10 years, about 38 per cent of the government's total revenue was from the energy sector[1]. However, with the recent decline in energy prices, government's revenue from the energy sector has fallen to about 16.1 per cent in FY2016/17.

Fiscal policy has generally been challenged over the review period. It is clear from the graph that fiscal policy has been highly pro-cyclical (**Figure 3**). It can be observed from the graph that an increase in oil prices is associated with widening non-energy fiscal deficits and lower prices are associated with relatively high fiscal deficits. This implies that fiscal policy is not amended in a timely manner in response to adverse energy price shocks. **Figure 3** also demonstrates the exposure of fiscal policy to swings in energy prices[2]. Apart from generally high and persistent fiscal deficits, the structure of government spending has been heavily directed towards recurrent expenditures to meet the social needs of the population. To a lesser extent, government's spending has been directed towards capital projects which are essential to building the productive capacity of the economy.

Figure 3: Real Oil Price and Non-Energy Fiscal Deficit: 1993 – 2016



Note: WTI – West Texas Intermediate Crude Oil Price

Sources: Central Bank of Trinidad and Tobago, Ministry of Finance and Authors' calculations

[1] Represents an average for the period 2006-2016.

[2] Figure 4 does not plot the trend in natural gas prices which is also a relevant energy commodity price for Trinidad and Tobago. However, both crude oil and natural gas prices have generally trended in a similar manner over the review period.

Following the decline in energy prices in mid-2014, the government has been taking steps towards fiscal consolidation by reducing subsidies especially on gasoline, as well as by reducing spending in various ministries (such as on contract employment and on goods and services). Several tax changes have been introduced to bolster non-energy revenue, such as higher corporation tax, and the proposed introduction of a property tax. Fiscal consolidation has, however, been slow, given the downwardly sticky nature of certain recurrent expenditure. In the context of lower revenues, financing of fiscal deficits has led to rising public debt (60.2 per cent of GDP at end-September 2017). TT's credit rating was also downgraded by two major international credit rating agencies in 2017. These conditions have resulted in a reduction in the fiscal space of the government in generating economic activity.

The decline in energy prices has revealed some major weaknesses in the economy as well as in fiscal and monetary policy behaviors. The present situation reveals that the current economic structure of the TT economy which is heavily reliant on the energy sector, has not led to sustainable economic growth but rather to major fluctuations in economic cycles. The effect of adverse price shocks can quickly move the economy from prosperity and growth to recession, which has severe negative economic implications for the country. More recently, when the cycle is on a downward path, both monetary and fiscal policies appear to be constrained in stimulating economic growth.

Since the severe terms of trade shock in mid-2014, monetary policy has been accommodative in an effort to stimulate non-energy economic growth. Monetary policy, however, has to balance a range of considerations especially the need to stimulate growth and prevent potential capital outflows that may stem from rising foreign interest rates. Also, the transmission mechanism for monetary policy has tended to be weak, which has limited the ability of the Central Bank to ensure a full and timely pass-through from its policy rate to banking sector interest rates[3].

In the context of constrained monetary policy, fiscal policy can be a potential source for stimulating economic activity under the current economic conditions. However, due to the continued fiscal deficits, and the need to borrow, expansionary fiscal policy may only provide a limited boost to activity. This is because high domestic borrowing by a government, especially from the local commercial banks can potentially have a crowding out effect or increase the level of domestic interest rates. This may have the effect of further hindering the private sector's ability to borrow for investment purposes.

With the current economic scenario facing TT, monetary policy will have to maintain a sharp focus on ensuring price stability. Fiscal policy, on the other hand, needs to move to a more sustainable position (a much lower deficit or to a surplus) as soon as possible. This could be achieved via a faster pace of reduction in payments on recurrent spending such as on transfers and subsidies. A reduction in expenditure implies a smaller fiscal deficit to be financed by borrowing which will constrain the increase in public debt. In the medium term, the reversion to fiscal surplus is likely to provide more fiscal space to accommodate an economically viable monetary-fiscal policy mix via greater coordination. Under the current circumstances where lower revenue has prompted higher deficits and financing needs, it is important that the government streamlines its expenditure to avoid increasing the public debt which could undermine the potential for policy coordination.

4. Methodology and Data

The potential for healthy policy coordination exists when the two policy-making authorities are independent and have the ability to pursue their own objective without compromising the other's. Many economists have endorsed independence of both of these authorities on the basis that a lack of independence can lead to inappropriate policy mixes that can undermine growth and inflation. One of the riskiest forms of interaction is when a central bank, due to a lack of independence, gives

[3] The Central Bank of Trinidad and Tobago Monetary Policy Report (November 2017) estimated the speed of the pass-through of policy rate changes to commercial bank interest rates to be 12 months.

in to the demands of the fiscal authority and persistently engages in the financing of budget deficits. This has tended to be a major cause of hyper-inflation, low investment and inadequate growth in many countries.

Testing for independence is therefore a necessary first step in our exercise. Although the institution may not possess a high degree of legal independence, as is the case in many countries, the execution of monetary policy should at least be carried out independently[4]. As regards the test of independence, we apply the Granger causality test to explore the existence of any true correlating relationship between the variables. The ratio of money supply to GDP (M2G) is used as an indicator of monetary policy stance and the non-energy fiscal deficit to GDP (FBG) is used as a proxy for fiscal policy[5]. The changes in these indicators represent changes in the policy stance. The data on money supply are obtained from the CBTT and both GDP and non-energy fiscal deficit are sourced from the Ministry of Finance. Both datasets are quarterly and cover the period QI: 1993–QIV: 2016.

We first conduct stationarity tests on the variables to determine the order of integration at the 5% and 1% significance levels. While the Granger causality test determines the impact of past information on one variable on the current value of another variable, the cointegration test establishes if there is an equilibrium relationship between the two variables over the long run. The two institutions are considered independent if there is no cointegration between the two variables. No cointegration suggests that government spending is not influenced by borrowing from the CBTT. To test for cointegration we apply (if necessary) the single equation residual based Phillips-Ouliaris (1990) test on money supply and (LGM2G) and government spending (LGFBG)[6,7].

If independence is observed between the two institutions, the next step is to compute the extent of coordination between them given different macroeconomic shocks. We do this using the set-theoretic approach (STA) similar to Arby and Hanif (2010) and Haleim (2016). A fundamental advantage of this method is that the information contained in the primary data is sufficient for analysis, which unlike other statistical methods, requires additional data to exist. Also, it is well suited for analysis of data constructs that are categorical and dimensional.

The STA involves the use of set theory. Under this approach two matrices are constructed, a macroeconomic environment shock matrix and a policy response matrix, which indicate the various paired outcomes. Both of these matrices can be compared to estimate the coordination coefficient between both policies. We define the coordination in **Table 1**. Given that the real GDP growth rate and inflation rate are major indicators of economic performance, shocks to both indicators represent the macroeconomic imbalances that necessitate proper coordination of policies to address them. There are four possible combinations of positive (P) and negative (N) shocks to growth or inflation. For instance, the upper left corner cell refers to positive shocks to both growth rate and inflation, while the lower left corner cell refers to negative shocks to growth rate and positive shocks to inflation.

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[4] Dincer and Eichengreen (2014) measured the degree of legal independence of a sample of central banks through an analysis of relevant central bank legislation. The study found that TT scored 0.25 (CBIW) and 0.28 (CBIU) on a scale from 0 to 1 (lowest and highest levels of independence, respectively), suggesting a relatively low degree of legal independence.

[5] Since May 2002, the CBTT began to utilize the Repo rate as its main policy instrument but still maintained its use of direct policy instruments (reserve requirements and special deposits etc.). The CBTT also utilized open market operations to manage liquidity (i.e. the money supply) and market interest rates. This paper therefore takes the traditional approach by using the money supply-to GDP ratio to gauge the monetary policy stance over the entire sample period. The money supply is assumed to be inversely related to interest rates in the economy. Hence, an increase in the money supply implies a fall in interest rates, while a fall in the money supply suggests an increase in interest rates in the economy. For oil-based economies, the non-energy fiscal deficit-to-GDP ratio is a relatively more reliable indicator of the policy stance of the central government than other measures such as the overall primary balance-to-GDP ratio which can be a potentially misleading indicator of the fiscal stance.

[6] The Phillips-Ouliaris (1990) test for co-integration is based on adjusting the conventional statistic using the Newey-West estimator of error variance which is robust to serial correlation and time-dependent heteroscedasticity.

[7] The variables were converted to logarithmic form (LG).

Table 1: Macroeconomic Environment Matrix

		Shocks to Inflation	
		Positive	Negative
Shocks to Real Output Growth	Positive	PP_t	PN_t
	Negative	NP_t	NN_t

Table 2: Policy Response Matrix

		Change in Monetary Policy	
		Contractionary	Expansionary
Change in Fiscal Policy	Contractionary	CC_t	CE_t
	Expansionary	EC_t	EE_t

Another matrix is constructed which represents the coordinating responses of monetary and fiscal policies. In this policy response matrix, policies are assumed to be countercyclical to different shocks as shown in **Table 2**. Each cell in the policy response matrix represents the appropriate policy coordination to respond to the given shocks in the corresponding cell in the macroeconomic environment matrix. To clarify, the proper countercyclical response to positive shocks to both growth and inflation is simultaneous contractionary fiscal and monetary policies (CC_t). Similarly, negative shocks to both GDP and inflation require simultaneous expansionary monetary and fiscal policies (EE_t).

The extent of coordination (ρ) is obtained through the following equation:

$$\rho = \omega/\sigma$$

$$\omega = n(PP_t \cap CC_t) + n(PN_t \cap CE_t) + n(NP_t \cap EC_t) + n(NN_t \cap EE_t) \quad \text{eq.(1)}$$

σ is the number of years in the analysis.

Based on the above formula, a perfect coordination exists when the policy response matrix is harmonized with the macroeconomic environment matrix, i.e. ρ equals 1, while coordination is absent when $\rho = 0$. In addition, policy coordination is considered weak when ρ

≤ 0.50 and this is therefore the minimum benchmark for adequate policy coordination.

The strength of the coordination can also be tested using a vector autoregressive (VAR) modelling approach (Lutkehpohl, 2005). Similar studies have also employed VAR modelling techniques (e.g. Tarawalie et al. (2013), Sethi (2016). The VAR modelling technique is very powerful for analysing multivariate economic time series data. It can also provide a clearer understanding of the dynamic relationship among policy variables and their impact on the economy. However, VAR models can produce results that can be counterintuitive or contradictory to economic theory.

The VAR model to be estimated is as follows:

$$Y_t = \alpha_1 + \sum_{s=1}^{n} \theta_s \, Y_{t-s} + \beta Z_s + \varepsilon_t \qquad \text{eq.(2)}$$

In the above, Y and Z are the vectors of endogenous and exogenous variables, respectively. Also, θ and β are the vectors of corresponding coefficients to be estimated, α is the vector of constants, ε is the error term which is assumed to be a white noise process, and n is the optimal lag length of the model and is determined using the lag length criteria testing. The variables of the VAR model are the output gap, the inflation deviation, non-energy fiscal balance ratio, broad money ratio, and the nominal exchange rate. Additional variables include the real crude oil price, and a dummy variable to represent the 2008/09 global financial crisis. The impulse responses of the money supply, non-energy fiscal deficit variables to innovations in the output gap, inflation and the exchange rate are analysed to determine the strength of the coordination. **Table 3** below provides a list of the variables and their description. Note that since TT's switch to a managed float exchange rate regime, it is possible that monetary policy may have had greater autonomy to respond to domestic inflation. However, this may not necessarily be the case, since countries with more flexible exchange rate regimes continue to take global interest rates in account when setting domestic interest rates to avoid significant movements in their exchange rates. The VAR model data covers the period QI: 1993 to QIV: 2016 and is of a quarterly frequency.

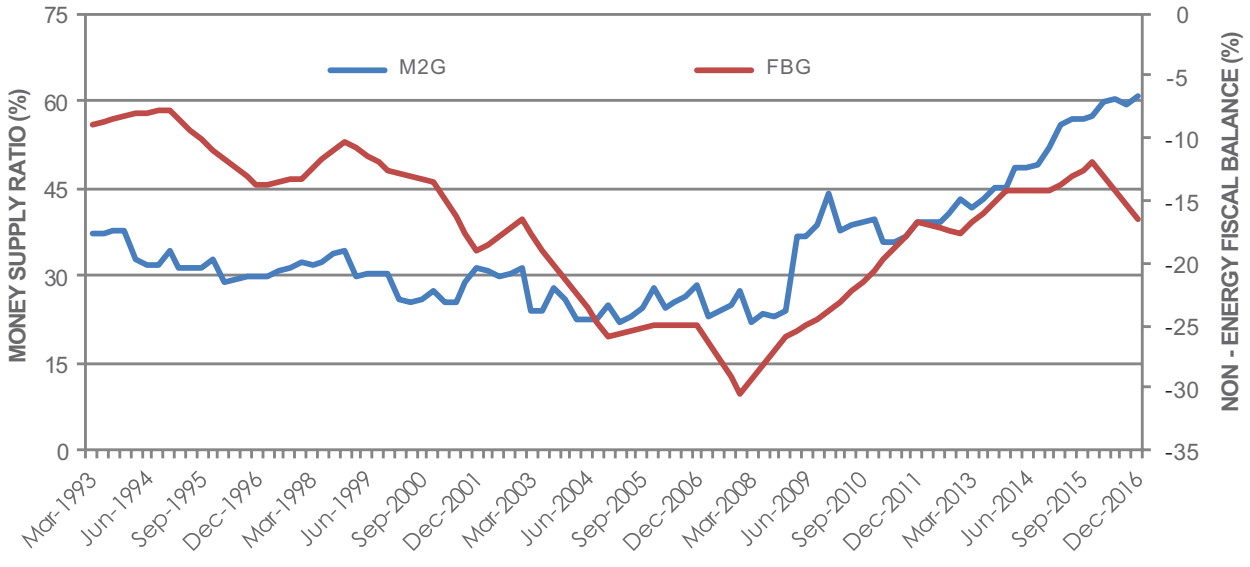
5. Analysis of Results

Figure 4 shows the trends in the money supply and the non-energy fiscal deficit. The graph indicates no clear cointegrating relationship between the two variables. In a developing country like TT high deficits by the government could be associated with high budgetary borrowing from the Central Bank. However, the overall movement in the money supply through changes in the monetary base is important from the perspective of gauging the monetary policy stance. **Figure 4** shows that the two variables trended quite differently during most of the period. For instance, during QI: 2002 to QIV: 2008 the money supply was stable while the non-energy fiscal deficit was declining. Between QI: 2009 and QIV: 2016 both variables diverged with the money supply increasing drastically compared to the non-energy fiscal deficit. The conflicting movements suggest that monetary and fiscal policies remained independent of each other in TT. The two variables are, however, subjected to more formal testing to determine the existence of any cointegrating relationship.

Table 3: List of Variables and Description

Variables	Notation	Description	Source
Output Gap	GAP_t	(Potential Total Real GDP - Actual Total GDP) / Potential GDP.	CBTT, CSO, Potential GDP - Authors calculation using the H-P filter in Eviews 8.0
Inflation Deviation from Threshold	$INFD_t$	Core Inflation - Inflation Threshold The inflation threshold is calculated using a similar method to Mubarik (2005).	CSO, CBTT Threshold Inflation - See Footnote 4 for authors' calculation.
Non-energy Fiscal Deficit	FBG_t	(Total Non-Energy Revenue - Total Expenditure) / Total GDP	Ministry of Finance of Trinidad and Tobago, CBTT.
Money Supply	$M2G_t$	Broad Money / Total GDP	CBTT
Nominal Exchange Rate	NEX_t	Nominal Exchange Rates is the price of the US Dollar in domestic (TT) currency.	CBTT
Real Oil Price	$ROIL_t$	Nominal Crude Oil Price (WTI) x US CPI/ TT RPI	International Financial Statistics, CBTT.

Figure 4: Trends in Money Supply and Non-Energy Fiscal Balance



Source: Central Bank of Trinidad and Tobago

(i) Testing for Independence (Granger Causality/Block Exogeneity Wald Test)

It is important to determine the order of integration of the indicators of monetary and fiscal policies before carrying out the Phillips-Ouliaris (single equation) cointegration test. In testing for stationarity, the unit root tests indicate that the monetary and fiscal policy variables were found to be I(0) variables (see **Table 9** considering the trend plus intercept specification). The results restrict further testing for a long-run relationship between the variables. However, we check for the existence of short-run relations between the variables.

We apply the Granger Causality Block Exogeneity test on the above indicators. The results of this test which are reported in **Table 4** indicate that we cannot reject the hypothesis of no causality from LM2G to LFBG. Also, we cannot reject the null of no causality from LFBG to LM2G. So it appears that there is no causality between the two variables. The results provide confirmation that the monetary and fiscal policies are independent of each other.

(ii) Set Theoretic Model Results

Given the independence of both indicators in this study, we then measure the extent of coordination utilising equation (1) described earlier which is based on the empirical information on the macroeconomic environment and policy response matrices. In the case of TT, the environment matrix is constructed based on shocks to real GDP and inflation for the country over the period (1993-2016). The shocks to growth rate are represented as deviations of the real GDP from potential GDP. Shocks to inflation are indicated as the divergence of inflation from the threshold level of inflation (6%).[8]

Table 4: VAR Granger Causality/Block Exogeneity Wald Test

Dependent Variable	Excluded Variable	Null Hypothesis	Chi Sq. (Prob.)	Decision	Result
LM2G	LFBG	LFBG doesn't Granger cause LM2G	1.053557 (0.5905)	Accepted	LFBG doesn't Granger cause LM2G
LFBG	LM2G	LM2G doesn't Granger cause LFBG	0.022355 (0.9889)	Accepted	LM2G doesn't Granger cause LFBG

[8] This study utilises the core inflation rate instead of the headline inflation rate since this measure excludes the more volatile food prices. To estimate the threshold inflation rate for TT, the paper follows an approach similar to Mubarik (2005) and Bhusal and Silpakar (2011). This Ordinary Least Squares (OLS) model is specified as: $RNGDP_t = \beta_0 + \beta_1 INF_t + \beta_2 D_t(INF_t - K_t) + \beta_2 PCG_t + \beta_3 RLR_t + E_t$…eq(a) where $RNGDP_t$ is the real non-energy GDP growth rate, INF_t is the core inflation rate, PCG_t is the private sector credit to GDP ratio, RLR_t is the real lending interest rate of commercial banks and K is threshold inflation rate. It is the rate of inflation at which structural break occurs and E_t is the random error term which represents measurement error in the explanatory variables. The dummy variable D is defined as follows: D = 1 if INF > K and D = 0 if INF < K. When the inflation rate is below the threshold, the effect of inflation on real GDP is estimated by the coefficient of inflation (β_1). However, when the inflation rate is at higher levels the coefficient of inflation is the sum of the betas ($\beta_1 + \beta_2$). In order to locate the threshold inflation rate we first allow for one break by varying the inflation threshold rate from a low to high level. Standard statistical tools are used to identify the threshold point and check the reliability of the regression estimates. Regressions were estimated for the values of K in an ascending order from low to high. The empirical analysis suggests that if inflation is above 6%, then economic growth performance could be adversely affected. It would be reasonable to conclude that policies that stabilise the inflation rate to a certain threshold level matters for long-run economic growth in TT.

With regard to the policy response matrix, changes in the money supply and the non-energy fiscal deficit represent stances for both monetary and fiscal policies, respectively. The expansionary policies are defined as positive changes in the stances, whereas contractionary policies are identified by negative changes in the stances.

From **Tables 5** and **6**, the extent of coordination can be calculated as follows:

$$\omega = n(PP_t \cap CC_t) + n(PN_t \cap CE_t) + n(NP_t \cap EC_t) + n(NN_t \cap EE_t)$$

$$= 1 + 3 + 0 + 4 = 8$$

$$\rho = 8/25 = 0.32 \text{ (or } 32\%)$$

Results obtained from equation (1) suggest that coordination has been very low over the period under study. Weak policy coordination may have complicated macroeconomic management in the country over the last 25 years. The results indicate a score below the benchmark of 50% for minimum policy coordination. In looking at the boom period (2004–2008), coordination stood at 28%. However, a score of 38% was calculated for the period 2009–2016. This suggests an improvement in policy coordination during the period following the global financial crisis, which was accompanied by volatility and severe adverse shocks to energy prices. Policy coordination improved as a result of the government's efforts to revive the domestic economy. While there was an improvement, the extent of coordination, however, remained weak during this sub-period.

(iii) Vector Autoregressive (VAR) Model Results

Use of VAR model for policy coordination analysis requires certain preconditions be met. First, VAR models require that all the variables must be stationary and not co-integrated. If certain variables are non-stationary,

Table 5: Macroeconomic Shock Matrix for Trinidad and Tobago

		Inflation *(Deviation from the Inflation Threshold)*	
		Positive	Negative
Growth *(Dev. from Potential Output)*	Positive	2007, 2008	2004-2006, 2009, 2010, 2013
	Negative	1993-2003	2011, 2012, 2014-2016

Note: The numbers represent calendar years.

Table 6: Policy Response Matrix for Trinidad and Tobago

		Monetary Policy	
		Contractionary	Expansionary
Fiscal Policy	Contractionary	1995, 1996, 2000, 2003, 2004, 2007, 2011	2005, 2006, 2009, 2014, 2016
	Expansionary	1993, 1994,1995, 2002, 2008, 2010	2001, 2002, 2003, 2012, 2013, 2015

Note: The numbers represent calendar years.

these variables must be converted to stationary status. This can be done using the method of first differencing. If, however, the variables are non-stationary, and are of the same order of integration, then cointegration should be tested for these variables and a more applicable model would be the Vector Error Correction Model (VECM). If no cointegration exists then a VAR model can be estimated.

Table 7 provides the results of three conventional unit root tests which are utilised to determine the order of integration of variables for econometric modelling purposes. The tests indicate that all the variables, except for the nominal exchange rate, are integrated of order one, i.e. I(1). Conventional tests, however, cannot provide conclusive evidence of the order of integration of the variables in the presence of structural breaks. It is possible that the variables could have been affected by macroeconomic shocks such as the 2008/09 global financial crisis.

Unit root testing, which accounts for possible structural breaks, is therefore conducted. Contrary to earlier findings of the conventional tests, the results of the breakpoint test show that the $LGAP_t$, $LFBG_t$, and $LM2G_t$ variables are stationary (using the trend plus intercept specification) **(Table 8)**. The VAR econometric estimation is carried out given that not all the variables are of the same order of integration and because four of the variables were found to be stationary, which restricts testing for co-integration.

Table 7: Unit Root Testing (ADF, PP and KPSS)

		LEVEL			FIRST DIFFERENCE		
Variables (Logarithmic Form)*	**Notation**	**ADF**	**PP**	**KPSS**	**ADF**	**PP**	**KPSS**
Output Gap/Potential GDP (%)	$LGAP_t$	-2.38	-2.28	0.22	-5.69	-5.73	0.10
Non-energy Fiscal Deficit/GDP (%)	$LFBG_t$	-1.91	-1.71	0.39	-6.88	-6.89	0.07
Inflation Dev. from Threshold (%)	$LINFD_t$	-2.51	-2.71	0.33	-7.91	-8.35	0.03
Broad Money/GDP (%)	$LM2G_t$	-0.76	-0.54	0.61	-10.91	-10.98	0.37
Nominal Exchange Rate	$LNEX_t$	-13.21	-9.75	1.03			
Real Oil Price	$LROIL_t$	-0.95	-1.20	0.31	-8.25	-8.24	0.08

Notes: * All variables were transformed in logarithmic form to correct for heteroscedasticity and to ensure that the data follow a normal distribution.
Critical values for ADF test are -3.50 (1%), -2.89 (5%), -2.58 (10%) - If T-stat > critical value, reject H_0:ō=0 (non-stationary)
Critical values for PP test are -3.57 (1%), -2.29 (5%), -2.60 (10%) - If T-stat > critical value, reject H_0:ō=0 (non-stationary)
Critical values for KPSS test are 0.739 (1%), 0.463 (5%), 0.347 (10%) - If T-stat > critical value, reject H_0:ō=0 (stationary)

Source: Authors' calculations using Eviews 8.0 and 9.0

Table 8: Unit Root Test with a Break Point

		LEVEL					
		Trend and Intercept			**Intercept Only**		
Variables (Logarithmic Form)	**Notation**	**Break Date**	**T-Stat**	**P-val**	**Break Date**	**T-Stat**	**P-val**
Output Gap/Potential GDP (%)	$LGAP_t$	Dec-04	-4.86	0.05	Dec- 01	-6.05	<0.01
Non-energy Fiscal Deficit/GDP (%)	$LFBG_t$	Dec-07	-4.86	0.05	Dec-07	-2.52	0.90
Inflation Dev. from Threshold (%)	$LINFD_t$	Dec-04	-4.48	0.14	Mar-03	-3.69	0.29
Broad Money/GDP (%)	$LM2G_t$	Dec-08	-7.44	<0.01	Dec-08	-3.80	0.23
Nominal Exchange Rate	$LNEX_t$	Dec-99	-23.84	<0.01	Dec-96	-15.80	<0.01
Real Oil Price	$LROIL_t$	Dec-15	-3.98	0.38	Mar-15	-4.01	0.15

Notes:
Critical values (Trend and Intercept) are -5.35 (1%), -4.86 (5%), -4.61 (10%) - If T-stat > critical value, reject H_0:ō=0 (Has a Unit Root)
Critical values (Intercept Only) are -4.95 (1%), -4.44 (5%), -4.19 (10%) - If T-stat > critical value, reject H_0:ō=0 (Has a Unit Root)

Source: Authors' calculations using Eviews 8.0 and 9.0

Following the estimation, robustness tests are executed in order to determine the reliability of the model. These include: the optimal lag order selection criteria which was used to determine the number of lags necessary to remove serial correlation, the LM residual serial correlation test, heteroscedasticity, autocorrelation and the inverse AR roots tests. Results of the Lag Length test indicate that four lags are needed to minimise the AIC criterion. The results of the other tests are shown in the appendix.

The impulse response functions are based on the generalized decomposition approach which does not require the variables be placed in any specified order. This is specifically useful in cases where the degree of endogeneity of the variables is not clear so as to determine the proper ordering of the variables. **Figure 5** below shows the impulse response function of the non-energy fiscal deficit to a shock in the other variables[9]. The response of the non-energy fiscal deficit to a positive shock in the output gap is to worsen from quarter 3 and for the rest of the forecast period. This indicates a clear pro-cyclical behavior of government's fiscal policy. This could occur as a result of improving revenue conditions during an upswing in energy prices and production which encourage the government to spend more, but is inflexible to a downturn in the business cycle. Also evident in the chart is the response of the non-energy fiscal deficit to its own shock where an initial shock to the deficit triggers a worsening of the deficit over many periods, i.e. from quarters 1 to 10. The response of the fiscal deficit to a shock to inflation is also pro-cyclical as it worsens over the forecast horizon before improving from quarter 7. This implies a non-supportive fiscal policy to increases in inflation. The response of the non-energy deficit to a shock in the money supply is to worsen over the first four quarters but the effect tapers off towards the zero line from quarters 6 to 10. This indicates that an increase in the money supply creates more room for government spending, resulting in a temporary, i.e. approximately a one-year period, widening of fiscal deficits. A depreciation in the nominal exchange rate results in a small change in government's fiscal deficit over the forecast horizon.

A positive shock to the output gap causes the money supply to decrease over the first five quarters before increasing from the sixth quarter and for the rest of the forecast period **(Figure 6)**. The response of the money supply to a shock in the fiscal deficit is to increase slightly over the first six quarters but the effect dies off over the remainder of the forecast period. This suggests that following a fiscal expansion, the Central Bank moves to mop up the excess liquidity which has a contractionary effect on the money supply. Also, a shock to inflation results in increases in the money supply initially, but declines from quarters 2 to 5, but then the effect dies off from quarter 6. An own shock causes the money supply to increase significantly in the first quarter but the effect discontinues thereafter. A depreciation in the nominal exchange rate results in a small response in the money supply.

6. Policy Recommendations and Conclusion

This paper empirically investigates the extent of coordination between monetary and fiscal policies in TT. It shows evidence of independence of monetary policy over the review period under a managed exchange rate regime since April 1993.

Having established the independence of both policies, the paper calculated the extent of coordination (using the STA) in response to macroeconomic shocks over the period 1993–2016. The results of the analysis indicate that over the last 25 years coordination of monetary and fiscal policies has been weak. The results of the VAR impulse response functions also indicate evidence of weak coordination of fiscal and monetary policies. Overall, fiscal policy appears to be conducted in a highly

[9] A positive (negative) shock to the non-energy fiscal deficit implies a smaller (larger) deficit or a contractionary (expansionary) fiscal policy.

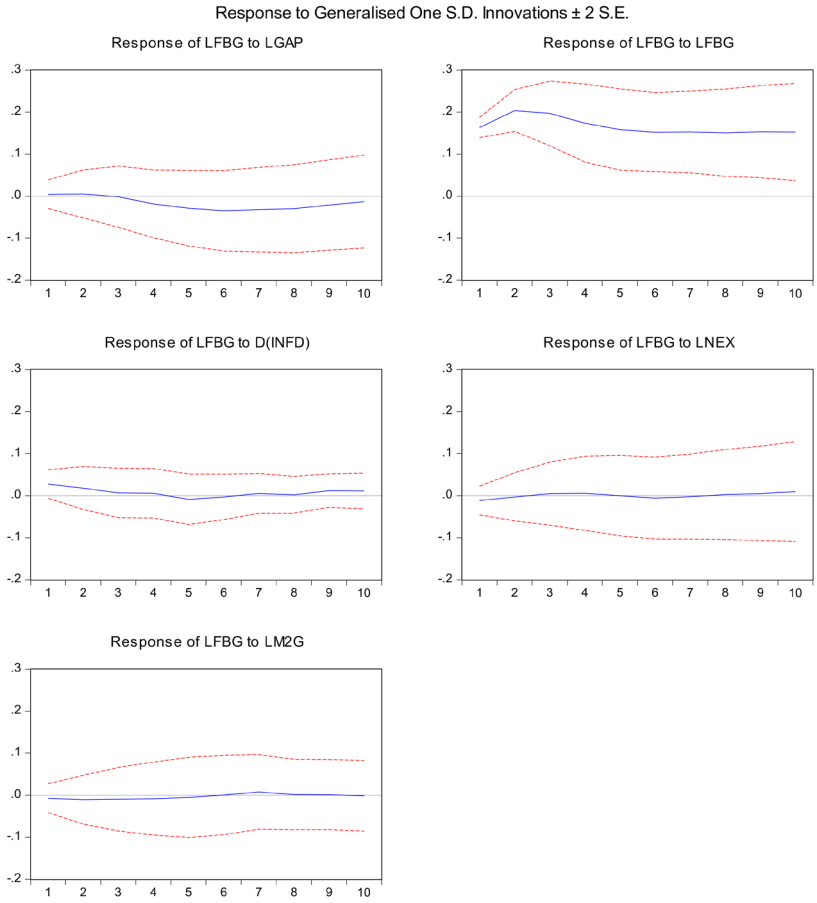
pro-cyclical manner, which implies that fiscal policy tends to be inflexible and therefore cannot be reversed quickly. The behavior of fiscal policy also seems to be non-supportive of inflation. With regard to monetary policy, it appears that while it moves to neutralise the impact of fiscal policy, especially by managing liquidity conditions, there are challenges associated with excess liquidity, which restricts the ability of this policy to respond effectively to inflation shocks.

The structural changes that have occurred in the economy especially over the last two and a half decades (such as the liberalisation of the foreign exchange market, interest rate liberalisation, free capital flows and the shift towards indirect monetary policy) present an important opportunity for policy coordination. While policy coordination increased somewhat in the period following the 2008/09 global financial crisis, based on the findings of this paper, a greater effort is needed by the authorities to improve it. The study reveals that the degree of policy coordination in Trinidad and Tobago is generally in line with some developing economies such as those in the South African region.

This study is only a first step in the understanding of the degree of policy coordination in Trinidad and Tobago. The study did not delve into the possible range of factors (such as institutional, developmental, or political etc.) that may be responsible for the outcome. Further research in this area is therefore necessary to clarify this issue. In the absence of such research some broad policy recommendations are made.

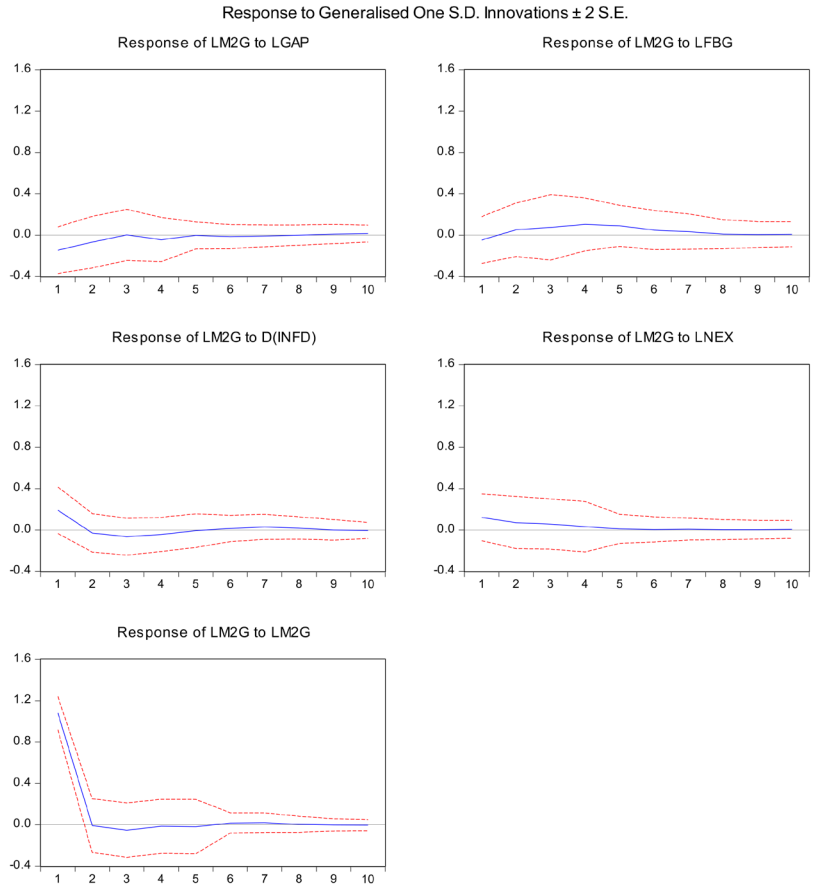
Greater policy coordination may be achieved through a formalized framework which details the policy objectives, institutional and operational arrangements for both authorities. Since such a framework does not exist for the country at the moment, there are two measures which can potentially facilitate greater policy coordination in the near future. Firstly, there is a need to strengthen the relationship between the monetary and fiscal authorities as regards liquidity management. This is likely to reduce the incidence of large unplanned liquidity injections which require mopping up by the Central Bank. Secondly, sound management of public debt is important if a higher degree of coordination is to be achieved going forward. High levels of public debt can reduce the fiscal space of the fiscal authority and hamper coordination with monetary policy.

Figure 5: The Response of Fiscal Policy in Trinidad and Tobago



Source: Authors' calculations using Eviews 8.0

Figure 6: The Response of Monetary Policy in Trinidad and Tobago



Source: Authors' calculations using Eviews 8.0

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Appendix

Table A.2:
VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h
Date: 01/15/18 Time: 14:31
Sample: 3/01/1993 12/01/2016
Included observations: 91

Lags	LM-Stat	Prob
1	15.93271	0.9168
2	34.65160	0.0947
3	30.22748	0.2159
4	29.98733	0.2248
5	20.65436	0.7117
6	15.21383	0.9362
7	13.55661	0.9689
8	26.09514	0.4025
9	7.552455	0.9997
10	10.36978	0.9955

Probs from chi-square with 25 df.

Cart A.1
Inverse Roots of AR Characteristic Polynomial

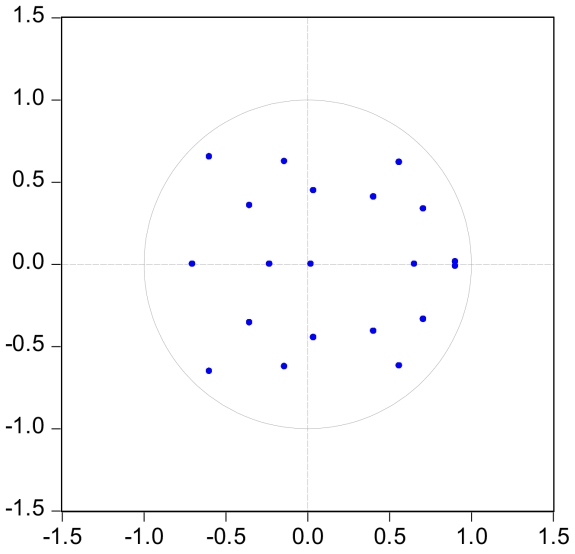

Table A.3:
VAR Lag Order Selection Criteria

Endogenous variables: LGAP LFBG D(INFD) LNEX LM2G
Exogenous variables: C D(LROIL) DUM0809
Date: 01/15/18 Time: 14:32
Sample: 3/01/1993 12/01/2016
Included observations: 87

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-156.6821	NA	3.56e-05	3.946715	4.371872	4.117913
1	157.4560	570.5037	4.64e-08	-2.700138	-1.566387*	-2.243611*
2	188.2788	52.43419	4.09e-08	-2.833995	-0.991650	-2.092140
3	207.1225	29.88999	4.80e-08	-2.692471	-0.141531	-1.665286
4	242.3872	51.88379*	3.92e-08*	-2.928442*	0.331091	-1.615929
5	260.3728	24.39414	4.87e-08	-2.767190	1.200938	-1.169347
6	272.8860	15.53372	7.03e-08	-2.480139	2.196584	-0.596967
7	287.1712	16.09133	1.01e-07	-2.233821	3.151496	-0.065320
8	302.9424	15.95248	1.46e-07	-2.021664	4.072247	0.432166

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table A.4:
VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 01/15/18 Time: 14:32
Sample: 3/01/1993 12/01/2016
Included observations: 91

Joint test:

Chi-sq	df	Prob.
653.1066	645	0.4039

Individual components:

Dependent	R-squared	F(43,47)	Prob.	Chi-sq(43)	Prob.
res1*res1	0.497902	1.083888	0.3924	45.30906	0.3759
res2*res2	0.902215	10.08485	0.0000	82.10160	0.0003
res3*res3	0.448239	0.887949	0.6521	40.78975	0.5676
res4*res4	0.389644	0.697772	0.8827	35.45757	0.7862
res5*res5	0.158199	0.205411	1.0000	14.39609	1.0000
res2*res1	0.458996	0.927339	0.5975	41.76867	0.5247
res3*res1	0.537927	1.272452	0.2096	48.95132	0.2465
res3*res2	0.556035	1.368935	0.1466	50.59919	0.1986
res4*res1	0.339320	0.561368	0.9712	30.87810	0.9164
res4*res2	0.491390	1.056017	0.4262	44.71649	0.3996
res4*res3	0.377259	0.662158	0.9131	34.33057	0.8246
res5*res1	0.164511	0.215221	1.0000	14.97053	1.0000
res5*res2	0.231455	0.329175	0.9998	21.06241	0.9980
res5*res3	0.175709	0.232994	1.0000	15.98955	0.9999
res5*res4	0.245777	0.356182	0.9996	22.36573	0.9961

Assessing the Exchange Rate Pass-Through to Inflation: The Case of Trinidad and Tobago

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Abstract

The exchange rate pass-through (ERPT) to domestic inflation is relevant for a small open and developing economy like Trinidad and Tobago (TT) that is heavily reliant on imported goods for intermediate and final consumption. The paper examines the relationship, speed and magnitude of the ERPT, using quarterly data between 1995 and 2016 of variables such as the nominal effective exchange rate (NEER), Gross Domestic Product (GDP), import prices, money supply, and government spending. Using a Vector Error Correction Model (VECM), impulse response functions and variance decomposition, the authors found that exchange rate transmission to domestic food and headline inflation rates were faster than observed in previous research, taking two (2) and three (3) quarters to pass through respectively. Based on the results, it is recommended that monetary and exchange rate policy should be coordinated more tightly.

1. Introduction

Trinidad and Tobago is a small open economy with increasing reliance on imported commodities both for direct consumption and use as intermediate goods. Therefore, the economy is vulnerable to external shocks which have the potential to disrupt foreign exchange earnings and also filter into higher domestic prices. Furthermore, TT is not an inflation targeter; as such, the impact of exchange rate pass-through to inflation poses a greater risk (Mishkin and Schmidt-Hebbel 2006) when compared to economies that directly pursue inflation stabilisation policies. In light of this reality, this paper aims to assess the degree of exchange rate pass-through to inflation in Trinidad and Tobago.

According to the literature, "exchange rate pass-through" refers to the degree to which exchange rate changes are transmitted to import prices and subsequently to final consumer prices. As countries become more open, the theoretical underpinnings of exchange rate pass-through become more important. Moreover, the acceleration of globalisation brought the concept to the forefront of considerations for economists and policymakers alike. The theory of purchasing power parity posits that any adjustments in the exchange rate should result in a proportional change in the inflation rate. Most exchange rate models and balance of payments techniques assume purchasing power parity and therefore a one-to-one relationship between exchange rate fluctuations and changes in domestic prices. Therefore, a complete

[1] The views expressed in this paper are those of the authors and do not necessarily represent those of the Central Bank of Trinidad and Tobago.

exchange rate pass-through to inflation is identified by this one-to-one relationship. For example a one per cent depreciation of the exchange rate is expected to result in a one per cent increase in domestic prices; however, an incomplete pass-through results in a less-than-one per cent change in domestic prices. Nevertheless, the extent of exchange rate pass-through is directly impacted by several other factors such as the level of economic openness, the monetary policy regime, composition of imports and overall economic conditions.

Some economies have adopted policies such as inflation targeting, which require a thorough understanding of exchange rate pass-through and inflation in order to better inform monetary policy. Understanding the role of exchange rate pass-through is necessary as the magnitude and speed of exchange rate changes across varying commodity categories differ. A study by An (2006) stated that the knowledge of the degree and timing of pass-through is of particular importance for the assessment of monetary policy transmission on prices and also for inflation forecasting. Inflation targeting requires information on the size and speed of exchange rate pass-through into inflation, as well as the level of exchange rate pass-through has important implications for "expenditure-switching" effects from the exchange rate. Where there is limited exchange rate pass-through, trade flows will remain insensitive to movements in the exchange rate. However, if prices respond rapidly to changes in the exchange rate and trade flows are sensitive to movements in prices, then the impact will be observed in the balance of payments as the current account adjusts to changes in import demand.

Despite the aforementioned fundamentals, a number of studies have shown that exchange rate pass-through is not only partial but is also falling in most economies. Taylor (2000) presented the argument that there has been a decline in the extent to which firms pass onchanges in costs to prices from either external or domestic shocks. Further, the decline appears to be correlated with a decline in inflation within most countries. Additionally, Gagnon and Ihrig (2004) observed that the pass-through of exchange rate adjustments into domestic inflation appears to have waned since the 1980s which is largely credited to increased emphasis on inflation stabilisation by central banks. This finding is significant as a low exchange rate pass-through leaves room for exercising more independent monetary policy actions and provides a greater degree of confidence in an inflation targeting regime.

The paper will therefore explore the domestic experience of the exchange rate pass-through to inflation and provide insight for future monetary policy measures. The sections are developed as follows: section two provides details on various sources of literature on the topic and is followed by a third section which looks at relevant facts on the economy of Trinidad and Tobago. The fourth and fifth sections employ the use of a Vector Error Correction Model (VECM) in estimating the case of Trinidad and Tobago and analyze the empirical findings. The paper concludes in a sixth section with policy recommendations to better assist in decision-making within the domestic economy.

2. Literature Review

With the increased openness of many economies, movements in nominal exchange rates have ignited concerns regarding the pass-through of exchange rate fluctuations to domestic prices. Echange rate pass-through has been broadly defined as *"the percentage change in destination-currency import prices resulting from a one percent change in an exchange rate between exporting and importing countries"* (Goldberg and Knetter 1996). The concept of exchange rate pass-through is important in inflation forecasting, which informs central banks' monetary policy. Therefore, a vast amount of literature exists which examines the exchange rate pass-through and inflation both regionally and internationally.

In a study by J. B. Taylor (2000), the argument was

presented that a low-inflation environment would support a low exchange rate pass-through to domestic prices while a high-inflation environment would automatically achieve a high exchange rate pass-through. Inflation has the characteristic of inertia such that periods of low inflation will predict low inflation in the future and high inflation normally preludes future high inflation. Furthermore, in an existing low-inflation environment, firms may not increase prices brought on by exchange rate shocks, as higher prices will result in reduced competitiveness for firms. However, if the firm expects the inflationary pressure in a high-inflation environment to be persistent, it may increase prices in response to exchange rate shocks. This is possible as any increase in price within this regime will seem reasonable to consumers. Taylor (2000) asserts that this relationship of price adjustment to movements in the exchange rate points to a high degree of exchange rate pass-through.

According to Bacchetta and Wincoop (2005), who examined the optimal invoicing choice exercised by firms, exchange rate pass-through to import prices is significantly affected by the currency in which prices are set. If firms wield significant market power and can set prices, they would favour setting prices in foreign currency during times of exchange rate volatility. Consequently, this would lead to high exchange rate pass-through to domestic prices. However, if firms face less international competition, as reflected in the size of their market share, there is greater incentive to price in the domestic currency resulting in a lower degree of exchange rate pass-through. Based on these factors laid out by Bacchetta and Wincoop (2005), exchange rate pass-through is determined by both the level of exchange rate volatility and the characteristics of the domestic market. Some additional factors that determine the exchange rate pass-through were also highlighted by An (2006), namely the micro factors of market structure, pricing behaviour of firms, responsiveness to markups and demand elasticity of imports. Also macro factors such as the size of the country, openness, aggregate demand volatility, inflation environment and monetary policy environment will be important.

Reviewing economies closer to home, Ramlogan (2004), using regression analysis and impulse response functions, examined the monetary transmission mechanism for four English-speaking Caribbean countries: Jamaica, Trinidad and Tobago, Barbados and Guyana. Results indicated that in all four economies, credit and exchange rate shocks were most signficant in explaining price variability, which is in keeping with a prioi expectations. While both credit and exchange rate shocks are important in explaining price movement in Trinidad and Tobago, the latter appears to be more important over the short to medium term. Meanwhile, prices in Jamaica and Barbados are more responsive to exchange rate shocks than a shock to credit, largely due to their dependence on tourism. According to Ramlogan (2004), the relationship between the exchange rate channel and price variability in small open economies is expected as these economies are heavily dependent on their ability to accumulate foreign exchange earnings in order to support the high marginal propensity to import both internediate and final goods.

Given Trinidad and Tobago's dependence on the energy sector, Watson (2003) evaluated the effectiveness of monetary policy measures on the real sector of the economy. The author examined three potential transmission mechanism channels: the money channel, the credit channel and the exchange rate channel. The findings highlighted that the exchange rate is the principal conduit of monetary policy transmission to the real sector. The analytical conclusion was that a small open economy such as Trinidad and Tobago has a high propensity to import both intermediate and capital goods which has a direct impact on production levels. Consequently, this tendency would influence cost of production which is directly linked to higher consumer prices.

DaCosta and Greenidge (2008) studied the determinants of inflation in selected Caribbean economies including

Trinidad and Tobago. Results indicate that short-run increases in money supply generate inflationary tendencies which are symptomatic of the monetarist view of too much money chasing too few goods. A later study focusing solely on the determinants of inflation in Trinidad and Tobago by Cheong and Ramrattan (2015) finds that in the long run, the money supply remained a contributor to inflation while government spending was a mitigating factor on domestic inflation rates. Overall, their combined variables resulted in a deflationary impact in the long run.

Looking more specifically at exchange rate pass-through to inflation, Borensztein and Queijo Von Heideken (2016) analysed the exchange rate pass-through and its determinants for a group of countries within South America. According to the evidence, in the short and medium terms, a moderate degree of exchange rate transmission to domestic prices for traded and non-traded goods exists when compared to previous decades. This finding is reflective of the stronger degree of credibility of the economies' monetary policy frameworks over time. Notwithstanding the strength of the monetary policy action, the outcome was aided by the success of floating exchange rates and inflation targeting systems. According to Calvo and Reinhart (2000), the region appears to have broken free from the policy dilemmas underlying its epidemic case of 'fear of floating.'

It is crucial to note that several empirical studies have indicated the exchange rate pass-through to inflation has not only been partial, but has also been falling since the 1990s for most economies. Dornbusch (1987) articulated the view that in the short run prices tend to be rigid, therefore the extent of price adjusment is limited resulting in an incomplete pass-through of the exchange rate to inflation. Moreover, Goldberg and Knetter (1996) posited that incomplete pass-through of exchange rate movement to inflation is not soley as a result of changes in international prices but is also a consequence of third-degree price discrimination. Over half of the effect of exchange rate changes is outweighed by destination-specific adjustments of markups over cost, albeit there are variations amongst different industries.

Many studies employ econometric approaches in analysing and interpreting the degree and magnitude of exchange rate pass-through and inflation within economies **(Appendix 3)**. Some of the methodologies used in the international literature were the Ordinary Least Squares (OLS) regression technique, Johansen Maximum Likelihood Procedure, Two-staged single equation method, panel cointegrating techniques, the time-varying paramenter and the Vector Autoregression (VAR) model. However, in several of the more recent studies, the VAR model was the primary instrument used to estimate the relationship between the exchange rate and inflation. Robinson (1998) attempted to forecast inflation in Jamaica using a VAR model. According to the results presented, a decline in the rate of depreciation of the exchange rate had an immediate dampening effect on prices within the first year, while contractionary monetary policy had a lagged effect of approximately two months. Christopher-Nicholls and Des Vignes (2002) also modelled the exchange rate pass-through to inflation using a VAR model for Trinidad and Tobago. The results revealed a high pass-through effect to inflation in Trinidad and Tobago, and the effect of the exchange rate shock persisted up to two and a half years. Similar to the conclusions drawn by Robinson (1998), a depreciation of the exchange rate has a dampening impact on production which contrains supply and, against the backdrop of strong demand, increases the inflation rate.

3. Stylized Facts

As a small developing economy, Trinidad and Tobago is susceptible to external shocks due to its heavy reliance on external relationships to meet the shortfall in domestic supply. The country's vulnerability is compounded by its high degree of openness which can be measured by its imports to Gross Domestic Product (GDP) ratio. Trinidad and Tobago's imports to GDP averaged 37.9 per cent over the period 1995 to 2016 with its lowest level at 29.2 per cent in 2010, reflective of the spillovers of the global recession. **(Chart 1)**. The country's main import categories comprise fuel (SITC 3 and 5), capital

goods (SITC 7) and manufactured goods (SITC 6) **(Table 1)**. According to the literature, fuel imports possess a high exchange rate pass-through to domestic prices whilst manufacturing and capital imports possess a low transmission to domestic prices (Campa, Golberg and Gonzalez-Minguez 2005).

The domestic economy's high import bill reflects the changes in the sectoral composition of the country's GDP over time. Trinidad and Tobago's food import bill averaged TT$3.2 billion over the period 1995 to 2016. The decreased levels of economic activity in the agriculture sector coupled with contractions in the manufacturing sector have resulted in increased demand for imports for both immediate consumption and intermediate products. In 1995, the manufacturing sector contributed 8.2 per cent to GDP while the agricultural sector contributed 1.7 per cent to GDP. However, by 2016, the manufacturing and agricultural sectors declined, contributing 7.5 per cent and 0.4 per cent to GDP, respectively.

The US continues to be the country's major sources of imports, supplying an average of 32.8 per cent of its total imports over the period 1995 to 2016. The United States Dollar (USD) is the most frequently used trading currency for Trinidad and Tobago. As such, fluctuations in the exchange rate have direct implications on the cost and the demand for imports.

The fluctuations in the domestic headline inflation have been influenced by both of its components – core and food inflation – over the period 1995 to 2016. Changes in the international commodity price environment have also contributed to fluctuations in domestic inflation rates via costs to importers. This is primarily due to the large imported components of the highest weighted categories for domestic food and core inflation. The highest weighted categories for food inflation are "Bread and Cereals" (19.0 per cent) and "Meat" (17.9 per cent) while the highest weighted categories for core inflation are "Housing, Water, Electricity, Gas and Other Fuels" (33.3

Table 1:
Import Share by SITC Categories

SITC Categories		Share in Imports (Per Cent)					
		2011	2012	2013	2014	2015	2016
0.	Food	7.8	7.3	7.1	8.1	9.6	8.0
1.	Beverage & Tobacco	0.7	0.7	0.7	0.9	1.1	1.1
2.	Crude materials	5.2	4.1	3.5	4.5	3.9	3.3
3.	Minerals, fuel, lubricants and related materials	38.9	41.8	51.1	43.4	28.5	32.6
4.	Oils & fats	0.6	0.5	0.4	0.5	0.5	0.5
5.	Chemicals	6.5	6.2	5.5	6.2	7.6	7.5
6.	Manufactured goods	8.4	7.9	7.9	9.4	11.3	9.3
7.	Machinery and transport equipment	27.7	27.0	19.2	22.5	31.1	31.5
8.	Miscellaneous manufactured articles	4.2	4.4	4.6	4.6	6.3	6.0
9.	Miscellaneous items	0.1	0.1	0.1	0.1	0.1	0.1

Source: Central Statistical Office of Trinidad and Tobago

per cent) and "Transport" (17.8 per cent). Moreover, the fluctuations in the headline inflation rate became more pronounced after 2001 as the food component became the main driver of movements in domestic inflationary conditions. Despite the lower overall weighting, price movements within the food index are more prominent and more common than price changes across the consumer durables segment of household consumption and other non-food items such as education, health, and transport. As such, food inflation has been the main driver of headline inflation.

Over the period 2004 to 2008, inflation was high and volatile due to demand pull inflation. The subsequent decline in the domestic headline and food inflation rates in 2009 were primarily driven by slower increases in the prices of food items both abroad and domestically. However, the resurgence in inflation rates in mid-2010 was as a result of adverse domestic weather conditions coupled with challenges posed by imported inflation as international prices for staples such as wheat increased. The rise in inflationary pressures in 2016 was attributed to the several revisions to domestic taxes[2] and the 5.5 per cent (year-on-year) depreciation of the Trinidad and Tobago dollar (TTD) relative to the USD by the end of the year **(Chart 1)**. The inflationary pressures exhibited by these circumstances such as adverse weather conditions, changes in tax policy and energy prices, would have been addressed through stepped-up monetary policy. However, low aggregate demand in the context of subdued domestic economic activity may have dampened the full pass-through effect of the depreciation of the currency to domestic retail prices.

The nominal effective exchange rate (NEER) index is a trade-weighted measure of an economy's exchange rate relative to the currencies of the country's main trading partners. The NEER indirectly measures fluctuations between the USD and other primary trading currencies such as the Euro dollar, pound sterling and Japanese yen. Through the inclusion of various currencies, the NEER reflects exchange rate movements in trading partner currencies rather than a single exchange rate, which is a direct limitation in applying the USD exchange rate **(Chart 1)**. The fluctuations in the NEER over 1995 to 2016 displayed several periods of improvements and deteriorations in Trinidad and Tobago's international competitiveness relative to its trading partners. In particular, the largest loss of competitiveness was 2008 – a 7.0 per cent appreciation of the NEER which implied that imports became cheaper from the domestic economy's perspective. The cheaper costs of imports coupled with the accelerated growth in domestic money supply manifested in increased demand for imports and were reflected in the higher value of imports during the year. The appreciated NEER also corresponded with an increase in imports as a percent of GDP between 2014 and 2016.

Broad money supply or M2 is defined as currency in active circulation plus demand, savings and time deposits held by residents other than the Central Government. Over the period of 1995 to 2003, money supply recorded a significant boost moving from TT$10.5 billion at the end of 1995 to TT$18.6 billion at the end of 2003 **(Chart 1)**. Subsequently, the period over 2004 to 2014 saw unprecedented growth (above 300 per cent) in money supply as it reached TT$87.1 billion at the end of 2014. This strong growth was accompanied by a rapid increase in nominal GDP of approximately 100 per cent while net official reserves tripled over the similar period. During this period the Central Bank of Trinidad and Tobago (CBTT) used a range of monetary policy instruments to tighten monetary policy conditions, including the Repo rate (its benchmark interest rate), net open market operations, reserve requirements, and liquidity absorption bonds. Money supply growth decelerated by 2015 and remained subdued in 2016.

Trinidad and Tobago can be described as a rentier state given the significant reliance of the economy on indigenous natural resources and the relationship between government expenditure and revenue. Much

[2] Several revisions to existing tax measures include; revisions to the Business Levy and Green Fund Levy (January 2016), the widening of the Value Added Tax (VAT) base (February 2016) and the reduction of the fuel subsidy on diesel and gasoline (April 2016).

of Government expenditure is financed through income earned by monetization of the country's energy deposits. Over the period 1995 to 2016, the economy experienced a surge in Government expenditure backed by increasing international energy prices **(Chart 1)**. In particular, over the period 2005 to 2014 government expenditure more than doubled from TT$22,444.6 million to TT$55,069.4 million as the economy benefited from substantial growth in energy revenue. Interestingly, the data revealed ongoing expansion in government expenditure in response to the 2008 Global Financial Crisis which has continued to present despite its deceleration to TT$47,267.2 million by 2016. According to Cheong and Ramrattan (2015), Trinidad and Tobago's expansionary fiscal policy post 2008 highlights the Government's approach to stimulate domestic economic activity through increased expenditure. Therefore, the Government has acted through fiscal policy measures to maintain a certain level of production in the economy.

Chart 1:
Stylized Facts - Trinidad and Tobago

Figure 1: Import Share to GDP

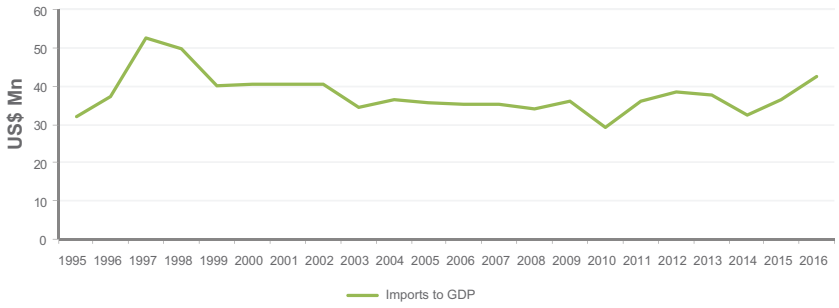


Figure 2: Domestic Quarterly Inflation Rates
(Year-on-Year)

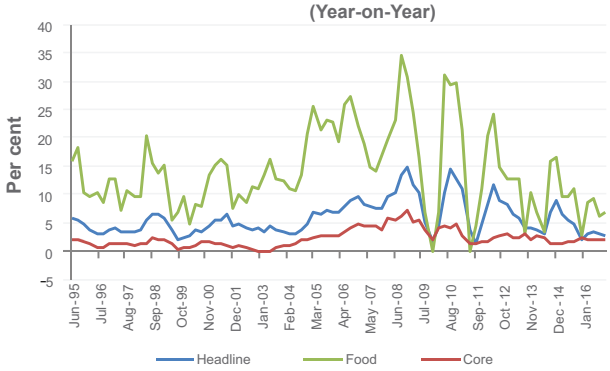


Figure 3: NEER and TTD/USD exchange rate

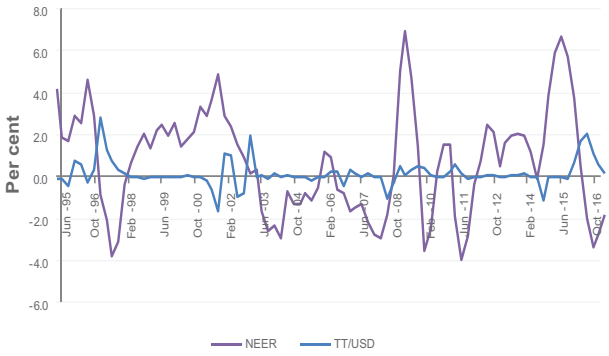
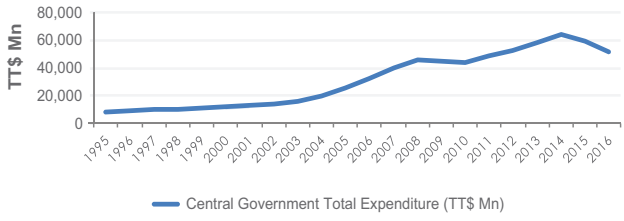


Figure 4: Broad Money (M2) and Imports

Figure 5: Central Government Total Expenditure



Sources: Central Statistical Office and Central Bank of Trinidad and Tobago

4. Modeling the Exchange Rate Pass-Through

The Vector Autoregression (VAR) Model has been the predominantly used econometric technique in the literature to examine the relationship between the inflation rate and its determinants as well as to investigate the speed and magnitude of ERPT. This paper follows a similar pattern by employing a VAR model using quarterly data over the period 1995 to 2016. The data was obtained from the Central Statistical Office (CSO), the CBTT and the US Bureau of Labour Statistics.

The seasonal component of the data series was removed using the Eviews 9.0 seasonal adjustment option, Census X-13, resulting in a smoothed trend of the variables. Two iterations of the VAR model were estimated: one for headline inflation rates and the other for food inflation rates. It was essential to include the latter iteration of the VAR model in our investigation of the ERPT as domestic food inflation has a large imported component, and it also removes the energy products from consideration. All of the variables, with the exception of the inflation rates, the monetary policy interest rate and the NEER were expressed in natural logarithms[3]. The two equations are defined below.

$$INFL_t = \alpha_0 + \alpha_1 LOILP + \alpha_2 IR + \beta_1 INFL_{t-i} + \beta_2 LIPI\_TT_{t-i} + \beta_3 NEER_{t-i} + \beta_4 LM2_{t-i} + \beta_5 LQGDP_{t-i} + \beta_6 LGEXP_{t-i} + \mathcal{E}_t \quad \textbf{(1.0)}$$

$$INFL\_F_t = \alpha_0 + \alpha_1 LOILP + \alpha_2 IR + \beta_1 INFL\_F_{t-i} + \beta_2 LUSEXPRF_{t-i} + \beta_3 NEER_{t-i} + \beta_4 LM2_{t-i} + \beta_5 LQGDP_{t-i} + \beta_6 LGEXP_{t-i} + \mathcal{E}_t \quad \textbf{(2.0)}$$

Where $INFL_t$ and $INFL\_F_t$ are the year-on-year percentage changes in inflation rates (end of period) for all commodities and food, respectively. The exogenous variables in the model are the WTI oil prices represented by *LOILP* and the Central Bank's monetary policy interest rate represented by *IR*[4]. The $LIPI\_TT_t$ is the change in Trinidad and Tobago's import price index while the $LUSEXPRF_t$ is the change in the US export prices index for food which are proxies for import prices. The US food export price index was used as a proxy for the domestic economy's food import prices due to the lack of available data on imported food prices and the fact that the US has supplied Trinidad and Tobago with an average of 44.4 per cent of its overall food imports over the period 2011 to 2016.

The $NEER_t$ is the year-on-year change in the nominal effective exchange rate which is used as a proxy for the changes in the value of the domestic currency; $LM2_t$ is the change in the domestic money supply which represents the purchasing power of consumers in the domestic economy. Meanwhile, $LGEXP_t$ denotes government spending which is used to represent a fiscal policy variable; $LQGDP_t$ is the change in the quarterly index of economic activity[5] which we used as a proxy for the unobservable local demand conditions and the epsilon term Ɛt is the error term.

Prior to estimating the equations, a series of diagnostic tests were conducted to examine the stability (or stationarity) of the variables. The individual unit root processes, namely, the Augmented Dickey-Fuller (ADF) and Philips Perron (PP) unit root tests were performed to determine whether the variables are integrated of the same order. The results of these tests suggest that all variables (with the exception of the NEER[6]) were integrated of order one, i.e., I(1) **(Appendix 1)**. Therefore, those variables must be first differenced for there to be stationarity. Next, the optimal lag length

[3] The use of logarithmic transformations to the variables was to infer elasticities for the explanation of the results.

[4] Since the onset of trade and financial liberalisation in the decade of the 1990s, the monetary policy framework of the Central Bank of Trinidad and Tobago has placed greater emphasis on the use of market-based instruments-3month Treasury Bill rate. However, in mid-2002, the Central Bank implemented a new monetary policy framework based on the use of the Repurchase ('Repo') rate.

[5] The Quarterly Index of Economic Activity (QIEA), which originated as the Quarterly Index of Gross Domestic Product, is constructed by the Central Bank of Trinidad and Tobago and is representative of selected indicators of economic activity.

[6] The NEER year-on-year percentage change was I(0) as its calculation is already differenced.

suggested by the Akaike Information Criterion (AIC) was used for Equations 1.0 and 2.0 which were five (5) and two (2) respectively **(Appendix 1)**. Following this, the Johansen cointegration test for the existence of cointegration was carried out, and the results concluded to reject the null hypothesis of no co-integration at all conventional levels of significance for both equations. The trace test indicated four (4) cointegrating equations were present for equation 1.0 and three (3) cointegrating equations present for equation 2.0.

Consequently, the unrestricted VAR model was not the most appropriate model to be used for Trinidad and Tobago. A Vector Error Correction Model (VECM) was instead employed as this model is designed for non-stationary variables that are found to be co-integrated. The unique design of the VECM restricts the long-run behaviour of the variables to converge to their cointegrating relationship while allowing for short-run dynamics. The VECM used the lag length and cointegrating equations for each iteration as indicated by the lag length criteria and the results indicated by the Johansen test. Robustness tests such as the AR Roots, Heteroskedasticity and Autocorrelation Lagrange Multiplier (LM) tests were conducted and revealed homoskedasticity and no serial correlation, confirming the stability of the model **(Appendix 1)**.

The results of the two iterations of the VECM estimated a negative Error Correction Term (ECT) of approximately 0.85 and 0.87 for the overall domestic inflation and food inflation rates respectively. Given the speed of adjustment is over 0.50, it indicated that the domestic economy has a relatively fast speed of adjustment of the short-term dynamics of the variables to converge to long-run equilibrium **(Table 2)**. Further analysis of the relationships and transmission path to overall domestic and food prices were derived from conducting Granger Causality Tests. However, since Granger Causality is limited to static relationships, the Impulse Response Functions (IRFs) and the Variance Decomposition were also used to augment the analysis of the transmission path.

Table 2:
The Vector Error Correction Model (VECM) Equation

Equation 1.0		
Variable	**Coefficient**	**T-Statistic**
Error Correction Term	-0.844836	-4.43978*
Equation 2.0		
Variable	**Coefficient**	**T-Statistic**
Error Correction Term	-0.868805	-7.62596*

*Denotes rejection of the null hypothesis at all levels (1%, 5%, 10%) of significance.

5. Reviewing and Analyzing the Empirical Findings

Granger Causality

The relationships established by the Granger Causality tests[7] revealed two avenues affecting domestic inflation: the first is via the NEER and the second is via the money supply **(Appendix 1)**. The relationship between the NEER and the domestic headline and food inflation rates implies cost-push inflation as changes in the exchange rate influence the cost of production and in turn domestic prices. The causal link between the money supply (M2) and the domestic headline and food inflation rates demonstrates demand-pull inflation. Demand-pull inflation occurs when increases in the purchasing power of consumers, represented by growth in the money supply, lead to upward price pressures from increased demand. This is simply expressed as "too much money chasing too few goods".

Impulse Response Functions

The impulse response functions demonstrate the effects of shocks emanating from the endogenous variable to other variables. The inflation rate dynamics varied for both the domestic headline and food inflation rates in the short run and long run. Firstly, the shock to the NEER was analyzed. In the short run (identified as the first four quarters) the shock to the NEER had the strongest immediate inflationary impact on domestic inflation rates. This finding is evidenced in Ramlogan (2004) where the exchange rate channel was the most significant in explaining price variability. In this paper, the author attributed an economy's high marginal propensity to import final and intermediate goods as having a direct link to movement in consumer prices. A positive shock to the NEER, interpreted as a depreciation of the domestic currency, implies that imports are more expensive to domestic consumers. The inflationary impact of the one per cent depreciation can lead to a 0.30 percentage point increase in the year-on-year headline inflation rate and a 0.59 percentage point increase in the year-on-year food inflation rate in the first quarter. By the second quarter of the forecast, the effect of the depreciation continued to rise for headline inflation with an increase of 0.65 percentage points while the inflationary impact decelerated to 0.09 percentage points for food inflation. The inflationary effects of the depreciation began to wane in the third quarter of the forecast for headline inflation, with an increase of 0.28 percentage points, and by the fourth quarter the inflationary impact from the depreciation was no longer reflected in the headline inflation rate. Meanwhile, the inflationary effects of depreciation were no longer reflected in the food inflation rates by the third quarter of the forecast **(Table 3)**.

Moreover, the results of a one per cent depreciation revealed that Trinidad and Tobago's ERPT to domestic headline and food inflation rates was incomplete as domestic prices did not react proportionately to the depreciation in the exchange rate.[8] This implies that price agents in the market only partially transfer costs resulting from the depreciation to domestic consumers. Generally, prices in the short run tend to be rigid and price adjustments limited as articulated by Dornbusch (1987). In addition, the imperfect competition in the domestic market coupled with the recent deceleration of the domestic headline inflation rate may have also played a role in the firm's reluctance to pass on price increases to domestic consumers. This behavior is corroborated by the findings of J.B. Taylor (2000) that in a low-inflation environment, firms may not pass through the increased prices brought about by an exchange rate shock as the higher prices will result in reduced competitiveness.

The short-lived rise in inflation rates resulting from a depreciation of the exchange rate reiterates the relatively fast short-run adjustment suggested by the coefficients of the VECM. Moreover, the findings for the ERPT to headline inflation, revealed an increased responsiveness and a faster speed of ERPT to domestic inflation compared to Christopher-Nicholls and Des Vignes in (2002). In that paper, there was an initial delay in Trinidad and Tobago's ERPT which subsequently rose

[7] The results were evaluated at 10% significance level.

[8] Balance of payments models normally assume a one-to-one response of import prices to exchange rates which is known as complete pass through (Peter 2003).

Table 3:
Short Run Effects of Inflation Rates to One Percent Depreciation in the NEER

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Headline Inflation	0.30	0.65	0.28	-0.04
Food Inflation	0.59	0.09	-0.53	-1.49

in the fourth quarter of the forecast and gradually led to an inflationary effect of 0.7 percentage points in the tenth quarter (two and a half years) before declining to a lower level of pass-through. A possible reason for the increased speed of ERPT between the studies could be attributed to the Central Bank's increased employment of monetary policy instruments to tighten liquidity conditions subsequent to 2002. The monetary policy environment was highlighted by An (2006) as one of the macro factors influencing the exchange rate pass-through. Similar results have been demonstrated in South American countries as active monetary policy actions have proven to lessen the transmission effect of exchange rate shocks to domestic inflation over time (Borensztein and Queijo Von Heideken 2016).

Imported inflation was also found to increase inflationary pressures in the short run. The headline inflation rate responded immediately to a shock in the import prices in the first two quarters, increasing from 0.06 percentage points in the first quarter to a 0.33 percentage points in the second quarter, before decelerating **(Appendix 2)**. Meanwhile, there was a one quarter lag in the response of food inflation to a shock in food import prices. However, the shock to food import prices began to contribute to a rise in the domestic food inflation rate in the second (0.51 per cent) and third quarters (0.80 per cent). Nevertheless, it decelerated by the fourth quarter of the forecast. The large degree of responsiveness of food inflation to the shock to food import prices may have been primarily due to the high imported component of food. Overall, the results were consistent with cost push inflation theories as increased import costs were transferred to domestic consumers in the form of higher prices.

Despite the initial one quarter delay, the shocks to money supply and quarterly GDP also contributed to increased inflationary pressures to the food and headline inflation rates in the short run, consistent with the monetarist view of inflation[9] and the law of supply, respectively. However, it is noted that the response of food inflation to the shocks to money supply and GDP were generally higher in the short run compared to that of headline inflation. This finding is consistent with DaCosta and Greenidge (2008) who studied the determinants of inflation in selected Caribbean economies including Trinidad and Tobago. Results indicate that short-run increases in money supply generate inflationary tendencies which are symptomatic of the monetarist view of too much money chasing too few goods.

A positive shock or increase in government spending

[9] The monetarist view of inflation is that an increase in the money supply is the principal cause of demand pull inflation.

did not contribute to inflationary pressures until the third quarter of the forecast for both food and headline inflation rates. The shock to government spending contributed to an increase in year-on-year headline inflation rate of 0.11 percentage points in the third quarter before diminishing to 0.01 percentage points in the fourth quarter of the forecast. Concurrently, the shock to government spending contributed to a 0.29 and 0.58 percentage point increase in the year-on-year food inflation rate in the third and fourth quarters of the forecast, respectively. The largest proportion of government spending is recurrent expenditure such as wages. Increased public sector wages may result in increased demand for food and, given the price inelasticity of demand for imported food in the Caribbean (Walters and Jones 2016), would also contribute to increase inflationary food pressures. Moreover, the results demonstrated that increased government spending generates a higher demand for goods which in turn results in 'demand-pull inflation'. Furthermore, there is a dampening impact on production from the exchange rate depreciation which results in supply constraints in the short run as seen in Robinson (1998). This, coupled with the backdrop of increased demand from government spending, places upward pressures on domestic prices.

With regard to the medium to long run (the five to thirty quarter horizon), the impulse response functions displayed fluctuations in the contributions of the variables to both domestic headline and food inflation rates. However, the results revealed that GDP and the money supply were significant factors in the upward movements of the domestic headline and food inflation rates in the long run. Government spending and food import prices also influenced the long run increases in the headline and food inflation rate respectively.

Variance Decomposition

When examining the variance decomposition for domestic headline inflation, it was evident that contemporaneously, the most relevant shock to headline inflation was the inflation expectation which contributed 92.9 per cent of the variation in headline inflation in the first quarter. However, its contribution declines to 66.1 per cent by the fourth quarter of the short run **(Appendix 2)**. The contributions of the shocks to NEER, money supply and overall import prices gradually increased over the short run accounting for 17.3 per cent, 7.2 per cent and 4.3 per cent of the variation in domestic headline inflation by the fourth quarter, respectively. Meanwhile, the contributions of shocks to the government spending contributed the least to the headline inflation rate by the fourth quarter, accounting for 1.2 per cent of the variation. However, through the medium to long term, the results revealed that contributions of the shocks to the NEER and GDP surpassed the contributions of all other endogenous variables at the end of the thirty quarters with 26.1 per cent and 23.2 per cent, respectively. Moreover, the combined impact of the variables resulted in an overall deflationary impact on the domestic inflation rates in the long run which corroborates the findings of Cheong and Ramrattan (2015).

Similar to the variance decomposition of the domestic headline inflation rate, shocks to the food inflation rate were dominated by its own lag which accounted for 95.8 per cent of that variation in the first quarter. By the fourth quarter, the contribution of the shock to food inflation declined to 67.8 per cent of its variation. Over the short run, the shocks to the money supply, NEER and GDP increased in their importance to the overall variation in domestic food inflation accounting for 13.6

per cent, 8.0 per cent and 4.6 per cent respectively in the fourth quarter. However, in the long run, contributions from the shocks to the NEER, money supply and government spending accounted for 52.4 per cent, 7.2 per cent and 6.7 per cent of the variation in food inflation respectively. Although the results from the IRFs revealed that GDP and food import prices were the main drivers of inflationary pressures for food inflation in the long run, the contribution of the shocks of those variables toward the overall variation in food inflation were lower than that of the government spending[10].

6. Conclusion and Recommendations

Given the openness of the Trinidad and Tobago economy, exchange rate fluctuations will pass-through to domestic prices. ERPT is an important topic of consideration for two primary reasons in that it assists in forecasting the direction and magnitude of domestic price changes and secondly, it is influential in the determination of monetary policy. Therefore, for most monetary authorities, the assessment of ERPT to inflation is necessary for providing proper policy recommendations.

Several relationships were identified among the key variables during the period of 1995 to 2016. The preliminary results indicate that during the reference period, a causal relationship existed between the NEER and domestic food prices, and also the NEER and overall commodity prices. These relationships imply 'cost-push inflation' as changes in the exchange rate influence domestic prices due to changes in the cost of imported intermediate goods in the production process. In the short run, the shocks to money supply and GDP also contributed to increased inflationary pressures to overall domestic commodity and food prices, consistent with the monetarist view of inflation that money supply is the principal cause of demand pull inflation.

The dynamic nature of the variables utilized in impulse response functions of the VECM revealed that Trinidad and Tobago's ERPT to domestic inflation rates was incomplete. Evidence also indicated that the domestic economy's ERPT to the headline inflation rate is relatively short-lived compared to a previous study done by Christopher-Nicholls and Des Vignes in 2002. This was attributed to the use of several monetary policy instruments such as net open market operations, reserve requirements, and liquidity absorption bonds and the introduction of the Repo rate in 2002 by the Central Bank to achieve price stability. The results of a one per cent depreciation in the exchange rate revealed immediate increases of 0.30 per cent and 0.59 per cent in headline and food inflation rates, respectively. The inflationary effects to headline inflation were reflected for three quarters while the depreciation resulted in increased food inflation for two quarters. The fast transmission of the depreciation in the exchange rate to food prices was expected as the large imported component makes the domestic economy highly susceptible to exchange rate movements.

Based on the preliminary results of the ERPT, the shock to the NEER had an immediate inflationary impact on headline and food inflation. The positive shock to the exchange rate implies that there is depreciation in the value of the domestic currency and as a result, the costs of imported goods become more expensive for domestic consumers. The inflationary pressures resulting from a one per cent depreciation took an estimated two (2) and three (3) quarters to pass-through to food and headline inflation, respectively. A positive shock to import prices

[10] Several alternative iterations of the VECM were conducted for comparative analysis. Variables such as the Bureau de Change rates and the bilateral TTD per USD were used. However results were inconsistent based on the historical domestic inflationary trends and the domestic economy's reality. The use of the NEER was a better reflection of the domestic economy's reality as it provided a holistic sense of Trinidad and Tobago's trading partners rather than limiting the analysis to bilateral exchange rate movements. The US export price index for all commodities was used as an alternative to Trinidad and Tobago's import price index, however we found this to be impractical as the US is not the only source market for imports as the US accounts for 26.0 per cent of total imports.

also resulted in increased inflationary pressures in food and headline inflation rates over the short run. This result is consistent with cost-push theories of inflation which indicate that higher import costs are transferred to consumers in the form of higher prices.

In the long run, the money supply and GDP were significant contributors to the inflationary effects for both the domestic headline and food inflation rates. However, the combined impact of the variables may result in an overall deflationary impact on the domestic inflation rates which corroborated the findings by Cheong and Ramrattan (2015). However, government spending only mitigated the upward pressures for food inflation in the long run.

Due to the dynamic nature of inflation and the impact of various elements of both the domestic economy and external sector on prices, it poses a challenge for monetary authorities to address price pressures. Stemming from the results, the degree of ERPT to inflation suggests that monetary policy needs to be conducted in tandem with exchange rate policy in order to achieve a delicate balance. Any form of inflation management framework by an economy should be actively pursued not only through proper monetary policy channels, but also considering exchange rate policies. By focusing on monetary policy without attention to the exchange rate, policymakers may not be able to achieve the desired changes in the direction and/or magnitude of domestic prices.

Falling activity in the manufacturing and agricultural sectors would have partially contributed to increased demand for imports of final and intermediate goods. In small states like Trinidad and Tobago with narrow production bases, attaining complete import substitution is not possible given that these economies are dependent on sourcing several intermediate products on the international market. However, incentives need to be put in place to encourage domestic manufacturers to either seek out competitive local alternatives to be utilized in the production process or to manufacture these goods themselves, if this can be done efficiently and give technology constraints. Shifts away from imported commodities in both of these sectors towards locally sourced products can contribute to lowering the degree of pass-through of exchange rate shocks to inflation. Furthermore, the government should increase the public's awareness of existing incentive programs in the agriculture sector and reduce the bureaucracy (red-tape) related to the acquisition of these incentives by potential farmers. This can result in increased productivity within the sector, which could subsequently lead to reduced imports.

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Appendix 1

Econometric Results: Unit Root Tests

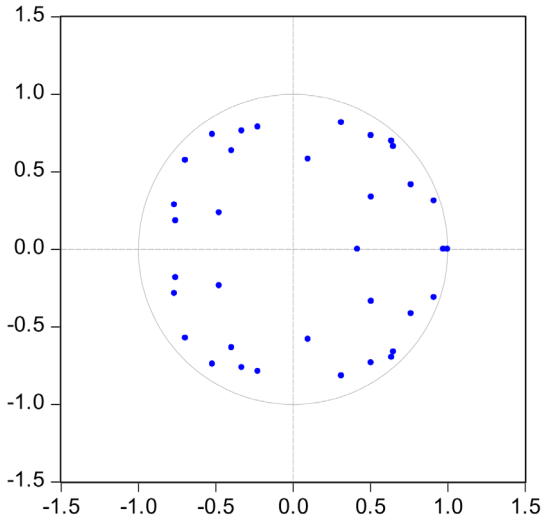
Variable	Augmented Dickey-Fuller			Philips Peron		
	Constant	Constant, Linear Trend	None	Constant	Constant, Linear Trend	None
INFL	0.41	0.82	0.39	0.01*	0.05**	0.21
D(INFL)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
INFL_F	0.28	0.60	0.36	0.00*	0.01*	0.10***
D(INFL_F)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
IR	0.66	0.34	0.33	0.60	0.60	0.23
D(IR)	0.00*	0.00*	0.00*	0.00*	0.01*	0.00*
OILP	0.43	0.38	0.78	0.52	0.68	0.82
D(OILP)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
LIPI_TT	0.54	0.99	0.81	0.51	0.98	0.80
D(LIPI_TT)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
LUSEXPRF	0.06**	0.00*	0.75	0.00*	0.00*	0.81
D(LUSEXPRF)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
LGEXP	0.52	1.00	1.00	0.62	0.78	1.00
D(LGEXP)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
LQGDP	0.17	1.00	1.00	0.22	1.00	1.00
D(LQGDP)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
NEER	0.00*	0.00*	0.00*	0.01*	0.05**	0.00*
LM2	0.95	0.78	1.00	0.94	0.67	1.00
D(LM2)	0.00*	0.00*	0.03*	0.00*	0.00*	0.00*

Significance level*- 1%, **-5%, ***-10%.

Optimal Lag Length (Equation 1.0)						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	487.7860	NA	4.26e-13	-11.45820	-10.92989	-11.24609
1	584.0545	171.4048	9.84e-14	-12.92816	-11.34324*	-12.29184*
2	635.0900	83.39958	6.95e-14*	-13.29488	-10.65336	-12.23435
3	656.9103	32.46432	1.03e-13	-12.94903	-9.250902	-11.46429
4	707.6753	68.09938*	7.79e-14	-13.30915	-8.554416	-11.40020
5	749.5848	50.08693	7.73e-14	-13.45329*	-7.641941	-11.12012

*indicates the lag order selected by the criterion.
LR: sequential modified LR test statistics (each test at 5% level)
FPE: Final Prediction Error
AIC: Akaike Information Criterion
SC: Schwarz Information Criterion
HQ: Hanna-Quinn Information Criterion

Cart A.1
Inverse Roots of AR Characteristic Polynomial



Pairwise Granger Causality Test

Null Hypothesis	Obs	F-statistic	Prob
Oil price does not Granger Cause inflation	83	4.57	0.0011
NEER does not Granger Cause inflation	83	2.25	0.0586
Government Spending does not Granger Cause inflation	82	3.41	0.0082
Money Supply does not Granger Cause inflation	83	1.97	0.0934
GDP does not Granger Cause inflation	83	1.94	0.0989
Oil Price does not Granger Cause interest rate	83	2.69	0.0275
Oil Price does not Granger Cause NEER	83	2.04	0.0826
Oil Price does not Granger Cause Government spending	82	2.14	0.0709
NEER does not Grange Cause Import prices	82	4.45	0.0014
NEER does not Grange Cause Money Supply	83	2.64	0.0301
NEER does not Grange Cause Government Spending	82	3.85	0.0038
GDP does not Granger Cause Import Prices	82	2.82	0.2224
GDP does not Granger Cause Government Spending	82	3.25	0.0107

Headline Inflation: VEC Residuals Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h		
Included observations: 82		
Lags	**LM-Stat**	**Prob**
1	35.19462	0.5067
2	54.03087	0.0272
3	29.38642	0.7743
4	35.82788	0.4767
5	32.50239	0.6357

Probs from chi-square with 36 df.

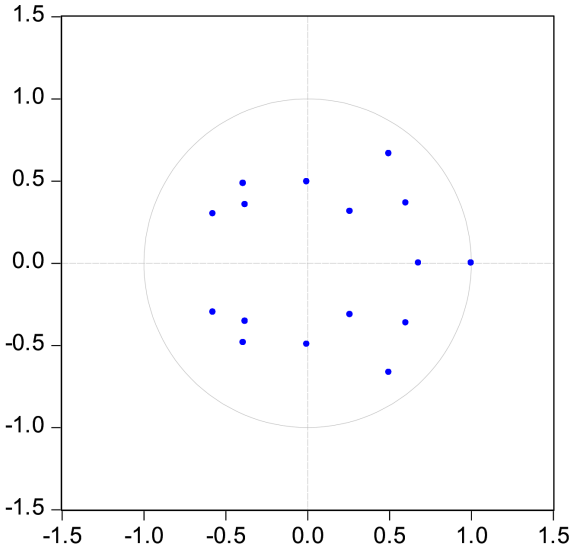
Headline Inflation
VEC Residuals Heteroskedasticity Test: No Cross Terms (only levels and squares)

Included observations: 82		
Joint Test		
Chi-sq	**df**	**Prob.**
1526.711	1512	0.3902

Optimal Lag Length (Equation 2.0)						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	222.6038	NA	2.74e-10	-4.990336	-4.462031	-4.778230
1	320.1722	173.7193	6.14e-11	-6.492004	-4.907091*	-5.855686*
2	367.5221	77.37673	4.75e-11*	-6.768832*	-4.127311	-5.708301
3	388.0538	30.54714	7.24e-11	-6.391556	-2.693426	-4.906813
4	433.6696	61.19198*	6.22e-11	-6.626088	-1.871350	-4.717134
5	468.0210	41.05405	7.42e-11	-6.585877	-0.774531	-4.252711

*indicates the lag order selected by the criterion.
LR: sequential modified LR test statistics (each test at 5% level)
FPE: Final Prediction Error
AIC: Akaike Information Criterion
SC: Schwarz Information Criterion
HQ: Hanna-Quinn Information Criterion

Inverse Roots of AR Characteristic Polynomial



Pairwise Granger Causality Test

Null Hypothesis	Obs	F-statistic	Prob
Interest rate does not Granger Cause Food Inflation	86	2.28	0.1092
Food Inflation does not Granger Cause Oil prices	86	2.89	0.0611
NEER does not Granger Cause Food Inflation	86	3.91	0.0239
Money Supply does not Granger Cause Food Inflation	86	3.18	0.0470
Oil Prices does not Granger Cause Interest Rate	86	3.77	0.0270
Interest Rate does not Granger Cause Oil prices	86	2.66	0.0757
Food Import Prices does not Granger Cause Interest Rate	86	3.14	0.0488
Oil prices does not Granger Cause Government Spending	85	3.67	0.0298
Oil Prices does not Granger Cause GDP	86	2.74	0.0708
Food Import Prices does not Granger Cause GDP	86	3.30	0.0417
Government Spending does not Granger Cause Money Supply	85	2.32	0.0865
GDP does not Granger Cause Government Spending	85	6.10	0.0034

Food Inflation: VEC Residuals Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h		
Included observations: 85		
Lags	**LM-Stat**	**Prob**
1	54.39572	0.0252
2	28.13784	0.8223

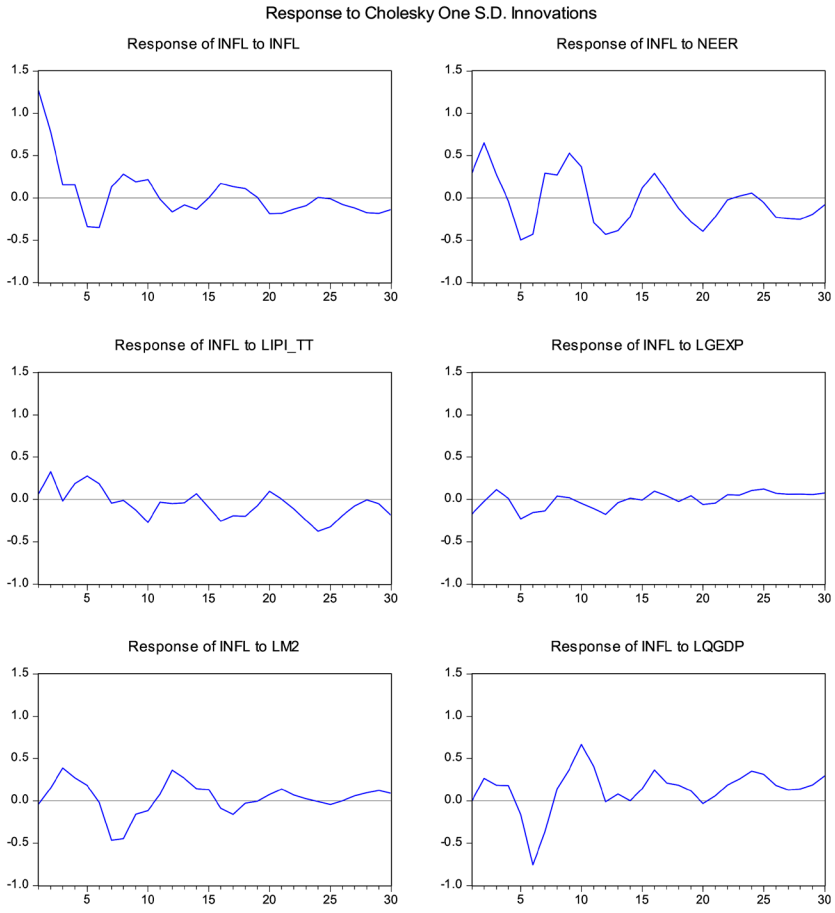
Probs from chi-square with 36 df.

Food Inflation
VEC Residuals Heteroskedasticity Test: No Cross Terms (only levels and squares)

Included observations: 85		
Joint Test		
Chi-sq	**df**	**Prob.**
723.4098	714	0.3953

Appendix 2

Impulse Response Functions (Headline Inflation)

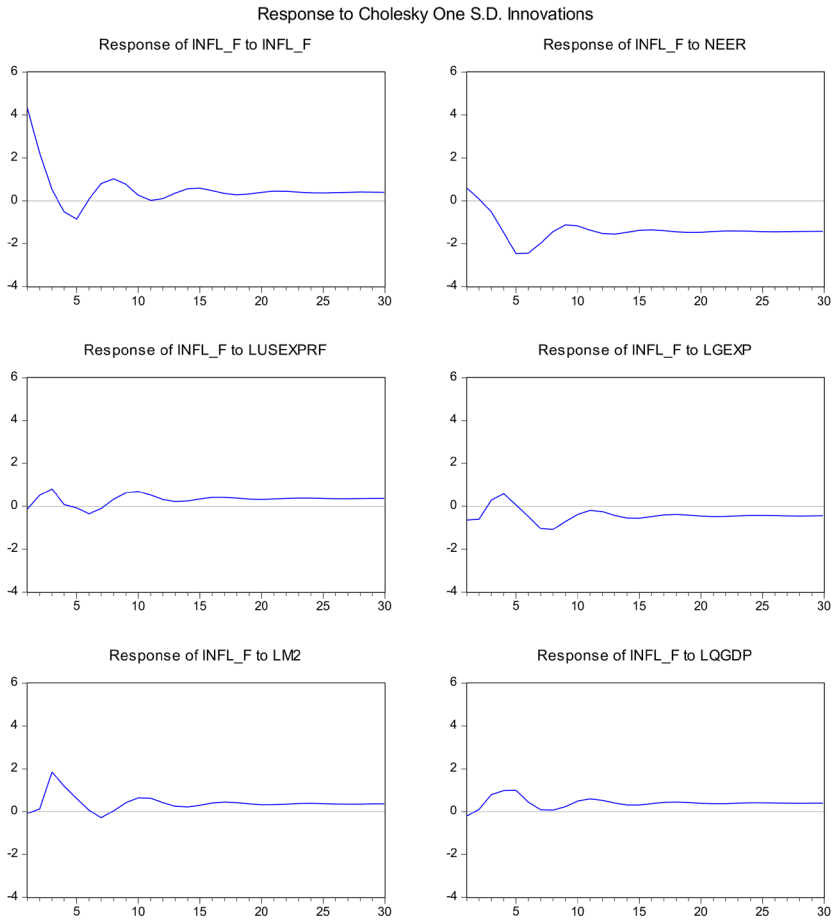


Variance Decomposition of Domestic Inflation (Headline Inflation)

Period	S.E.	Headline Inflation	NEER	Import Prices	Government Spending	Money Supply	GDP
1	1.317751	92.85781	5.142528	0.227369	1.683822	0.088312	0.000162
2	1.723444	74.75086	17.32959	3.734374	1.005102	0.822538	2.357531
3	1.807400	68.69490	18.08717	3.408458	1.300289	5.328257	3.180925
4	1.852794	66.05293	17.25499	4.278373	1.240245	7.204413	3.969043
5	1.996654	59.78640	21.07999	5.618140	2.403681	7.043317	4.068468
6	2.220257	50.85603	20.78792	5.251325	2.438302	5.702662	14.96376
7	2.324753	46.70256	20.54572	4.827668	2.568477	9.229892	16.12568
8	2.403636	45.04590	20.48918	4.519082	2.427792	12.08207	15.43597
9	2.504252	42.07743	23.30715	4.417546	2.242022	11.52790	16.42795
10	2.643353	38.44194	22.85398	5.026231	2.044570	10.53478	21.09850
11	2.693684	37.02280	23.18682	4.855250	2.129986	10.23079	22.57436
12	2.762889	35.54897	24.47393	4.650415	2.434686	11.43290	21.45910
13	2.805257	34.56969	25.63522	4.533321	2.380996	11.98239	20.89838
14	2.821768	34.39156	25.96447	4.532083	2.355387	12.10194	20.65456
15	2.832646	34.12791	25.93671	4.614323	2.338458	12.22820	20.75440
16	2.890154	33.13000	25.92667	5.229651	2.357816	11.83695	21.51891
17	2.913203	32.81480	25.59942	5.594326	2.340020	11.94831	21.70312
18	2.930756	32.56086	25.47528	5.993310	2.319913	11.81492	21.83572
19	2.948222	32.17660	26.11133	5.989784	2.311565	11.67555	21.73517
20	2.983487	31.80494	27.24951	5.946011	2.299600	11.46476	21.23518
21	3.001612	31.79001	27.47959	5.874455	2.295338	11.54265	21.01795
22	3.013749	31.72846	27.26552	5.966618	2.308400	11.50128	21.22972
23	3.037048	31.33277	26.85315	6.554182	2.299831	11.33156	21.62851
24	3.082572	30.41445	26.09678	7.860864	2.346760	11.00012	22.28103
25	3.118574	29.71754	25.53163	8.768510	2.443716	10.76778	22.77082
26	3.139800	29.38063	25.72279	9.013597	2.461784	10.62270	22.79849
27	3.156356	29.21676	26.05887	8.979600	2.471652	10.54589	22.72722
28	3.176446	29.14934	26.36770	8.866843	2.476552	10.50303	22.63653
29	3.196493	29.11251	26.40874	8.784041	2.475284	10.52046	22.69896
30	3.221744	28.83751	26.05930	8.995765	2.489076	10.43024	23.18811

Cholesky Ordering: NEER> Import Prices> Government Spending > Money Supply > GDP> Headline Inflation

Impulse Response Functions (Food Inflation)



Variance Decomposition of Domestic Inflation (Food Inflation)

Period	S.E.	Food Inflation	NEER	Food Import Prices	Government Spending	Money Supply	GDP
1	4.423077	95.79410	1.779377	0.095408	2.090617	0.033039	0.207458
2	5.016142	94.06261	1.418223	1.120807	3.086998	0.099235	0.212128
3	5.522077	78.49313	2.084597	3.035066	2.813898	11.29578	2.277523
4	5.973697	67.82151	7.972518	2.609047	3.337197	13.61395	4.645777
5	6.625274	56.79781	20.39235	2.135604	2.721537	11.92607	6.026637
6	7.101754	49.44455	29.59892	2.103436	2.823189	10.38858	5.641332
7	7.495571	45.52492	33.52618	1.907579	4.491528	9.471051	5.078740
8	7.784646	43.93826	34.50578	1.945443	6.107424	8.784811	4.718280
9	7.972937	42.79903	34.87275	2.470215	6.618136	8.654526	4.585342
10	8.142011	41.14806	35.50003	3.085048	6.568473	8.921485	4.776901
11	8.320265	39.40449	36.69644	3.348332	6.347067	9.117387	5.086281
12	8.495803	37.80816	38.40742	3.349917	6.175765	8.988713	5.270025
13	8.669972	36.47339	40.07278	3.277131	6.178399	8.717515	5.280775
14	8.839644	35.49159	41.29541	3.229163	6.327903	8.449479	5.206449
15	8.999265	34.67054	42.17526	3.256462	6.486520	8.263791	5.147427
16	9.150805	33.79738	42.96487	3.350325	6.550385	8.188008	5.149036
17	9.301053	32.84730	43.81699	3.442538	6.528544	8.159637	5.204988
18	9.452813	31.89223	44.76569	3.488324	6.483925	8.100219	5.269612
19	9.604243	31.00796	45.73298	3.496300	6.466750	7.991898	5.304112
20	9.753060	30.23594	46.60821	3.494432	6.493917	7.861970	5.305526
21	9.897872	29.56126	47.35024	3.505740	6.545606	7.743053	5.294110
22	10.03845	28.93367	47.99690	3.536772	6.588904	7.653302	5.290449
23	10.17617	28.31497	48.60793	3.577396	6.607802	7.589378	5.302517
24	10.31264	27.70059	49.22004	3.612565	6.608330	7.533691	5.324783
25	10.44839	27.10657	49.83496	3.635359	6.605709	7.471497	5.345899
26	10.58303	26.54937	50.43074	3.649122	6.611460	7.400535	5.358776
27	10.71595	26.03401	50.98580	3.661179	6.627243	7.327603	5.364165
28	10.84675	25.55279	51.49591	3.676779	6.646824	7.260415	5.367286
29	10.97554	25.09336	51.97217	3.696447	6.663053	7.202203	5.372768
30	11.10272	24.64805	52.42889	3.717151	6.673234	7.150904	5.381779

Cholesky Ordering: NEER> Food Import Prices> Government Spending > Money Supply > GDP> Food Inflation

Appendix 3

Summary of Empirical Methodologies Found in Literature

Authors	Country	Model	Inflation Targeter	Exchange Rate Regime	Time Period	Results
De Vignes and Christopher-Nicholls (2002).	Trinidad and Tobago	VAR/VECM	No	Managed Float	Quarterly data: 1985-2001	A depreciation in the NEER results in an initial decline of 0.2 per cent in domestic prices. The effect is not felt until the fourth quarter where prices begin to rise and the ERPT persists up to quarter 10 (two and a half years) before leveling off at a new and higher equilibrium.
Rowland (2004)	Colombia	VAR and Johansen framework of multivariate cointegration	Yes	Floating	Monthly data; 1983:2002	Exchange rate pass through is incomplete, import prices respond quickly to exchange rate movements where 80.0 per cent is passed from import prices in 12 months, 28.0 per cent for producer prices and 15.0 per cent for consumer prices. The Exchange rate shock therefore only has a little impact on consumer prices.
Aliyu, Yakub, Sanni and Duke (2009)	Nigeria	VAR/VECM	No	Gradual deregulation of foreign exchange market.	Quarterly data : 1986:2007	ERPT is low and incomplete. A one percent shock to the exchange rate results in 14.3 per cent and -10.5 per cent pass through to import and consumer prices respectively. ERPT in Nigeria declines over the distribution chain and partly overturn the conventional wisdom that ERPT is always considerably higher in EMDE's than in developed economies.
Nidhaleddine Ben Cheikh (2011)	27 OECD countries	Panel Cointegration Technique: FM-OLS and DOLS	Various types	Various types	Quarterly data: 1994-2010	Individual estimates of ERPT are heterogeneous across 27 OECD countries, ranging from 0.23 per cent in France to 0.98 per cent in Poland (incomplete ERPT). However, it is important to mention that there is an evidence of complete pass-through for 5 out of 27 countries, namely Czech Republic, Italy, Korea, Luxembourg and Poland. The results indicate a regime-dependence of ERPT, that is, countries with higher inflation regime and more exchange rate volatility would experience a higher degree of pass-through. Both FM-OLS and DOLS estimators show that pass-through elasticity does not exceed 0.70 per cent. These results are in line with estimates in the literature of exchange rate pass-through into import prices for industrialized countries. These findings are in line with Taylor's hypothesis.

Summary of Empirical Methodologies Found in Literature (Continued)

Authors	Country	Model	Inflation Targeter	Exchange Rate Regime	Time Period	Results
Nidhaleddine Ben Cheikh,Wael Louhichi (2014)	12 Euro Area countries	VECM	Various types	Various types	1990-2010	A higher pass-through to import prices with a complete pass-through (after one year) detected for roughly half of Euro Area countries. These estimates are relatively large compared to single-equation literature. The magnitude of the pass-through of exchange rate shocks declines along the distribution chain of pricing, with the modest effect recorded for consumer prices.
Nidhaleddine Ben Cheikh,Wael Louhichi (2014)	63 countries	Panel Threshold Approach	Various types	Various types	Annual data: 1992-2012	Examined the role of inflation regime in explaining the ERPT to import prices. Found two (2) thresholds in study and objectively divided sample into three (3) inflation regimes for comparison using grid search. Higher inflation rates experience the higher degree of ERPT.
Mujica and Saens (2015)	Chile	Single Equation	Yes: gradual Implementation	From a band system to a floating regime	Quarterly data: 1986-2009	ERPT to prices diminishes significantly in countries that adopt an inflation targeting regime.
Jiminez-Rodriguez, Morales-Zumaquero (2016)	G-7: Canada, Japan, Italy, Germany, France, UK	Single Equation, VAR, time varying approach	Yes	Varying	Quarterly data: 1970-2014	The Taylor's hypothesis holds. The ERPT declines over time and has been low for those economies with low inflation. ERPT is positively related to inflation volatility. ERPT depends on the exchange rate regime(higher ERPT for fixed regimes).
Karagoz, Demirel and Bozdag (2016)	Asia Pacific, South America and Turkey	VAR	Yes	Variable traits of dollarization	Quarterly data: 2002-2010	There is a positive relation between inflation and pass through. Pass through effects in Asia Pacific economies is lower than the pass through effect in Latin America and Turkey. Exchange rate based shocks and commodity based shocks (such as increases in gold or oil prices) may cause more of an effect on Latin America and Turkey. Pass through coefficients for producer prices are higher than the pass through to consumer prices for both groups.

Summary of Empirical Methodologies Found in Literature (Continued)

Authors	Country	Model	Inflation Targeter	Exchange Rate Regime	Time Period	Results
Lariau, El Siad and Takebe (2016)	Angola and Nigeria	VAR for Nigeria VECM for Angola.	Nigeria - Yes	Nigeria: Shift from fixed to a managed float Angola; de-dollarized	Monthly data: 1995-2005	For Angola, the long run ERPT to prices is high, although it has weakened in recent years reflecting the de-dollarization of the economy. There was no stable long run relationship between exchange rate and prices and changes in the exchange rate do not have a significant pass through effect on inflation. However the pass through on core inflation is significant. Nigeria's low ERPT to headline inflation is the non-responsiveness of food prices to changes in the NEER because most of the food is locally produced (Agricultural sector accounts for 20.0 per cent of GDP). In contrast, Angola's long run ERPT has been relatively high given the country's less diversified economic structure and therefore heavy reliance on imports. However, the pass through effect has weakened as a consequence of de-dollarization.
Borensztein and von Heideken (2016)	Brazil, Chile, Colombia, Paraguay, Peru and Uruguay	VAR	Yes	Floating Exchange Rate Regimes	Monthly data: 1999 (Chile) 2002 (Brazil) 2003 (Uruguay, Peru and Colombia) 2004 (Paraguay) to 2015	The ERPT in the countries were moderate and has become lower over time. The moderation has benefitted from adoption of the floating exchange rate regime and monetary policy credibility. Despite the lower ERPT, exchange rate continues to be a large determinant of inflation in several countries.

Price Stability and Financial Stability in Trinidad and Tobago: Is There a Relationship? What is the Direction of This Relationship?

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Keywords: Price stability, financial stability, Bayesian VAR

Abstract

The relationship between price stability and financial stability has been questioned for many years and regained prominence over the last decade due to the global financial crisis. This paper aims to analyze the relationship between price and financial stability using simple correlation and causal analysis as well as a traditional Bayesian Vector Auto Regression (VAR) model. It was found that while the correlation between the variables was moderate to high, no causal relationship existed between them as illustrated by the use of the Granger Causality test. Furthermore, impulse response functions from both the reduced form VAR and the Bayesian VAR suggested that there was little relationship between price and financial stability in Trinidad and Tobago. As a result, it can be inferred that financial stability requires its own tools and policies and monetary policy tools are not sufficient to promote and maintain financial stability.

1. Introduction

What is financial stability? According to Valvi, Fragkos and Frangos (2012), "up to now, there is no single, widely accepted definition of financial stability (FS), and many academics and practitioners have dealt with it from different angles. This difficulty in deriving a definition is due to the interdependence and the complex interactions of different elements of the financial system among themselves and with the real economy." Schinasi (2004) stated that "financial stability is a condition in which an economy's mechanisms for pricing, allocating, and managing financial risks are functioning well enough to contribute to the performance of the economy." Researchers at the forefront of financial stability research such as Agenor and Silva (2011) stated that "Indeed, even though substantial progress has been achieved in recent years, there is still no consensus (or at least much more controversy) on defining 'financial stability' and how to measure it in its various dimensions." Does price stability imply financial stability? This is a question that has been researched for decades, but interest in the topic has increased greatly since the global financial crisis in 2007/2008. Other related questions include: can monetary policy promote financial stability? Or is there a greater need for macroprudential policies? The literature does not provide definitive answers to these questions. Authors such as Blot et al. (2015) and Christe and Lupu (2014) put forth the view that financial stability and price stability possess little relationship with each other. Others such as Smets

(2014), Van den End (2010) and Apostoaie (2010) argued that price stability is a useful and in some cases necessary prerequisite for financial stability.

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Before analyzing the linkage between price and financial stability, it is important to clarify these concepts. Price stability is usually the single most important macroeconomic objective of any central bank. It refers to a stable price level or low level of inflation. Some countries have explicitly defined price stability in terms of a year-on-year price change of no more than two percent. On the other hand, by its very nature, financial stability has been very difficult to define. The term is broad and encompasses the state and interconnectedness of financial intermediaries, financial markets and financial infrastructure. A stable financial system should foster the development of an economy and alleviate financial imbalances that build endogenously, or due to significant and unanticipated events (Schinasi, 2004).

This paper aims to test if there is a relationship between price stability and financial stability in Trinidad and Tobago and to examine the direction of this relationship between the selected set of indicators. There is a void in quantitative analysis on the relationship between price and financial stability in Trinidad and Tobago and as such, this paper provides a useful starting point for measuring this relationship. The paper uses quarterly data of selected financial stability and price stability indicators between March 2000 and March 2015 to determine the direction and magnitude of shocks to the indicators. Correlation analysis and Granger Causality were used as well as a reduced form VAR as proposed by Blot et al. (2015) and a Bayesian VAR. Both models found that shocks to both price and financial stability indicators have relatively insignificant responses on each other.

The remainder of this paper proceeds as follows: Section two encompasses the relevant literature that lays the foundation for the analysis. Section three examines the variables and indicators used to proxy price and financial stability in the local context. In addition, it gives a brief data description and correlation and causal analysis. Section four includes the estimation of the reduced VAR and the Bayesian VAR and their respective impulse response functions. Lastly, section five gives a conclusion and some brief policy recommendations.

2. Literature Review

Investigations into the relationship between price and financial stability have been conducted in various ways. Some authors have examined policy movements. Schwartz (1988) put forth the view that shocks to financial stability are often made worse in the presence of price fluctuations. As such, inflation targeting and monetary policy can also contribute to financial stability. Bordo and Wheelock (1998) stated that price shocks in the form of commodity price shocks and real estate markets can cause financial distress if they continue for a number of years. Furthermore, speculation and investments may increase due to inflation expectations. However, if there is an abrupt decline in prices, borrowers may not be able to repay their loans thereby contributing to credit risks, default and the failure of financial institutions. They concluded that regardless of the triggers of the financial distress, it is usually intensified during inflationary/disinflationary pressures. Apostoaie (2010) studied the relationship between two main objectives of the central bank, that is, price stability and financial stability. The author concluded that emphasis should be placed on both financial and price stability. Given the interconnectedness of the macroeconomic and financial sectors in an economy, if financial shocks occur, there may be consequences for macroeconomic objectives such as price stability; and if the economy is faced with macroeconomic shocks such as volatile inflation rates, it puts pressure on the financial system. Gilchrist and Leahy (2002) examined how asset prices influenced financial stability which in turn impacted price stability. One way they proposed that financial stability might impact price stability is through the wealth effect. When an asset price boom occurs, it leads to an increase in consumption as

proposed by Friedman's permanent income hypothesis. This rise in consumption usually fuels higher levels of inflation. Additionally, the authors proposed that the relationship works both ways and when asset prices fall, consumption and consequently inflation fall as well.

Smets (2014) found that many economies now turn to macroprudential policies, but to varying extents. For example, some economies make minor adjustment sto their inflation targeting frameworks, while others place financial stability and price stability on the same level. Smets (2014) argued that the most seen scenario is somewhere in between and concluded that macroprudential policies can be used to monitor and maintain financial stability, and monetary policy can assist macroprudential policies in maintaining financial stability. Christe and Lupu (2014) examined the relationship between price stability and financial stability and the policies used to achieve both objectives. The authors argued that the policies to achieve price stability were short-term and changed as business cycles change. However, the policies for financial stability were long-term. It is believed that if a central bank broadens its operational framework to now include financial stability, it may lead to a shift away from a central bank's independence and less emphasis will be placed on the primary objective of price stability. However, it was proposed that since financial stability is of crucial interest to the economy, there should be a specific focus on price stability and a general focus on financial stability due to the linkages in the economy.

Authors have also conducted empirical investigations into the interaction of monetary policy and financial stability. While the main focus of monetary policy for many central banks is inflation, the concept of financial stability is more nebulous and can be measured by a variety of variables.

Kunt and Detragiache (1998) used a logistic regression for both developing and developed nations in the presence of repeated systemic banking sector problems between 1980 and 1994 and found that financial crises usually occur when the rate of inflation is high. High and volatile inflation rates are usually accompanied by contractionary monetary policy in the form of higher nominal interest rates and maturity transformation problems. The authors also found that where there is the presence of an explicit deposit insurance scheme, banking crises are usually more frequent and severe due to moral hazard.

Private sector credit can affect inflation in contrasting ways. On the one hand, when there is high inflation or increased inflation volatility, the financial markets could be affected by increased uncertainty and less credit may be offered. Higher inflation could be a sign of the heating up of the economy, which may be related to higher credit growth. Tinoco-Zermeno, Venegas-Martinez and Torres-Preciado (2014) in looking at Mexico found a negative relationship between inflation and private sector growth. They hypothesized that inflation dynamics distort bank managers' ability to assess whether or not a firm is potentially profitable investment, leading to reduced lending. In a more recent paper Tinoco-Zermeno, Venegas-Martinez and Torres-Preciado (2018), with a wider set of countries, once again found that inflation and private sector credit have a negative relationship, though they infer that while it is significant for developing countries it is insignificant for developed ones.

Van den End (2010) used an early warning signal approach to map the trade-off between price stability and financial stability. Using the variables of credit-to-GDP and inflation the author found that periods of financial stability coincided with price stability in both the US and UK. He then investigated the relationship between macroprudential and monetary policy. Using a binary probit model, he analyzed which macroeconomic conditions and variables lead to the interference in the coordination between both monetary policy and macroprudential policy. The estimated results suggested that simultaneous macroeconomic and financial disturbances interfere with the optimal policy coordination between both policy objectives.

Abu, Mohammad and Prevez (2011) used an Autoregressive Distributed Lag (ARDL) framework to estimate quarterly data between 1985 and 2005 for Bangladesh in an attempt to illustrate the relationship between the financial sector and inflation. A proxy of credit to the private sector as a share of GDP is used to represent the financial sector. They argued that an efficient financial sector allocates its resources efficiently, which should stimulate economic activities. However, inflation can lead to volatility in the financial markets, specifically with equity returns and lower levels of investment due to policy measures to curb high inflation rates. Their estimated results led to the inference that inflation interferes with the efficiency of the financial markets in both the short and long term.

Yüksel and Oktar (2017) examine the factors that influence capital adequacy in Turkey. In looking at the macro economic factors they noted that the capital adequacy ratio is positively related with inflation rate. They argue that a high inflation rate can increase uncertainty, causing banks to hold a higher level of capital.

Blot et al. (2015) investigated the link between price and financial stability in the US and Eurozone using monthly data between 1993 and 2012. The authors estimated both a Vector Autoregression (VAR) model and a Dynamic Conditional Correlation analysis, using the consumer price index and the GDP deflator as a measure of price stability, while financial stability was measured using relevant composite indices which capture a wide range of financial sector indicators including volatility of interest rates, exchange rates, and stock markets. The authors also included factors such as house prices and oil prices. None of the estimated models showed a robust link between price and financial stability and more so, this relationship was not stable over time. The authors therefore questioned the conventional wisdom of 'leaning against the wind' since evidence showed that financial instability can still occur in the presence of low inflation rates.

Non-performing loans (NPLs) is one of the key variables that regulators across the globe use in assessing the potential risk for financial instability. Numerous studies have examined the relationship between NPLs and inflation in the Caribbean. Inflation can erode the purchasing power of consumers and lower their ability to repay loans as their real income is reduced. Inflation also results in a fall in the real value of outstanding loans thus potentially making debt servicing easier. Investigations into this relationship for Barbados by various authors have found differing results. Chase et al. (2005), Greenidge and Grosvenor (2010), Guy and Lowe (2011) found that inflation had a significant negative impact on NPLs. Grosvenor and Guy (2013) using a two regime Markov Switching model found mixed results; in periods with low NPLs, the relationship with inflation is significant and negative, while in periods of high NPLs the relationship is significant and positive. Meanwhile Wood and Skinner (2018) found that inflation had an insignificant impact on the NPLs ratio. A similar finding of an insignificant relationship was found by Khemraj and Pasha (2009) when they looked at NPLs in Guyana.

3. Data Description and Stylized Facts

The dataset uses quarterly data from March 2000 to March 2015 on key macroeconomic and financial stability variables for Trinidad and Tobago.

The correlation between CAR and CPI is highly positive with a correlation coefficient of 0.72. This is contrary to what is observed in the literature. Cao (2014) in the study of commercial banks in the US found that moderate inflation is supposed to lead to a capital loss by the bank and more so by the banks that are systematically important. Cao (2014) stated that *"due to the mismatch of maturity between assets and liabilities, a persistent increase in inflation rate causes a larger decline in bank asset value than in liability value. We find that a one percent permanent increase in inflation rate leads to an average 15 percent loss of Tier 1 capital to U.S. commercial banks."* Hortlund (2005) also supports this view as he found an inverse relationship between inflation and capital in Swedish banks. Furthermore, Blot et al. (2015) also found a negative correlation between CPI and CAR. Granger causality (see **Table 2**) also led to the non-rejection of CPI causing CAR in Trinidad and Tobago.

Table 1:
Variables and Definitions

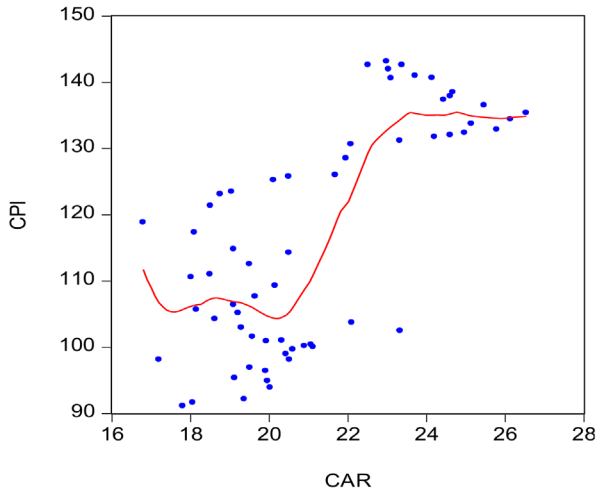
Variable	Notation	Definition
Capital Adequacy Ratio	CAR_t	The capital ratio is calculated using the definition of regulatory capital and risk-weighted assets. The total capital ratio must be no lower than 8 per cent (Basel II).
Private Sector Credit	PSC_t	Loans and credit to the private sector. Measured in TT Millions[1].
Non-performing Loans	NPL_t	A loan that is in default or close to being in default. Non-performing loans are usually those past due in excess of 3 months. This is expressed as a per cent of total loans.
Oil Price	OP_t	Price of oil per barrel as measured by the West Texas Intermediate
Productivity Index	PI_t	This is an index of the various productive sectors, excluding the energy sector in Trinidad and Tobago. The production index is viewed as a measure of output.
Consumer Price Index	CPI_t	An index of consumer prices which measures changes in the prices of goods and services bought for household consumption. Core inflation is used which excludes food price inflation, with a base year 2003=100
Stock Market Index	SMI_t	This is an index of the prices of all the stocks traded on the Trinidad and Tobago Stock Exchange, with the weights based on the volume of the transaction
10-year Government Bond Yield	$YIELD_t$	10-year interest rate on government bonds
Interest Rate	R_t	This is the lowest rate on loans granted to customers. It does not include concessionary rates on certain categories of loans, for example, staff loans.

Source: Central Bank of Trinidad and Tobago

[1] Ideally this should be represented as a per cent of Gross Domestic Product. However, the Central Statistical Office has not produced quarterly nominal GDP for this period.

Additionally, a 96 per cent correlation was found between CPI and PSC. Arsene and Guy-Paulin (2013) in their analysis found that there is a bi-directional relationship between CPI and PSC. A low and stable rate of inflation promotes economic growth which results in an increased demand for PSC and this in turn will contribute to an increasing inflation rate through spending. This was supported by Younus (2012) who found that PSC is highly correlated to the inflation rate as well as a significant causality relationship exists between both variables. Conversely, Korkmaz (2015) in a panel analysis of 10 selected European nations found that PSC did not contribute to the inflation rate in the economy. Whilst the data for Trinidad and Tobago yielded a high correlation between the two variables, there was no significant causal relationship between them.

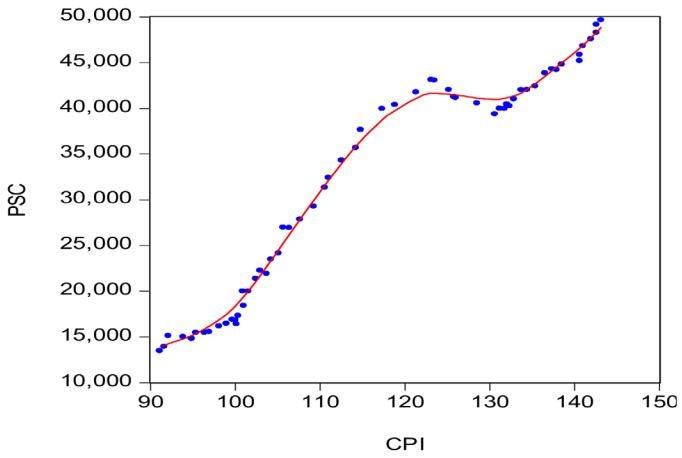
Figure 1: Correlation between CPI and CAR



Source: Authors' Calculation

A moderately high correlation coefficient of 60 per cent was found between CPI and NPL in Trinidad and Tobago. These results are consistent with Farhan et al. (2012) in their analysis which also found a positive and statistically significant relationship between NPL and CPI. Endut et al. (2013) in their panel analysis of Asian Pacific economies found that in the short run, inflation and non-performing loans have an inverse relationship since central banks increase interest rates to curb inflation. However, in the long run, inflation volatility is positively correlated with non-performing loans. In Trinidad and Tobago, even though there was a moderately high positive correlation, no causal relationship existed between NPL and CPI. This is illustrated in **(Figure 3)**.

Figure 2: Correlation between PSC and CPI



Source: Authors' Calculation

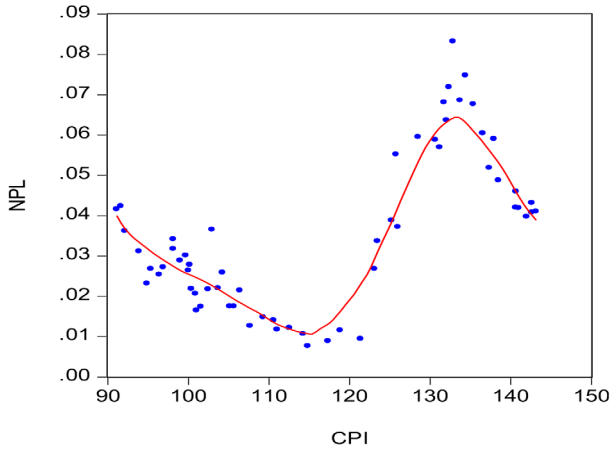
Table 2:
Granger Causality Test

LCPI does not Granger Cause LPI	1.74248*
LNPL does not Granger Cause LCPI	1.51339*
LCPI does not Granger Cause LPSC	0.49678*
LCPI does not Granger Cause LCAR	2.31574*
where * denotes the non-rejection of the null hypothesis at a 5% significance level	

Source: Authors' Calculation

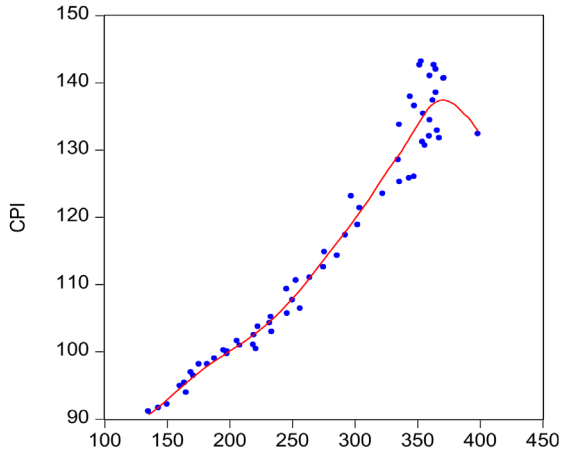
Furthermore, a near perfect correlation of 97 per cent was found between CPI and the productivity index. However, the causal link between both variables was insignificant. This was consistent with the relationship found by Yildirim (2015) where the author's estimation found that inflation had a greater impact on productivity than increases in real wages. Similarly, there was a feedback relationship.

Figure 3: Correlation between NPL and CPI



Source: Authors' Calculation

Figure 4: Correlation between CPI and PI



Source: Authors' Calculation

4. Methodology, Estimation and Results

All variables required for estimation log linear were tested for stationarity using the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests. They were all non-stationary in levels but stationary in first difference. That is, all variables were I(1) in levels. As such the model was estimated using logged differenced stationary variables.

Following the convention in the literature, this paper starts off with a Vector Autoregression (VAR) model to assess the relationship between price and financial stability to determine whether the relationship follows a particular direction or is feedback in nature. Blot et al. (2015) proposed the following specification:

$$Y_t = \alpha + \gamma_1 Y_{t-1} + \cdots + \gamma_p Y_{t-p} + \varepsilon_t \quad (1)$$

$$Y_t' = [PI_t, CPI_t, PSC_t, IR_t, SMI_t, YIELD_t, CAR_t, NPL_t,] \quad (2)$$

Y_t' is a 8 ⨯ 1 vector of endogenous differenced stationary variables α' is a 8 ⨯ 1 vector of constants, γ_p' is a 24 ⨯ 8 matrix of coefficients and ε_t' is a 8 ⨯ 1 vector of residuals. Oil price (OP_t) was also included in the model as an exogenous variable.

Orthogonalisation[2] of the residuals so that the model becomes identifiable[3] was done using the Cholesky Decomposition. This is necessary since the co-variance matrix is unlikely to be diagonal[4]. Using the Cholesky Decomposition, the endogenous variables assume a particular ordering, where residual correlation of any variable pair is attributed to the first variable in the system. By using the Cholesky Decomposition, the variables are arranged such that the initial variables in the system have contemporaneous effects on all subsequent variables in the ordering but only lagged effects on the variables prior to it. The macroeconomic variables are ordered after the risk variable since it is advocated that they have a lagged reaction to the financial variables. That is, the latter ordered variables in the system and respond instantaneously to shocks on real sector variables. The model was also estimated using three lags as suggested by the Final Prediction Error lag length criteria.

Model Robustness

Before interpreting the impulse response functions of the estimation, the robustness of the model needs to be validated to strengthen the reliability and validity of the inferences. Several tests for model robustness were undertaken and the following was found.

Using the Jarque-Bera, serial correlation and inverse AR roots tests, it was found that the model had normally distributed residuals, no serial correlation existed and the VAR model did not explode. The model therefore satisfies the various checks for model robustness.

Table 3:
Stationarity Testing

Variable	ADF (Level)	ADF (First Differenced)	Phillips-Perron (Level)	Phillips-Perron (First Differenced)	KPSS (Level)	KPSS (First Differenced)
CAR_t	-1.82*	-13.11**	-2.83*	-13.20**	0.14***	0.43****
PSC_t	-0.39*	-4.09**	-0.78*	-6.59**	0.20***	0.30****
NPL_t	-2.00*	-8.95**	-2.12*	-8.84**	0.15***	0.14****
OP_t	-1.24*	-5.81**	-1.31*	-4.53**	0.19***	0.26****
PI_t	-0.47*	-7.36**	-1.45*	-9.12**	0.25***	0.60
CPI_t	-1.73*	-2.62	-1.24*	-6.87**	0.12***	0.17*****
SMI_t	-1.88*	-5.36**	-1.65*	-5.35**	0.13***	0.10****
$YIELD_t$	-0.93*	-5.83**	-1.28*	-5.89**	0.22***	0.15****
R_t	-1.89*	-5.19**	-1.80*	-5.18**	0.09	0.12****

Where * denotes the variables are not significant at the 10 per cent level of significance and ** denotes the significance at the 1 per cent level of significance.*** and **** denotes the significance and insignificance respectively of the KPSS test at 5 per cent level of significance since the hypotheses are opposite to that of the ADF and the PP.

[2] Orthogonality implies that $AA^T = I$ and $A^{-1} = A^T$.
[3] Non-identifiability implies the inability to distinguish among explanations of the responses.
[4] Entries outside the leading diagonal are non-zero.

5. Impulse Response

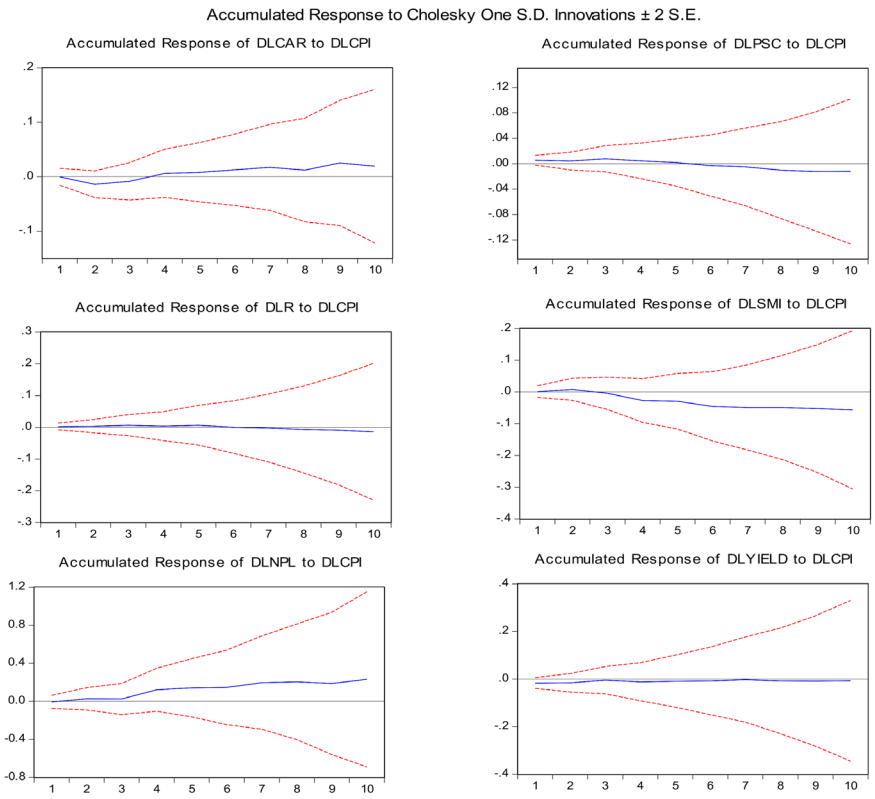
Impulse response functions are used to assess the relationship between both price and financial stability indicators. Firstly, a one standard deviation shock was applied using Monte Carlo simulations with 100,000 iterations to the measure of price stability (CPI) to examine the responses of the financial stability indicators in Trinidad and Tobago. Analysis revealed that a shock to the CPI was inconsequential for all variables. NPL had an initial shock; however, this decayed after several quarters.

Table 4:
Model Diagnostic

Test	Statistic/Description	Inference
Jarque-Bera	16.86	Residuals normally distributed
Serial Correlation LM	51.12 (3 lags)	No serial correlation exist
AR Roots	All roots are less than modulus one	VAR model is stable

Source: Authors' Calculation

Figure 5: Response of Financial Stability to Shocks in Price Stability



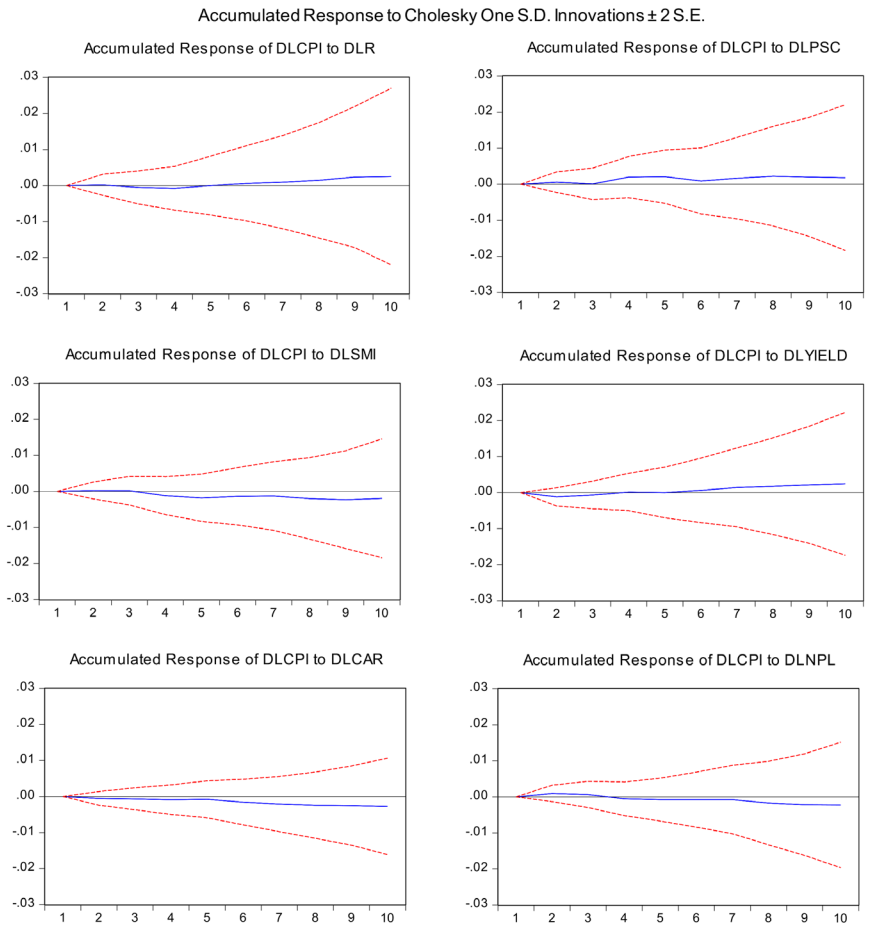
Source: Authors' Calculation

Similarly, a one standard deviation shock was applied to the financial stability indicators to assess its impact on price stability. Similar to the response of financial stability to a shock in the CPI, shocks to the financial stability indicators have almost no impact on the CPI.

Bayesian VAR

With a reduced form VAR, when a dataset is not sufficiently large, the problem of over-parameterisation or over-fitting the model can occur. To overcome this problem, one can adopt a Bayesian specification of the VAR model. According to Ciccarelli and Rebucci (2003), a Bayesian VAR can overcome the problem of over-fitting since it does not assign "too much weight on a particular value of the model parameters such as zero restrictions on certain parameters and as such, it is known to produce better forecast than a reduced form VAR". In estimating the Bayesian VAR, the choice of priors is extremely important to the researcher. One of the most renowned priors available is the Litterman/ Minnesota (1986) prior. It assumes that the prior mean

Figure 6: Response of Price Stability to Shocks in Financial Stability



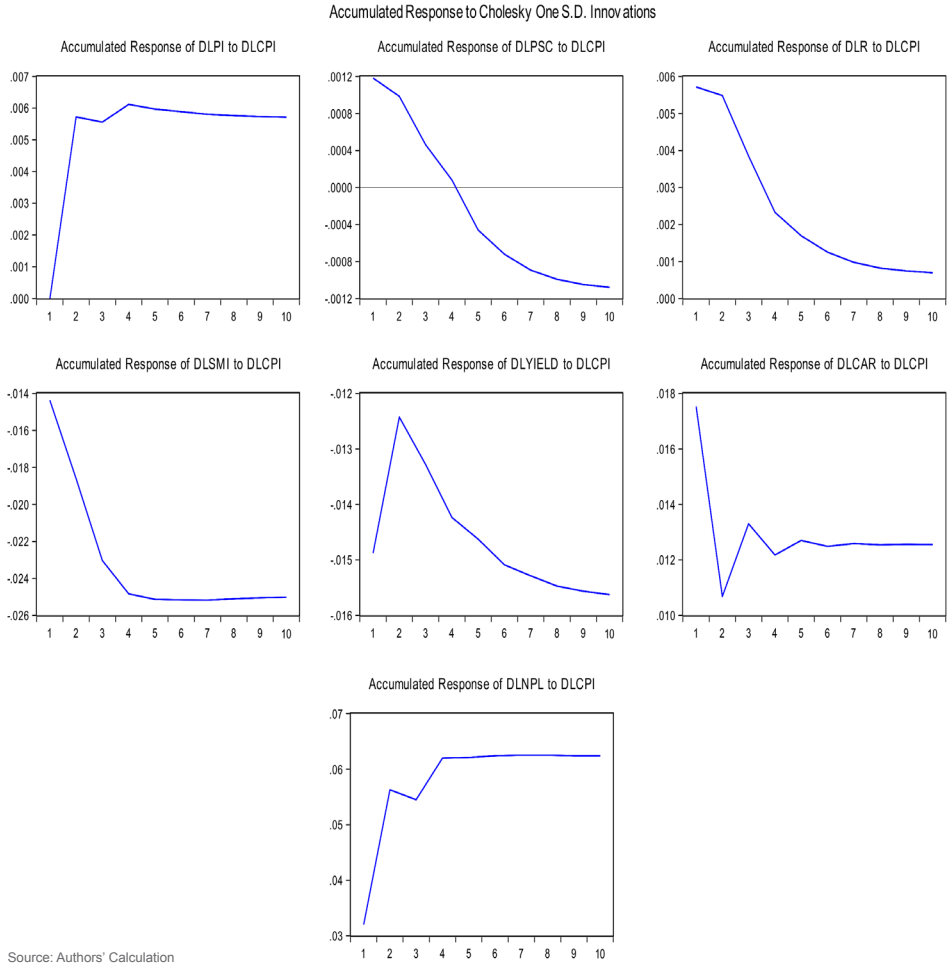
Source: Authors' Calculation

is near zero which avoids over-fitting the model and the overall tightness of the variance should be small so as the prior information dominates the sample. The Bayesian VAR was estimated using the same lag length as the reduced form VAR, that is, a lag length of three.

A one standard deviation shock was applied to the price stability indicator (CPI) and the following responses were found. It can be seen that in the accumulated responses after the second to fourth period, there was little response of the financial stability indicators to a price shock.

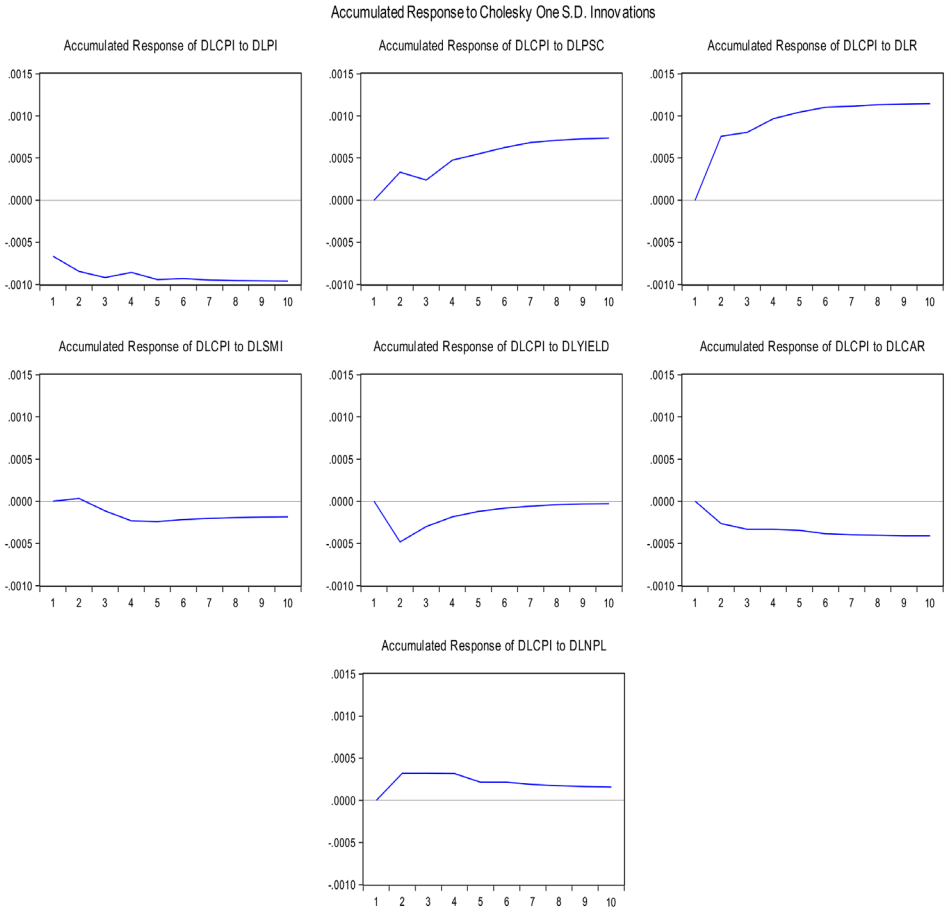
Additionally, a one standard deviation shock was applied to the financial stability indicators and the accumulated response to the price stability variable was observed. Once again, it can be seen that after the second to fourth period, the accumulated responses plateaued, indicating little additional response to a financial stability shock as time progresses.

Figure 7: Response of Financial Stability to Shocks in Price Stability



Source: Authors' Calculation

Figure 8: Response of Price Stability to Shocks in Financial Stability



Source: Authors' Calculation

6. Conclusion and Policy Recommendations

The aim of this paper was to estimate the relationship between price stability and financial stability using correlation analysis and VAR analysis between 2000 and 2015. Correlation analysis revealed that there was a moderate to high linear relationship between the various indicators. However, correlation does not imply causation since the Granger Causality test signaled that there was no causal relationship among the variables as well. This was followed by an estimation of a reduced form VAR model as well as a Bayesian VAR model, and the relationships were analysed through the use of impulse response functions. Both the reduced form VAR and the Bayesian VAR found that a shock to the price (financial) stability indicators did not lead to any significant response to the financial (price) stability indicators.

While the model produced those results, the recent experience of the international financial crisis highlighted that the pursuit of financial stability cannot be divorced from the objectives of price stability. It is believed that a stable financial system will promote efficient investments and proper avenues for savings. This will in turn facilitate economic growth and reduce unemployment. A strong labour force will contribute to the balance sheets of corporations and households, further fostering financial stability. On the other hand, price stability allows for the allocation of resources in the economy and assists in price setting within financial markets, which directly buttresses financial stability.

Some policymakers believe in the 'benign neglect' approach whereby a central bank should focus on its primary objective of price stability i.e. inflation control and by extension growth and full employment, and allow financial stability to be distinctly addressed by prudential regulation or market discipline. In many instances since the 2008/2009 financial crisis, financial stability has become a secondary mandate for some central banks or a primary mandate of a new regulatory authority within some countries. An even more popular approach is "leaning against the wind". One interpretation of this approach, used by the European Central Bank, is that policymakers should monitor closely developments in asset prices and credit within the financial system and their risks to price stability. Therefore, financial stability becomes a secondary objective, with stabilizing growth in asset prices achieving long-run price stability.

In Trinidad and Tobago, the Central Bank has the primary objective of monetary policy, and therefore achieving price stability. While there is no explicit mandate in legislation for the Central Bank to promote financial stability, it is a widely accepted view, especially against the backdrop of the international and local financial crisis, that the Bank must consider the integral role of financial stability within the organisation. A conditional coordinated approach is being recommended whereby price stability and financial stability should operate with a level of co-ordination while retaining their distinctive primary objectives. In other words, in deliberating on price stability decisions, consideration should be given to the possible impact of desired policy direction on financial stability. On the other hand, the macroprudential policy tools developed under the umbrella of financial stability should target specific financial imbalances in the system, while simultaneously not hampering the ability to meet the objective of price stability. Within the Central Bank, there should be clear institutional structures for achieving both price and financial stability to ensure proper decision making, accountability and communication. In some jurisdictions, this conditional coordinated approach is undertaken by a governing committee of the central bank which is established one tier above the price and financial stability structures. This ensures that a collaborative, holistic approach is maintained to ensure "leaning" is achieved and synergies are created.

In closing, financial stability policies are now becoming popular amongst central banks, therefore making the understanding of the interactions of price and financial stability a crucial piece of knowledge. Further, the

interaction of microprudential and fiscal policies with price and financial stability also requires further investigation. This paper can be further expanded through the use of a structural VAR in which exogenous shocks can be introduced into the model. In the end, the ultimate goal is to reduce the probability of systemic disruptions and minimize the unfavorable effects on the real economy.

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