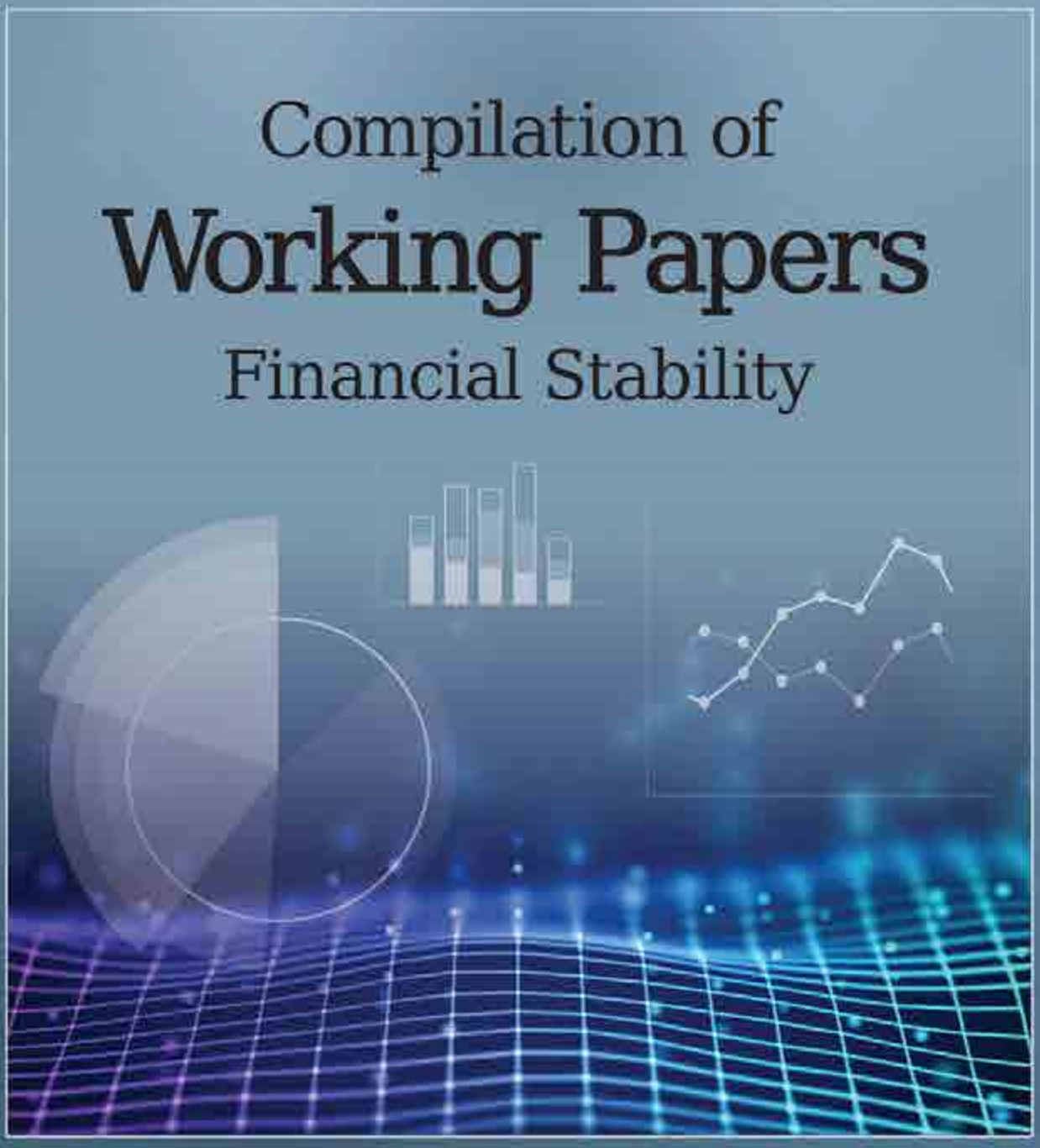
Central Bank of Trinidad & Tobago

Compilation of Working Papers

Financial Stability



CENTRAL BANK OF TRINIDAD & TOBAGO

Compilation of Working Papers Vol. 2. 2021

Publisher:

Central Bank of Trinidad and Tobago
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Eric Williams Plaza
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Port of Spain

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ISBN:

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Foreword

For every central bank, the conduct of theoretical and empirical research is crucial to the design of optimal policies to influence economic systems or elicit desired household behavioural changes so as to achieve one of its core mandates of stable growth. Ever since its creation in 1968, the Bank's Research Department has maintained a steady output of high quality research that not only feeds the Bank's policy directions but also educates and informs the general public of the country's economic conditions.

In recognition of the Bank's 55th Anniversary, the Research Department tasked itself with producing a special two-volume publication of its research works. Volume I, *Monetary Policy*, provided useful insights into the evolution of the Bank's monetary operations and its use of monetary instruments for macro-management of aggregate demand to achieve price stability and growth. A key message of that 2020 publication was that monetary strategy is largely contextual and in the context of Trinidad and Tobago, the openness of its economy with concentrated global trade networks reduces the effectiveness of the Bank's monetary policy.

Volume II, *Financial Stability*, steps into a major policy field for central banks since the 2007/08 global financial crisis, which has also become a fertile area of research. In comparison to the long history of central banks' deep involvement in monetary policy, the history of macro-prudential policy for the management of macro-financial cycles, spillovers and feedback loops is fairly new. This volume provides good coverage of some key issues that are central to the study of financial stability and design of macro-prudential instruments: assessing and measuring the vulnerability of sectors that create and transmit material risks; understanding the macro-financial linkages; and estimating macro-financial spillovers. This volume also takes the opportunity to introduce a new area of focus for central banks, climate risk and its implications for monetary and financial stability.

This compilation of working papers is not meant to be a complete source of information and knowledge on the chosen subject matter. Indeed, the works presented in this volume focus solely on the Trinidad and Tobago's financial system and a sub-set of questions within a vast and expanding field of financial stability research. Nonetheless, the questions discussed and evidence presented in this volume may contain useful insights that might be relevant to similar financial systems like ours.

Personally, I will like to thank all the authors that contributed to the success of this volume. I sincerely hope that this volume finds favour with most readers and provides a solid springboard for future studies.

Dr. Dorian M. Noel, CAIA
Deputy Governor, Monetary Operations and Policy

Preface

The dual mandate of central banks has come into sharp focus over the past decade as policymakers employed primarily monetary policy tools to address severe financial market disturbances. Such strategies may have led to sub-optimal outcomes and unintended consequences in some instances, highlighting the need to strengthen the toolkits available to contain systemic risks. Integrating a macro-prudential policy approach alongside already firmly established microprudential policy frameworks, represents the new frontier for financial stability regulation and supervision. This compilation highlights many of the foundational research issues that the Central Bank of Trinidad and Tobago has considered in designing and calibrating its responses to contemporary financial stability challenges.

The opening paper by Mrs. Kateri Duke and Mrs. Nikkita Persad investigates the resilience of the financial sector to climate change. Climate change has been a priority item for many financial regulators and central banks as countries ramp up efforts to meet their climate commitments. Using descriptive analysis, the authors explore approaches utilised internationally to conduct climate stress tests, namely extreme weather-related shocks (physical risk) or changes made to regulation, technology and public perception amidst the movement to a low-carbon economy (transition risk). In the second paper Mrs. Kateri Duke and Mr. Yannick Melville delve into micro and macro data analysis to determine the balance sheet resilience of households and non-financial corporates. Households and firms are key economic agents whose financial decisions can have direct implications for the health of the financial system. The micro analysis revealed that households' borrowing decisions are influenced by the level of economic activity and income, while non-financial corporates prefer to finance their operations with debt and will only issue equity if macro-financial developments threaten to increase the cost of credit. Meanwhile, the macro analysis found that households were able to stave off the effects from adverse shocks by leaning on social safety nets and restructuring their outstanding credit.

Mr. Yannick Melville investigates macro-financial linkages in Trinidad and Tobago in the third paper. The analysis seeks to establish relationships between domestic economic and financial variables, particularly how economic developments affect key risk indicators of the banking and insurance sectors. Having established these linkages, the fourth paper also by Mr. Melville, examines the impact of financial stress on Trinidad and Tobago's Gross Domestic Product by comparing movements in financial stability indicators and the domestic output gap.

Economic shocks are increasing in frequency and severity. Such shocks have the potential to undermine investment decisions and stymie potential growth. In the final paper, Mr. Yannick Melville and Mrs. Nikkita Persad explore the relationship between economic uncertainty and the performance of the banking sector through the development of an economic policy uncertainty index for Trinidad and Tobago. They found that a rise in economic uncertainty: (i) contracts lending from the commercial banking sector; (ii) increases the amount of credit extended by the non-banking sector; and (iii) erodes non-banks' liquidity and capital buffers.

Preface

The Bank wishes to express its gratitude to those professionals who took the time to read the articles in this compilation and provide thoughtful comments. They include Professor Michael Brei (University of Lille); Professor Philip Davis (Brunel University); Dr. Dave Seerattan (University of the West Indies); Dr. Leo-Rey Gordon (Bank of Jamaica); and Mr. Martijn Gert Jan Regelink (World Bank). We indeed value their scholarly insights.

In closing, I am optimistic that each reader will find some aspects captivating and ultimately lead to a deeper understanding of the financial stability issues in Trinidad and Tobago. As these papers inveigle scholastic debate, the Bank hopes to improve the level of public discourse on financial stability matters and anticipates information-rich feedback that can support the Bank's efforts at strengthening its oversight of domestic financial stability.

Dr. Kevin Finch
Manager, Research

CHAPTER I
EXPLORING THE FINANCIAL SECTOR'S RESILIENCE TO CLIMATE CHANGE: THE NEW FRONTIERS OF STRESS TESTING

Kateri Duke and Nikkita Persad

ABSTRACT

The global conversation on climate change has intensified and risks related to the environment have moved to the fore. Small island developing states of the Caribbean are particularly susceptible to weather-related natural disasters. At the same time, climate-related policies are being introduced by governments worldwide to limit man-made greenhouse gas emissions, which have been argued to contribute to global temperature changes, rising sea levels and intense weather phenomena. In an effort to remain forward-looking with evolving financial stability threats, this paper discusses climate-related risks and the transmission to the insurance and commercial banking sectors in the Trinidad and Tobago context. The paper further explores approaches utilised internationally to conduct stress tests related to climate change, namely extreme weather-related shocks (physical risk) or changes made to regulation, technology and public perception amidst the movement to a low-carbon economy (transition risk). The paper finds that international approaches are still in the developmental or nascent stages and to date there has been no standard regulatory climate risk stress test to be applied to financial systems. While climate risk awareness is building in the domestic financial industry, further work and collaboration with external stakeholders in the financial and scientific fields is necessary to expand technical capacity for the assessment of climate-related risk.

I.1 INTRODUCTION

The global conversation on climate change has intensified and risks related to the environment have moved to the fore.[1] As such, climate-related policies are being introduced by governments worldwide to limit man-made greenhouse gas (GHG) emissions, which have been argued to contribute to global temperature changes[2]. The last five-year and ten-year averages were the warmest on record, with the six highest annual global mean temperatures occurring in 2015 to 2020 (World Meteorological Organization 2021). Projections from the Intergovernmental Panel on Climate Change (IPCC) (2018) suggest that if this long-term trend were to continue unabated, climate-related risks would become more challenging to address and some human, environmental and socio-economic impacts may become irreversible.

[1] The World Economic Forum's *Global Risks Report 2021* ranked environmental-related risks – extreme weather events, climate action failure, human environmental damage and biodiversity loss – as four of the top five global risks by likelihood of occurrence within the next ten years, three of which ranked among the top five risks by impact (World Economic Forum 2021).

[2] The Intergovernmental Panel on Climate Change (IPCC) (2007) asserts that "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations".

The concern is shared regionally where the small island developing states of the Caribbean are particularly susceptible to the effects of weather-related natural disasters. Caribbean states are among the 25 most vulnerable nations in terms of disasters per capita and damages have exceeded gross domestic product (GDP) in the most destructive cases[3] (Ötker and Srinivasan 2018). Global temperature changes increase the frequency and intensity of extreme weather phenomena. Hurricane seasons within the last two decades have been among the most active on record. While relatively insulated from the direct effects of recent hurricanes, Trinidad and Tobago has not been immune to severe floods associated with excessive rainfall that have triggered insurance payouts and government relief. Weather-related stresses could impact macroeconomic conditions, which could have knock-on effects for the financial sector.

Despite its marginal contribution to GHG emissions on a global scale[4], Trinidad and Tobago has committed to reducing its carbon footprint in the local power generation, transportation and industry ("carbon-intensive") sectors by 2030. This entails the development and implementation of a robust policy and legislative framework to support climate change mitigation and adaptation. Policies designed to restructure core business activities or create additional financial burdens on the target sectors (for example, in the form of taxes) can have a direct impact on the profitability of these organisations. In fiscal year 2019, the energy sector accounted for approximately 34 per cent of GDP[5] and 34 per cent of government revenue[6]. Given Trinidad and Tobago's position as an energy-based economy and the connectivity between these carbon-intensive sectors and economic agents, organisation distress can have system-wide implications for macro-financial stability.

In an effort to remain forward-looking with respect to evolving financial stability threats, this paper explores climate-related risks as it pertains to the insurance and commercial banking sectors. The Central Bank of Trinidad and Tobago (CBTT) has routinely assessed the impact of natural disasters on the commercial banking system as part of its stress testing framework. This paper aims to build on the current framework and broaden the scenario to consider the transmission mechanism of extreme, but plausible, weather-related events (physical risk) or changes made to regulation, technology and/or public perception amidst the movement to a low-carbon economy (transition risk). Specifically, it will investigate the scenarios and techniques that are being employed internationally to conduct stress tests related to these two aspects of climate-related risk.

The structure for the paper is as follows. Section I.2 provides a background on global warming and the vulnerability of the region to associated effects. Section I.3 presents major climate-related risks and discusses associated financial impacts. Section I.4 reviews international stress testing approaches to climate-related risks and examines climate risk awareness among financial institutions in Trinidad and Tobago. Section I.5 proposes recommendations for a way forward and Section I.6 concludes.

[3] For example, Hurricane Maria (2017) resulted in losses of approximately 225 per cent of GDP in Dominica. Similarly, Hurricane Ivan (2004) cost Grenada an estimated 200 per cent of GDP.

[4] Latest data at the time of publication suggests that Trinidad and Tobago accounted for less than 1 per cent of global carbon dioxide emissions (from fuel combustion) in 2018, though it ranked among the top fifteen carbon emitters on a per capita basis (International Energy Agency 2021).

[5] Ministry of Finance, Government of the Republic of Trinidad and Tobago. 2020. *Review of the Economy 2020*. Government of the Republic of Trinidad and Tobago.

[6] Ministry of Finance, Government of the Republic of Trinidad and Tobago.

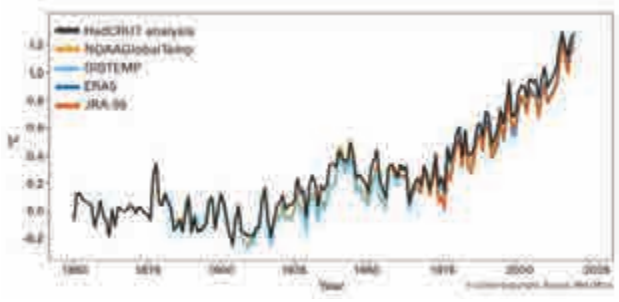
I.2 GLOBAL WARMING AND ITS IMPACT ON THE CARIBBEAN

In the 2015 Paris Agreement under the United Nations Framework Convention on Climate Change, world leaders pledged to proactively respond to the threat of global climate change by limiting the global temperature rise this century to well below 2°C above the pre-industrial baseline[7], and further pursuing efforts to cap the increase at 1.5°C. The IPCC, an independent body founded in 1988 by the World Meteorological Organization and the United Nations Environment Programme, advocates for the achievement of these targets and has played a pivotal role in disseminating scientific assessments on climate change, its impacts and risks, and possible response options. Experts suggest that the present trend of global warming, propelled by observed increases in anthropogenic (man-made) GHG emissions, puts the globe on the path to breaching the 1.5°C limit between 2030 and 2052 (IPCC 2018).

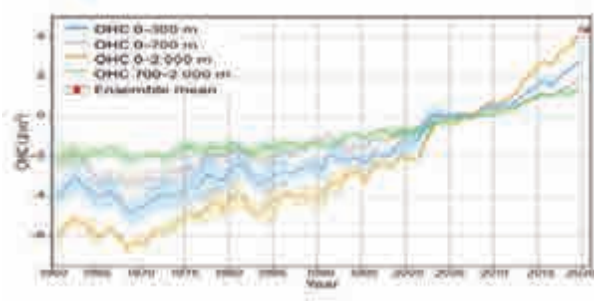
While reference is usually made to increases in air surface temperature, global warming considers both changes to temperature on land as well as the heat content of the ocean caused by the absorption of excess heat generated due to GHG emissions. In 2020, the global average surface temperature was approximately 1.2°C (with a margin of error of ±0.1°C) above pre-industrial levels (**Figure I.1, Panel A**).[8] Temperatures have been formally measured since the late 1800s and 2020 measured as one of the three warmest years in history (2016 holds the record for the highest temperature). In addition, heat content in the upper 2000-metre layer of the ocean continued to surpass previous records in 2019 (**Figure I.1, Panel B**).[9] Focusing on the longer-term trend, each decade since 1980 has been incrementally warmer than the last (World Meteorological Organization 2021).

Figure I.1: Historical Global Temperature Changes

PANEL A: *Global mean surface temperature with respect to the 1850 - 1900 baseline for five global temperature datasets, 1850 – 2020 (°C)*



PANEL B: *Global mean ocean heat content change for the 0 - 2000m layer relative to the 2005 - 2017 climatology, 1960 - 2019 (J/m²)*



Source: World Meteorological Organization (2021).

Note: The shaded regions in Panel B represent the 2-sigma standard deviation.

[7] The pre-industrial baseline refers to the period from 1850 - 1900.

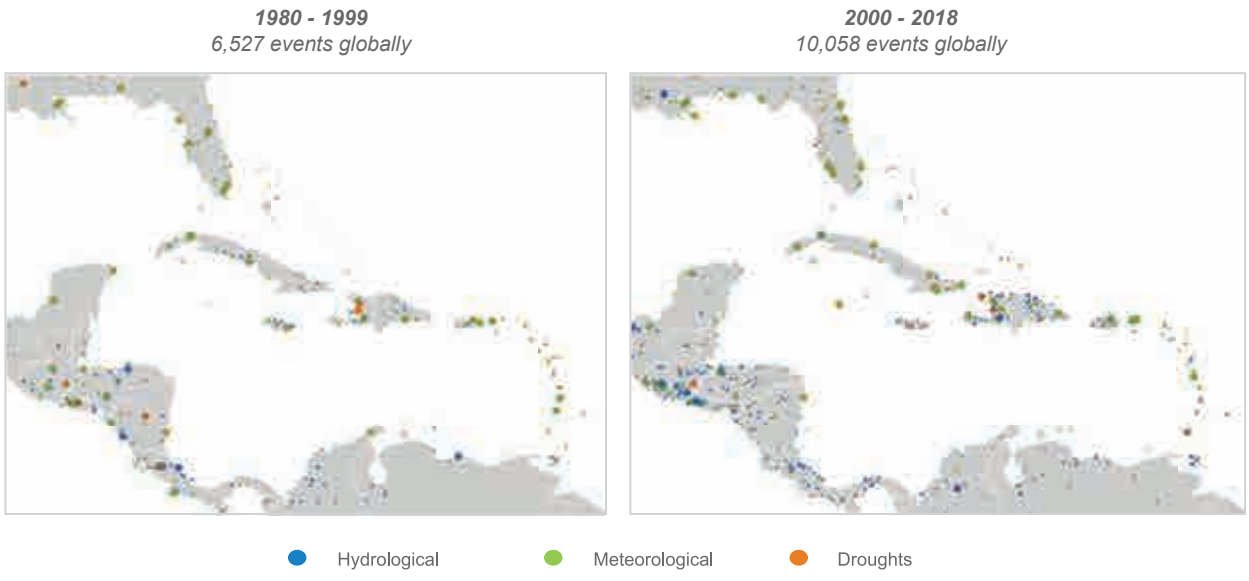
[8] The 1.5°C limit refers to the long-term average, not the average for an individual year (World Meteorological Organization 2021).

[9] Ocean heat content in 2020 is expected to exceed the 2019 level, based on preliminary analysis of three global datasets. The ensemble mean and spread for 2020 is represented by the red point in Panel B.

Rising global average temperatures are associated with widespread changes in long-term weather patterns, that is, climate. Small island developing states, such as those within the Caribbean, are disproportionately more vulnerable to the effects of changing climate due to their size, location and topography. Warmer sea surfaces contribute to stronger rainfall and intensify wind speeds of tropical cyclones. The unfavourable temperature can also lead to loss of coral reefs, which would have otherwise provided a natural coastal barrier to waves and storms. As temperature increases, seawater expands, resulting in rising sea levels. Globally, melting glaciers and ice sheets (land ice) also increase the volume of water in the ocean. Sea level rises exacerbate the effects of extreme weather making flooding and erosion more likely in low-lying, coastal areas. Flooding and storms can therefore be directly related to the impact of global warming on the oceans. Additionally, reduced rainfall events can lead to longer dry spells and heat waves, increasing the occurrence of bushfires and droughts.

Global reinsurer MunichRe has recorded relevant loss events since 1980 to illustrate the increasing frequency and intensity of extreme weather, including hydrological events such as floods and associated landslides; meteorological events such as hurricanes; and droughts. **Figure I.2** shows that the number of relevant weather-related loss events (worldwide) has increased by over 50 per cent in the nineteen-year period from 2000 to 2018, compared to the previous two decades, with a notable increase in hydrological losses in Latin America and the Caribbean.

Figure I.2: Relevant Weather-Related Loss Events, 1980 - 2018



Source: Munich Re NatCatSERVICE

Note: Relevant loss events exceed defined thresholds of normalised overall losses and/or fatalities. These events are considered in number statistics and trend analyses. Threshold values are: fatalities ≥ 1; and/or normalised overall loss ≥ US$100,000; US$300,000; US$1,000,000; or US$3,000,000 (depending on assigned World Bank income group of each affected country).

Specifically, the Caribbean region is exposed to tropical cyclones, including hurricanes, by virtue of its geographic location. While there is some variability on an annual basis, the number of cyclones forming in the Atlantic Basin has risen considerably over the last 20 years, particularly with respect to those developing into major hurricanes (**Table I.1**). Between 2000 and 2019, 14 Category 5 hurricanes occurred, compared to 5 from 1980 to 1999. Above-normal seasons are expected to continue. There were 30 named storms in 2020, which exceeded the previous record set in 2005 (28 storms). The number of storms developing into hurricanes (14) was the second highest behind 2005 levels. Seven of these hurricanes strengthened to major hurricanes, equaling the 2005 record.

Further evidence suggests that the observed increases in frequency and intensity have been accompanied by longer durations, which have been fueled by warmer sea surface temperatures (Li and Chakraborty 2020). Together, these factors have contributed to greater associated losses. **Figure I.3** maps cyclone activity against estimated meteorological losses for the Caribbean. Data compiled from the Centre for Research on the Epidemiology of Disasters[10] shows that the 2017 hurricane season took its toll on the region with an estimated US$81 billion in economic losses due to Hurricanes Maria and Irma. According to MunichRe, the entire North Atlantic region (including the US) affected by these hurricanes suffered US$215 billion in losses; MunichRe suggests that around 57 per cent of these losses were uninsured.[11]

While hurricanes evidently pose the biggest threat to the region, hydrological losses and droughts have also impacted economies. The Centre for Research on the Epidemiology of Disasters estimates that hydrological losses in the Caribbean over the last forty years have been close to US$987 million. Meanwhile, available data suggests that droughts and forest fires have cost regional economies a minimum of US$277 million.

Table I.1: Number of Cyclones in the Atlantic Basin, 1980 - 2020

Period	Tropical Depressions	…of which Named Storms	…of which Hurricanes	…of which Major Hurricanes		
				Category 3	Category 4	Category 5
1980 - 1989	145	93	52	7	7	3
1990 - 1999	133	110	64	11	12	2
2000 - 2009	173	151	74	13	15	8
2010 - 2019	166	155	72	12	12	6
2020	31	30	14	2	5	0

Source: Compiled from the US National Hurricane Centre

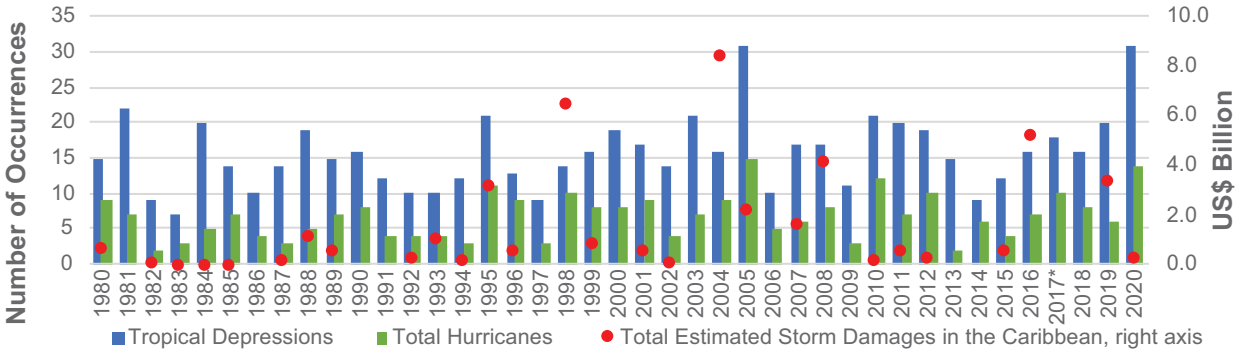
Note: Tropical cyclones with maximum sustained surface winds of less than 17 m/s (34 kt, 39 mph) are usually called "tropical depressions". Once the tropical cyclone reaches winds of at least 17 m/s (34 kt, 39 mph) it is typically called a "tropical storm" and is assigned a name. If winds reach 33 m/s (64 kt, 74 mph), then it is called a "hurricane". Hurricanes are categorised according to the Saffir-Simpson Hurricane scale (1-5).

[10] The non-profit Centre for Research on the Epidemiology of Disasters is a World Health Organisation collaborating centre. They launched the Emergency Events Database (EM-DAT) in 1988, which contains essential core data on the occurrence and effects of over 22,000 mass disasters since 1900. The database is compiled from various sources, including UN agencies, non-governmental organisations, insurance companies, research institutes and press agencies.

[11] Löw, Petra. "Hurricanes cause record losses in 2017 - The year in figures." MunichRe, January 4, 2018. Accessed August 21, 2018. https://www.munichre.com/topics-online/en/climate-change-and-natural-disasters/natural-disasters/2017-year-in-figures.html.

The Trinidad and Tobago Meteorological Service (TTMS) has observed air temperature rises of 0.27°C per decade in Trinidad and 0.17°C per decade in Tobago, since 1960 (Kerr 2012). This is in line with the IPCC average for the Caribbean of 0.2°C. Projections for Trinidad and Tobago based on General Circulation Models and Regional Climate Models **(Figure I.4)** suggest that air temperature could reach between 2.4°C and 3.6°C by the end of the century. Moreover, projections for precipitation suggest that total annual rainfall would decrease. Since 1960, the TTMS has noted that average rainfall has fallen by 2.6 per cent (6.1mm) per month, per decade within the first three months of the 'wet season'[12]. The Caribbean region has also experienced an average (though, not uniform) sea level rise of 10cm over the twentieth century due to global warming. This supports projections of increased sea surface temperature and sea level rise by 2100.

Figure I.3: Number of Cyclones in the Atlantic Basin and Total Estimated Storm Damages in the Caribbean, 1980 – 2020



Source: US National Hurricane Centre, Emergency Events Database (EM-DAT)

Note: For the Total Estimated Storm Damages series, the 2017 data point has been removed due to scaling issues. According to the EM-DAT, total storm damage in the Caribbean in 2017 was US$81 billion. Further, only non-zero values are represented.

Figure I.4: Key Climate Projections for 2100 for Trinidad and Tobago

AIR TEMPERATURE	ANNUAL RAINFALL	MONTHLY RAINFALL	SEA SURFACE TEMPERATURE	SEA LEVEL RISE
↑	↓	+ 7mm ↕ - 40mm	↑	↑
2.4 - 3.6°C	22 - 30 per cent		0.9 - 3.1°C	75 - 126cm

Source: GORTT (2019)

[12] The 'wet season' occurs from June to December.

Recognising the importance of delaying the effects associated with rising temperatures, the Government of the Republic of Trinidad and Tobago (GORTT) confirmed its commitment to reduce GHG emissions (carbon dioxide, methane and nitrous oxide) under the 2015 Paris Agreement through the ratification of its Nationally Determined Contributions (NDCs) in February 2018 (GORTT 2018). The NDCs are based on the carbon reduction strategy developed by Solaun et al. (2015) for the power generation, transportation and industry[13] sectors. **Table I.2** highlights the contribution of these sectors to GHG emissions in 2012.[14] Specific objectives of the reduction strategy include (i.) the reduction of GHG emissions by 15 per cent (cumulative emissions of the three sectors referenced against a 2013 baseline) by the year 2030; and (ii.) the reduction of public transport emissions by 30 per cent or 1,700,000 tonnes of carbon dioxide (compared to 2013 levels) by December 2030. The GORTT's Ministry of Planning and Development is responsible for the coordination and implementation of these commitments.

Achieving nationally determined contributions in line with IPCC targets will necessitate the introduction of legislation, regulation and other policies designed to minimise GHG emissions. These may restrict carbon emissions, encourage fuel efficiency, mandate disclosures and impose taxes or fines on polluting firms – all of which can weigh on the bottom line of institutions in the targeted industries, as well as deplete the value of carbon-intensive assets.

Table I.2: Share of GDP and GHG Emissions by Sector, 2012

SECTOR	Share of TT GDP, 2012 (per cent)	Share of GHG Emissions (per cent)
Power generation	1	19
Transportation	5	7
Industry	46	74

Source: Solaun et al. (2015)

[13] "Industry" includes petroleum exploration and production, pipeline operations, natural gas processing, refining, iron and steel processing, LNG production, cement manufacture, and petrochemical production. Electricity generation and distribution, as well as light manufacturing, are not included (Solaun, et al. 2015).

[14] It is noted that there has already been a decrease in emissions in the transportation sector, as a result of the transition from traditional gasoline to Compressed Natural Gas use. Additionally, most electricity in Trinidad and Tobago is produced from natural gas, which generates lower carbon emissions from combustion.

I.3 FINANCIAL SECTOR IMPLICATIONS OF CLIMATE-RELATED RISK

This section focuses on potentially systemic climate-related risks – including physical and transition risks – which could materialise within the Caribbean.

I.3.1 Physical Risk

RISK	Physical Risk		
TRIGGERS	Excess Rainfall	Tropical Cyclones	Extreme Heat

Physical risks of climate change emanate from weather-related events including flooding, storms and extreme heat. As described in Section I.2, flooding and storms are directly related to the impact of global warming on the oceans and effects are particularly pronounced in small island developing states with low-lying, coastal areas such as those in the region. Extreme flooding and storms can manifest as risks to the financial sector via the following channels:

- Increased mortality due to natural disasters;
- Increase in water-borne diseases in flooded areas;
- Property damage and loss of agricultural products through flooding and (coastal) erosion;
- Decrease in yield and value of agricultural land (coastal) due to soil salinisation;
- Disruption in power and water supply;
- Disruption in business operations/trade; and
- Growth in shadow banking activity as already highly leveraged entities seek emergency financing.

Although excess rainfall events are expected to intensify, projections for precipitation suggest that total annual rainfall would decrease (GORTT 2019). Reduced rainfall coupled with heat waves can lead to increased incidences of bushfires and more severe droughts, as well as affect the quality of human life. Extreme heat can manifest as risks to the financial sector via the following channels:

- Increased morbidity and mortality due to heat waves in high humidity;
- Increase in vector-borne diseases, such as those transmitted by mosquitos, due to rising temperatures in humid conditions;
- Property damage and loss of agricultural products due to uncontained bushfires; and
- Increased morbidity due to poor air quality as a result of bushfires.

It should be noted that such difficulties can have macroeconomic feedback effects such as diminished productive capacity and factor productivity, rising unemployment and inflation. Macroeconomic policies executed to respond to a significant physical event may have unintended consequences if they are asynchronous with the existing business and financial cycles. For example, a lowering of interest rates to facilitate reconstruction financing may lead to heightened inflationary pressures. At the same time, widespread government relief to support recovery efforts may undermine fiscal positions. At the end of fiscal year 2019,

financial assistance was provided to 10,679 households by the GORTT's Ministry of Social Development and Family Services through the Disaster Relief (Flooding) grant amounting to TT$138.4 million (GORTT 2019).[15] Many of these cases were victims of severe flooding and numerous landslides throughout Trinidad triggered by excess rainfall in October 2018[16] and the passing of Tropical Storm Karen in September 2019. Sovereign susceptibility to physical climate risks can negatively influence credit rating assessments (Moody's Investors Service 2016). More generally, the strain on the real economy can indirectly affect financial markets.

In light of the aforementioned, the risks to the insurance and commercial banking sectors are as follows:

(i) Insurance Sector

Physical risks of climate change are expected to affect general and long-term insurers through the same channels, but with different impacts on their financial statements. Infrastructural damage can spur an increase in property insurance claims in the general insurance sector. Results of a survey issued to local general insurers by the Association of Trinidad and Tobago Insurance Companies (ATTIC) indicated that 85 per cent of property flood claims (and 38 per cent of motor flood claims) incurred in 2018 were directly attributable to the October 2018 floods (ATTIC 2018). As at December 2018, 92.3 per cent of property premiums (and 14.9 per cent of motor vehicle premiums) were ceded, implying general insurers could recover losses due to the surge in claims.[17] However, such events can trigger increases in reinsurance rates[18] which the general insurers may decide to pass on to clients. In the aftermath of the October 2018 floods, 11 of 15 general insurance companies expressed interest in revisiting policies and prices relating to flood insurance coverage (ATTIC 2018). This could include raising premiums in areas more prone to damage from weather-related events or restricting insurance altogether to protect against unpredictable losses. Such a decision can reduce property insurance penetration and possibly adversely affect property valuations, which can weigh heavily on real estate investments.

Physical risk factors may also give rise to liability risk when individuals who have suffered damages from weather-related events seek to recover losses from those they believe may have been responsible (Bank of England 2015). Increased underwriting risk for liability insurers may result due to claims made against polluting companies or firms in carbon-intensive industries. Shorter-term effects may be felt on insurers' balance sheets stemming from changing investor sentiment and market expectations with respect to their ability to remain resilient in the face of physical risks.

Long-term insurers face challenges via increased rates of morbidity and mortality. Wider economic distress due to decreased food production and unavailability of power and water could also have a deteriorating effect on public health. While reduced life expectancy and unexpected health problems will result in payouts sooner than anticipated (due to death and illness), mortality and morbidity risks are naturally hedged (to some extent) by longevity-related products such as pensions and annuities. Additionally, insurers may face an increase in policy lapses or surrenders as persons seek liquidity. Risks to these insurers are typically longer-term due to the nature of their products and investments. The largest

[15] Compare this to disaster relief provided for the period October 2017 to August 2018 of TT$9.9 million (GORTT 2018).

[16] According to the Minister of Works and Transport, Trinidad alone received a month's worth of rainfall in three days. T&T Express. 'A month's worth of rainfall, in 72 hours'. https://trinidadexpress.com/news/local/a-month-s-worth-of-rainfall-in-hours/article_d513a23a-d601-11e8-a931-ef6995b8d2d7.html

[17] As at December 2020, 92.7 per cent of property premiums (and 14.4 per cent of motor vehicle premiums) were ceded.

[18] As an example, global reinsurer Willis Re stated that property reinsurance prices rose in 2018 by 20 to 40 per cent in catastrophe-hit areas in the Caribbean and 5 to 10 percent in loss areas in the US and Latin America.

share of investments is held in GORTT securities (47.9 per cent as at December 2020). Lowered interest rates will therefore have a material impact on balance sheets. As with general insurers, long-term insurers may choose to increase premiums to safeguard against potential losses.

(ii) Commercial Banking Sector

Physical shocks related to climate change may manifest as credit, market and operational risks to the commercial banking sector. Credit risks stem from rising defaults by private sector customers (households and businesses) with inadequate insurance coverage as affected parties may prioritise expenditure for rebuilding and resettlement.[19] Households may face additional debt-servicing difficulties due to loss of income (inability to work). At the same time, harsher economic conditions, lower productivity and significant costs of recovery may weigh on businesses' continuity and profitability, diminishing their debt repayment capacity. Credit risks may also arise when indebted businesses are subjected to legal action for their perceived role in global warming and the manifestation of weather-related events. In the absence of liability insurance, businesses may be required to financially compensate affected parties out-of-pocket, which could lead to greater debt-servicing constraints. Real estate mortgages, which account for approximately 37.8 per cent of the sector's private sector loan portfolio as at December 2020, are particularly susceptible as the value of the underlying asset may be impaired. Banks may consider this risk in their underwriting process and may reduce credit supply to customers who are considerably exposed to physical risks associated with weather-related events.

Banks are also susceptible to market risk due to possible devaluations in their real estate investments. Moreover, sovereign credit rating downgrades, due in part to expansionary fiscal policy, can negatively affect the value of banks' investments in GORTT securities (59.7 per cent of the total investment portfolio as at December 2020). Banks may seek to limit their losses by reducing their exposure to sovereign risk, though alternative options for investment are limited. This, coupled with generalised losses in financial markets due to strain on the economy, can further impair the balance sheet.

Operational risks to the commercial banking sector result from potential business disruption in areas vulnerable to physical shocks. This considers the operating capacity of branches as well as the ability of staff to physically report to work. Damaged information technology infrastructure necessary to complete transactions (and unavailability of other infrastructure such as automated teller machines) can also lead to operational losses. However, this risk may be mitigated by robust business continuity planning.

[12] This may be alleviated to some extent by social welfare support provided by the Government. At the same time, the Government may request financial institutions to offer a moratorium on loan payments in response to a natural disaster or pandemic. As an example, GORTT requested the deferral of mortgages and rent payments made to state enterprises Housing Development Corporation and Trinidad and Tobago Mortgage Finance Company as a result of the October 2018 floods. In 2020, commercial banks introduced sweeping measures in response to the COVID-19 crisis including, inter alia, a moratorium on debt payments, debt restructuring and waiver of selected fees.

I.3.2 Transition Risk

RISK	Transition Risk		
TRIGGERS	Introduction of Climate - Related Policy	Advances in "Green" Technologies	Changing Consumer and Investor Preferences

Transition risks of climate change relate to developments in policy, technology and public perception amidst the movement to a low-carbon economy. The introduction of legislation, regulation and other policies designed to minimise GHG emissions can directly impact profitability and asset values of fossil fuel companies (and those that provide ancillary products and services); industrial manufacturers (that are large consumers of energy); and producers of energy-consuming goods (Sustainability Accounting Standards Board 2016). Risks may also emanate from the development of "green" technologies that support transition by reducing the demand for carbon-intensive and other transition-sensitive assets, increasing energy efficiency, encouraging the use of renewable energy or capturing carbon dioxide. Companies that utilise these technologies may increase market share at the expense of non-green companies.

Moreover, public awareness and involvement in climate change mitigation and adaptation efforts, as well as changing risk perceptions and uncertainty in the political commitment to climate-related policy, could lead to changing consumer and investor preferences. In particular, investors have been increasing pressure on organisations to disclose useful information on climate-related financial exposures that will allow them to manage and price climate-related risks appropriately. In 2017, the Financial Stability Board's Task Force on Climate-Related Financial Disclosures (TCFD) introduced recommendations for "consistent, comparable, reliable, clear and efficient climate-related financial disclosures by companies" to support informed decision-making by financial sector participants including investors, lenders and insurance underwriters (TCFD 2017). Though voluntary, non-adherence to these recommendations may expose companies to liability risk.

At the same time, the emergence of renewable energy companies (and those that provide ancillary products and services) and industries offering energy-efficient products and services also introduces upside risks to the financial sector. New lending and investment opportunities, as well as additional sources of premium could be presented. From a macroeconomic view, new jobs could be created for persons with different skillsets and more efficient processes should result in long-term cost reductions and revenue growth.

Developments in climate-related policies, new technologies and shifting preferences can trigger transition risk via the following channels:

- Sudden repricing (or devaluation) of carbon-intensive assets;
- Reduced demand for fossil fuels, related services, and energy consuming products;
- Increasing unemployment in carbon-intensive and other transition-sensitive industries;
- Readjustment of business models to incorporate "green" technologies;

- Higher renewable energy costs and overvaluation of renewable assets in the short term;
- Postponement of consumption and investment decisions due to uncertainty; and
- Sudden investment withdrawals from companies whose assets have large climate risk exposure, including carbon-intensive firms and institutions exposed to carbon-intensive industries.

Timing is key to transition as sudden and disorderly repricing of assets exacerbates risks to financial market stability. The subsidy on natural gas used for power generation in Trinidad and Tobago and limited availability of renewable energy assets may lead to overpricing. At the same time, the issue of stranded assets arises when value attributed to carbon-intensive assets is left unrealised due to GHG emission limits. It is estimated that 80 per cent of known global carbon reserves will have to remain unutilised in order to stay within IPCC targets (Carbon Tracker Initiative 2014). This will significantly deplete the value of carbon-intensive assets with knock-on effects for asset holders. Hydrocarbon resource-rich sovereigns could face national balance sheet impairments.

Moreover, implementation of climate change policies could consume additional capital resources as exposures to fossil fuel-dependent sectors are reduced or business models are readjusted to incorporate cleaner technologies. Mitigating policies could also suggest the implementation of a carbon tax, which increases the cost of producing carbon products. Companies that cannot successfully transition to "green" technologies will face revenue losses as a result of reduced demand in carbon-intensive industries. This can challenge profitability and increase volatility in shareholder returns.

Financial stability risks emerge largely from financial institutions' exposure to organisations in the power generation, transportation and industry sectors (the sectors identified in the GORTT's carbon reduction strategy) as well as exposure to other transition-sensitive sectors. However, indirect effects can be felt through exposures to GORTT as a shortfall in energy sector revenues can reduce government earnings. This could impinge on GORTT's debt repayment capacity and may result in higher public sector-related non-performing loans. Losses can also trickle down to the financial sector through declines in economic activity and tighter liquidity due to decreased fiscal injections.

In light of the aforementioned, the risks to the insurance and commercial banking sectors are as follows:

(i) Insurance Sector

Transition risks of climate change are expected to affect long-term and general insurers primarily through investment exposures. Limits on production, repricing of assets and changing investor preferences will directly affect the performance of these portfolios. Exposure to GORTT can affect insurance companies similarly through their investment portfolio. It should be noted that potential losses in long-term and general insurance products may be offset by new sources of premium as insurers could shift business models to target renewable energy companies and industries offering energy-efficient products and services. Low-carbon investments will allow greater diversification of insurers' investment portfolios. Similar to physical risks, transition factors may also induce liability risks resulting in increased claims against insured companies for failure to, inter alia, mitigate GHG emissions, adapt investment strategies, or disclose climate-related risks.

(ii) Commercial Banking Sector

Transition risks of climate change are expected to increase the vulnerability of the commercial banking sector to credit, market, reputational and liability risks via exposures to transition-sensitive industries. Reduction

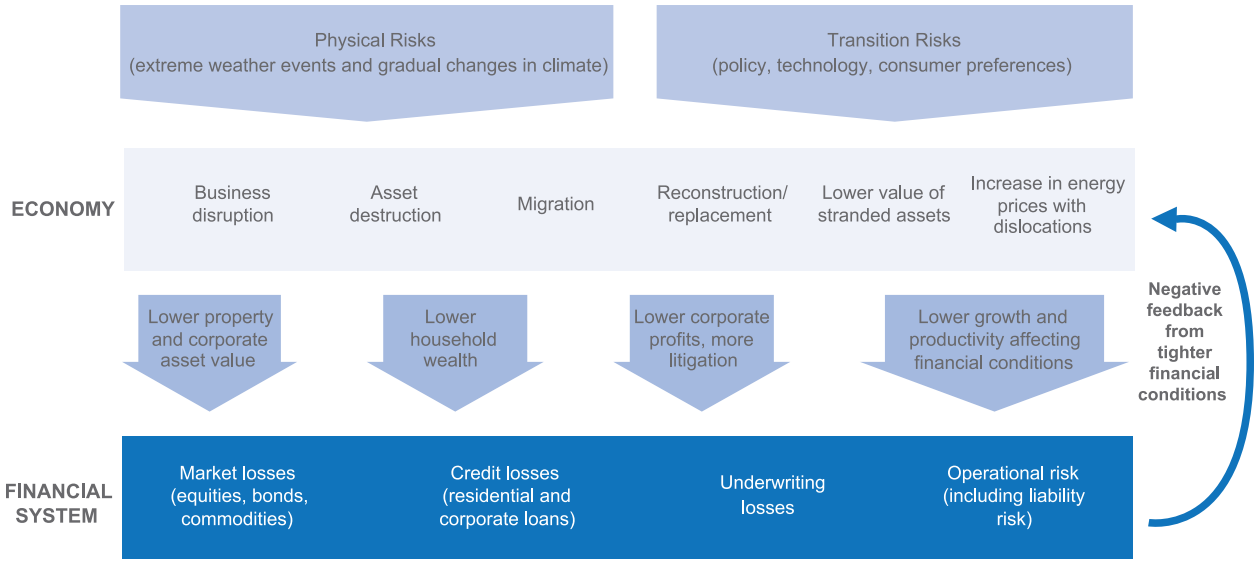
in the demand for fossil fuels, related services and energy consuming products, and the associated shift toward renewable energy resources could induce organisation distress, constricting the bottom line and hampering debt-servicing capabilities. Though direct credit exposures to carbon-intensive sectors are limited, consideration must be given to those transition-sensitive sectors which could be impacted by policy changes such as those related to energy efficiency for commercial and residential real estate. If such policies are implemented, these exposures can worsen credit risk in commercial bank mortgage portfolios. Moreover, liability claims made against uninsured companies can reduce funds available for debt repayment.

Similar to the insurance sector, market risk stems from the disorderly repricing of carbon-intensive assets on bank balance sheets and a sudden correction in financial markets. Lower corporate profitability in non-green companies, compounded by the introduction of a carbon tax, could lead to further financial market losses. Negative perceptions and pressures from corporate social responsibility groups surrounding the commercial banking sector's ability to manage climate-related risks through their exposures to affected industries, as well as changing sentiment regarding climate change accountability, may also give rise to reputational risk which can affect investor appetite. This may be exacerbated by credit rating downgrades due to the incorporation of climate-related risks in credit rating methodologies. Banks are also susceptible to negative feedback effects of sovereign credit rating downgrades owing to GORTT's energy revenue dependency. Direct liability risks may also arise due to failure to disclose and mitigate climate-related exposure.

Notably, renewable energy companies and industries offering energy-efficient products and services provide banks with new lending opportunities and allow for greater diversification of investment portfolios. This may offset some losses experienced due to the downside risks of movement to a low-carbon economy.

Figure I.5 illustrates the general transmission of physical and transition shocks throughout the wider economy and the feedback effects from the financial system.

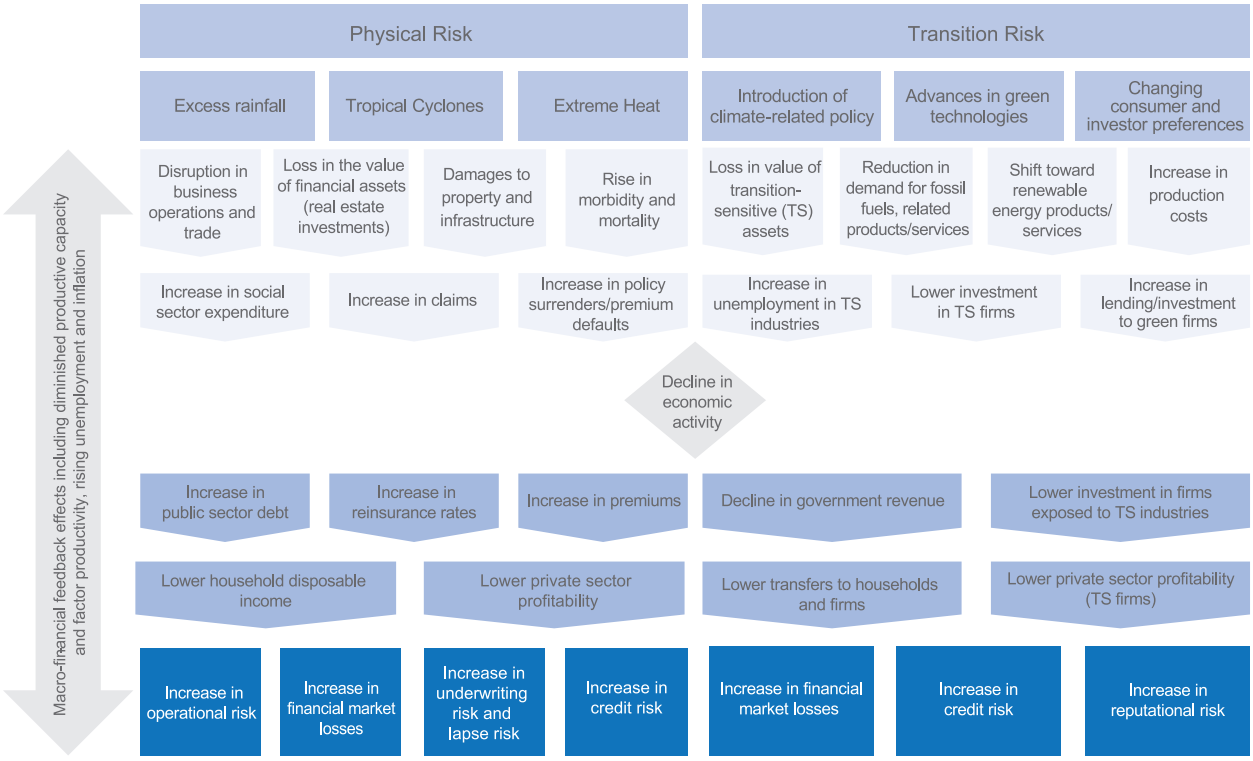
Figure I.5: Transmission Channels of Climate-Related Shocks



Source: Grippa, Scmittmann and Su (2019)

Figure I.6 complements this overview and explores the proposed transmission channels of climate-related shocks in the Trinidad and Tobago context, as discussed in this section.

Figure I.6: Proposed Transmission Channels of Climate-Related Shocks in Trinidad and Tobago



Source:Authors

I.4 STRESS TESTING CLIMATE-RELATED RISKS

I.4.1 International Approaches

Stress testing is considered a useful tool and has been recommended by international bodies for assessing the effects of extreme, but plausible, climate-related shocks on the macro-financial system. Results from stress tests can serve as useful input into decision-making at the institution and regulatory level and can guide action plans for the mitigation of climate-related risks. Internationally, development of climate-related regulatory stress tests is in the nascent stages. Nevertheless, some financial regulators and supervisors have accelerated macroprudential surveillance and analysis of climate-related risks, as well as begun to lobby for its inclusion in comprehensive risk management frameworks at the micro level.

In April 2020 the Basel Committee on Banking Supervision (BCBS) conducted a stocktaking exercise on 27 members and observers to gather information on climate-related financial risk initiatives. Most respondents (24) indicated that they had undertaken research to measure climate-related risk to the financial sector and had utilised varying approaches, including scenario analysis and stress testing. However, 18 respondents indicated that banks in their jurisdictions had been surveyed on the impact of climate-related financial risks and found that only a few banks actually performed stress tests. Respondents noted that lack of data and the uncertainty in measuring and tracing the impact of climate-related risk on the financial sector were key challenges in the modelling exercise (BCBS 2020). Results of the BCBS study supported conclusions of a Central Banking focus report on climate change risk management[20]. In particular, it was emphasised that most central banks were not yet collecting data relating to climate change, but institutions were developing proficiencies in this area (Central Banking 2019).

Several authorities have cited challenges with the analysis of climate scenarios on account of insufficiently granular climate and environmental data (including balance sheet exposures), as well as the unavailability of specific tools to capture idiosyncratic features of climate-related risks (including varying time horizons; uncertainty in the timing of "green" policy and technology development; and the complexity of transmission channels and macro-financial feedback loops) (NGFS 2020).

The Network of Central Banks and Supervisors for Greening the Financial System (NGFS)

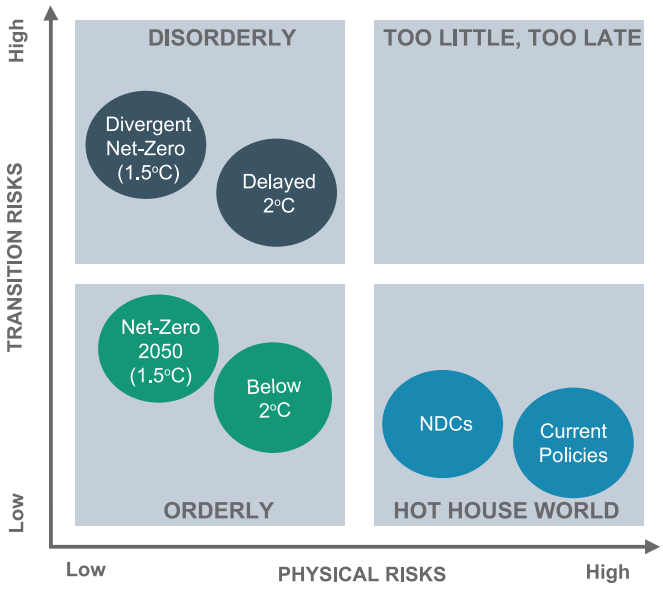
In December 2017, the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) was established by eight organisations as a forum to share best practices and collaborate on issues related to environmental risks. NGFS membership has expanded to 90 central banks or financial supervisors, and a further 14 organisations have been designated as observers[21] as at April 2021. In particular, the NGFS seeks to support the fulfilment of those objectives outlined in the 2015 Paris Agreement that are in line with central bank mandates (NGFS 2019). This has led to the identification of five workstreams – micro-prudential/ supervision, macro-financial, scaling up green finance, bridging the data gaps and research. The macro-financial workstream's main objective is the development of an analytical framework for assessing climate-related risks, which includes the quantification of climate-related risks in a stress scenario.

While the risks brought about by climate change are at the forefront, to date there has been no international standard regulatory stress test for transition and physical

[20] Thirty-four out of one hundred central banks provided responses, mainly from European countries (44 per cent). The study was conducted in March 2019.
[21] International or regional financial institutions and international or regional standard setting, regulatory, supervisory and central bank bodies which have demonstrated a proven commitment in sustainable finance are eligible to be observers (NGFS 2020).

risks. It is in this vein that the NGFS suggested six climate scenarios for reference by central banks, supervisors and the broader economy (NGFS 2021) (**Figure I.7**). The definition and calibration of forward-looking scenarios has been challenging given the immense uncertainty in the global warming trajectory and the variability in climate-related policies across sectors and economies. As such, the proposals represent a range of lower and higher risk outcomes that vary according to temperature rise and speed of transition. "Orderly" scenarios consider the early introduction of climate policies, which gradually become more stringent; they are associated with relatively low physical and transition risks. On the other hand, "disorderly" scenarios assume that policies have been delayed or are applied suddenly or unevenly across sectors and economies, resulting in high transition risks but subdued physical risks. The "hot house world" scenarios reflect partial implementation of climate policies globally, which fail to limit temperature increases; these generate high physical risks but low exposure to transition risks. Moreover, the "too little, too late" quadrant represents significant exposure to both physical and transition risks, but a specific scenario has not been defined.

Figure I.7: NGFS Scenarios



ORDERLY

Net-Zero 2050 limits global warming to 1.5°C through stringent climate policies and innovation, reaching net zero CO_2 emissions around 2050. Some jurisdictions reach net zero for all greenhouse gas emissions.

Below 2°C gradually increases the stringency of climate policies, giving a 67 per cent chance of limiting global warming to below 2°C.

DISORDERLY

Divergent Net-Zero Policies reaches net zero by 2050 but with higher costs due to divergent policies introduced across sectors leading to a quicker phase out of oil use.

Delayed 2°C assumes annual emissions do not decrease until 2030. Strong policies are then needed to limit warming to below 2°C. Negative emissions are limited.

HOT HOUSE

Nationally Determined Contributions (NDCs) includes all pledged but not yet implemented policies.

Current Policies assumes that only currently implemented policies are preserved, leading to high physical risks.

Source: (NGFS 2021)

Several academic and research experts have collaborated with the NGFS to expand the dataset related to physical and transition risks by enhancing the econometric analysis for the quantification of scenarios. The partnerships have facilitated improved regional coverage, deeper granularity in sectoral data, integration of physical and transition risk models, and expansion of macroeconomic outputs. Specifically, the updated modelling framework supplements scenario narratives with data projections produced by a suite of climate, natural catastrophe, integrated assessment and macroeconomic models. Multiple greenhouse gas emissions pathways and the associated global mean temperature rises contextualise model output. Climate and natural catastrophe models produce, inter alia, global mean temperature rises, precipitation by region and agricultural yields by crop. Estimates are then applied as exogenous shocks into macroeconomic models to project corresponding GDP losses. Transition pathways are projected using integrated assessment models (IAMs)[22], which estimate variables such as emissions pathways, carbon prices, energy demand and capacity, and renewable energy investment flows. Finally, the impacts of physical and transition risks on key macroeconomic and financial variables are captured using a global macroeconometric model (National Institute Global Econometric Model (NiGEM)) and IAMs. The framework also provides country-level climate data and allows for the production of country-level transition variables through the application of a standardise, downscaling methodology[23].

UN Environment Finance Initiative (UNEP FI) and Acclimatise

Sixteen banks coordinated under the UNEP FI partnered with the climate risk advisory firm Acclimatise in developing techniques that could be used to integrate physical climate risks into banks' stress testing frameworks. The report sought to reflect the differences in vulnerability to climate-sensitive sectors such as agriculture and energy and the impact on bank portfolios. However, it outlined a consistent approach that various banks could employ. Climatic scenarios were examined based on IPCC projections (in most cases a 2°C scenario in the 2020's and both a 2°C and 4°C scenario in the 2040's). Changes in borrowers' revenue, cost of goods sold and production were examined under incremental events (rising temperatures and changes in precipitation patterns) and extreme climate events (cyclone, flood, wildfire, drought and heat). As such, data on borrowers' assets, locations and their output were required. These estimates were then used to assess credit risk for individual borrower and sector portfolios. The report highlighted that some institutions have conducted at least one of the physical risk methodologies and noted that there were issues relating to obtaining granular data (UNEP Finance Initiative and Acclimatise 2018).

Bank of England Prudential Regulatory Authority (PRA)

In April 2019, the PRA released a report on the scenario specifications, guidelines and instructions for completing both the long-term and general insurance stress test for climate change scenarios. The guideline aims to foster consistency in approaches across institutions as the PRA recognised different insurers would apply different scenarios based on their business models. Consequently, various scenarios and assumptions were developed to ensure uniformity in the completion of the stress test exercise whilst insurers were advised to employ their existing models for the execution of the test (Bank of England 2019).

Some examples of stress scenarios are provided below for both physical and transition risks. The report cited that these scenarios were based on publicly available research.

[22] IAMs are useful for scenario analysis because they provide internally consistent estimates across economic, energy, land-use and climate systems (NGFS 2020b).
[23] This approach is applicable for 132 countries. It is assumed that each country begins in its current state and gradually converges to the regional pathway projected by the IAM (NGFS 2021).

Physical Risks

- Scenario 1 – Increase in the frequency of major hurricanes by 10 per cent in 2050 and 20 per cent in 2100.
- Scenario 2 – Increase in average sea level by 4cm in 2050 and 10cm in 2100.
- Scenario 3 – Increase in property-related claims by 10 per cent in 2050 and 25 per cent in 2100.

These scenarios are geared towards assessing the financial impact on insurers' current liabilities.

Transition Risk

- Scenario 1 – Decrease in the equity value of the oil sector by 28 per cent in 2022 and a decrease by 10 per cent in 2050.
- Scenario 2 – Credit ratings downgrade as countries stress their balance sheets to cope with adaptation strategies to -5 basis points in 2050 and -10 basis points in 2100.

These scenarios are geared towards assessing the financial impact on insurers' assets.

Further to this, the PRA released a discussion paper for consultation in December 2019 outlining possible scenarios to assess both physical and transition risks for banks, insurers and the rest of the UK financial system, with the intention of conducting the test every other year (Bank of England 2019).

Three scenarios were developed:

- An early policy action scenario – indicates that transition to a low carbon economy commences early and global temperature stays below 2°C.
- Late policy action scenario – indicates that the global climate goal is met but the transition is delayed.
- No additional policy action scenario – indicates that climate goals cannot be met since there is no policy action implemented.

Association of British Insurers (ABI)

The ABI conducted an analysis to investigate insured losses due to climate change in the insurance industry of the US, Japan and Europe (ABI 2005). Various scenarios were considered as outlined below:

- Scenario 1: US Hurricanes – Increase in average wind speed by 4, 6 and 9 per cent.
- Scenario 2: Japanese typhoons – Increase in average wind speed by 4, 6 and 9 per cent.
- Scenario 3: European windstorms – Increase frequency of windstorms that occur once every 20 years or less, by 20 per cent.

These scenarios were simulated using the AIR catastrophe model, which is a software solution that estimates the risks emanating from natural perils. This model involves various aspects:

- Hazard component – the model generates a series of plausible events which are used to estimate the severity, frequency and location of future natural disasters designed by environmental scientists. Data relating to property location, replacement value and physical characteristics of the property are required.

- Engineering component – this component is executed by structural engineers whereby a damage function is developed to compute the costs that buildings are expected to face based on how they were constructed and the purpose of their use (for example agriculture, businesses). Hence, data on the cost of damage to property is required.

- Financial component – this aspect is conducted by actuaries and statisticians that use the cost of damage to property to estimate insured losses for insurance companies.

Results of the three scenarios outlined above are as follows:

Table I.3: Annual Average Insured Losses of ABI Stress Test

US Hurricane		Japa/nese Typhoon		European Windstorm	
Shock	*Annual average insured losses*	*Shock*	*Annual average insured losses*	*Shock*	*Annual average insured losses*
4 per cent	2.5 billion	4 per cent	1.0 billion	20 per cent increase in frequency of storms	0.5 billion
6 per cent	4.0 billion	6 per cent	1.5 billion		
9 per cent	6.5 billion	9 per cent	2.5 billion		

Source: ABI (2005)

De Nederlandsche Bank (DNB)

DNB[24] utilised stress testing to examine the impact of transitioning to a low-carbon economy on banks, insurers and pension funds. The study involved the development of four extreme, but plausible, scenarios including a government policy shock; technological shock; double scenario shock (combination of policy and technological shock); and a drop in consumer and investor confidence **(Figure I.8)**. These shocks were determined based on peer reviews and expert judgement. The scenarios were translated into an impact on macroeconomic variables using the National Institute Global Econometric Model (NiGEM), then the effect across industries that have exposure to the financial system based on carbon emissions was assessed.

Results revealed that the mining, petrochemical and utilities industries were the most susceptible to transition risk. The total impact on financial institutions was thus determined by the aggregated macroeconomic impact in each scenario considering the effects on the various industries under the study. Financial institution losses as a per cent of stressed assets were most significant for the double shock scenario with 3 per cent, 11 per cent and 10 per cent losses for banks, insurance companies and pension funds, respectively (DNB 2018). Data on equity and bond holdings of institutions, surveys on banks' loan exposure by industry and carbon emissions by industry were used.

[24] In 2017, the DNB undertook a simple stress test to assess the impact of flooding on the financial sector using scenarios from the National Flood Risk Analysis for the Netherlands. Results indicated that financial institution losses could sum up to euro 35.9 billion (DNB 2017).

Figure I.8: DNB Climate Change Stress Test Scenarios

Policy Scenario Shock	Definition - Policies to reduce carbon dioxide emissions implemented suddenly. Assumption - Implementation of the policies results in an international increase in carbon prices by USD 100 per ton of emissions. Simulation - NiGEM is employed to model the macroeconomic impact of this scenario based on shocks to prices of coal, oil, and gas equal to a carbon price increase of USD 100 per ton of emissions. Result - Reduction in GDP, stock prices and higher inflation and interest rates.	**Technology Scenario Shock**	Definition - Unexpected technological developments result in a surge in the share of renewable energy. Assumption - Technological development estimated by altering the production function so that there is a 25 per cent fall in the amount of fossil fuels required to produce output. In addition, 6 per cent of capital stock is written off in the first year and 4 per cent in the second year. Simulation - NiGEM employed to model the macroeconomic effects of technological developments/ increase in the share of renewable energy based on the assumptions identified. Result - Interest rates and GDP generally decrease in the short term and increase in the long term.
Double Scenario Shock	Definition - Strong climate change mitigation policies are abruptly implemented while simultaneous unanticipated technological breakthroughs allow the share of renewable energy in the energy mix to grow faster than expected. Assumption - Carbon price increases by USD 100 per ton of emissions, coupled with technological advancements in renewable energy resulting in capital write offs of fossil fuel. Simulation - Combination of the policy and technology shock. Result - General increase in GDP in the long term and instability in stock prices.	**Confidence Scenario Shock**	Definition - Uncertainty regarding government policies reduces consumers', businesses' and investors' confidence. Assumption - Negative consumption shocks which amount to one percentage point per year relative to baseline. Business conservatism modelled by increasing the cost of capital for firms by one percentage point relative to the baseline and increasing the equity risk premium by one percentage point. Simulation - NiGEM used to model macroeconomic effects due to a negative consumption shock, lower business investment and increased risk premium based on assumptions identified. Result - Significant deterioration in GDP and stock prices.

Source: De Nederlandsche Bank (2018), Author

European Union

Battiston (2016) utilised a Value-at-Risk approach to stress renewable and non-renewable investment strategies of large European Union banks. Two scenarios were considered in the analysis: i) a bank characterised by having all its current equity holdings in utilities invested in renewables-based utilities and having no fossil fuel investments; and (ii) a bank characterised by maintaining all its current equity holdings in fossil fuel industries and by having all its equity holdings in utilities invested in fossil fuel-based utilities. Climate Value-at-Risk for banks under the two aforementioned scenarios were conducted based on the economic impact assessment of climate policies provided by the Low climate IMpact scenarios and the Implications of required Tight emission control Strategies (LIMITS) database[25].

China

Monasterolo, Zheng, and Battiston (2018) assessed the exposure of energy and non-energy investments to climate risk under moderate to severe greenhouse gas emissions scenarios of two major policy banks[26] in China. To undertake this analysis, financial flow data pertaining to foreign financing in the energy sector or projects provided by the two Chinese policy banks for Africa, Europe, Asia and the Middle East were sourced from the Global Economic Governance Initiative (GEGI) database. This facilitates the computation of the size of the exposure (loans) by region or year to fossil fuel or renewable energy projects or sectors. Following this, various climate policy shocks which can alter macroeconomic performance in the aforementioned sectors, and by extension the market share, were applied. This was facilitated using market share forecasts for the sectors from the LIMITS database. The change in market share for the various energy and non-energy projects and the resultant defaults on loans were expected to alter loan portfolio values of the two policy banks. A Climate Value-at-Risk model was applied and results indicated that policy banks experienced losses between 4 per cent and 22 per cent of their loan portfolio, particularly for the coal, oil and gas power generation projects.

[25] Database that provides results for different scenarios based on research effort undertaken by Europe, China, India, Japan and the USA.

[26] Policy banks are institutions that are responsible for financing economic and trade development, and state investment projects. The report focuses on two of three policy banks in China: the China Development Bank and the Export-Import Bank of China. These banks oversee energy portfolios and are thus highly exposed to fossil fuels investments.

Table I.4: Summary of International Approaches to Stress Testing Climate-Related Risk

Jurisdiction	Organisation/ Author	Climate-Related Risk	Scenarios	Models/Tools Employed
-	NGFS	Physical and Transition	Explored scenarios that may be orderly or disorderly, as well as scenarios that fail to mitigate rising temperatures (hot house world).	Utilised a suite of models
-	UN Environment Finance Initiative	Physical	Incremental events (rising temperatures and changes in precipitation patterns) and extreme climate events (cyclone, flood, wildfire, drought and heat) examined under a 2°C scenario in the 2020's and both a 2°C and 4°C scenario in the 2040's.	Based on institutions' estimations and model/ tools
UK	Prudential Regulatory Authority*	Physical	Increase in the frequency of major hurricanes by 10 per cent in 2050 and 20 per cent in 2100. Increase in average sea level by 4cm in 2050 and 10cm in 2100. Increase in property related claims by 10 per cent in 2050 and 25 per cent in 2100.	Based on individual insurance company existing models
		Transition	Decrease in the equity value of the oil sector by 2022 and a decrease by 15 per cent in 2050. Credit ratings downgrade as countries stress their balance sheets to cope with adaptation strategies to negative 5 basis points in 2050 and negative 10 basis points in 2100.	Based on individual insurance company existing models (not disclosed)

Table I.4: Summary of International Approaches to Stress Testing Climate-Related Risk (Continued)

Jurisdiction	Organisation/ Author	Climate-Related Risk	Scenarios	Models/Tools Employed
UK	Association of British Insurers	Physical	US Hurricanes - Increase in average wind speed by 4, 6 and 9 per cent. Japanese typhoons - Increase in average wind speed by 4, 6 and 9 per cent. European windstorm - Increase frequency of windstorms that occur once ev ry 20 years or less by 20 per cent.	AIR
The Netherlands	De Nederlandsche Bank*	Transition	Gov rnment policy shock Technological shock Combination of policy and technological shock Drop in consumer and investor confidence	NiGEM
EU	Battiston (2016)	Transition	Assess i) a bank characterised by hav ng all its current equity holdings in utilities invested in renewables-based utilities and hav ng no fossil fuel inv stments, (ii) a bank characterised by keeping all its current equity holdings in fossil fuel and by having all its equity holdings in utilities inv sted in fossil fuel-based utilities.	Climate VAR
China	Monasterolo, Zheng, and Battiston (2018)	Transition	Assess the ex osure of energy and non-energy projects for two Chinese policy banks under moderate to sev re greenhouse gas emissions scenarios.	Climate VAR

Source: Author's compilation

*Refers to a central bank or other regulatory body

I.4.2 Climate-Related Risk Awareness in Trinidad and Tobago

In an attempt to be forward-looking and safeguard the financial sector from the fallout of climate-related issues, the CBTT is investigating the avenues by which climate-related risk management can be strengthened at the macro and micro levels. A cross-departmental project team has been charged with the task of revisiting and expanding the stress testing exercise, incorporating the insights of several technical assistance missions in recent years[27]. The feasibility of utilising dynamic stress testing has also been examined to quantify the interlinkages between the financial system and the real economy. However, challenges remain in establishing statistically significant relationships between macro-financial variables. Nevertheless, climate change awareness is growing among financial institutions and the CBTT is encouraging robust risk management practices in this area. In 2020, Trinidad and Tobago was the first small island state to have an FSAP which included an extensive Climate and Environmental Risk and Opportunities Assessment. The assessment provided guidance on the supervisory response to climate risks (including stress testing).

Banking Sector

At the institutional level, awareness of climate-related risks and the incorporation of climate issues into risk management practices are mixed. These were the findings of a climate change survey issued by the CBTT in early 2020 to the commercial banking sector. Out of the eight commercial banks, responses were received from four. Two banks rated the awareness of climate-related risks as high or medium, as well as indicated that climate change was considered in their risk management practices under broader environmental-related risks. Notably, one bank stated that the organisation was actively engaged in exploring tools and methodologies to assess the impact of such risks on their business portfolio. The remaining institutions indicated that there was low awareness of climate risks and no specific internal policy relating to environmental risks. However, attempts were being made to incorporate climate-related risks into risk management procedures going forward.

At the regulatory level, the CBTT has conducted routine stress testing for the commercial banking sector to examine the impact of a local and regional natural disaster (see Box 1). While climate-related physical risk is embedded in these tests, the transition aspect is not captured. As CBTT transitions to Pillar 2 under the Basel II/III Capital framework[28], the banking sector is required to conduct an Internal Capital Adequacy Assessment Process (ICAAP) which would then be reviewed under the Supervisory Review and Evaluation Process (SREP). The ICAAP involves an individual bank detailing their forward-looking assessment of the optimal capital required in the short to medium term, relative to their risk profile. A key element in the ICAAP is stress testing of financial statements according to an institution's idiosyncratic risks. The SREP, which is conducted on a bank's ICAAP, ensures that there are adequate buffers and mitigants to safeguard against risks that can affect the bank's business model. While the CBTT will not typically prescribe specific stress test scenarios for banks under Pillar 2, the regulator has the authority, through the Inspector of Financial Institutions, to request a sector-wide test for risks deemed systemic (such as the longer-term, climate-related risks).

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[27] Technical assistance missions sponsored by the Caribbean Regional Technical Assistance Centre, as well as a Financial Sector Assessment Program (FSAP), were conducted in Trinidad and Tobago with respect to stress testing banks and insurance companies. These fora provided useful insight into stress testing natural disasters or climate-related risks for the Trinidad and Tobago financial sector.

[28] Pillar 2 will be introduced in Phase 2 of the CBTT's Basel II/III Project Implementation Plan. Policy proposals and implementation timelines pertaining to Pillar 2 were issued to the banking industry in November 2019. However, due to the COVID-19 pandemic, the CBTT has signalled its intention to delay the introduction of Phase 2 elements to January 2022.

Insurance Sector

The CBTT conducted a climate risk survey for the insurance industry in January 2020 to understand climate change policies and risk management practices at the micro level. Responses were received from seven insurance companies from both the long-term and general sectors. All respondents indicated that there was no climate change policy in place at their institution. However, three respondents (two long-term and one general) stated that there were mechanisms available to identify climate-related risks through statistical analysis or risk assessment reviews. In terms of whether the industry utilised catastrophe models to stress test climate change scenarios, one long-term insurance company noted that they utilised reinsurers' industry models to obtain information on the impacts of different climate change scenarios. One general insurance company shared that they conducted their own modelling to assess the impact of catastrophic events on its operations. They further postulated that the lack of data posed a significant challenge to the robustness of the models produced. Additionally, some companies noted that they would be affected by climate-related risks through morbidity and mortality rates, as well as increases in their loss ratio. As such, insurers are engaged in building awareness of climate change issues and encouraging policyholders to obtain adequate insurance coverage.

With respect to the insurance industry, the supervisory stress testing framework is in the developmental stages. However, a natural disaster stress test for insurers was conducted in the context of the 2019/2020 FSAP. Similar to the banking sector, research on physical and transition climate-related risk scenarios specific to the insurance industry are being examined by the CBTT (see **Box I.1**). Moreover, the CBTT has made attempts to enhance the directive in the insurance industry through the Financial Conditions Report (FCR), which is mandatory under the new Insurance Act[29] for both long-term and general insurance companies. Under the FCR, insurance companies are required to undertake stress testing exercises based on the risks they deem relevant to their institution (may/may not include natural disaster risk). The Inspector of Financial Institutions can request information to ascertain the company's ability to meet its obligations under different scenarios or cope with specific risks.

[29] The Insurance (Amendment) Act, 2020 came into effect on January 1, 2021.

BOX I.1: STRESS TESTING NATURAL DISASTERS IN TRINIDAD AND TOBAGO

Commercial Banking Sector

The Central Bank of Trinidad and Tobago introduced a stress testing framework for commercial banks in 2010 (Hilaire, et al. 2011), which incorporates climate-related physical risk in two scenarios – a local natural disaster and a regional natural disaster. In the absence of a formal macroeconometric model of the local economy, the scenarios rely on an aggregation of single factor shocks and the quantification of shock parameters has been made largely on expert judgement. The impact on commercial banks' capital adequacy positions is assessed.

A local natural disaster shock is expected to severely affect the economy's productive capacity leading to declines in GDP and the country's income earning capacity. Consequently, commercial bank capital is reduced by a credit shock, interest rate shock, foreign exchange shock and a loss in the value of financial investments. Moreover, public sector securities would carry a higher risk weight. In a regional natural disaster scenario, the sector can be impacted through the trade and financial channels. Lower intra-regional trade on account of the shock reduces export revenues and the domestic manufacturing sector's output and income. This results in a decrease in overall GDP and a general increase in private sector credit risk. The commercial banking sector can also be affected via the financial channel given direct exposures to the region in the form of loans, investments and equity holdings. Bank capitalisation may be challenged by the increasing provisions for non-performing public and private sector loans in the region, as well as write downs on equity holdings and private sector investments. A risk weight on claims on regional public sector entities is also applied.

On average, results indicated that the aggregate commercial banking sector is resilient to both a local and regional disaster shock as the post-shock capital adequacy ratios (CARs) were above the Basel I minimum regulatory capital requirement (8 per cent) over the last three years (**Table 1**).

BOX I.1: STRESS TESTING NATURAL DISASTERS IN TRINIDAD AND TOBAGO (CONTINUED)

Table 1: Commercial Banking Sector Post-Shock CAR, 2017 – 2019[1]

(per cent)

	Dec-2017		Dec-2018		Dec-2019	
	Post-shock CAR	*Change from pre-shock CAR*	Post-shock CAR	*Change from pre-shock CAR*	Post-shock CAR	*Change from pre-shock CAR*
Local Disaster	18.7	*-1.2*	18.3	*-1.6*	18.4	*-1.6*
Regional Disaster	19.0	*-1.0*	18.7	*-1.2*	18.6	*-1.3*

Source: Central Bank of Trinidad and Tobago

Insurance Sector

In August 2020, the CBTT released a draft insurance sector stress testing framework which details the risk factors (and parameters) to be assessed for the sector and individual insurers. Notably, a composite natural catastrophe scenario that involves the occurrence of two natural disaster events (a storm and an earthquake) during an economic crisis is considered. Under this scenario, it is envisaged that a storm would result in severe flooding, wind damage and landslides, while the earthquake would lead to significant damage to buildings, injuries and loss of life. Consequently, the long-term and general insurance sectors would be exposed to credit, interest rate and foreign exchange risks, losses on mortgages and real estate values, increased claims, as well as higher expenses and greater technical provisioning. The draft framework also includes two variations of a pandemic scenario, one of which assesses the implications of a major hurricane occurring during a pandemic.

Various missions conducted by the International Monetary Fund and the World Bank have highlighted that the domestic insurance industry is vulnerable to environmental shocks, namely natural disasters. The 2019/2020 Financial Sector Assessment Program applied a catastrophic scenario to the long-term and general insurance institutions, which assessed the impact of three consecutive natural disaster events in the region within a specified timeframe. Results indicated that vulnerabilities exist within the industries.

[1] Effective September 2020, the local and regional disaster scenarios are no longer conducted on a routine basis. Alternatively, annual macro-financial scenarios are developed to reflect the current economic climate.

I.5 THE WAY FORWARD

The CBTT framework for natural disaster stress testing for commercial banks can be foundational in developing the approach to stress testing climate-related risks for the banking and insurance sectors. However, the current methodology does not adequately capture the broader dimensions of climate risks or the interactions between the real economy and the financial sector. The development of a robust climate-related stress test for the domestic financial sector requires a specification of scenarios deemed relevant for Trinidad and Tobago; a thorough examination of transmission channels and macro-financial feedback effects; and a solid grasp of financial sector portfolio vulnerabilities.

Quantitative climate-related data has proven to be a challenge in many jurisdictions, as a significant proportion is not collected on standard regulatory returns and/or is not publicly available. A comprehensive dataset should capture two aspects – financial institution balance sheet data and environmental data. For example, assessing physical risk requires information on physical assets and loss estimates of property, as well as probable location and frequency of a disaster event. Meanwhile, transition risk can be gauged using data such as exposures to fossil fuel industries and carbon emissions by sector. **Table I.5** summarises the data needs that have been identified by international supervisors for the assessment of climate-related risk, including the proposed degree of granularity for each variable.

Table I.5: Data Needs for the Assessment of Climate-Related Risk

	PHYSICAL RISK		TRANSITION RISK	
	Balance Sheet Data	*Environmental Data*	*Balance Sheet Data*	*Environmental Data*
●	Sector exposures as per internationally recognised sector classification system	Sensitivity to physical climate hazards per sector	Sector exposures as per internationally recognised sector classification system	Average carbon intensity per sector
●	Country exposures	Vulnerability to physical climate impacts per country		
●	Location-specific exposures (district-level)	Vulnerability to physical climate impacts per district	Single-name exposures (firm-level)	Carbon emissions data from individual firms
●	Location-specific exposures (facility-level, counterparty disclosures)	Vulnerability to physical climate impacts per geographical location	Revenue streams from single-name exposures (activity-level)	Carbon intensity of business activities
●	Value chain exposures (location-specific data for vulnerable producers, suppliers, aggregators and distributors etc)	Vulnerability to physical climate impacts per geographical location	Sector exposures (value chain)	Input-output tables (embedded emissions)

● Low Granularity ● Medium Granularity ● High Granularity

Source: Adapted from NGFS (2020)

Collaboration with external stakeholders in the financial and scientific fields will be important in identifying and collating sectoral exposures to effectively capture transmission channels and gain insight on how climate change risks will impact financial statements. A multi-disciplinary approach is indispensable. Over the medium-term, avenues to deepen relationships with the Environmental Policy and Planning Division of the Ministry of Planning – the coordinating agency for GORTT efforts towards achieving the country's climate goals – should be actively explored. In addition, collaboration with the Caribbean Catastrophe Risk Insurance Facility SPC could be beneficial in understanding the types of models employed as a basis to design top-down stress tests for the insurance sector. The Trinidad and Tobago Meteorological Service can also be consulted to garner information on weather-related events in the country.

As gleaned from supervisory surveys, climate change awareness is building in the domestic financial industry and the CBTT should continue to support these efforts both internally and externally. Supervisory examiners should be sensitised to the wide range of issues surrounding climate risk, beyond natural disasters, through external training or knowledge sharing within the CBTT. This will aid in surveillance and assessment of climate risk management at institutions for appropriate incorporation into supervisory scoring. Financial institutions may support this objective by voluntarily adopting (and sharing the results of) disclosure recommendations set forth by the Financial Stability Board's TCFD. The industry-led task force seeks to standardise communication of climate-related risks through four elements – governance, strategy, risk management, and metrics and targets[30]. The internationally-consistent disclosures may assist firms, supervisors and investors in evaluating, pricing and managing climate-related risks.

Climate-related stress tests for the financial sector would be predominantly bottom-up – through the ICAAP and the FCR regulatory approaches – with an element of supervisory review. However, the regulator must also adopt a systemic perspective, examining how climate risk at the sector level will affect the financial system as a whole. As such, a more robust, top-down climate stress test would have to be designed to give the regulator insight into the 'baseline' effects of climate-related risks. Models such as dynamic stochastic generalised equilibrium model, as in the case of NiGEM model utilised by the DNB, can be leveraged to capture the broader and complex interrelationships within the macro-financial system. However, given existing capacity constraints on the data front and the structure of the domestic economy (energy and non-energy), moving towards the conduct of a climate VAR along the lines of Monasterolo, Zheng, and Battiston (2018) appears more practical in the short to medium term. Ideally, the choice of models should be guided by data availability and the risk that can destabilise the system. Exploration and research into international natural catastrophe models to estimate the impacts of weather-related events under different scenarios can also be undertaken in the short term.

As international experience with the various approaches gains traction, Trinidad and Tobago should seize the early opportunities for technical assistance and peer-to-peer collaboration in central bank groupings such as the NGFS. The NGFS has proposed a structured course of action for conducting a climate-related and environmental risk assessment for the financial sector, which can serve as a useful starting point for further work at the CBTT (**Table I.6**). Based on survey results, the group notes that the development of a thorough report has taken up to "one year and a dedicated team fully supported by senior management" in some organisations. The NGFS emphasises iteration in the three phases of development, namely the preparatory, analytical and concluding phases. Specifically, stress testing and scenario analysis is included in the analytical phase.

[30] Governance refers to the organisation's governance around climate-related risks and opportunities; strategy entails the actual and potential impacts of climate-related risks and opportunities on the organisation's businesses, strategy, and financial planning; risk management includes the processes used by the organisation to identify, assess, and manage climate-related risks; and metrics and targets are those used to assess and manage relevant climate-related risks and opportunities (TCFD 2017).

Table I.6: Conducting a Climate-Related and Environmental Risk Assessment

PREPARATORY PHASE	Set up a project organisation consisting of a core project team, a steering group, and a broad network of different specialists
	Develop a project plan
	Set up interviews with financial institutions, environmental specialist, scientists and other experts
	Develop a qualitative survey for financial institutions
	Develop a quantitative data request (template covering physical and transition risks)
	Determine which climate-related and environmental risks are material in their jurisdiction
	Determine how these risks are transmitted through the economy to the financial sector
ANALYTICAL PHASE	Assess quantitative and qualitative information
	Determine the climate-related and environmental exposures in the financial sector in terms of financial risks (credit risk, operational risk, market risk, etc.)
	Develop a few extreme but plausible scenarios or set up vulnerability assessments of exposures to the risks
	Conduct a stress test or a sensitivity test to estimate the potential magnitude of the risks, and determine losses and impact on prudential ratios and/or other risk indicators
CONCLUDING PHASE	Develop a story line (main findings and conclusions), supported by quantitative and qualitative data and pictures
	Determine a supervisory response to the findings of the assessment, including recommendations for supervision, policymakers and financial institutions
	Publish a report and organise media events and outreach workshops to share results with internal and external stakeholders
	Set the key risk indicators that will help monitor the climate-related and environmental risks

Source: NGFS (2020)

I.6 CONCLUSION

The intensification of climate-related disasters and the emergence of policies designed to stymie global warming have unearthed vulnerabilities in the financial system to physical and transition risks. The Caribbean is especially susceptible to climatic events with quantifiable risks measuring multiples of regional GDP. Regulatory bodies and financial organisations have championed stress testing so that institutions can gauge the financial stability impacts emanating from climate-related risks, the results of which can support effective policy decision-making. However, international approaches to stress testing climate change are still in the developmental phase and, to date, there has been no standard regulatory stress test to be applied to financial systems. Nevertheless, the cases presented in this study offered insight into different scenarios, shocks, databases and models that can be applied in the Trinidad and Tobago context. While climate risk awareness is building in the domestic financial industry, further work and collaboration with external stakeholders in the financial and scientific fields is necessary to expand technical capacity for the assessment of climate-related risk.

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APPENDICES CHAPTER I

A1: Glossary of Terms

TERM	DEFINITION
Anthropogenic	Resulting from the influence of human activities.
Carbon dioxide (CO_2)	A gas produced by burning fossil fuels (oil, gas and coal) and organic compounds.
Carbon-intensive industries	Refers to fossil fuel companies (and those that provide ancillary products and services); industrial manufacturers (that are large consumers of energy); and producers of energy-consuming goods. In the local context, this refers to the power generation, industrial and transportation sectors.
Carbon neutrality	Arriving at net zero carbon dioxide emissions via balancing the emission and removal of CO_2.
Carbon price	Cost applied to CO_2 or CO_2-equivalent emissions.
Climate Change	Alterations in the state of the climate that persist over an extended period of time. According to the United Nations framework, this change is brought about both directly and indirectly by human activity. On the contrary, the Intergovernmental Panel on Climate Change attributes changes to natural internal processes or external forcing such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.
Decarbonisation	The process of reducing carbon emissions.
Extreme weather event	An event that is rare at a specific place and time of year.
Fossil fuels	Carbon-based fuels from fossil hydrocarbon deposits which includes coal, oil and natural gas.
Global warming	Rise in global mean surface temperature of the earth's climate system.
Greenhouse gas	Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation.
Green central banking	Central banking that takes account of environmental risks, including risks from climate change, which may have a material impact on the short- and long-term stability and development of the financial sector and the macroeconomy.
Mitigation measures	According to climate policy these measures include technology or practices (example waste minimisation) that reduce the effects of climate change.
Nationally Determined Contributions	Countries who joined the Paris Agreement have specified these strategies for reducing GHG emissions and dealing with the impact of climate change, including reduced national GHG emission targets.
Negative emissions	Removal of greenhouse gases from the environment.
Non-renewable energy	Energy from sources (example fossil fuels) that cannot be replenished quickly in the short term.
Paris Agreement	Agreement under the United Nations Framework Convention on Climate Change adopted by numerous countries to curb global warming and to deal with the impacts of climate change.
Renewable Energy	Energy sources that can be restored by nature.
Stress Test	Tool used to gauge the vulnerability of financial institutions' portfolios to extreme but plausible shocks.
Scenario	Plausible events that may occur in the future.
Stranded assets	Assets that incur devaluations because of unexpected changes in their revenues due to innovations and restrictions on GHG emissions.

Source: (IPCC 2018, United Nations 2007, U.S. Department of Energy 2001, Steinbach and Wellmer 2010)

CHAPTER I
END

CHAPTER II
RESILIENCE OF THE HOUSEHOLD AND NON-FINANCIAL CORPORATE SECTORS IN TRINIDAD AND TOBAGO

Kateri Duke and Yannick Melville

ABSTRACT

This paper assesses the health of the household and non-financial corporate (NFC) sectors in Trinidad and Tobago by exploring new ways of measuring their resilience in the context of the evolving economic and financial landscape. A two-pronged approach of micro and macro data analysis is used to: (i) construct financial soundness indicators for the sectors; and (ii) estimate the effect of macro-financial shocks on household and NFC non-performing loan ratios, as well as on loan growth in household refinancing and debt consolidation. The microanalysis revealed that households' borrowing decisions are influenced by the level of economic activity and the degree of income challenges. While NFCs prefer to finance their operations with debt, they will issue equity if macro-financial developments threaten to increase the cost of credit. In the context of the collapse in oil prices in 2014 and subsequent challenges in economic recovery, microdata has shown a growing reliance on debt financing. The macro analysis showed that NFCs rely on the government to provide a supportive environment for their operations as, over time, an increase in the overall fiscal balance lowered businesses' debt servicing capacities. Recently, firms have responded to tight fiscal conditions by downsizing. However, these actions may do more 'harm than good' in the long run as unemployment had a significant negative impact on NFCs' income or debt servicing ability. At the other end, households were particularly susceptible to adverse changes in inflation and exchange rates. However, it was observed that economic agents in the household sector could stave off the effects from adverse shocks by leaning on social safety nets and restructuring their outstanding credit. Debt restructuring helps preserve financial stability within the commercial banking sector by protecting asset quality but these loan categories have had characteristically higher NPL ratios when compared to other segments. Additionally, there is a risk that external shocks may create an environment where there is not enough fiscal space to help leveraged households. This paper therefore serves as a useful starting point for evaluating resilience and highlights the need for more comprehensive sectoral databases to improve macroprudential surveillance and assess household and NFC sector risks to financial stability.

II.1 INTRODUCTION

Balance sheet interlinkages among institutional sectors exacerbate the economic impact of household and non-financial corporate (NFC) decisions in response to changing macro-financial conditions. In particular, mounting and unsustainable debt levels in the private sector have the potential to disrupt financial stability largely due to a financial system's claims on consumers and businesses.

Overleveraging was central to the impact of the 2009 global financial crisis (GFC), ignited by breakdowns in the US housing market. As evidenced during the GFC, adverse developments in the macro-financial environment can increase pressure on household and NFC balance sheets, which may trigger debt-servicing difficulties and lead to a higher incidence of defaults. Consequently, rising non-performing loans (NPLs) on the balance sheets of financial institutions diminish their loss absorption capacity and increase their susceptibility to negative shocks. Weakened financial positions could amplify intermediaries' role in propagating a crisis by impinging on their ability to facilitate the flow of funds from household and NFC savings into productive investments (Andries 2009, CBTT 2016). As such, financial instability may have knock-on effects on monetary and macroeconomic stability. In the absence of appropriate remedial action and adequate containment policies, second-round effects could prove long-lasting and far-reaching.

Past crises have spurred regulators to design and develop indicators that could flag building vulnerabilities within the household and NFC sectors in order to pre-empt deterioration in asset quality that could impact financial institution profitability and solvency. Research on early warning indicators (EWIs) is plentiful, particularly in the aftermath of the GFC (Drehmann and Juselius 2013). However, there have been several shortcomings highlighted for their predictive power (Lau, Yung and Yong 2003, Babecký, et al. 2011) as they are generally developed on the basis of past performance in selected variables. As history shows, no two crises are alike and risk factors evolve over time. Financial soundness indicators (FSIs), introduced by the International Monetary Fund (IMF) in 2006, therefore serve as useful complements to EWIs as they paint a picture of the health of a sector at a point in time. FSIs aid in the continuous monitoring and assessment of sectoral resilience, that is, the ability to remain stable (without undergoing catastrophic changes in basic functioning) in the event of a shock (Lau, Yung and Yong 2003). Where there are robust inter-sectoral balance sheet linkages, the FSIs for households and NFCs are intended as leading indicators of financial institution asset quality (IMF 2019).

In financial economics, stress testing has originated as a means of gauging resilience by evaluating the vulnerability of sectors to extreme, but plausible shocks to their financial statements (Borio, Drehmann and Tsatsaronis 2012). At the Central Bank of Trinidad and Tobago (CBTT), such a framework is in place to assess the resilience of the commercial banking sector to various risks that can materialise within the economy. While the stress tests intuitively consider shocks to the real sector and the pass-through to the banking system, there is no formal framework in place to quantify the result of a direct, instantaneous shock to household and NFC balance sheets. Such an analysis would require granular and timely balance sheet data. However, this type of data is limited for Trinidad and Tobago, particularly with respect to the asset side. For the household sector, the latest comprehensive dataset was compiled from the 2008/2009 Household Budgetary Survey (HBS) conducted by the Central Statistical Office (CSO). Further, data availability in the NFC sector relies solely on information reported in published financial statements, but only a small proportion is obliged to do so in keeping with reporting requirements for listed companies.

To circumvent this challenge and provide useful support for macroprudential analysis, this paper uses key household and NFC sector debt statistics (reported by commercial banks) to evaluate the entities' response to macro-financial shocks. Inferences from microdata provided by the HBS and the annual reports of listed NFCs complement macro data based on the financial institutions' regulatory returns (to proxy the liability side of household and NFC balance sheets). The paper proceeds with a review of the literature guiding the analysis of the sectors in Section II.2. Section II.3

provides an overview of the domestic environment and the debt profiles of the household and NFC sectors in Trinidad and Tobago. Section II.4 describes the data and methodology utilised, while Section II.5 presents and discusses the model's results. The paper concludes in Section II.6 with recommendations for future work.

II.2 LITERATURE REVIEW

Following the events of the GFC, regulators have been dedicating additional resources to explore the avenues for evaluating balance sheet resilience. Noteworthy empirical studies on household and NFC sector balance sheet resilience are highlighted below:

- **Household Sector**

Ampudia, Vlokhoven and Żochowski (2014) assessed Eurozone households' resilience to adverse macro-financial shocks based on the responses of financial fragility indicators, namely the financial margin, exposure at default and loss given default. These indicators were constructed using three traditional measures of financial burden, which were computed using data collected in the Household Finance and Consumption Survey for most euro area countries between 2008 and 2011. In the absence of detailed information on defaults, collateral and loan-to-value ratios, the authors used 'sensitivity analysis' – techniques that examine how changes in key financial variables impact portfolios without considering the underlying causes of these changes. However, these approaches are often criticised for overlooking the dynamic feedback mechanisms between the macroeconomy and the financial sector. Schechtman and Gaglianone (2011) provided a deeper assessment of household sector resilience through two distinct multifactor macro models, which estimated the value of Brazilian household sector NPLs at risk following an adverse macroeconomic scenario. A reduced-form approach (Wilson 1997a, Wilson 1997b) and an alternative quantile regression model (Koenker and Xiao 2002) were applied, leveraging quarterly data on credit granted to households by the Brazilian financial system for the period 1995 to 2009. While these data-intensive approaches allow for a more detailed analysis of households' structural vulnerabilities, stress tests generally only provide a quasi-assessment of households' financial positions.

An appreciation of the implications of the data gaps in the household sector was reflected in Wallace, Jones and Rhodes (2014). This paper evaluated the significance of the fall in house prices on homeowners' equity in Northern Ireland between 2007 and 2013, by combining survey data provided by the Family Resources Survey with supplementary information collected from interviews with lower-income households, policymakers and other housing stakeholders. Commentary or qualitative data has emerged as a valuable means to profile the average household's economic preparedness. Moreover, the Bank for International Settlements' Irving Fisher Committee on Central Bank Statistics (2015) supported that data gaps in household sector assessments could be filled by survey information as was utilised in Ampudia, Vlokhoven and Żochowski (2014). This was also demonstrated in Mahabir et al. (2014) which, given underdeveloped domestic sectoral databases, evaluated the resilience of the household sector in Trinidad and Tobago using income, expenditure and credit information collected in the 2008/2009 HBS.

However, there has been some uncertainty surrounding the limitations of survey data as it may come from samples that poorly represent true population characteristics. André (2016) and Carter, Moore and Jackman (2012) attempted to address this concern by employing indicators based on the aggregate household sector. More specifically, Carter, Moore and Jackman (2012) described how macroeconomic conditions influenced household borrowing practices in Barbados by examining financial credit data between 1990 and 2010.

- **NFC Sector**

Drehmann, Patton and Sorensen (2005) applied a vector autoregressive (VAR) model to evaluate the impact of shocks on NFC sector liquidation rates and probabilities of default in the UK using quarterly data from 1992 to 2004. By combining macroeconomic factors with financial system information on NFC institutions, the VAR provided a distinct analytical framework for stress testing through impulse response functions. However, VARs can only model the first-round effects of a shock (that is, the impact of the shock on the variable of interest) and are ill-suited to scenario analysis. While Karpowicz, Lipinsky and Park (2016) also modelled a VAR and applied impulse response functions to examine the impact of changes in NFC financial indicators on GDP growth in Brazil, the authors provided a deeper assessment through dynamic stochastic general equilibrium (DSGE) models. The use of a DSGE model allowed for second-round effects (that is, the feedback effects from the shock).

Notably, there appears to be no set standard for assessing aggregate NFC sector financial health and soundness. Financial stability reports from several central banks construct indicators on the economic condition of NFC institutions from information collected in surveys or as outlined in their annual financial statements. For instance, the Central Bank of Portugal (2014) produced a series of indicators on the financial positions of NFC institutions through survey information collected from 380,000 companies in Portugal. Meanwhile, the Bank of Jamaica (2014) assessed the macroprudential risk emanating from the NFC sector by analysing financial ratios based on leverage, profitability, liquidity and gearing indicators (using the information from financial statements of listed companies, along with a subset of unlisted enterprises). While it appears that the use of survey or financial statement data depends on the data gathering constraints of that country, credible insight on NFC financial health and soundness can be derived from these statistics.

From the discussion, there appear to be three main conceptual streams in the literature when evaluating household or NFC sector balance sheet resilience. The first, main stream measures each sector's response to adverse macro-financial scenarios through the application of stress testing models. The second conceptual stream uses survey data to determine the financial profile of the average household or firm. Finally, the third stream is based on the assessment of sectoral indicators of financial health and soundness.

II.3 BACKGROUND

II.3.1 The Domestic Economic and Financial Environment

While the stock of debt may entail risks for households and NFCs, empirical work demonstrated that on its own, high levels of debt are not an adequate indicator of financial stability risks. Interpretation of household and NFC indicators must be made in the context of the underlying domestic economic and financial environment. This will support regulators in making informed decisions for the activation of systemic risk mitigators. **Figure II.1** illustrates conditions in the macroeconomy over the period March 2009 to December 2019. The local economy faced several setbacks from marked declines in domestic activity following the collapse of oil prices in 2014. To contain and mitigate the impact of this trade shock, the Government of the Republic of Trinidad and Tobago (GORTT) used various safety net instruments under the Social Sector Investment Program (SSIP).[31] While unemployment rates held steady throughout the

[31] Publications by the GORTT (GORTT 2014, GORTT 2017) showed that when oil prices dropped by more than 50 per cent between 2013 and 2016, the actual expenditure for "Allocations and Expenditure for Social Programmes and Initiatives Under Recurrent Expenditure by Ministry" grew by approximately 17.4 per cent (from $8.1 billion to $9.5 billion). Over the period of review, the actual expenditure for key social safety net programmes such as the Community-Based Environment Protection and Enhancement Programme (CEPEP), On the Job Training (OJT) Programme, Public Assistance Grant (PAG), Target Conditional Cash Transfer Programme (Food Support Programme) and Unemployment Relief Programme (URP) rose by 9.6 per cent (from $1.8 billion to $2.0 billion).

period, proxy indicators of labour market conditions suggested that some households may have been confronted with a loss of income. Retrenchment[32] notices filed with the Ministry of Labour and Small Enterprise Development peaked in 2015[33] as over 1,700 persons were retrenched. A proportion of these job cuts were attributed to downstream companies, dependent on the output of ArcelorMittal Point Lisas Trinidad, which were forced to control operating costs following the closure of the steel plant. Subdued economic conditions and the loss of export revenues from these closures (Bobb, et al. 2020), inter alia, contributed to tighter foreign exchange market conditions. The exchange rate depreciated toward the end of 2015 into 2016 (**Figure II.2**). Notwithstanding, the Trinidad and Tobago dollar has remained broadly stable (vis-à-vis the US dollar) from March 2017 to December 2019. For the same period, the weighted average loan rate has remained relatively steady at around 8 per cent.

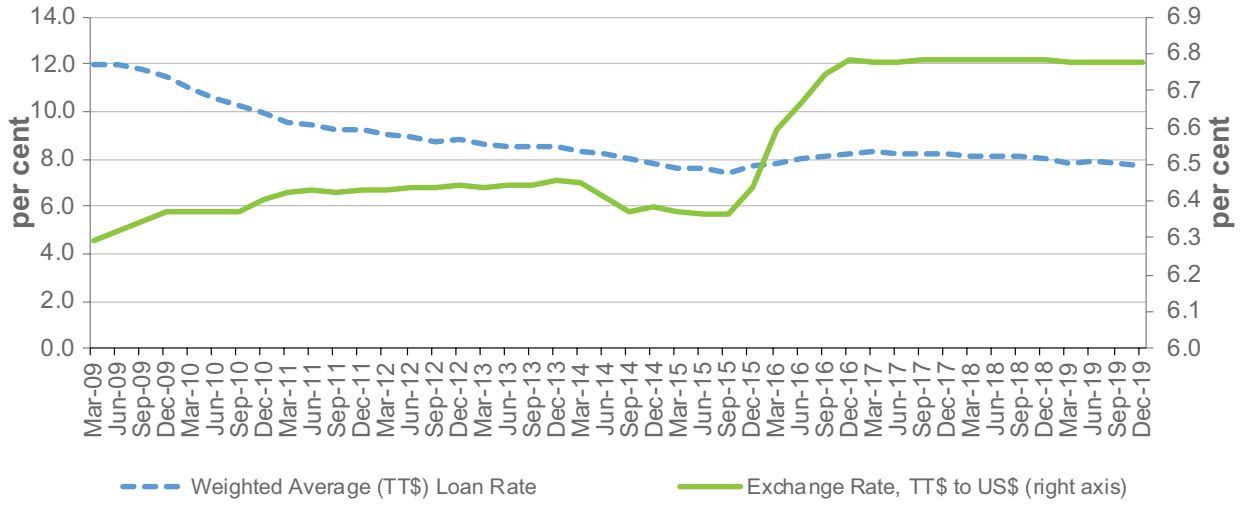
Figure II.1: Real GDP Growth, Labour Market Indicators and the Inflation Rate, Mar 2009 - Dec 2019

Sources: Central Bank of Trinidad and Tobago, CSO, Ministry of Labour and Small Enterprise Development

[32] Retrenchment is defined as "the termination of employment of a worker at the initiative of an employer for the reason of redundancy" where redundancy is "the existence of surplus labour in an undertaking for whatever cause" (Ministry of the Attorney General and Legal Affairs 2016).

[33] The number of persons retrenched spiked again in 2018 following the restructuring of a large telecommunications services provider.

Figure II.2: The Weighted Average Loan Rate and the Exchange Rate, Mar 2009 - Dec 2019

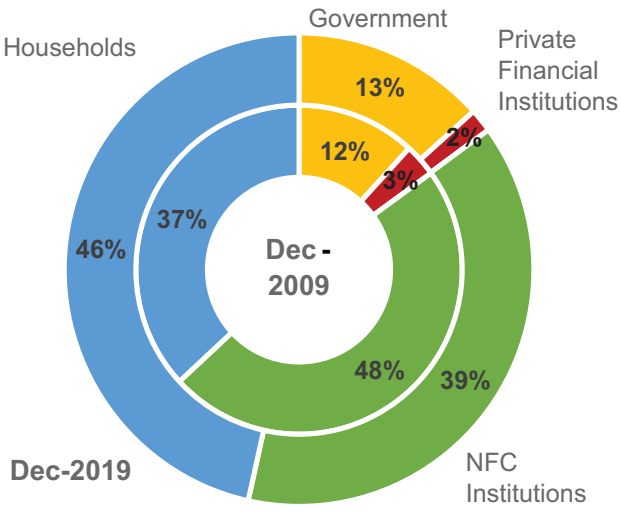


Source: Central Bank of Trinidad and Tobago

Despite weak economic growth, the Trinidad and Tobago financial system has remained sound. It continued to be dominated by the banking system[34], that is, commercial banking and non-bank financial institutions[35], whose loan portfolios are highly concentrated in loans to households and NFC institutions. As of December 2019, these sectors accounted for approximately 85 per cent of total banking system loans **(Figure II.3)**. While the total share has remained unchanged since December 2009, there has been some redistribution of the proportion in favour of the household sector. It is worth noting that locally-owned banks account for most banking sector loans to households and NFC institutions – 52 per cent and 68 per cent, respectively. **Figure II.4** shows banking system loans grew steadily from 2009 to 2013 and surged in 2014 before slowing to a low of 1.8 per cent at the end of 2016 in the aftermath of the sharp fall in oil prices. Loan growth has rebounded on account of the persistently low interest rate environment and comfortable liquidity positions in the banking sector (CBTT 2019a).

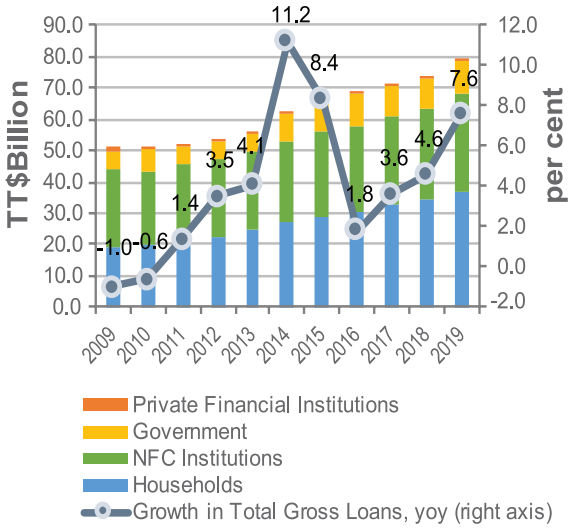
[34] As at December 2019, the banking system accounted for approximately 47 per cent of total financial system assets.
[35] Non-bank financial institutions in Trinidad and Tobago refer to trust and mortgage finance companies, as well as finance and merchant houses.

Figure II.3: Banking System Distribution of Loans by Sector, Dec 2009 - Dec 2019



Source: Central Bank of Trinidad and Tobago

Figure II.4: Banking System Loan Growth by Sector, 2009 - 2019

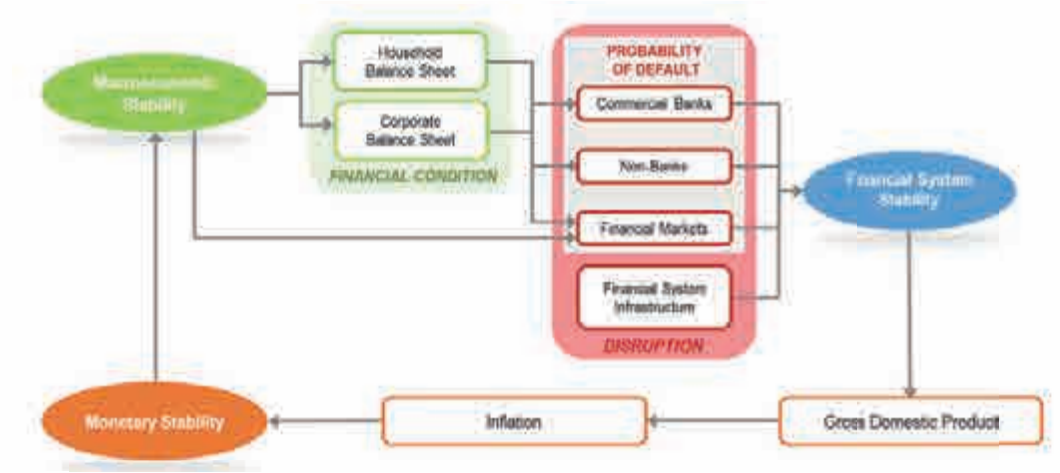


Source: Central Bank of Trinidad and Tobago

The significant exposure of the local banking system to households and NFCs has repercussions for financial stability should the sectors face distress. **Figure II.5** illustrates the feedback effect between the real and financial sectors, by which fragility in household and NFC balance sheets can affect financial, monetary and macroeconomic stability. The magnitude of the effect however, is dependent on the sectors' debt profiles and capacity to service outstanding obligations through disposable income and/or liquidation of available assets. In consideration of these factors, the IMF has proposed a suite of FSIs[36] specific to the household and NFC sectors to inform macroprudential surveillance and serve as leading indicators of financial institution asset quality (IMF 2019). The indicators will be discussed in the following sections in the context of the debt characteristics of the local household and NFC sectors.

[36] FSIs were first proposed in the 2006 Financial Soundness Indicators Compilation Guide based on surveys with member countries, experience from Financial Sector Assessment Programmes and discussions with other international agencies. Criteria for selection included focus on core markets and institutions, analytical significance, availability, as well as relevance and usefulness in practice (IMF 2006). After consultation with stakeholders, a revised Guide was published in 2019 to enhance data coverage (IMF 2019).

Figure II.5: Feedback Effect between the Real and Financial Sectors



Source: Santoso and Sukada (2009)

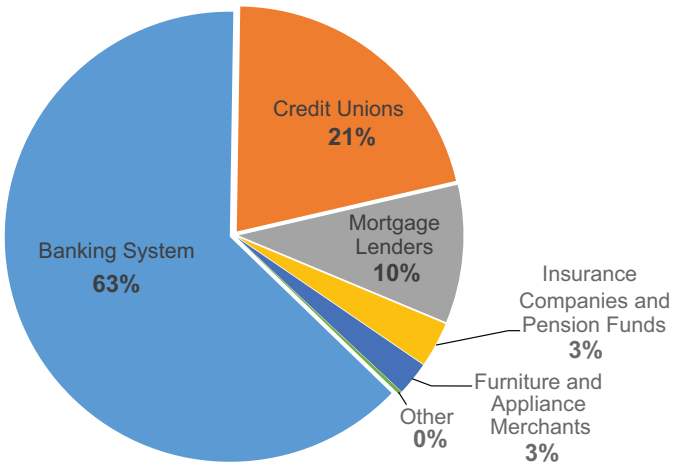
II.3.2 Household Sector

A household in Trinidad and Tobago is defined by the CSO (2012) as one or more persons living together and sharing at least one of the main daily meals. As consumers, households are one of the drivers of economic activity and their behaviour can play an important role in the magnitude of an economic downturn and its speed of recovery (Kask 2003). Shocks to households include, but are not limited to, rising unemployment, increasing variable interest rates and a fall in property prices.

Concerning household debt, CBTT attempts to capture a more inclusive measure beyond credit provided by the domestic banking system. It also includes credit unions, insurance companies, thrift institutions, mortgage lending institutions and furniture and appliance merchants.[37] In comparison to peer countries, an analysis conducted by the IMF in the context of a 2020 financial sector review found that the level and growth of household debt in Trinidad and Tobago is among the highest. This has been driven largely by credit provided by commercial banks and non-bank financial institutions, which dominates at an estimated 63 per cent of total household debt **(Figure II.6)**. Banking system credit to households represented 46 per cent of total loans on the system's balance sheet as of December 2019 **(Figure II.3)**

[37] For those components that are not collected by the CBTT or published in annual financial statements, the CBTT uses expert judgement in their interpretation of available data (CBTT 2016).

Figure II.6: Distribution of Estimated Household Debt by Major Lender[38], Dec 2019



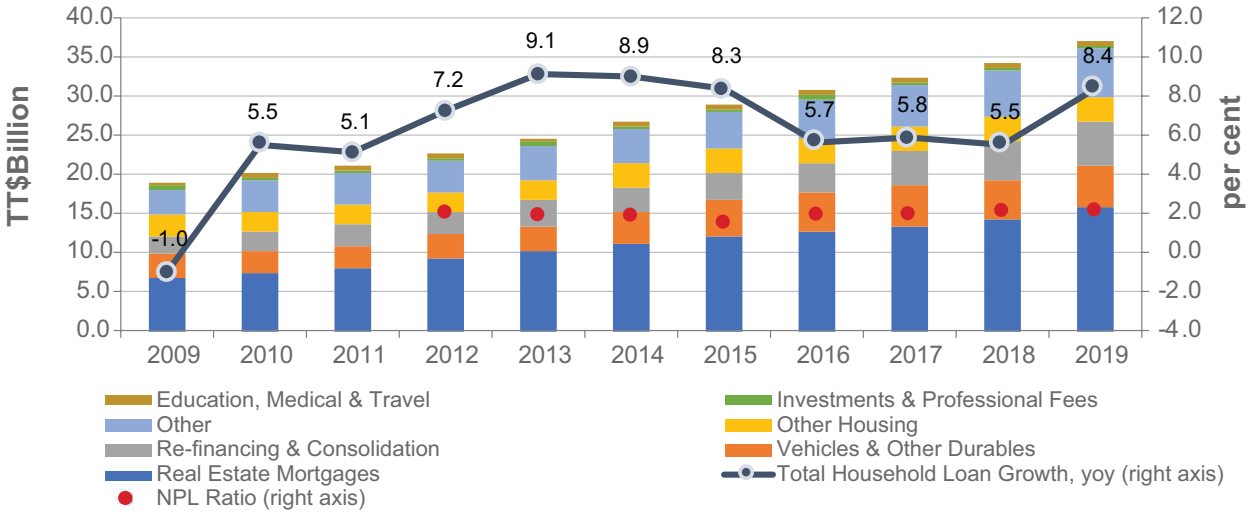
Source: Central Bank of Trinidad and Tobago

Research shows that downturns such as the 2009 GFC are more severe when preceded by rapid increases and unsustainable levels of household debt (IMF 2012). **Figure II.7** shows that the stock of household credit, attributable to the banking system only, has gradually increased over the period under review and stood at $37.1 billion at the end of 2019. Notably, aggregate household loan growth slowed during the period 2016 to 2018 on account of the bleak economic environment. Against this backdrop, double-digit growth was observed in the refinancing and consolidation segment, suggesting that households may have been rationalising their debt obligations. This loan category has had characteristically higher NPL ratios when compared to other segments. However, overall lending continued to be concentrated in real estate mortgages (43 per cent) and vehicles and other durables (14 per cent), which contributed positively to low household sector NPLs[39]. The ratio averaged just under 2.0 per cent for the period.

[38] The "Other" category refers to loans granted by thrift institutions and the National Insurance Board, as well as estimates of hidden and unrecorded debt provided by money lenders, pawn brokers and credit concessions. The category accounts for less than 1 per cent of total estimated household debt.

[39] Data for household NPLs is available from 2012 for the commercial banking sector only. The commercial banking sector contributes approximately 95 per cent of total banking system loans to households.

Figure II.7: Banking System Loans to Households by Type[40], 2009 - 2019



Source: Central Bank of Trinidad and Tobago

Continuous monitoring of household sector resilience is necessary to gauge its vulnerability to potential macro-financial shocks. While there are several indicators of financial soundness for the household sector, IMF (2019) recommends the following:

1. **Household debt-to-Gross Domestic Product (GDP)**: a measure of total household indebtedness as a share of annualised GDP. The ratio indicates credit risk, as excessive household debt signals increased vulnerability to economic and financial market shocks.
2. **Household debt service and principal payments-to-income**: a flow measure of the household sector's ability to cover debt payments with gross disposable income. A high debt service ratio indicates greater financial susceptibility to shocks and may signal reduced consumption in subsequent periods.
3. **Household debt-to-income**: a measure of total household indebtedness as a share of annualised gross disposable income. This indicator assesses the debt sustainability of a household, with high or rising ratios suggesting increasing vulnerability to shocks.

Estimated household debt data produced by the CBTT lends to the calculation of an estimated household-debt-to-GDP ratio (Section II.5). However, household debt service payments as well as income data are not collected by the regulator. Further, conclusions

[40] The "Other" category includes credit card loans and other miscellaneous expenses, where credit cards account for over 50 per cent of the total.

drawn from the FSIs must take into account assets held by the sector, which can be liquidated in the event of a shock. These data points are not currently available for Trinidad and Tobago on a frequent basis and were last compiled and published in the 2009 HBS produced by the CSO.

II.3.3 Non-Financial Corporate Sector

NFCs are institutional entities[41] that are wholly-owned or majority-owned by private individuals, households or any other private or quasi corporations and whose principal activity is the production of goods or non-financial services (CBTT 1995). Trends in NFC sector profitability have implications for economic activity through capital investments and productivity, generation of taxes and creation of jobs (Australian Government, Joint Standing Committee on Foreign Affairs, Defence and Trade 2015). Thus, developments in the sector are closely monitored to ensure institutions can withstand shocks such as, inter alia, weak economic growth, increasing domestic interest rates and rising inflation.

Notably, 96 per cent of NFC sector loans with licensed financial institutions are held with the banking system **(Figure II.8)**. On the other hand, this accounts for 39 per cent of total banking system loans **(Figure II.3)**. Therefore, as debtors, NFCs can have a direct impact on the asset quality of institutions' loan portfolios. Moreover, licensed financial institutions invested over $13.0 billion in NFC securities ($4.9 billion) and quoted stocks/shares in NFC institutions ($8.5 billion) at the end of 2019. This was largely attributable to the pensions and insurance sectors **(Figure II.9)**. NFC investments in securities and shares represented 17 per cent and 15 per cent of total pension and insurance sector investments, respectively, but less than 3 per cent of investments on the balance sheet of the banking sector.[42] Though direct investment exposures are minimal, weaknesses in NFC balance sheets and increases in NFC sector risks can result in potential trading losses should financial institutions decide to off-load their investment portfolios (MAS 2015).

From 2009 to 2018, growth in banking system loans to businesses, of which NFC institutions account for 96 per cent[43], fluctuated below 5 per cent **(Figure II.10)**. Growth in several loan segments was challenged as some institutions deleveraged amidst the slowdown in economic activity. However, aggregate growth was buttressed by robust demand in the major categories. As of December 2019, total loans to businesses was $32.0 billion, comprising mainly loans to finance, insurance and real estate companies and real estate mortgages. Further, the ratio of foreign business loans to total business loans was moderate at 25.5 per cent. NPL ratios in the business sector[44] were generally higher than households, averaging 6.2 per cent for the period.

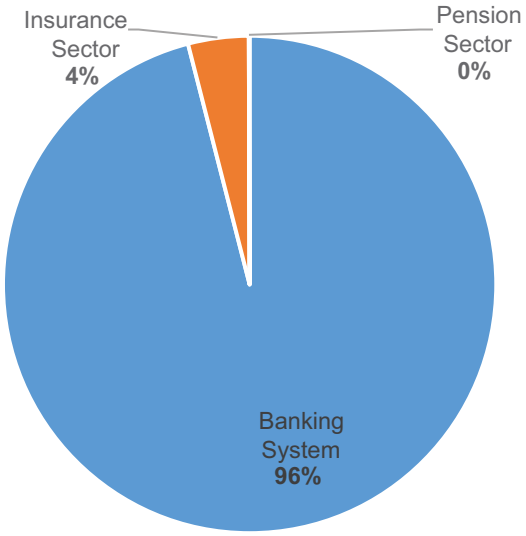
[41] Includes both incorporated and unincorporated enterprises.

[42] Financial institution investment portfolios are heavily concentrated in treasury bills, central and other government securities (56 per cent).

[43] The remaining 4 per cent is attributable to private financial institutions, that is, commercial banks and other financial institutions.

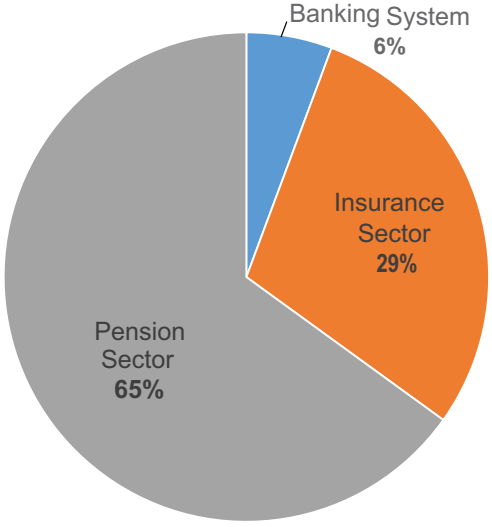
[44] Data for business sector NPLs is available from 2012 for the commercial banking sector only. The commercial banking sector contributes approximately 95 per cent of total banking system loans to the business sector.

Figure II.8: Licensed Financial Institutions Share of Loans to NFCs, Dec 2019



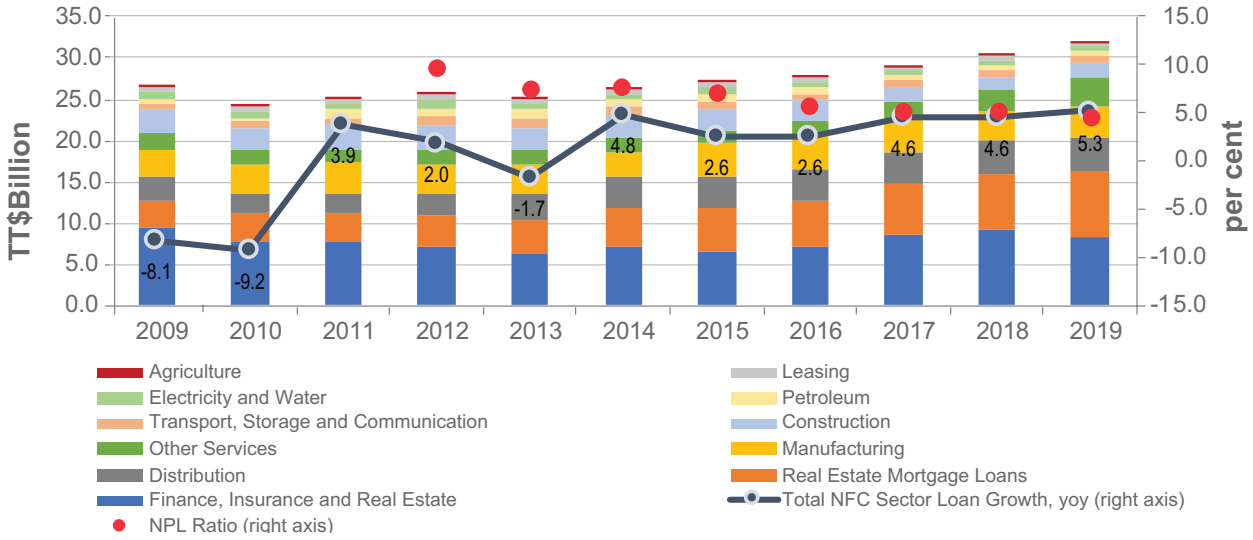
Source: Central Bank of Trinidad and Tobago

Figure II.9: Licensed Financial Institutions Share of Investments in NFCs, Dec 2019



Source: Central Bank of Trinidad and Tobago

Figure II.10: Banking System Loans to Businesses by Type, 2009 - 2019



Source: Central Bank of Trinidad and Tobago

The IMF (2019) recommends the following FSIs which focus on the NFC sector's repayment capacity in the face of adverse shocks:

1. **Total debt-to-equity:** a stock measure of total NFC indebtedness as a share of capital and reserves. Increases in the leverage ratio indicate rising vulnerability to adverse shocks.
2. **External debt-to-equity:** a stock measure of the sector's debt to non-resident creditors as a share of capital and reserves. Funding from non-residents, typically denominated in foreign currency, tends to demonstrate volatility in times of stress.
3. **Foreign currency debt-to-equity:** a stock measure of the sector's debt in foreign currency as a share of capital and reserves. This indicator estimates the level of foreign currency risk faced by the sector.
4. **Total debt-to-GDP:** a measure of total NFC indebtedness as a share of annualised GDP. Increases in this ratio indicate rising vulnerability to adverse shocks and decreased debt sustainability.
5. **Return on equity:** a measure of net income after taxes as a percentage of the average value of capital and reserves over a period. This FSI gauges profitability of the sector which serves as a leading indicator of financial distress and repayment capacity in the event of a shock.
6. **Earnings-to-interest and principal expenses:** a flow measure of the sector's earnings before interest and tax as a percentage of debt service payments. This indicates credit risk posed by the sector by its inability to meet debt obligations.
7. **Earnings-to-interest expenses:** a flow measure of the sector's earnings before interest and tax as a percentage of interest expenses. This ratio may be utilised as an alternative to the debt service ratio (earnings-to-interest and principal expenses) where principal payments are not known.

IMF (2006) stresses that FSIs for the NFC sector should be calculated using data collected from internally consistent financial statements. While this data is available for several NFCs, particularly those large-scale firms listed on the local stock exchange, it only captures a percentage of the market. As such, interpretation of the aggregate results must be made with care.

II.4 DATA AND METHODOLOGY

In keeping with the empirical literature, household and NFC sector balance sheet resilience was explored using micro and macro level data in a series of VAR models. More specifically, microdata was used to develop a financial profile of the average household or firm. From this information, a subset of IMF-recommended FSIs (discussed in Section II.3) was computed to gauge the financial health and soundness of the household and NFC sectors. Finally, following Drehmann, Patton and Sorensen (2005), macro data was entered into VAR models to evaluate each sector's response to adverse macro-financial scenarios.

II.4.1 Data

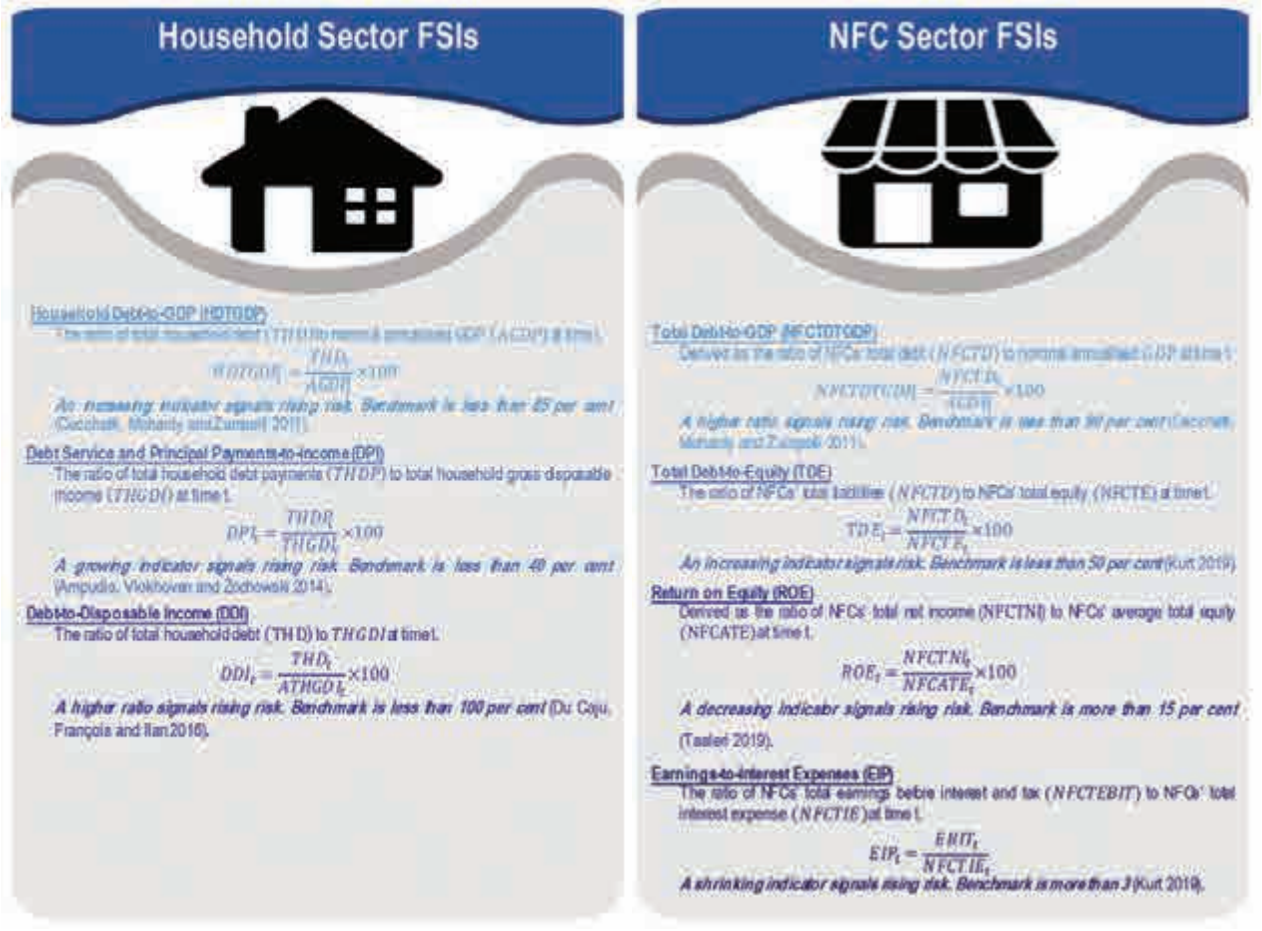
II.4.1.1 Micro Data

The following subset of IMF-recommended FSIs[45] **(Figure II.11)** was computed for households and NFC institutions using all pertinent information from the CBTT regulatory returns; the 2008/2009 Trinidad and Tobago HBS; and the financial statements of NFC institutions listed[46] on the Trinidad and Tobago Stock Exchange (TTSE).

[45] See Appendix II.A1.

[46] While several companies were delisted over the period of interest, their records were still used to compile FSIs for the NFC sector given the limited dataset. Listed NFC FSIs are therefore based on data collected from the annual reports of some 20 NFC institutions that have been listed at some point during the period 2010 – 2019. 2010 was the starting point of the analysis, as several listed NFCs did not have readily accessible reports for 2009 and, given the size of the companies involved, these omissions would have skewed the assessment.

Figure II.11: Financial Soundness Indicators



Source: Cecchetti, Mohanty and Zampolli (2011), Ampudia, Vlokhoven and Żochowski (2014), Du Caju, François and Ilan (2016), IMF (2019), Kurt (2019), Taaleri (2019), Authors

II.4.1.2 Macro Data

The commercial banking sector is the main unit of analysis, given the sheer size of its operations. Further, credit risk assessments feature prominently in these analyses as domestically, "continued robust overall credit growth has been a source of risk for the overall health of the financial sector" (IMF 2016). Against this background, the framework used to evaluate the resilience of household and NFC balance sheets considered the indicators proposed in **Table II.1.**

Table II.1: Macro-Financial Indicators[47]

Sector	Indicator		Rationale
Macro	Exchange Rate (TT$ to US$)		A depreciation in the exchange rate can dampen: (i) a borrower's real purchasing power; and (ii) income (profit) margins by raising operating costs (De Bock and Demyanets 2012, Bazdresch, Garza and de Larrea 2018).
	Inflation Rate (%)		According to Nkusu (2011), inflation reduces the real value of outstanding debt if wages (and/or producer prices) are sticky downwards (they move up easily but prove quite resistant to moving downwards).
	Overall Fiscal Balance (TT$ Million)		Fiscal deficits may be stimulative if excess spending provides incentives to improve the incomes (and financial solvency) of business enterprises and households. Deficits may also be part of a government's strategy to smooth fluctuations in the business cycle (CRS 2019). However, deficit financing can crowd-out private sector borrowing, hampering growth prospects for these entities.
	Real GDP Growth Rate (%)		Higher economic activity can raise incomes and improve loan repayment capacities (Adebola, Yusoff and Dahalan 2011, Rasmidatta 2011, Moussa 2015).
	Unemployment Rate (%)		Unemployment can force households into a position where it is impossible or challenging to comply with their contractual debt obligations (Steffen, Hackethal and Tyrell 2010). Unemployment can also hamper the financial solvency of businesses as the average firm relies on the income they receive from the active workforce.
	Weighted Average Loan Rate (%)		Higher interest rates can: (i) raise debt burdens; and (ii) increase NPLs (Khemraj and Pasha 2009).
Financial	Commercial Banks	Business Sector – NPLs-to-Total Loans	NPL ratios and the growth in refinanced and consolidated loans serve as good measures of credit risk as: (i) NPLs are a key indicator of asset quality; and (ii) 'bad times' are typically associated with a rise in debt reorganisation (as discussed in Section II.3, total loans for debt refinancing and consolidation have risen strongly since the collapse of oil prices in 2014).
		Household Sector – Consolidated Loan Growth	
		Household Sector – NPLs-to-Total Loans	
		Household Sector – Refinanced Loan Growth	

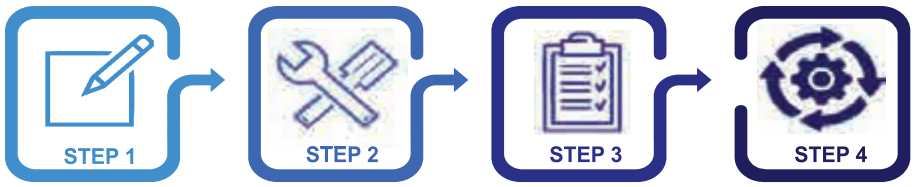
Source: Adapted from several noted studies

[47] There is no data available on the refinanced and consolidated loan portfolio of the business sector.

II.4.2 Methodology

In keeping with the literature, emphasis was first placed on developing a financial profile of the average household and firm and constructing FSIs to gauge these sectors' financial health and soundness. Once this was completed, the paper followed Drehmann, Patton and Sorensen (2005) and evaluated households and NFC institutions' response to adverse macro-financial scenarios using VARs. These models can be used to assess financial resilience as they allow researchers to trace the effect of an increase in an independent variable onto a dependent variable. The paper used the 'Financial' indicators in **Table II.1** as its dependent variables as: (i) NPLs are a key indicator of asset quality; and (ii) 'bad times' are typically associated with a rise in debt reorganisation (as discussed in Section II.3, remarkable growth in total loans for debt refinancing and consolidation has been observed since the collapse of oil prices in 2014). For independent variable selection, one should be guided by theory, previous empirical investigations and clinical considerations (Stoltzfus 2011). Therefore, to ensure that the VARs used independent variables that have a meaningful and statistically significant impact on the financial health of the household and NFC sectors, the FSIs were used in univariate Ordinary Least Square (OLS) regressions and Granger Causality[48] tests to screen out which macroeconomic variables – from the list of 'Macro' indicators in **Table II.1** – were not appropriate for inclusion in the analysis.[49] Further, it should be noted that macro-financial developments will have a different impact on credit quality depending on the type of borrower (Bofondi and Ropele 2011). Given the list of 'Financial' indicators, four separate VARs were conducted in this study. Based on the foregoing, the methodology can be summarised **(Figure II.12)** as follows:

Figure II.12: Steps Followed to Evaluate the Resilience of Household and NFC Sectors' Balance Sheet Resilience



Develop a Financial Profile

Micro data was used to develop a financial profile of the average household or firm.

Construct FSIs

The micro data was used to generate a subset of IMF-recommended FSIs to evaluate the financial health and soundness of the household and NFC sectors

VAR: Independent Variable Selection

FSIs were used in univariate OLS regressions and Granger Causality tests to screen out macroeconomic variables, with low predictive powers, to ensure that the VARs used independent variables with a meaningful and statistically significant impact on the financial health of the household and NFC sectors.

Run VARs

The selected 'Macro' indicators were used alongside the 'Financial' indicators as inputs for the VAR. However, as macro-financial developments will have a different impact on credit quality depending on the type of borrower, given the list of 'Financial' indicators, four separate VARs were conducted to thoroughly examine households' and NFC institutions' response to adverse shocks

Source: Authors

[48] Determines whether one time series is useful in predicting the future values of another time series.

[49] There may be some apprehension that the VAR variable selection process overlooks the fact that the variable of concern in the VARs (NPL ratio and refinanced and consolidated loan growth) behaves quite differently from the FSIs. However, prudential regulations (whose goal is to mitigate financial risks to the economy) may encumber the true relationship between credit risk indicators and the macroeconomy. For instance, as indicated in Appendix II.A2, NPL ratios and refinanced and consolidated loan growth have poor univariate OLS and Granger Causality results with the macro-variables. In Trinidad and Tobago, NPLs and loan renegotiations are guided by the "Guideline for the Measurement, Monitoring and Control of Impaired Assets" (CBTT 2007). Further, evidence on the link between FSIs and the credit risk indicators is provided in Appendix II.A3.

II.4.2.1 Univariate OLS Models and Granger Causality Tests

Univariate OLS models can be used to trace the economic and statistical relationships between a dependent variable and a list of possible independent variables. It allows researchers to determine the 'best' independent variables for a regression as econometric models should only use variables with high predictive powers. The univariate OLS model used in this study can be represented as follows:

Equation II.1
OLS Model

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$$

Where:

- y_t is the dependent variable (HDTGDP, NFCTDTGDP, TDE, ROE and EIP), at time t;
- β_0 is the constant term;
- x_t is the independent variable (Real GDP Growth Rate (%), Inflation Rate (%), Exchange Rate (TT$ to US$), Weighted Average Loan Rate (%), Unemployment Rate (%) and Overall Fiscal Balance (TT$ Million)) at time t;
- β_1 is the number of units y changes provided x increases by one unit; and
- ε_t is the error term.

It should be noted that, in univariate OLS regressions: (i) economic significance is based on the sign of $\mathbf{X}_t$ and whether or not it conforms with standard empirical considerations; and (ii) statistical significance is simply dependent on the p-values of $\mathbf{X}_t$. For this paper, based on the information in **Table II.1**, **Table II.2** highlights the economic relationships that are expected to be reflected in the univariate OLS results. Further, given the small sample size for the univariate OLS[50], statistical significance was recognised with a 90 per cent confidence interval.

Notwithstanding the analytical benefits from univariate OLS, these regressions cannot legitimately deduce cause-and-effect relationships between two variables. Therefore, to bolster analyses on the impact of the macroeconomy on the financial health of the household and NFC sectors, univariate OLS results were complemented with Granger Causality test statistics. Granger Causality tests attempt to see if adding lagged values of one variable (x) can improve the explanation of another variable (y) – y is said to be Granger-caused by x (or its lagged values) if it helps in the prediction of y. A typical Granger Causality test is modelled as:

Equation II.2
Granger Causality Test

$$y_t = \beta_0 + \beta_1 y_{t-1} + \cdots + \beta_l y_{t-l} + \beta_1 y_{t-1} + \cdots + \beta_l x_{-l} + \varepsilon_t$$

$$x_t = \beta_0 + \beta_1 x_{t-1} + \cdots + \beta_l x_{t-l} + \beta_1 y_{t-1} + \cdots + \beta_l y_{-l} + Y_t$$

Table II.2: A Priori Expectations

Indicator	A Priori Expectation
Exchange Rate (TT$ to US$)	Worsen
Inflation Rate (%)	Improve or Worsen
Overall Fiscal Balance (TT$ Million)	Worsen
Real GDP Growth Rate (%)	Improve
Unemployment Rate (%)	Worsen
Weighted Average Loan Rate (%)	Worsen

Source: Authors

[50] As a general rule of thumb, the smaller the sample size, the higher the error margin. Some researchers argue for ten observations per independent variable (often called the 'rule of ten'). Based on this criterion, each model should have met the sample size pre-requisite as the regressions were estimated using micro and macro data over 2009 to 2019. However, other studies have used population parameters, confidence intervals and/or standard errors to determine the most appropriate sample sizes for their models. As such, the univariate OLS results should be interpreted with care.

Where:

- y_t and x_t are the two variables being tested for Granger causality;
- β_0 is the constant term and l is the selected lag length (1 in this paper given the short time series);
- β_l is the coefficient of the independent variables; and
- ε_t and Y_t are the error terms.

II.4.2.2 VAR Models

A VAR provides a systematic way to capture information from the inter-relationships observed across individual time series. More importantly, VARs allow for impulse response functions – systems that trace the effects of a one-time shock (a one unit increase) in an independent variable on the future values of the dependent variable. These functions will be used to explore households' and NFC institutions' resilience. The VAR model used in this study can be represented as follows:

Equation II.3
VAR Model

$$Zy_t = W + \Gamma(L)y_{t-1} + \varepsilon_t$$

Where:

- y_t is the vector of n endogenous variables (Household Sector – NPLs-to-Total Loans, Business Sector – NPLs-to-Total Loans, Household Sector – Refinanced Loan Growth, Household Sector – Consolidated Loan Growth), Real GDP Growth Rate (%), Inflation Rate (%), Exchange Rate (TT$ to US$), Weighted Average Loan Rate (%), Unemployment Rate (%) and Overall Fiscal Balance (TT$ Million)) at time t;
- Z is a $n \times n$ matrix of contemporaneous coefficients of y_t and W denotes the $n \times 1$ vector of constant;
- $\Gamma(L)$ is the $n \times n$ matrix of lag operator polynomials which captures the lags of the endogenous variables; and
- ε_t is the $n \times 1$ vector of white noise processes (that is, $\varepsilon_t \sim N(0,\Omega)$).

The VARs were conducted using quarterly macro data over June 2012 to December 2019 as NPL data by economic sector is only available from June 2012.[51]

II.5 RESULTS

II.5.1 Micro Data

The 2009 household debt service and principal payments-to-income ratio (3.9 per cent) suggested that the average individual possessed adequate financial resources to meet debt obligations at the point in time, while the 2009 debt-to-income ratio (13.4 per cent) indicated that average debt levels did not compromise a household's consumption expenditure.[52] While there is no official benchmark for the household debt-to-GDP ratio, household debt as a percentage of GDP appeared stable in 2009 at 27.1 per cent **(Figure II.13)**.[53] Collectively, these FSIs suggested that the average household in Trinidad and Tobago had a strong and healthy balance sheet position in 2009.

[51] Accumulated generalised impulse response functions treat the spikiness in traditional impulse response functions, which follows when the endogenous variables are not stationary at level. Further, as one of the main criticisms of traditional impulse response analysis has been the potential to 'manipulate' results (given the sensitivity of impulse response functions to variable ordering) generalised impulse response functions (which are insensitive to variable ordering) were used.

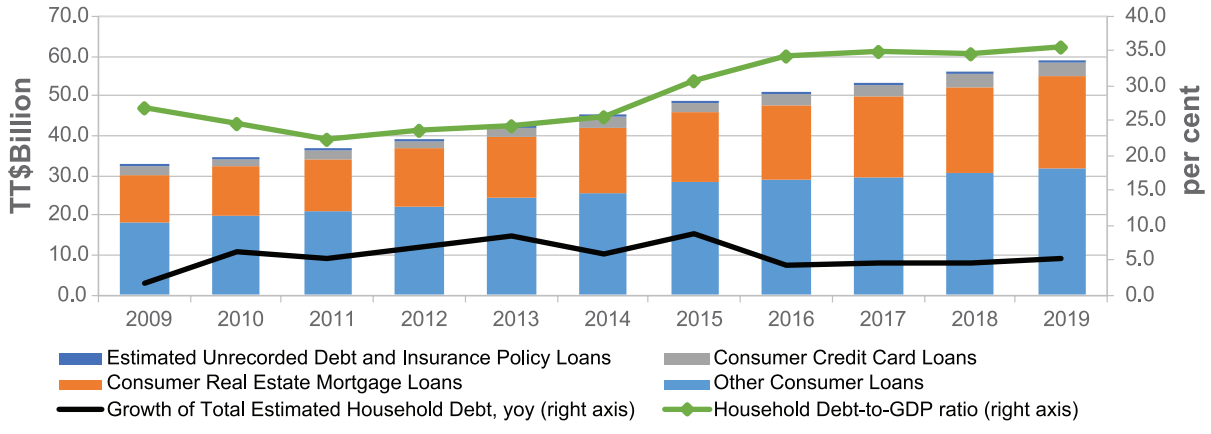
[52] The ratios were derived from the 2009 HBS. According to Ampudia, Vlokhoven and Żochowski (2014) a household is financially vulnerable if their debt service and principal payments-to-income ratio is above 40 per cent. Further, following Du Caju, François and Ilan (2016), a household can be classed as over-indebted when household debt is equal to or above 100 per cent of their annual income.

[53] An empirical study conducted on advanced and emerging market economies, between 1980 and 2010, found that the negative long-run impact of household debt on GDP growth is felt more intensely as the ratio exceeds 85 per cent (Cecchetti, Mohanty and Zampolli 2011).

Using the 2009 HBS for income data, as well as information on wage and salary increases from collective agreements registered with the Industrial Court of Trinidad and Tobago, it is estimated that the median wage in Trinidad and Tobago grew by 3.8 per cent annually between 2009 ($6,030.00) and 2019 ($8,791.18). Given that the household debt-to-GDP ratio increased, on average, by 0.7 per cent per year over that period, it appears that the average household was in a better financial position in 2019 than in 2009. Even so, over the last five years: (i) retrenchments have grown at an average annual rate of 13.5 per cent; (ii) food prices have grown at an average annual rate of 5.1 per cent; and (iii) GDP per capita has contracted at an average annual rate of 1.2 per cent.

NFC sector profitability **(Figure II.14** and **II.15)** has remained fairly stable in an uncertain operating environment. However, large debt-to-equity ratios (approximately 80 per cent in 2019, **Figure II.16**) suggest signs of a growing reliance on debt financing. While this may seem alarming, the earnings-to-interest expenses ratio and the debt-to-GDP ratio imply that interest costs are quite manageable and debt levels are sustainable **(Figure II.17)**.[54] That said, these FSIs may not be a true reflection of the NFC sector in its entirety, as the majority of businesses in the real economy do not operate on the TTSE. As an example, in 2011, the Compete Caribbean Partnership Facility (CCPF)[55] conducted a survey on 370 firms in Trinidad and Tobago, which found that firms source the majority of their financing from their internal funds and retained earnings (85 per cent). With this in mind, the average firm appeared to be financially self-sufficient. However, retained earnings may not be sufficient enough for financing operations as business sector growth has slowed since the 2014 collapse in oil prices. For instance: (i) according to available capacity utilisation rates, manufacturers operated at only 64.4 per cent of their full capacity in 2019 (as opposed to 72.3 per cent in 2014); (ii) between 2014 and 2018, sales in the retail trade sector grew (on average) by only 0.1 per cent; and (iii) over the last five years crude oil and natural gas production have fallen (on average) by 5.1 and 2.2 per cent, respectively.[56]

Figure II.13: Estimated Household Debt-to-GDP, 2009 - 2019



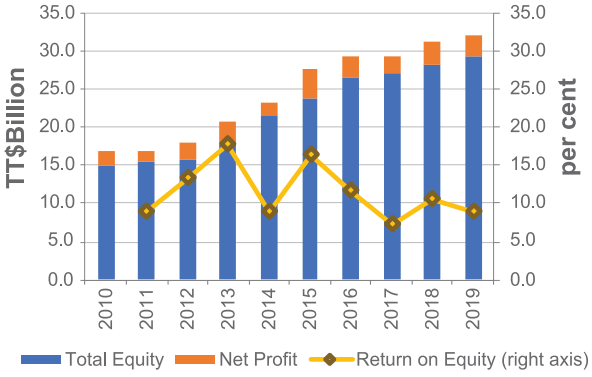
Source: Central Bank of Trinidad and Tobago

[54] An empirical study conducted on advanced and emerging market economies, between 1980 and 2010, found that the negative long-run impact of corporate debt on GDP growth is felt more intensely as the ratio exceeds 90 per cent (Cecchetti, Mohanty and Zampolli 2011). Further, while higher numbers are favourable, Kurt (2019) noted that an earnings-to-interest and principal expenses ratio of 3 represents a strong ability to pay off debt.

[55] The CCPF is a partnership between the Caribbean Development Bank, the Inter-American Development Bank and the UK Department for International Development (DFID). The organisation acts as a private sector development programme. It aims to increase productivity and foster innovation and competitiveness within the Caribbean.

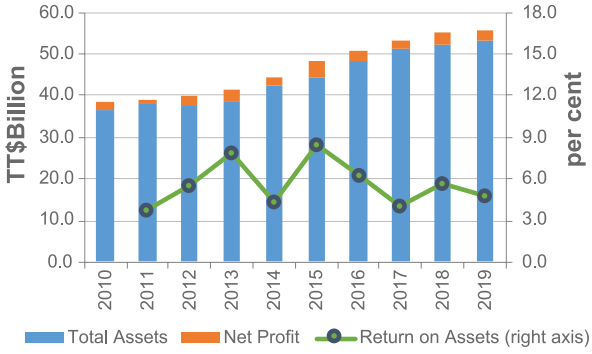
[56] According to the latest available information from the CSO, as of March 2019, the three largest contributors to GDP (at market prices) were: (i) trade and repairs (20.9 per cent); (ii) manufacturing (19.5 per cent); and (iii) mining and quarrying (16.5 per cent). The statistics on activity in the manufacturing, retail trade and energy sectors were sourced from the CBTT's Economic Bulletin publications.

Figure II.14: NFC Institutions Return on Equity, 2011-2019



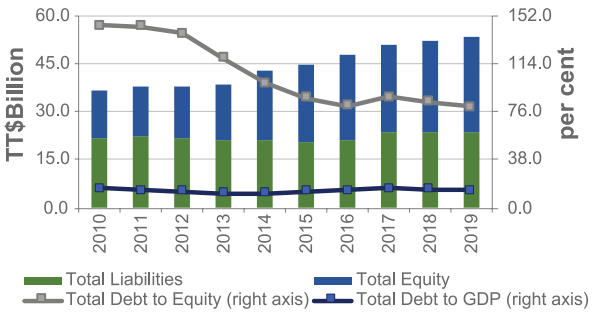
Source: Authors' calculations and the annual financial statements of 20 NFCs

Figure II.15: NFC Institutions Return on Assets[57], 2011-2019



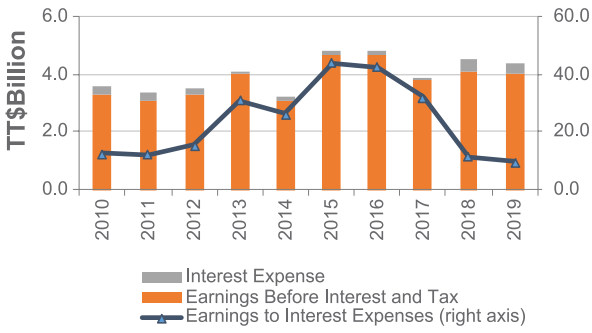
Source: Authors' calculations and the annual financial statements of 20 NFCs

Figure II.16: NFC Sector Total Debt-to-Equity, 2010-2019



Source: Authors' calculations and the annual financial statements of 20 NFCs

Figure II.17: NFC Sector Earnings-to-Interest Expenses, 2010-2019



Source: Authors' calculations and the annual financial statements of 11 NFCs[58]

[57] While Return on Assets $\left(ROA_{ct} = \frac{NFCATNI_t}{NFC's\ average\ total\ assets_t} \times 100\right)$ is not an FSI recommended by the IMF for NFCs, it was included in this paper's assessment on listed NFCs as it is an important indicator of a company's ability to generate profits from capital investments.

[58] While the TTSE has information for 20 NFCs, not all financial statements clearly defined interest expense.

II.5.2 Macro Data

II.5.2.1 FSI OLS and Granger Causality Results

While the FSIs implied a low probability of default, the analysis revealed that households and NFC institutions might be becoming more dependent on credit. However, it should be noted that borrowing choices are not made in a vacuum. They are informed by myriad factors encompassing, but not limited to, economic and financial stability. **Table II.3** highlights the macro-financial variables – specifically, their univariate OLS regression results – that may play a role in the borrowing decisions of the average household and NFC institution in Trinidad and Tobago.[59]

It was observed that the exchange rate had a positive, statistically significant impact on household debt-to-GDP, while inflation, interest rates, overall fiscal balance and real GDP growth all had a negative statistically significant impact on household debt-to-GDP. In general, these findings suggest that households borrow responsibly in 'good times' but in 'bad times' stagnant economic conditions fuel a rise in household debt-to-GDP – it is uncertain if this will be because of a fall in the denominator (due to lower economic activity), a rise in the numerator (as households try to smooth consumption in the short run) or both. At the same time, it should be noted that the unemployment rate did not have a statistically significant relationship with household debt-to-GDP, as discussed in Section 3, expansionary fiscal policy may be shielding the labour market against fluctuations in the business cycle.[60] Nevertheless, the univariate OLS demonstrated collectively that household debt-to-GDP tends to be influenced by the level of economic activity and/or the demand for credit to smooth consumption. Further, while 'loan support' facilities (for example, cash advances, payday loans and restructured

Table II.3: The Univariate OLS Regression Coefficients of Selected Macroeconomic Indicators and Key Risk Indicators

FSI	Coefficient Sign					
	Exchange Rate (TT$ to US$)	Inflation Rate (%)	Overall Fiscal Balance (TT$ Million)	Real GDP Growth Rate (%)	Unemployment Rate (%)	Weighted Average Loan Rate (%)
Household Sector Debt-to-GDP	**Worsen***	**Improve***	**Improve**	**Improve***	Improve	**Improve**
NFC Sector Total Debt-to-GDP	**Worsen***	Improve*	Improve	Improve*	**Worsen***	Worsen*
NFC Sector Total Debt-to-Equity	**Improve**	**Worsen***	**Worsen***	**Worsen**	**Worsen***	Worsen*
NFC Sector Return on Equity	Worsen*	Improve*	Improve	Improve*	Worsen*	Improve
NFC Sector Earnings-to-Interest Expenses	Worsen*	Worsen*	Worsen*	Worsen	**Worsen***	Worsen*

Source: EViews' Output

Note: All OLS results can be found in Appendix II.A4. For the cells with an asterisk, the univariate OLS coefficients had signs that were consistent with a priori expectations. For the bolded cells, univariate OLS coefficients were statistically significant.

[59] It should be noted that there were not enough observations for households' debt service and principal payments-to-income ratio and debt-to-disposable income ratio to run suitable univariate OLS regressions.

[60] The GORTT recorded budget deficits between 2014 and 2019 (the overall fiscal balance averaged at -$6.4 billion over this period) to support the recovery of the local economy. Some of the initiatives that could have supported the labour market over that period include raising the personal allowance by 20 per cent; finalising wage settlements for several large state enterprises (like Petrotrin and Trinidad and Tobago Electricity Commission); and increasing the minimum wage by 40 per cent (between 2014 and 2019).

credit) and SSIPs help households to withstand shocks, reliance on these systems may at times discourage households from holding sufficient reserves in cases of emergency.

For NFCs, the only deemed statistically significant independent variables for debt-to-GDP were unemployment and the exchange rate (adverse changes in both variables worsened debt-to-GDP). In other words, real GDP growth, inflation rates, interest rates and the fiscal balance do not appear to be major considerations when firms decide to borrow. This development suggests that, to a large extent, financing decisions may be driven by corporate-specific factors such as profitability and asset size (profitable and/or large corporations have easier access to credit, perhaps at lower costs because they are perceived to be least at risk for financial distress). The OLS results for total debt-to-equity showed that real GDP growth, unemployment, inflation and fiscal balance had positive statistically significant impacts on total debt-to-equity. However, the exchange rate had a negative statistically significant relationship, suggesting that listed NFCs only issued shares when faced with a depreciation in the exchange rate. In recent years, stakeholders in the business community have raised their concerns[61] on the impact of rising exchange rates on their financial costs. It is reasonable to assume that, when faced with a sudden rise in the exchange rate which may reduce the attractiveness of foreign currency credit, businesses may seek to lower their weighted average cost of capital via share issuances.

Moreover, between 2014 and 2019, when the exchange rate depreciated by 5.8 per cent[62], three large-scale NFCs[63] started/finished the process of 'going public'. The last NFC to have done so was Supreme Ventures Limited in October 2008. For the most part, NFCs have produced robust profit margins as the return on equity ratio seems to be insulated from major macro-financial developments – there were no statistically significant OLS results for the return on equity ratio. Earnings-to-interest expenses had only one statistically significant OLS result, unemployment (worsens the earnings-to-interest expenses ratio). This finding supports the assessment made from the univariate OLS regressions for the return on equity ratio, that is, earnings (the numerator in the earnings-to-interest expenses ratio) were generally insulated from major macro-financial developments during the period under review **(Appendix II.A5)**. However, a sizeable shock for example, the COVID-19 pandemic, can upend the long run stability of such a relationship.

The Granger Causality statistics **(Table II.4)** provided further insights on the nexus between the macroeconomy and the household and NFC sectors. Namely, household debt-to-GDP Granger-causes inflation rate, exchange rate and the overall fiscal balance while unemployment Granger-causes household debt-to-GDP. The former result may have come about as expenditure influences the level of demand (a key determinant of inflation rates) and supply (a key determinant of exchange rates) of goods and services – and with it, the level of sales taxes, tariffs or excises (key determinants of the overall fiscal balance). On the other hand, the latter observation reinforces some of the findings from the univariate OLS regressions – namely, households will access 'loan support' facilities to try to mitigate the impact of adverse shocks. For the corporate sector real GDP growth rate, inflation rate, interest rates and unemployment Granger-causes NFC sector total debt-to-GDP while NFC sector total debt-to-GDP Granger-causes unemployment. Additionally, unemployment and interest rates Granger-causes NFC sector total debt-to-equity while NFC sector

[61] "Forex still No 1 issue for business community", T&T Guardian (2015), October 22, 2015, https://www.guardian.co.tt/article-6.2.370732.40dd996325.

[62] Between 2014 and 2019 the exchange rate moved from TT$6.38/US$1 to TT$6.76/US$1. However, five years before then (between 2009 and 2013) the exchange rate fluctuated between TT$6.3/US$1 and TT$6.42/US$1.

[63] These NFCs include Trinidad and Tobago NGL Limited (listed in October 2015), CinemaOne Limited (listed in April 2019) and Endeavour Holdings Limited (issued a prospectus to go public in October 2019).

total debt-to-equity Granger causes inflation rate, real GDP growth rate and unemployment. Collectively, these results show that causality is observed mainly between the independent variables and the debt-related FSIs for the NFC sector. It is a reminder that NFC borrowing has not yet reached a level that would systemically impact the macroeconomy. Even so, as observed with the univariate OLS findings for total debt-to-equity, certain macroeconomic conditions can induce adjustments in NFC's borrowing. With regards to profitability, it was observed that the inflation rate and exchange rate Granger-cause NFC sector return on equity. Interestingly enough, this result coincides with the Granger Causality test statistics for household sector debt-to-GDP – specifically, households' demand for goods and services influences inflation and exchange rates, variables that often have a direct impact on the sales and costs of doing business. NFC sector earnings-to-interest expenses Granger-causes real GDP growth, exchange rate and the overall fiscal balance while unemployment Granger-causes NFC sector earnings-to-interest expenses. This finding shows the importance of solvent businesses to the macroeconomy and public purse. Also, the main impediment to solvency is unemployment as customers are the lifeblood of a business.

Table II.4: The Granger Causality Test Results of the Selected Macroeconomic Indicators and Key Risk Indicators

FSI	Causality Between the FSI and the Independent Variable					
	Exchange Rate (TT$ to US$)	Inflation Rate (%)	Overall Fiscal Balance (TT$ Million)	Real GDP Growth Rate (%)	Unemploy-ment Rate (%)	Weighted Average Loan Rate (%)
Household Sector Debt-to-GDP	yes	yes	yes	-	-	-
NFC Sector Total Debt-to-GDP	-	-	-	-	yes	-
NFC Sector Total Debt-to-Equity	-	yes	-	yes	yes	-
NFC Sector Return on Equity	-	-	-	-	-	-
NFC Sector Earnings-to-Interest Expenses	yes	-	yes	yes	-	-

FSI	Causality Between the Independent Variable and the FSI					
	Exchange Rate (TT$ to US$)	Inflation Rate (%)	Overall Fiscal Balance (TT$ Million)	Real GDP Growth Rate (%)	Unemploy-ment Rate (%)	Weighted Average Loan Rate (%)
Household Sector Debt-to-GDP	-	-	-	-	yes	-
NFC Sector Total Debt-to-GDP	-	yes	-	yes	yes	yes
NFC Sector Total Debt-to-Equity	-	-	-	-	yes	yes
NFC Sector Return on Equity	yes	yes	-	-	-	-
NFC Sector Earnings-to-Interest Expenses	-	-	-	-	yes	-

Source: EViews' Output

II.5.2.2 VAR Results

The VAR should be constructed using the Granger Causality and univariate OLS results for the variables of concern (that is, the NPL ratio and refinanced and consolidated loan growth). However, as indicated in Appendix II.A2, NPL ratios and refinanced and consolidated loan growth have poor univariate OLS and Granger Causality results with the macro-variables. This may be because prudential regulations may encumber the true relationship between credit risk indicators and the macroeconomy – NPLs and loan renegotiations are guided by the "Guideline for the Measurement, Monitoring and Control of Impaired Assets" (CBTT 2007). As such, for the VAR variable selection process, emphasis was placed on the Granger Causality and univariate OLS results of the FSIs. Notably, the FSIs generally produced signals that were both consistent with theoretical underpinnings and the macro-financial environment of Trinidad and Tobago. As such, attempts were made to construct VAR regressions using the variables that were both highlighted by the Granger Causality tests and univariate OLS regressions. However, regardless of the lag length used, the resulting simulations were statically insignificant. On closer inspection, it was observed that the Granger Causality results recommended, more often than not, less variables for VAR inclusion than the univariate OLS regressions. In other words, there was the risk that the Granger Causality results were advocating for underfitting the VARs. In light of this, the VARs were based solely on the univariate OLS regressions for the FSIs.

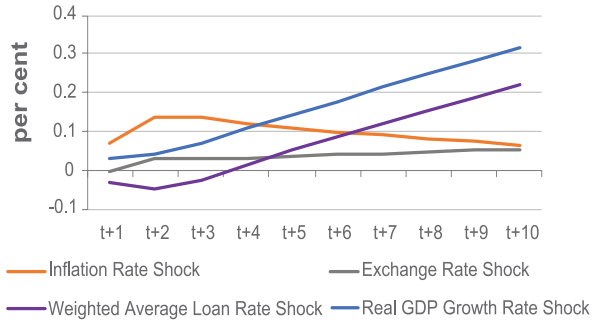
Four separate VARs were estimated in this study, as macro-financial developments will have a different impact on credit quality depending on the type of borrower (Bofondi and Ropele 2011). However, given gaps in the available data set, three of the VARs focused on the household sector while the other examined the NFC sector's resilience to credit risks. The VARs are listed below:

(i) Household Sector NPL VAR, which captures commercial banks' household sector NPL-to-total loan ratio, real GDP growth (per cent), inflation rate (per cent), weighted average loan rate (per cent) and the exchange rate (TT$ to US$).
(ii) Business Sector NPL VAR, which captures commercial banks' business sector NPL-to-total loan ratio, inflation rate (per cent), exchange rate (TT$ to US$), unemployment rate (per cent) and the overall fiscal balance (TT$ Million).
(iii) Household Sector Refinanced Loan Growth VAR, which captures commercial banks' refinanced loan growth (yoy, per cent), real GDP growth (per cent), inflation rate (per cent) and the weighted average loan rate (per cent).
(iv) Household Sector Consolidated Loan Growth VAR, which captures commercial banks' consolidated loan growth (yoy, per cent), real GDP growth (per cent), inflation rate (per cent) and the weighted average loan rate (per cent).

II.5.2.2.1 NPL VAR Results

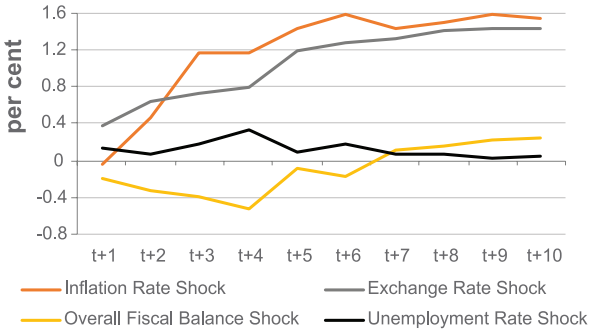
Once preliminary results revealed statistical significance from the estimated VARs, quarterly accumulated generalised impulse response functions (recall that the VARs were conducted using quarterly macro data over June 2012 to December 2019) were computed as follows **(Figure II.18** and **Figure II.19)**:

Figure II.18: Impact of Adverse Macro-Financial Shocks on Household Sector NPL Ratio *



Source: EViews' Output

Figure II.19: Impact of Adverse Macro-Financial Shocks on NFC Sector NPL Ratio



Source: EViews' Output

Note: * All of the adverse responses, except for GDP, reflect a positive shock in the underlying macroeconomic indicator. The negative shock in GDP was acquired by multiplying its impulse responses by -1. As noted in Ravn (2012) the impulse response to a positive shock is the mirror image of the response to a negative shock (of the same type and size).

Keep in mind that the impulse response functions reflect the impact on the household and business sectors' NPL ratios from a one unit increase in the macro-financial indicators. Even so, for both households and businesses:

(i) an increase in the exchange rate increased NPL ratios as, following De Bock and Demyanets (2012) and Bazdresch, Garza and de Larrea (2018), a depreciation in the exchange rate can dampen a borrower's real purchasing power; and

(ii) price hikes hamper debt service capacities as wages and producer prices, in recent years, have struggled to stay ahead of the inflation rate.[64]

Alongside these developments, the VARs showed that over time, an increase in the overall fiscal balance worsened firms' NPLs – implying that businesses ultimately rely on the government to engender a supportive economic environment for their operations. Although the last fiscal balance surplus was observed in 2011, government expenditure has shrunk by 19.6 per cent since the collapse of oil prices in 2014. To meet recent tight fiscal conditions, as discussed in Section II.3, some businesses responded by deleveraging and/or implementing 'staff rationalisation exercises' to restructure and streamline their operations (this might explain why corporate sector NPLs initially improve). However, these developments may not help firms to better meet their financial obligations in the long run as it was observed that firms' actions to reduce business costs can greatly reduce the demand for business output as unemployment reduced firms' ability to meet their debt obligations. At the other end, the VARs showed that a contraction in economic activity and/or an increase in the weighted average loan rate worsened households debt servicing capacities.

Collectively, the impulse response functions showed that, in most cases, the negative effect of shocks that impair households' and NFCs' debt service capacities tend to accelerate over time. That said, when faced with similar shocks, businesses defaulted

[64] Between 2015 and 2019 collective agreements registered with the Industrial Court of Trinidad and Tobago and the CSO's Producer Price Index revealed that: (i) the median wage increased at an average annual rate of 3.8 per cent; and (ii) prices received by domestic producers for their output increased at an annual average rate of 1.3 per cent. However, over that period, food prices grew at an average annual rate of 5.1 per cent while headline inflation (a measure of total inflation including food and commodity prices) grew at an average annual rate of 2.9 per cent.

at a higher rate than households. This observation suggests that debt restructuring may be cushioning the impact of systemic shocks on households' balance sheet positions. In fact, in Trinidad and Tobago, past experiences show that banks tend to manage default rates and loan losses in periods of high financial stress through loan restructuring facilities.[65] With this in mind, there is a risk that the econometric models, thus far, have been overestimating the resilience of the household sector. To address this gap in the analysis, the next section explores developments in the debt consolidation and debt refinancing loan portfolios for the commercial banking sector.

II.5.2.2.2 Debt Restructuring VAR Results

"Debt reorganisation is defined as bilateral arrangements involving both the creditor and the debtor that alter the terms established for servicing an existing debt" (Shepherd and Kitili 2006).[66] These practices typically fall under two broad categories – debt refinancing (involves closing a single loan and opening a new loan usually at a lower interest rate) or debt consolidation (combining multiple debts into a single loan with more favourable terms). As observed in Figures II.20 and II.21, households have mutually exclusive reasons for seeking refinancing and debt consolidation loans. More specifically, keeping all other things constant, households will only seek to address balance sheet imbalances via refinance loan programmes when there is an increase in the inflation and exchange rates. For the most part households prefer to consolidate their loans as three out of the four macro-financial variables (specifically, the exchange rate and the weighted average loan rate and real GDP growth) provoked a positive response from debt consolidation growth in the early stages of the forecast horizon. During 2014 and 2019 (77 per cent of the period of interest), the refinanced loan portfolio grew by 48.7 per cent and the debt consolidation loan portfolio grew by 74.2 per cent during a period where inflation[67] fell by 470 basis points, weighted average loan rate fell by 300 basis points, the exchange rate fell by 5.8 per cent and real GDP growth fell by 33 basis points (2014 GDP contracted by 0.9 per cent while 2019 GDP contracted by 1.2 per cent).

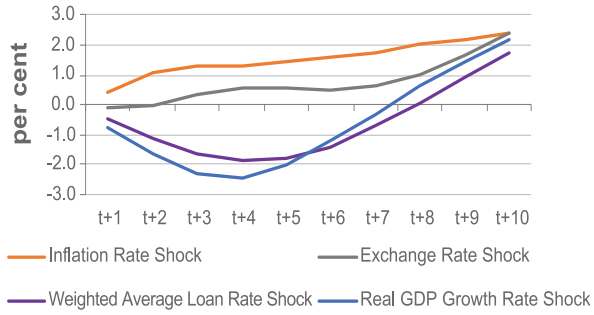
Collectively, the observations made from **Figures II.20 and II.21** are consistent with findings in the CBTT's November 2019 Monetary Policy Report. That is, there has been a persistent expansion in consumer debt for consolidation and refinancing purposes following lacklustre economic conditions since the 2014 collapse in oil prices. Notwithstanding that debt reorganisation practices help to preserve financial stability by reducing the probability of default in bad times, there are limitations on the effectiveness of these practices. *"In Trinidad and Tobago, loans can be renegotiated a maximum of two times over the life of the original loan and not more than twice in a five-year period in the case of mortgage"* (CBTT 2019b). Further, the focus on protecting bank asset quality ignores the potential for encouraging economic agents to make unwise financial decisions with respect to their debt exposures, thus lowering their true resilience to adverse macro-financial conditions. Instead, by improving the detection and coverage of credit losses in their loan loss provisioning frameworks, banks may be able to heighten their asset quality by dampening the pro-cyclical lending behaviour that compromises households and NFC institutions' balance sheet positions. Nonetheless, it should be emphasised that the VAR results should be interpreted with care as impulse response functions only served as a guide of the effect of an unencumbered economic shock on key household and NFC debt indicators based on commercial bank data.

[65] For example in 2009 Republic Bank moved to assist individual loan customers who lost their jobs and companies having revenue and cash flow problems, because of the slowing down of the country's economy (T&T Express 2009) while RBC Royal Bank Trinidad and Tobago Limited in its 2011 financial statements note that where possible the Bank seeks to restructure loans rather than take possession of collateral (RBC 2011).

[66] All four major commercial banks in Trinidad and Tobago (who as of December 2019 offer approximately 97 per cent of household sector loans and 90 per cent of NFC sector loans) offer debt consolidation services.

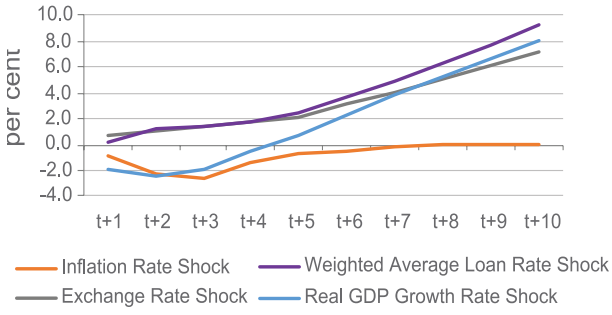
[67] Period average.

Figure II.20: Impact of Macro-Financial Shocks on Household Sector Refinanced Loans (yoy, growth) *



Source: EViews' Output

Figure II.21: Impact of Macro-Financial Shocks on Household Sector Debt Consolidated Loans (yoy, growth) *



Source: EViews' Output

Note: * All of the adverse responses, except for GDP, reflect a positive shock in the underlying macroeconomic indicator. The negative shock in GDP was acquired by multiplying its impulse responses by -1. As noted in Ravn (2012) the impulse response to a positive shock is the mirror image of the response to a negative shock (of the same type and size).

II.6 CONCLUSION AND RECOMMENDATIONS

This paper sought to assess the health of the household and NFC sectors in Trinidad and Tobago by exploring new ways of measuring their resilience in the context of the evolving economic and financial landscape.

Using microdata from the CSO and the TTSE, the paper estimated a subset of IMF-recommended FSIs for households and NFCs. Generally, the FSIs indicated that debt financing has been on the rise since the collapse of oil prices in 2014, but there has been a low probability of default within the sectors. Further, univariate OLS regressions suggested that household borrowing is influenced by the level of economic activity and/or the demand for credit to smooth consumption. On the other hand, NFCs prefer using debt to help finance their operations but will issue shares in response to a depreciation in the exchange rate.

The macro analysis explored the vulnerabilities within the household and business sectors that, if realised, could weaken their stability. Results suggested that an increase in the exchange rate and/or the inflation rate could worsen economic agents' NPL ratios (a key indicator of credit risks) as lower real purchasing power hampers borrower's ability to meet their debt obligations. It was also observed that an increase in the overall fiscal balance will, over time, increase business NPLs. While businesses often respond to tight fiscal conditions by deleveraging and/or implementing 'staff rationalisation exercises', some of these actions that firms take to bring down business costs can actually undermine their organisation as unemployment reduced firms' ability to meet their debt obligations.

Collectively, the micro and macro analyses showed that households generally adjust well in response to 'bad times'. While this may be because social safety nets or programs are buffering exogenous shocks, there was evidence that households tend to lean on debt restructuring facilities to manage credit risks. These strategies have helped to preserve financial stability within the commercial banking sector by protecting asset quality. Additionally, as higher household and corporate sector NPLs can have a significantly negative impact on the macro-environment, these loan support facilities may be integral for leaning against adverse shocks. Even so, refinancing and debt consolidation may not be a 'silver bullet' as these programmes may encourage households and NFCs to make unwise financial decisions with respect to their debt exposures thus lowering their true resilience to adverse macro-financial conditions. These loan categories (debt consolidation and refinancing) have had characteristically higher NPL ratios when compared to other segments.

There was some indication that social safety net programs were cushioning the impact of downswings in the business cycle on households' balance sheet positions. However, as Trinidad and Tobago and by extension the rest of the world grapples with the far-reaching economic consequences of the novel coronavirus pandemic, it is uncertain if the domestic government will have access to the same level of financial resources needed to support these social programs. With questions over government's available fiscal space, it may be more practical for policymakers to limit the systemic risks from the household and NFC sectors' pro-cyclical borrowing behaviour through macroprudential tools and other measures used to target and reduce risks stemming from vulnerabilities within financial markets. For households, some governments have leaned towards caps on the loan-to-value ratio (the maximum amount which can be borrowed in relation to an asset's value) and the debt-to-income ratio as: (i) debt-to-income limits ensure against unsustainable increases in debt; and (ii) loan-to-value limits add another constraint on households' ability to over borrow. On the other end, to address latent risks associated with the

demand and supply of credit to NFCs, some governments use collateral rules and specific capital surcharges as: (i) collateral rules could be aimed at business sectors with systemic vulnerabilities (to help limit possible credit risks and (ii) specific capital surcharges serve to better regulate the supply of credit to NFCs in risky sectors. All suggested tools can be adjusted in a counter-cyclical manner.

Despite the purported benefits from these macroprudential instruments, it should be noted that interpretation of the results, as regards the financial stability impact, must be made with care given severe data gaps. A complete understanding of the resilience of the household and NFC sectors in response to credit risk relies on comprehensive data capturing both the asset and liability sides of the sectoral balance sheets (Appendix II.A8). With respect to the household sector, data of this nature may be best gleaned by conducting Household Asset Surveys (national surveys that focus on how wealth is distributed in households and the factors that affect their financial planning). This would improve the reliability of the results presented in future work and open avenues for the in-depth analysis of vulnerabilities by, inter alia, income brackets. To bridge the information gap between the public versus private firms as well as circumvent reduced comparability of financial statements, a similar survey approach should also be adopted for the NFC sector to facilitate construction of a more suitable NFC sector balance sheet.

Further, results of similar macro-analyses can be used to supplement the existing stress testing framework employed by the CBTT by incorporating econometric analysis that captures interrelationships between the real and financial sectors. This can also be expanded to identify weaknesses within other sectors, for example, the real estate sector. This paper and its suggestions for future work can improve the CBTT's macroprudential surveillance approach by providing a more comprehensive assessment of sector resilience, which, in combination with expert judgement, will aid regulators in gauging the risks posed to financial stability by households and NFC institutions.

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APPENDICES CHAPTER II

II.A1: FSIs' Nominal Values

Year	Household Sector Debt-to-GDP	NFC Sector Total Debt-to-GDP	NFC Sector Total Debt-to-Equity	NFC Sector Return on Equity	NFC Sector Earnings-to-Interest Expenses
2009	27.1	-	-	-	-
2010	24.7	15.2	144.1	-	12.5
2011	22.5	13.7	143.2	8.9	12.3
2012	23.8	13.2	137.5	13.2	15.5
2013	24.4	12.0	118.4	17.8	30.8
2014	25.6	12.0	98.5	9.0	26.4
2015	30.8	12.9	86.6	16.2	43.9
2016	34.2	14.3	80.3	11.5	42.6
2017	35.2	15.6	87.7	7.3	32.0
2018	34.8	14.6	83.7	10.6	11.5
2019	37.8	14.2	80.1	8.8	9.5

Source: Authors

II. A2: Univariate OLS Regressions and Granger Causality Tests for the Financial Indicators

Univariate OLS Regressions for the Financial Indicators

Macro-Variable	Household Sector – NPLs-to-Total Loans	Business Sector – NPLs-to-Total Loans	Household Sector – Refinanced Loan Growth	Household Sector – Consolidated Loan Growth
Exchange Rate (TT$ to US$)	**0.6713**	**-3.5064**	**9.1625**	**21.4209**
Inflation Rate (%)	-0.0137	**0.2093**	**-0.5779**	**-1.1168**
Overall Fiscal Balance (TT$ Million)	0.0000	0.0001	0.0001	0.0003
Real GDP Growth Rate (%)	-0.0103	**-0.0064**	**-0.0710**	**-0.1704**
Unemployment Rate (%)	0.0920	0.0398	-0.2051	2.3869
Weighted Average Loan Rate (%)	0.0385	-0.1823	-0.4187	0.8169

Source: EViews' Output

Note: Bolded cells indicate statistical significance at, at least, the 10 per cent level.

II.A2: Univariate OLS Regressions and Granger Causality Tests for the Financial Indicators

Granger Causality Test Results for the Financial Indicators

Financial Indicator	Causality Between the Financial Indicator and the Independent Variable					
	Exchange Rate (TT$ to US$)	Inflation Rate (%)	Overall Fiscal Balance (TT$ Million)	Real GDP Growth Rate (%)	Unemployment Rate (%)	Weighted Average Loan Rate (%)
Household Sector – NPLs-to-Total Loans	1.5745	7.0599	0.8823	1.4212	0.1966	1.1580
Business Sector – NPLs-to-Total Loans	0.5322	1.5770	0.2011	0.1177	0.1012	0.0097
Household Sector – Refinanced Loan Growth	1.3098	0.9689	2.2057	0.4300	0.6316	0.2369
Household Sector – Consolidated Loan Growth	0.0002	**3.1532**	0.7812	0.0342	0.5770	0.5364

Financial Indicator	Causality Between the Independent Variable and the Financial Indicator					
	Exchange Rate (TT$ to US$)	Inflation Rate (%)	Overall Fiscal Balance (TT$ Million)	Real GDP Growth Rate (%)	Unemployment Rate (%)	Weighted Average Loan Rate (%)
Household Sector – NPLs-to-Total Loans	**6.1429**	**3.34531**	0.01603	0.29634	**4.84617**	0.16465
Business Sector – NPLs-to-Total Loans	**8.8603**	**18.4850**	0.5422	0.1894	**3.9258**	1.5127
Household Sector – Refinanced Loan Growth	2.2344	1.1842	0.1755	1.1879	**2.9914**	0.2532
Household Sector – Consolidated Loan Growth	**3.33408**	2.45518	1.62224	0.92814	1.31117	0.03498

Source: EViews' Output

Note: Bolded cells indicate statistical significance at, at least, the 10 per cent level.

II.A3: Univariate OLS Regressions and Granger Causality Tests for the Financial Indicators and FSIs

Given the lack of economically meaningful and statistically significant relationships between the Financial Indicators and the macro-indicators, to show that the variable selection process for the VAR was reasonable, the relationships between the sectoral FSIs and Financial Indicators was explored. It was observed that, for households, their Financial Indicators share a strong, economically meaningful and statistically significant link with their FSI. While the same cannot be said about the corporate sector, the paper persisted with selecting the economically meaningful and statistically significant macro-variables for the FSIs as the inputs for the VARs so as to ensure that a consistent approach was used throughout the paper to empirically test the resilience of each economic sector.

Univariate OLS Regressions for the Financial Indicators and FSIs

Financial Indicator	Household Sector FSI	NFC Sector FSIs			
	Total Debt-to-GDP	Total Debt-to-GDP	Total Debt-to-Equity	Return on Equity	Earnings-to-Interest Expenses
Household Sector – NPLs-to-Total Loans	**16.6911***	-	-	-	-
Business Sector – NPLs-to-Total Loans	-	-0.4063	-4.9760	-0.3582*	4.4111
Household Sector – Refinanced Loan Growth	**1.3256***	-	-	-	-
Household Sector – Consolidated Loan Growth	0.5032*	-	-	-	-

Source: EViews' Output

Note: For the cells with an asterisk, the univariate OLS coefficients had signs that were economically meaningful. Bolded cells indicate statistical significance at, at least, the 10 per cent level.

II.A3: Univariate OLS Regressions and Granger Causality Tests for the Financial Indicators and FSIs

Granger Causality Test Results for the Financial Indicators and FSIs

Financial Indicator	Causality Between the Financial Indicator and their corresponding FSI				
	Household Sector Debt-to-GDP	NFC Sector Total Debt-to-GDP	NFC Sector Total Debt-to-Equity	NFC Sector Return on Equity	NFC Sector Earnings-to-Interest Expenses
Household Sector – NPLs-to-Total Loans	**5.5678**	-	-	-	
Business Sector – NPLs-to-Total Loans	-	2.7312	0.0653	0.9902	1.0769
Household Sector – Refinanced Loan Growth	2.9326	-	-	-	
Household Sector – Consolidated Loan Growth	3.9117	-	-	-	

Financial Indicator	Causality Between the FSI and their corresponding Financial Indicator				
	Household Sector Debt-to-GDP	NFC Sector Total Debt-to-GDP	NFC Sector Total Debt-to-Equity	NFC Sector Return on Equity	NFC Sector Earnings-to-Interest Expenses
Household Sector – NPLs-to-Total Loans	0.6096	-	-	-	-
Business Sector – NPLs-to-Total Loans		3.2972	0.1869	0.4916	1.6004
Household Sector – Refinanced Loan Growth	0.0073	-	-	-	-
Household Sector – Consolidated Loan Growth	0.3917	-	-	-	-

Source: EViews' Output

Note: Bolded cells indicate statistical significance at, at least, the 10 per cent level.

II.A4: Univariate OLS Regressions and Granger Causality Tests for the FSIs

Univariate OLS Regressions for the FSIs

Macro-Variable	Household Sector	NFC Sector			
	Total Debt-to-GDP	Total Debt-to-GDP	Total Debt-to-Equity	Return on Equity	Earnings-to-Interest Expenses
Exchange Rate (TT$ to US$)	**28.8568**	**5.5875**	**-98.8807**	-9.3208	-15.5331
Inflation Rate (%)	**-1.3858**	-0.1556	**6.7400**	0.4582	-0.2786
Overall Fiscal Balance (TT$ Million)	**-0.0007**	-0.0001	**0.0043**	0.0003	-0.0010
Real GDP Growth Rate (%)	**-0.6230**	-0.1847	**6.0951**	0.7395	-0.9875
Unemployment Rate (%)	-0.9505	**1.0355**	**20.4293**	-2.4725	**-10.0475**
Weighted Average Loan Rate (%)	**-2.7586**	0.2378	**27.3259**	3.0286	-6.7791

Source: EViews' Output

Note: Bolded cells indicate statistical significance at, at least, the 10 per cent level.

II.A4: Univariate OLS Regressions and Granger Causality Tests for the FSIs

Granger Causality Test Results for the FSIs

FSI	Causality Between the FSI and the Independent Variable					
	Excha-nge Rate (TT$ to US$)	Inflation Rate (%)	Overall Fiscal Balance (TT$ Million)	Real GDP Growth Rate (%)	Unemployment Rate (%)	Weighted Average Loan Rate (%)
Household Sector Debt-to-GDP	**15.0625**	**7.3607**	**3.1376**	0.2937	0.9379	2.2351
NFC Sector Total Debt-to-GDP	0.2247	1.4006	0.0871	0.0073	**11.5616**	0.4266
NFC Sector Total Debt-to-Equity	3.5186	**8.2314**	1.9361	**5.1254**	**6.8004**	0.0287
NFC Sector Return on Equity	1.0585	0.1771	1.3649	3.5736	0.2924	0.2779
NFC Sector Earnings-to-Interest Expenses	**4.0385**	0.2870	**4.0613**	**12.1935**	1.4339	1.2369

FSI	Causality Between the Independent Variable and the FSI					
	Excha-nge Rate (TT$ to US$)	Inflation Rate (%)	Overall Fiscal Balance (TT$ Million)	Real GDP Growth Rate (%)	Unemployment Rate (%)	Weighted Average Loan Rate (%)
Household Sector Debt-to-GDP	0.6233	0.2417	2.1141	1.4901	**4.7257**	2.3389
NFC Sector Total Debt-to-GDP	1.5961	**4.8060**	0.8627	**4.0989**	**58.7537**	**8.3224**
NFC Sector Total Debt-to-Equity	0.36413	0.01164	0.03174	1.26612	**16.801**	**6.83135**
NFC Sector Return on Equity	**7.8717**	**20.9662**	2.7007	3.0546	0.0192	0.2672
NFC Sector Earnings-to-Interest Expenses	3.5202	1.9818	1.9841	0.0966	**7.0515**	0.0589

Source: EViews' Output

Note: Bolded cells indicate statistical significance at, at least, the 10 per cent level.

II.A5: Review of the Univariate OLS Results

Dependent Variable	Independent Variable	A Priori Expectation	Result	Commentary
Household Sector Debt-to-GDP	Real GDP Growth Rate (%)	Improve	**Improve***	An increase in Real GDP Growth Rate (%) improves Household Sector Debt-to-GDP. Given the univariate OLS model inputs, this development may be because the denominator is growing at a faster pace than the numerator.
	Inflation Rate (%)	Improve or Worsen	**Improve***	An increase in Inflation Rate (%) improves Household Sector Debt-to-GDP. This development suggests that households are less willing to borrow when there is an increase in the inflation rate.
	Exchange Rate (TT$ to US$)	Worsen	**Worsen***	An increase in Exchange Rate (TT$ to US$) worsens Household Sector Debt-to-GDP. This development suggests that when there is an increase in the exchange rate, to maintain their consumption standards/levels, households will increase their borrowing.
	Weighted Average Loan Rate (%)	Worsen	**Improve**	An increase in Weighted Average Loan Rate (%) improves Household Sector Debt-to-GDP. This may be because households are unwilling to enter into new loan arrangements when the cost for borrowing these funds has increased.
	Unemployment Rate (%)	Worsen	Improve	An increase in Unemployment Rate (%) improves Household Sector Debt-to-GDP. This adverse development may be because fiscal stimulus packages may be shielding the labour market against fluctuations in the business cycle
	Overall Fiscal Balance (TT$ Million)	Worsen	**Improve**	An increase in Overall Fiscal Balance (TT$ Million) improves Household Sector Debt-to-GDP. This adverse development may occur as tight fiscal policy (higher taxes and/or lower fiscal expenditure) can squeeze economic agents' income/revenue, making them less inclined (or qualified) to borrow.
NFC Sector Total Debt-to-GDP	Real GDP Growth Rate (%)	Improve	Improve*	An increase in Real GDP Growth Rate (%) improves NFC Sector Total Debt-to-GDP. Given the univariate OLS model inputs, this development may be because the denominator is growing at a faster pace than the numerator.
	Inflation Rate (%)	Improve or Worsen	Improve*	An increase in Inflation Rate (%) improves NFC Sector Total Debt-to-GDP. This development suggests that listed NFCs are less willing to borrow when there is an increase in the inflation rate.
	Exchange Rate (TT$ to US$)	Worsen	**Worsen***	An increase in Exchange Rate (TT$ to US$) worsens NFC Sector Total Debt-to-GDP. This development suggests that when there is an increase in the exchange rate, to maintain their sales and/or production levels, listed NFCs will increase their borrowing.
	Weighted Average Loan Rate (%)	Worsen	Worsen*	An increase in Weighted Average Loan Rate (%) worsens NFC Sector Total Debt-to-GDP. This may be because the interest rates have a direct impact on the cost of a loan.
	Unemployment Rate (%)	Worsen	**Worsen***	An increase in Unemployment Rate (%) worsens NFC Sector Total Debt-to-GDP. Given that loan contracts are ratified before exogenous shocks are realised, and high unemployment can have a negative impact on multiple segments of the real economy, the univariate OLS results presented here may be because the denominator is falling at a faster pace than the numerator.
	Overall Fiscal Balance (TT$ Million)	Worsen	Improve	An increase in Overall Fiscal Balance (TT$ Million) improves NFC Sector Total Debt-to-GDP. This adverse development may occur as tight fiscal policy (higher taxes and/or lower fiscal expenditure) can squeeze economic agents' income/revenue, making them less inclined (or qualified) to borrow.

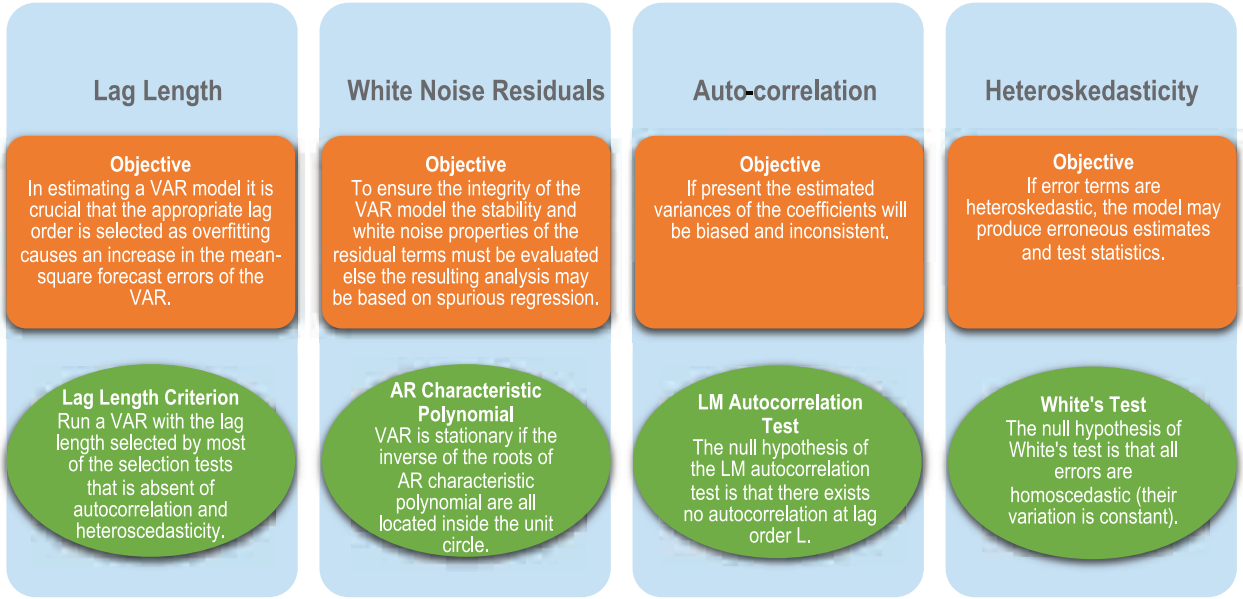
NFC Sector Total Debt-to-Equity	Real GDP Growth Rate (%)	Improve	**Worsen**	An increase in Real GDP Growth Rate (%) worsens NFC Sector Total Debt-to-Equity. This development suggests that when there is an increase in economic activity, listed NFCs are more willing to borrow (raising total debt, the numerator in the ratio NFC Sector Total Debt-to-Equity) to finance their operations than issue shares.
	Inflation Rate (%)	Improve or Worsen	**Worsen***	An increase in Inflation Rate (%) worsens NFC Sector Total Debt-to-Equity. This development suggests that when there is an increase in the inflation rate, listed NFCs are more willing to borrow to finance their operations than issue shares.
	Exchange Rate (TT$ to US$)	Worsen	**Improve**	An increase in Exchange Rate (TT$ to US$) improves NFC Sector Total Debt-to-Equity. This adverse development suggests that when there is an increase in the exchange rate, listed NFCs are more willing to issue shares (raising total equity, the denominator in the ratio NFC Sector Total Debt-to-Equity) to finance their operations than borrow. The preference for equity-based financing may be because exchange rates can raise loan values as they directly influence the cost of a good/service. In other words, if there is a depreciation NFCs may have to borrow additional funds to acquire necessary goods/services.
	Weighted Average Loan Rate (%)	Worsen	**Worsen***	An increase in Weighted Average Loan Rate (%) worsens NFC Sector Total Debt-to-Equity. This is because interest rates have a direct impact on the cost of credit.
	Unemployment Rate (%)	Worsen	**Worsen***	An increase in Unemployment Rate (%) worsens NFC Sector Total Debt-to-Equity. This development suggests that when there is an increase in the unemployment rate, listed NFCs are more willing to borrow to finance their operations than issue shares. The preference for debt may occur as firms recognise that individuals are less willing to take-up long-term investments when labour market conditions are depressed.
	Overall Fiscal Balance (TT$ Million)	Worsen	**Worsen***	An increase in Overall Fiscal Balance (TT$ Million) worsens NFC Sector Total Debt-to-Equity. This development may be because NFCs can access credit markets more readily when there is no competing interest from the government for loans.
NFC Sector Return on Equity	Real GDP Growth Rate (%)	Improve	Improve*	An increase in Real GDP Growth Rate (%) improves NFC Sector Return on Equity. In other words, higher economic activity improves listed NFCs profitability.
	Inflation Rate (%)	Improve or Worsen	Improve*	An increase in Inflation Rate (%) improves NFC Sector Return on Equity. This development may occur if NFCs possess economies of scale - the ability to reduce or spread the cost per unit of production as volume of production increases.
	Exchange Rate (TT$ to US$)	Worsen	Worsen*	An increase in Exchange Rate (TT$ to US$) worsens NFC Sector Return on Equity. This may be because exchange rates have a direct impact on financing costs - higher financial costs can reduce the avenues for firms to raise profits.
	Weighted Average Loan Rate (%)	Worsen	Improve*	An increase in Weighted Average Loan Rate (%) improves NFC Sector Return on Equity. This may be because, when faced with higher financial costs, businesses tend to cut back on operational expenditure (by for example downsizing or cutting staff) to help preserve their profitability.
	Unemployment Rate (%)	Worsen	Worsen*	An increase in Unemployment Rate (%) worsens NFC Sector Return on Equity. This may be because unemployment can greatly reduce the demand for business output.
	Overall Fiscal Balance (TT$ Million)	Worsen	Improve	An increase in Overall Fiscal Balance (TT$ Million) improves NFC Sector Return on Equity. As tight fiscal policy (higher taxes and/or lower fiscal expenditure) can squeeze economic agents' income/revenue, the observed univariate OLS result suggests that, during these periods, listed NFCs may impose cost-cutting measures (such as streamlining supply chains, downsizing and/or retrenching staff) to preserve their profitability.

NFC Sector Earnings-to-Interest Expenses	Real GDP Growth Rate (%)	Improve	Worsen	An increase in Real GDP Growth Rate (%) worsens NFC Sector Earnings-to-Interest Expenses. While higher economic activity presents listed NFCs with greater opportunities to raise their sales (increasing earnings before interest and taxes, the numerator in NFC Sector Earnings-to-Interest Expenses) earlier univariate OLS regressions (namely, NFC Sector Total Debt-to-Equity and Real GDP Growth Rate (%)) showed that listed NFCs will also raise their debt to meet the additional operational expenses over these periods (which will increase total interest expense, the denominator in the ratio NFC Sector Earnings-to-Interest Expenses). As such, the observed univariate OLS result for NFC Sector Earnings-to-Interest Expenses and Real GDP Growth Rate (%) may have occurred because total interest expenses grow at a faster rate than earnings before interest and taxes when there is an increase in real economic activity.
	Inflation Rate (%)	Improve or Worsen	Worsen*	An increase in Inflation Rate (%) worsens NFC Sector Earnings-to-Interest Expenses. This may be because high inflation can greatly reduce the demand for business output.
	Exchange Rate (TT$ to US$)	Worsen	Worsen*	An increase in Exchange Rate (TT$ to US$) improves NFC Sector Earnings-to-Interest Expenses. This may be because higher exchange rates increase the value of outstanding foreign debt (raising the denominator in this ratio).
	Weighted Average Loan Rate (%)	Worsen	Worsen*	An increase in Weighted Average Loan Rate (%) worsens NFC Sector Earnings-to-Interest Expenses. This is because interest rates have a direct positive impact on the denominator of this ratio (total interest expense).
	Unemployment Rate (%)	Worsen	**Worsen***	An increase in Unemployment Rate (%) worsens NFC Sector Earnings-to-Interest Expenses. This may be because unemployment can greatly reduce the demand for business output.
	Overall Fiscal Balance (TT$ Million)	Worsen	Worsen*	An increase in Overall Fiscal Balance (TT$ Million) worsens NFC Sector Earnings-to-Interest Expenses. This result coincides with findings from earlier univariate OLS regressions (namely, NFC Sector Total Debt-to-Equity and Overall Fiscal Balance (TT$ Million)) which showed that listed NFCs will raise their debt (which will increase total interest expense, the denominator in the ratio NFC Sector Earnings-to-Interest Expenses) when there is a fiscal surplus.

Source: Authors

Note: For the cells with an asterisk, the univariate OLS coefficients had signs that were consistent with a priori expectations. For the bolded cells, univariate OLS coefficients were statistically significant. Results that did not display statistical significance should be interpreted with care.

II.A6: VAR Model Specification Tests



Source: Adapted from EViews' Manuals and Lütkepohl (2007)

Note: **Orange** rectangles discuss the objective of the specification test and **green** ovals describe the test statistic or index for the specification test.

II.A6.1: VAR Lag Length Selection Tests

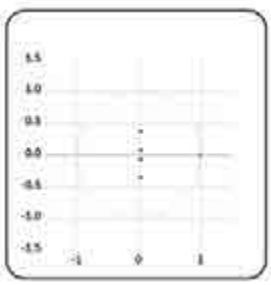
Econometric Model	Lag	LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
Household Sector NPL VAR	0	NA	0.00058	6.73726	6.98268	6.80237
	1*	**104.99630**	0.00001	2.98746	**4.46003**	3.37814
	2	27.41608	0.00002	2.96187	5.66157	3.67810
	3	34.67791	**0.00001**	**0.71046**	4.63731	**1.75225**
Business Sector NPL VAR	0	NA	1666.66400	21.60760	21.85630	21.66158
	1*	26.31073	3384.33500	22.23451	23.72668	22.55835
	2	32.09184	2427.33600	21.40628	24.14193	21.99998
	3	**38.87048**	**67.49818**	**16.01313**	**19.99227**	**16.87671**
Refinanced Loan Growth VAR	0	NA	0.18077	12.47868	12.71658	12.55141
	1*	137.33370	0.00217	8.02196	**9.44932**	8.45832
	2	40.61610	0.00143	7.41849	10.03532	8.21848
	3	**40.89302**	**0.00050**	**5.79645**	9.60275	**6.96008**
Consolidated Loan Growth VAR	0	NA	0.50185	13.49978	13.73768	13.57251
	1*	118.60010	0.01411	9.89458	**11.32195**	10.33094
	2	30.17800	0.01723	9.90512	12.52195	10.70511
	3	**49.28559**	**0.00296**	**7.58370**	11.39000	**8.74733**

Source: EViews' Output

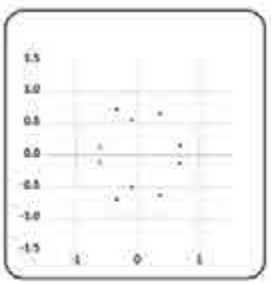
Note: Bold cells refer to the lag length selected by the criterion. Given that the literature suggests different criteria for estimating the maximum lag lengths a common way to overcome this problem, is to run a VAR with the lag length (selected by most of the selections tests) that is absent of autocorrelation and heteroskedasticity (Lütkepohl, 2007). Even so, given the short length of the time series, where possible, the paper used VARs with 1 lag length.

II.A6.2: VAR White Noise Residual Tests

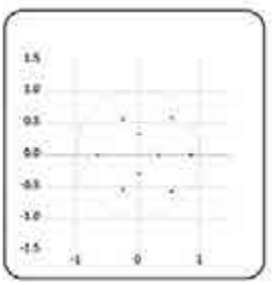
A. AR Characteristic Polynomial Roots Graph for Household Sector NPL VAR



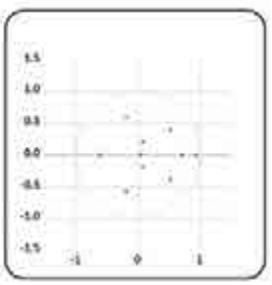
B. AR Characteristic Polynomial Roots Graph for Business Sector NPL Ratio VAR



C. AR Characteristic Polynomial Roots Graph for Refinanced Loan VAR



D. AR Characteristic Polynomial Roots Graph for Consolidated Loan Growth VAR



Source: EViews' Output

II.A6.3: Auto-correlation Tests

Lags	Household Sector NPL VAR		Business Sector NPL VAR		Refinanced Loan Growth VAR		Consolidated Loan Growth VAR	
	LM-Stat	Prob	LRE-Stat	Prob	LRE-Stat	Prob	LRE-Stat	Prob
1	**27.02973**	**0.3544**	**36.34792**	**0.0665**	**36.0721**	**0.0705**	46.68916	0.0053
2	**26.58611**	**0.3769**	**25.25737**	**0.4480**	**21.9648**	**0.6378**	**30.65887**	**0.2006**
3	**29.79876**	**0.2319**	51.49566	0.0014	**30.7798**	**0.1964**	**36.70229**	**0.0616**
4	**28.14121**	**0.3014**	**33.57217**	**0.1174**	**30.9203**	**0.1917**	**30.23501**	**0.2156**
5	**31.65133**	**0.1683**	**29.79549**	**0.2320**	**20.5849**	**0.7155**	**22.49593**	**0.6070**
6	**21.05976**	**0.6893**	**33.79945**	**0.1123**	**24.6843**	**0.4802**	**19.12206**	**0.7912**
7	**21.51083**	**0.6638**	**14.60537**	**0.9501**	**24.7634**	**0.4757**	**15.22373**	**0.9360**
8	**21.57154**	**0.6603**	**27.64479**	**0.3245**	**22.7145**	**0.5942**	**19.65486**	**0.7647**
9	**19.24253**	**0.7853**	**21.85320**	**0.6442**	**18.7194**	**0.8104**	**16.40728**	**0.9022**
10	**21.37936**	**0.6713**	**17.51620**	**0.8622**	**22.2530**	**0.6211**	**12.82927**	**0.9785**
11	**21.41352**	**0.6693**	**23.92052**	**0.5240**	**27.5457**	**0.3292**	**24.63256**	**0.4831**
12	**31.08799**	**0.1861**	**11.30375**	**0.9913**	**28.2546**	**0.2963**	**16.68012**	**0.8931**

Source: EViews' Output

Note: Bold cells refer to no autocorrelation for the associated probability of greater than 5 per cent.

II.A6.4: Heteroskedasticity Tests

Household Sector NPL VAR		Business Sector NPL VAR		Refinanced Loan Growth VAR		Consolidated Loan Growth VAR	
Chi-sq	P-value	Chi-sq	P-value	Chi-sq	P-value	Chi-sq	P-value
177.1508	0.0643	146.0840	0.5752	310.55214	0.3257	319.0958	0.2146

Source: EViews' Output

Note: All null hypothesis were significant at the 5 per cent level.

II.A7: Unit Root Test

All indicators, except for the key debt indicators[68], were differenced to the level that was recommended by at least two of the three traditional unit root tests.

Lags	Augmented Dickey Fuller Unit test		Phillips Perron test		Kwiatkowski-Phillips-Schmidt-Shin test	
	Test statistic	Level	Test statistic	Level	Test statistic	Level
Real GDP Growth Rate (%)	-5.7104	I(1)	-5.7044	I(1)	0.2081	I(0)
Inflation Rate (%)	-6.2966	I(1)	-12.0717	I(1)	0.3243	I(1)
Exchange Rate (TT$ to US$)	-3.2527	I(2)	-4.5848	I(2)	0.1120	I(1)
Weighted Average Loan Rate (%)*	-11.09544	I(2)	-4.6944	I(1)	0.3134	I(0)
Unemployment Rate (%)	-3.8519	I(1)	-3.9550	I(1)	0.2863	I(0)
Overall Fiscal Balance (TT$ Million)	-9.2014	I(0)	-8.7887	I(0)	0.1849	I(0)

Source: EViews' Output

Note: As each unit root test produced a different result for this statistic, the paper settled on using first differenced Weighted Average Loan Rate (%) as two of the three unit root tests indicated that this variable had a unit root.

[68] To improve the interpretability of the final results as "differencing, a standard approach for reducing nonstationarity, can distort multivariate interactions" (Zapata and Garcia 1990).

II.A8: Proposed Data Requirements for the Household and NFC Sectors

Time Frame	Sector	Focus	Intention	Data Requirements	Collection Frequency	Possible Institutions to Collaborate With
Short-term	**Household and NFC**	Stock taking of information available to monitor activities in the sectors	To identify and develop proposals to close major data gaps.	NA	• There is no agreed protocol on the timing of repeat investigations on the balance sheet positions of NFCs. In various jurisdictions data collection frequency appears to depend on agency resources, the size of the NFC sector and survey costs. • Several key statistics in the household sector are best captured through the use of large-scale surveys on the population. Given that this is typically a cost-intensive exercise, it is recommended that these surveys be carried out annually.	• The Central Statistical Office (CSO) • The Ministry of Planning and Development • The Trinidad and Tobago Stock Exchange (TTSE) • The Trinidad and Tobago Securities and Exchange Commission (TTSEC) • Ministry of the Attorney General and Legal Affairs • The Credit Bureau of Trinidad and Tobago
Medium-term	**NFC**	Revenue and expenditure	To assess NFCs' profitability.	**Total revenue:** *Revenue from sales of goods and services* *Interest income* **Total expenses:** *Cost of sales* *Interest expenses* *Taxes*		
		Financial structure	To assess how NFCs finance their overall operations.	**Financial assets:** *Currency and deposits* *Debt securities* **Total liabilities:** *Loans* *Debt securities* *Other liabilities* **Total equity:** *Capital and reserves*		
		Non-financial assets	Non-financial assets are important in evaluating a company's long term viability.	**Non-financial assets:** *Buildings* *Inventory* *Equipment*		
		Adjustments to financial statements	Hidden expenses have a tendency to worsen companies' financial positions.	**Extraordinary items:** *Provisions for bad debts and uncollectible accounts*		
	Household	Gross disposable income	The amount of money households have available for spending and saving after income taxes is used to gauge the overall state of the economy and provides a measure of their ability to satisfy debt obligations.	**Income:** *Wages and salaries from employment* *Property income receivable* *Current transfers (for example from government)* *Other income* **Taxes and contributions:** *Taxes including social security contributions and other current transfers*		
		Total assets.	The wealth of the household provides a measure of their ability to satisfy debt obligations.	**Non-financial assets:** *Residential and commercial real estate* *Other non-financial assets* **Financial assets:** *Currency and deposits* *Debt securities* *Shares and other equity* *Financial derivatives* *Other assets*		
		Liabilities.	An understanding of the complete indebtedness of a household aids in measuring the susceptibility to economic and financial market shocks.	*Financial derivatives* **Debt:** *Loans* *Other liabilities*		
		Other useful statistics.	To deepen assessments on the household sector.	*Debt-service payments (interest and principal)* *Debt collateralised by real estate* *Consumer Confidence Index* *Other qualitative statistics*		
Long-term	**NFC**	Credit history.	It is important to gauge how NFCs manage their financial responsibilities. These statistics help to not only flag potential credit risks but can also aid financial institutions to improve their general provisioning regimes.	**Credit details:** *Loan status* *Collateral value* *Number of late payments* **Interest rate type:** *Fixed* *Floating* *Hybrid*		
		Upcoming maturities on the loan and bond markets.	The timelines for financial debt instruments may provide valuable insight on the sustainability of NFCs' debt portfolios.	**Loan term:** Short-term Medium-term Long term **Maturity date of the bond**		

Source: Authors

CHAPTER II
END

CHAPTER III
MACRO-FINANCIAL LINKAGES IN TRINIDAD AND TOBAGO

Yannick Melville

ABSTRACT

The paper determines domestic macro-financial linkages by using deterministic forecasting techniques to simulate how economic developments affect key risk indicators of the banking and insurance sectors. Ordinary Least Square regressions found that a stable energy and foreign exchange market were critical to the positive performance of the financial sector. Meanwhile, Autoregressive Distributed Lag models showed that the domestic financial sector demonstrated significant resilience to softer economic conditions. Be that as it may, there were some unfavourable movements in a few risk indicators. While these developments did not signal a significant deterioration in financial stability, it should be noted that: (i) long-term insurance companies appeared most susceptible to credit risk; (ii) financial institutions prefer to keep their liquidity levels high during 'bad times' and; (iii) the observed financial sector (particularly commercial banks and long-term insurance companies) increase their exposure to the sovereign during economic downturns.

III.1 INTRODUCTION

Several theories have been put forward in an attempt to establish the driving factors behind financial crises. Earlier works believed that failures in financial institutions occur due to negative macro-economic shocks (Ostrup, Oxelheim and Wihlborg 2009). However, the more recent studies note that crises occur when a financial problem subverts macro-economic stability (Gerba, Henry and Żochowski 2017).

The differences between the two 'schools of thought' are best demonstrated when evaluating the 2010 European Union (EU) Sovereign Debt Crisis (SDC) and the 2007/08 United States of America (US) Mortgage Liquidity Crisis (MLC). More specifically, for the 2010 EU SDC, large current account and fiscal deficits in a mix of core and periphery European countries contributed, to almost €1 trillion in losses in European banks between 2007 and 2010 (European Commission 2014, Gourinchas, Martin and Messer 2017). On the other hand, for the US MLC, American households lost nearly US$20 trillion worth of their financial assets as elaborate mortgage-backed securities sent several major financial intermediaries into receivership between 2006 and 2009 (Goodwin, et al. 2019). Irrespective of the classification used, as each sector turned into a powerful propagator of shocks which initially were not generated inside it, regulatory communities have recognised that the links between the real and the financial sector are key in the run-up to financial crises (BIS-FSB-IMF 2011).

In Trinidad and Tobago, oil and gas production accounts for a large share of the economy's Gross Domestic Product (GDP). As an energy-based economy, the financial sector intermediates a portion of the flows between oil and gas companies and the government. The domestic financial system accounted for 8.9 per cent of

GDP (as at June 2020), but is not a significant provider of finance to the energy sector. Nevertheless, macro-financial links have had a significant impact on Trinidad and Tobago's economic stability as the collapse of a major local and regional financial institution in 2009, spilt over to the domestic economy, causing an approximate loss of 10 per cent of GDP (Dookeran 2010). Following this systemic event, several pieces of legislation were passed to improve how domestic regulators: (i) pro-actively treat vulnerabilities that could ultimately disrupt financial stability and; (ii) flag potential **systemic risks**. In keeping with the demand for highly sophisticated risk measurement systems to help support these objectives, the paper seeks to determine the nature and robustness of domestic macro-financial linkages – the interactions and channels between the financial sector and the macro-economy through which domestic and external shocks can flip the state of the financial sector from stability to instability (BIS 2011). More specifically, the paper aims to: (i) evaluate how domestic economic activity affects the financial system and; (ii) establish how this relationship influences the build-up and spread of systemic risks in Trinidad and Tobago. To this avail, the remainder of the paper is organised as follows. Section III.2 reviews the relevant literature on macro-financial linkages. Section III.3 provides a historical overview of the domestic macro-financial environment. Section III.4 presents the data and methodological approach that will be used to gauge domestic macro-financial linkages. Section III.5 discusses the results of the model, including a comparison with previously noted works and Section III.6 discusses the policy implications of the domestic macro-financial linkages and concludes with some recommendations for future work.

III.2 LITERATURE REVIEW

To best understand macro-financial linkages one must first cover the economic sectors and transmission channels that transmit systemic risk across the real and financial systems (see Figure III.1). With this in mind, it should be noted that the literature highlights three key economic sectors (Beck and Torre 2006, Demirgüç-Kunt and Levine 2008, Dieterich, et al. 2018). These include: (i) the financial sector, which supports the production and consumption activities of economic agents in the household and corporate sectors; (ii) the real sector, which produces goods and services and; (iii) the public sector, which can influence the economy through monetary and fiscal policies, but their actions may be constrained by the external sector as exogenous shocks could push borrowers into financial distress.

The propagation and amplification of the conditions in these sectors take place through transmission channels. The literature (BIS 2011) specifically identifies three transmission channels, which broadly relate to macro-financial linkages. Firstly, the borrower balance sheet channel which applies to the corporate and household sectors and stems from the inability of lenders to fully assess borrowers' risks and solvency (research on the borrower balance sheet channel focuses on asset prices and default-risk indicators). The second transmission channel, the bank balance sheet channel recognises that adverse shocks to financial institutions' balance sheets can fuel sharp contractions in credit which can have magnified effects on economic activity (asset size and bank capitalisation have been noted to influence the strength of the bank balance sheet channel). Research on the final transmission channel, the liquidity channel, is a bit more involved as Brunnermeier (2009), draws a distinction between two types of liquidity, funding liquidity (an institutions' ability to get funding) and market liquidity (the ease with which an institutions' assets can be traded). In the literature, leverage and maturity mismatch indicators are typically used to capture movements in the liquidity channel.

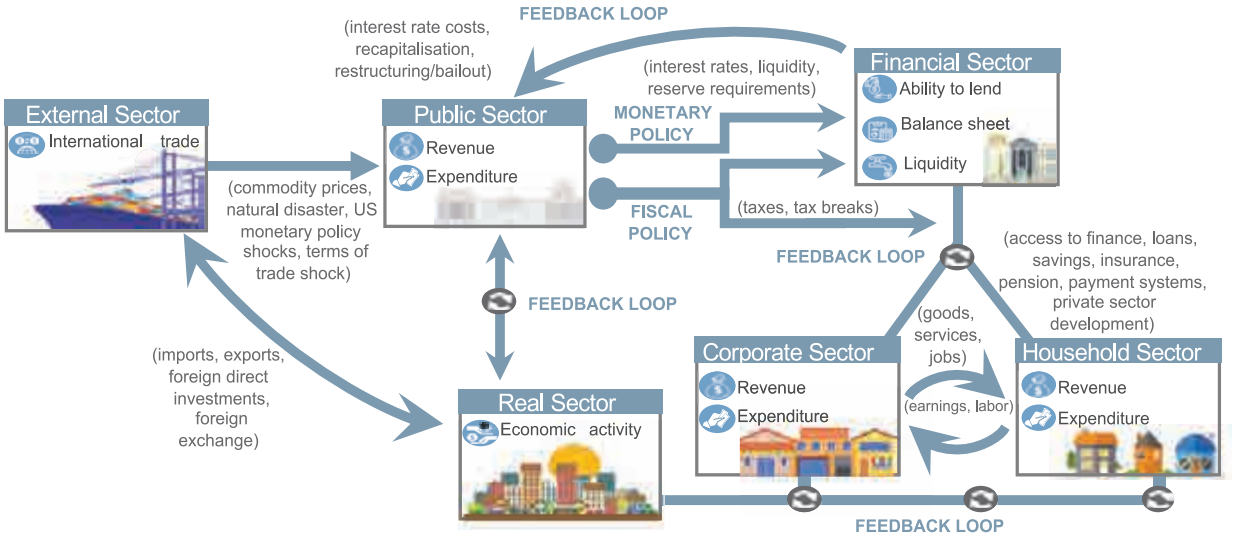
In light of the preceding, most country studies on macro-financial linkages use stress-testing techniques to disentangle domestic macro-financial linkages as these systems simulate the interactions and channels between the financial sector and the macro-economy through which domestic and external shocks can flip the state of

the financial sector from stability to instability (BIS 2011). Traditionally, these models fell into two broad categories; single equation tests (which look at the impact of a marked change in a key macro-economic variable on financial institutions' balance sheet positions) and multi-equation tests (which use a system of equations to capture a situation that could impair the resilience of the financial sector). Examples of these techniques in practice are highlighted in Gremi (2013) and Prieto, Eickmeier and Marcellino (2016). More specifically, Gremi (2013) explored the link between macro-economic developments and the financial sector by estimating how GDP growth, inflation, unemployment, interest rates and exchange rates affect non-performing loans for commercial banks in Albania between 2005 and 2013. Using an Ordinary Least Square Regression Gremi (2013) found that periods of economic growth are typically characterised by high levels of lending and low levels of non-performing loans. Further, inflation has a small negative impact on problem loans while interest and exchange rates share a positive correlation with credit quality. Prieto, Eickmeier and Marcellino (2016) on the other hand, attempted to evaluate macro-financial conditions in the United States by using a Bayesian Vector Autoregressive model to estimate how financial conditions affected real sector activity between 1958 and 2012. The paper's model used GDP growth, the GDP deflator, inflation, house price inflation, the corporate bond spread, stock price inflation and the Federal Funds rate. Impulse Response Functions and Variance Decompositions showed that: (i) over 2008/09, for GDP, the explanatory power of financial shocks rose to roughly 50 per cent; (ii) over time credit spread shocks impact on growth increased, and (iii) negative housing market shocks have a more significant impact on the macro-economy than positive shocks.

Despite the purported benefits of single and multi-equation stress tests, following the difficulties regulators faced in dealing with the events that unfolded during the 2008/09 global financial crisis (GFC), international financial organisations (BIS 2009, IMF 2012) advised countries to adopt **dynamic stress testing**. These systems are attuned to better capture macro-financial linkages as they consider the intra-sectoral and inter-sectoral links between the real and financial sector that can fuel systemic risks. Yet still, adherence to dynamic stress testing principles in practice has been uneven (IMF 2012). Notably, this may be because dynamic stress testing is often difficult to implement as these systems typically call for models that can estimate multiple non-linear relationships simultaneously (Grauwe 2010). In the literature, this is often accomplished by using Dynamic Stochastic General Equilibrium (DSGE) models – a macro-economic method that applies microeconomic principles and general equilibrium theory in a tractable manner to better predict economic phenomenon. DSGEs have two distinguishing features: (i) macro-economic behaviors are estimated from basic assumptions involving the rational and forward-looking optimising behaviour of individual economic agents; and (ii) they capture fundamental interactions between households, firms and policy makers (BIS 2011). Financial regulators have significantly benefited from DSGEs when it comes to prudential supervision as indicated in Geršl et al. (2012). Specifically, Geršl et al. (2012) notes that, while the Czech National Bank (CNB) uses Autoregressive Fractionally Integrated Moving Average with Exogenous Input (ARIMAX)[69] to predict movements in key risk indicators (for their financial system) to baseline and adverse scenarios, the values for these scenarios came from the CNB's DSGE model. Notwithstanding the previous, the DSGE is an econometric approach that depends heavily on access to granular data across the real and financial sectors. For developing countries, these data can be difficult to obtain as indicated in Dieterich, et al. (2018) which used *"diverse approaches"* to traverse some data gaps when assessing macro-financial linkages in low-income countries in sub-Saharan Africa. Nevertheless, as the CNB's methodology was based on the rules of the European Banking Authority for EU-wide stress testing, and keeping in line with international best practices, the paper will evaluate macro-financial linkages in Trinidad and Tobago through an approach similar to that of the CNB.

[69] Geršl et al. (2012) notes that Autoregressive Distributed Lag (ARDL) models have also been used in a few instances.

Figure III.1: Snapshot of the Macro-Financial Linkages That Transmit Systemic Risk Across the Real and Financial Systems



Source: Adapted from Dieterich, et al. (2018)

III.3 STYLISED FACTS

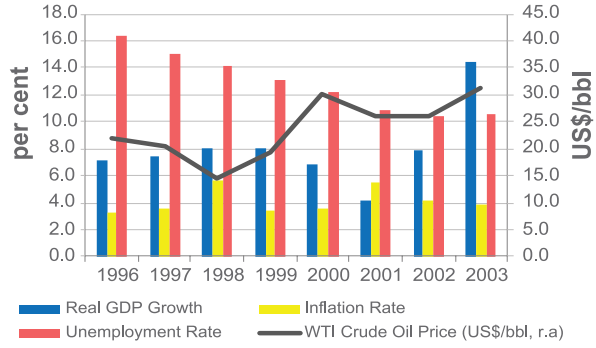
Between 1996 and 1998 several oil exploration and development companies signed production sharing contracts with the Government of the Republic of Trinidad and Tobago (GORTT). Meanwhile, in 1999, Trinidad and Tobago entered the liquified natural gas market with the commissioning of Atlantic LNG Train 1 plant, while methanol production received a boost (in 2001) with the coming on-stream of the Titan Methanol Company (MEEI 2014). Due to these initiatives, inter alia, between 1996 and 2003 **(Figure III.2)**: (i) real economic activity accelerated from 7.1 per cent to 14.4 per cent; (ii) unemployment fell from 16.3 per cent to 10.5 per cent; and (iii) the inflation rate hovered between 3 and 6 per cent. Further, to support economic activity, monetary policies were loosened – the Central Bank of Trinidad and Tobago (CBTT) also began to move away from direct monetary instruments.[70] Collectively, these accommodative economic conditions supported a sustained period of high credit growth **(Figure III.3)**.

GDP grew at a more moderate pace in 2007 and 2008, with much of the fall off occurring as energy sector production fell *"because of lower output associated with maturing oil fields" (CBTT 2007) and "technical problems at major energy plants"* (CBTT 2008). Furthermore,

[70] The CBTT implemented an indirect monetary policy framework based on the use of the Repurchase ('repo') rate – the rate that the CBTT charges commercial banks for borrowing funds on an overnight basis (CBTT 2009)c).

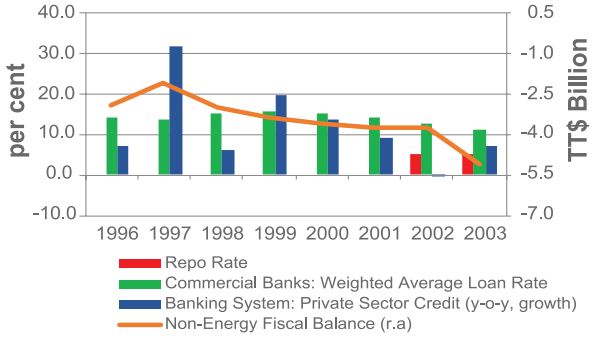
international food prices leapt considerably due to "biofuel demand, growing incomes in emerging economies, depreciation of the US dollar and speculation" (FAO 2009). Collectively, these developments (lower energy sector production and high international food prices) fueled domestic inflationary pressures **(Figure III.4)**. To combat this surge in prices, the Central Bank of Trinidad and Tobago (CBTT) adopted a tight monetary stance and the repurchase agreement (repo) rate was raised, in small increments, from 5 per cent in 2004 to 8.75 per cent by 2008.[71] However, in 2009, the monetary stance was re-evaluated as: (i) the economy contracted amid a collapse in oil and gas prices due to low global demand for energy commodities with the deepening of the international financial crisis (CBTT 2009, GORTT 2009) and; (ii) the CBTT received a request for extensive liquidity support from a major financial conglomerate, the CL Financial Group, in January 2009 (CBTT 2018a). Despite these interventions, economic activity in the financial sector subverted, as evidenced by the declines in the profitability ratios for the banking and insurance sectors **(Figure III.5)**.[72]

Figure III.2: Selected Indicators of Real Sector Activity: 1996 – 2003



Source: Central Bank of Trinidad and Tobago

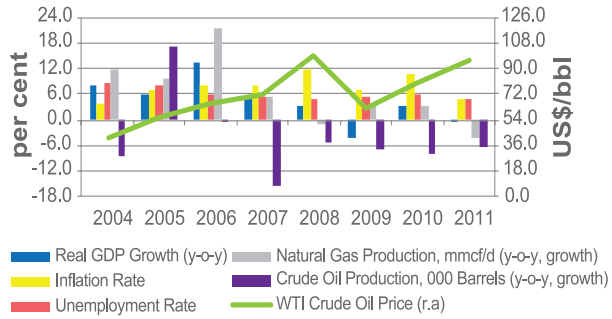
Figure III.3: Selected Indicators of Public and Financial Sector Activity: 1996 – 2003



Source: Central Bank of Trinidad and Tobago

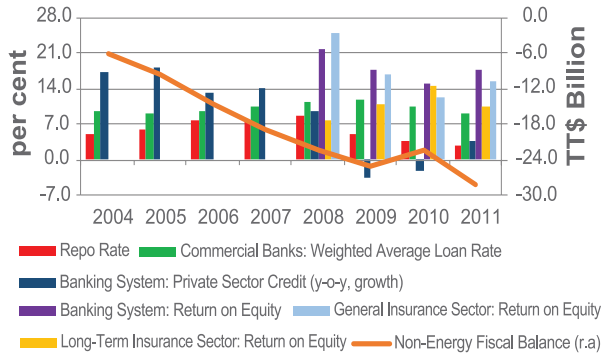
Note: y-o-y stands for year-on-year while r.a stands for right axis. Also, the banking system is comprised of 8 commercial banks and 16 non-bank financial institutions (NBFIs).

Figure III.4: Selected Indicators of Real Sector Activity: 2004 – 2011



Source: Central Bank of Trinidad and Tobago

Figure III.5: Selected Indicators of Public and Financial Sector Activity: 2004 – 2011



Source: Central Bank of Trinidad and Tobago

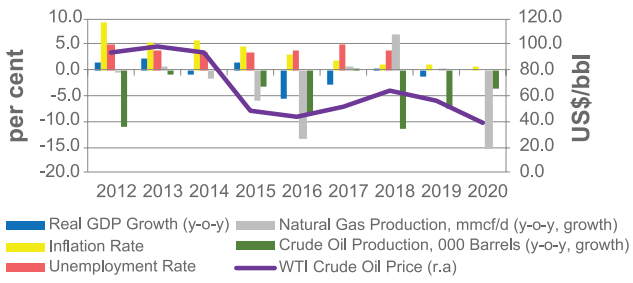
[71] In May 2002, the CBTT introduced a new framework for the conduct of monetary policy, the repurchase agreement (repo) rate.

[72] In 2009, the banking and insurance sectors represented 65.4 per cent of total financial system assets under supervision. Also, Life Insurance and Non-Life have been renamed as Long-Term and General Insurance, respectively, following the proclamation of the Insurance Act on January 1st , 2021.

Although interest rate cuts improved private sector credit growth in 2011, 2012 and 2013, higher lending did not have the desired impact on the real sector as Trinidad and Tobago experienced multiple periods of sluggish growth – due in part to oil and gas production stoppages (see **Figure III.6**) as a result of safety upgrades/maintenance work at several major companies in the domestic energy sector (CBTT 2015). In addition, facing growing competition from the shale energy market, the Organization of Petroleum Exporting Countries raised their production quotas in 2014 to make oil prices more competitive. This, alongside a fall in economic activity in key energy-intensive emerging market countries (IMF 2016), fueled a 54 per cent drop **(see Figure III.6)** in oil prices between 2014 and 2016. While budgetary adjustments cushioned some of the impact of the trade shock, the domestic economy contracted in 2016 and 2017. Be that as it may, there was some rebound in GDP growth in 2018, as several large-scale gas projects came on stream (CBTT 2018c).

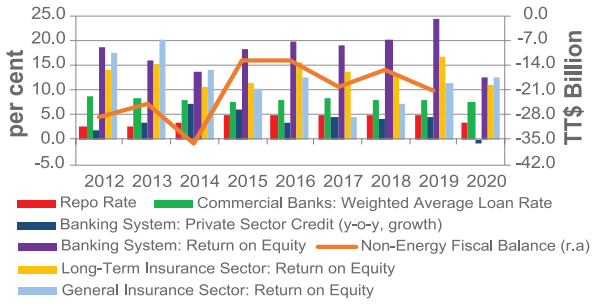
Further, as indicated by the relatively high financial ratios observed in **Figure III.7**, "the financial sector in Trinidad and Tobago is sound and has demonstrated resilience to the softer economic conditions" (CBTT 2018b). However, presently growth prospects for the financial sector may be tilted to the downside as the COVID-19 pandemic has weighed heavily on economic conditions over 2020. For instance, Labour Minister Stephen Mc Clashie noted that the Labour Ministry received 2,262 retrenchment notices from January to October – this number exceeded the annual retrenchment figures for the last five years (Alexander 2020). Also, according to a survey by Trinidad and Tobago's Confederation of Regional Business Chambers, approximately 5,000 businesses have closed in T&T over the last 12 months since the pandemic hit in 2020 (Lall 2021). Notably **(Figure III.7)**, these factors, inter alia, have: (i) lowered financial sector profits (particularly for the banking and long-term insurance sector); and (ii) reduced credit growth.

Figure III.6: Selected Indicators of Real Sector Activity 2012 – 2020



Source: Central Bank of Trinidad and Tobago

Figure III.7: Selected Indicators of Public and Financial Sector Activity 2012 – 2020



Source: Central Bank of Trinidad and Tobago

Note: There is no domestic publicly available data for: (i) Real GDP Growth for 2020; (ii) Unemployment Rate for 2019 and 2020; and (iii) the Non-Energy Fiscal Balance for 2020.

III.4 DATA AND METHODOLOGY

Although the CNB's process for banking sector dynamic stress testing was followed to design the approach used to determine the nature and robustness of domestic macro-financial linkages in Trinidad and Tobago, to support research on the inherent risks within the macro-financial sector, dynamic stress tests were conducted on commercial banks, NBFIs and, the long-term and general insurance sectors.[73] Further, as with Dieterich, et al. (2018), the paper focused on financial institutions' response to macro-economic shocks that can fuel; credit, income, foreign exchange, liquidity, solvency and sovereign risks.

III.4.1 Data

Considering the literature, quarterly data (from March 2009 to December 2020[74]) for the following indicators **(Table III.1)** were used to proxy; credit, income, foreign exchange, liquidity, solvency and sovereign risks for each of the observed financial sectors:

Table III.1: Systemic Risks Evaluated in the Model

Risk	Description	Commercial Banking Sector Risk Indicators	NBFI Sector Risk Indicators	Long-Term Insurance Sector Risk Indicators	General Insurance Sector Risk Indicators
Credit	The risk that counterparties will fail to honour their debt obligations.	NPLs-to-Gross Loans (Non-Performing Loans-to-Gross Loans)	NPLs-to-Gross Loans	Asset Quality ((Real Estate + Unquoted Equities + Debtors)/Total Assets)	Asset Quality
Income	Financial institutions' ability to use their income to absorb stress related losses.	NII-to-Gross Income (Non-Interest Income-to-Gross Income)	NII-to-Gross Income	Investment Yield	II-to-NP (Investment Income-to-Net Premium)
Foreign Exchange	The risk of reduced earnings due to adverse fluctuations in exchange rates.	NOPFXCL (Net Open Position in Foreign Exchange-to-Capital)	NOPFXCL	NOPFXCL	NOPFXCL
Liquidity	Institutions' may not have immediate access to funds to meet their financial obligations.	LA-to-TA (Liquid Assets-to-Total Assets)	LA-to-TA	LA-to-CL (Liquid Assets-to-Current Liabilities)	LA-to-CL
Solvency	The risk that a bank cannot meet maturing obligations because of a negative net worth.	Regulatory Capital to-RWA (Regulatory Capital to Risk-Weighted Assets)	Regulatory Capital to-RWA	Capital-to-TR (Capital-to-Technical Reserves)	Capital-to-Assets
Sovereign	High levels of sovereign debt can give rise to debt sustainability concerns.	GLITA (Government Loans and Investments to Total Assets)	GLITA	GNLITA (Government Net Loans and Investments to Total Assets)	GNLITA

Source: Adapted from Geršl, Jakubík and Konečný, et al. (2012), BCBS (2013), Henry and Kok (2013), Almarzoqi, Naceur and Scopelliti (2015), BCBS (2017), CBR (2017) and ECB (2017)

[73] As of December 2020, these institutions collectively make up approximately 61.6 per cent of total domestic financial system assets. While pension funds are regulated by the CBTT, at the time of this study, there were not enough observations to effectively evaluate the linkages between the pension and real sectors.

[74] The period for the analyses was dependent on data availability.

III.4.2 Methodology

Dynamic stress testing uses **hypothetical macro-economic scenarios and deterministic forecasting techniques**[75] to predict movements in key balance-sheet items (Geršl, Jakubík, et al. 2012, CBR 2017).

III.4.2.1 Hypothetical Macro-Economic Scenarios

The general starting point for any stress testing exercise is the scenario, the set of hypothetical events that could have a bearing on the resilience of the financial system (Geršl, Jakubík, et al. 2012). Dynamic stress testing exercises (DSTE) are often based on baseline (projections of key macro-economic variables under the actual or current state of affairs) and adverse (projections of macro-economic variables under a set of unfavorable conditions) scenarios.[76] Various econometric models can be employed to develop these macro-economic scenarios but, *"at present, there is no single 'best' approach for macroprudential modelling; the approach must be tailored to the data available and to the question at hand"* (BCBS 2012). With this in mind, to help determine domestic macro-financial linkages, the paper followed the CNB. It used in-house forecasts and assumptions (see **Table III.2)** to develop its baseline and adverse hypothetical macro-economic scenarios.

The CBTT's in-house forecasting regime follows recommendations outlined in the IMF's financial programming and policy (FPP) program where, *"the forecaster calibrates or estimates the parameters of the relationships supplied by economic theory to arrive at values that are reasonable for the country in question"* (IMF 2013). It should be noted that the IMF's FPP program forecasts over 100 variables; however, the more independent variables in a forecasting model, the more uncertainty there is about the validity of the model (Steve 1993). With this in mind, existing literature on dynamic stress testing informed the choice of the following candidate explanatory variables from the CBTT's FPP database (see **Table III.3**).

Table III.2: Macro-Economic Scenario Assumptions[77]

Baseline Scenario Assumptions	Adverse Scenario Assumptions
• Energy prices are likely to remain well contained in 2019 and 2020 as the Organization of the Petroleum Exporting Countries has decided to maintain its output levels until their 176th meeting (Tan 2018). • The domestic economy is expected to receive a boost from several anticipated large scale projects in the energy and non-energy sectors. The positive turnaround in the real sector is expected to fuel improvements in lending and investment.	• The adverse forecasts for 2021 and 2022 assume that the direct and indirect impact of COVID-19 on Trinidad and Tobago will worsen. Namely, energy prices will remain weak due to falling global energy demand and excess supply while the economic costs of providing preventative health care measures will deepen. • Based on the aforementioned: (i) energy sector production may contract; (ii) no growth may be recognised for 2021 (there may be a subtle recovery in economic conditions in 2022); (iii) unemployment is likely to increase; (iv) inflation may remain low (under two per cent); and (v) fiscal deficits may widen due to falling revenue and a rise in spending on health care measures.

Source: Author

[75] Deterministic forecasting techniques refer to econometric models that make projections of the dependent variable using known, future values of the independent variables (Hyndman and Athanasopoulos 2013).

[76] The baseline scenarios are used to validate the efficacy of the forecasting regime while the adverse scenarios are used to inform policy decisions (Geršl, Jakubík, et al. 2012, BBk 2015).

[77] Baseline projections for the risk indicators were only estimated for 2019 and 2020 (to generate the out-of-sample test statistics needed to evaluate the efficacy of the forecasting approach used in the paper) while adverse projections for the risk indicators were estimated for 2021 and 2022.

Table III.3: A priori Expectations

Macro-economic Variable	A priori Expectation						Reasons
	Credit	Income	Foreign Exchange	Liquidity	Solvency	Sovereign	Why
Real GDP Growth (%)	Decrease (-)	Increase (+)	Decrease (-)	Increase (+)	Increase (+)	Decrease (-)	Higher economic activity can raise incomes, improving loan and premium payment capacities (Adebola, Yusoff and Dahalan 2011, Rasmidatta 2011).
Inflation Rate (%)	Increase (+)	Decrease (-)	Increase (+)	Decrease (-)	Decrease (-)	Increase (+)	Higher inflation can; discourage investments, hamper borrowers' ability to meet their debt obligations and compromise asset values (Audo 2014).
Exchange Rate (TT$ to US$)	Increase (+)	Decrease (-)	Increase (+)	Decrease (-)	Decrease (-)	Increase (+)	While a depreciation can help to improve export revenue, a lower exchange rate can decrease purchasing power and with it, loan and premium payment capacities and dampen external liquidity by compromising the value of financial sector's foreign-asset holdings (Takáts and Villar 2011).
WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu), Natural Gas Production (mmscf/d) and Crude Oil Production (bbl/d)	Increase (+) or Decrease (-)						Maino, Imam and Ojima (2013) found that government spending, augmented by activities in the energy sector, may raise businesses' and households' incomes but, the new found optimism can encourage overspending which may reveal itself over time in the form of rising loan defaults and/or missed premium payments.
Unemployment Rate (per cent)	Increase (+)	Decrease (-)	Increase (+)	Decrease (-)	Decrease (-)	Increase (+)	Is negatively correlated with household debt, loan and premium payment ability and financial sector liquidity (Steffen, Hackethal and Tyrell 2010).
Overall Fiscal Balance (TT$ Billion)	Increase (+) or Decrease (-)						Fiscal deficits can stimulate economic activity. Higher economic activity can improve the incomes of business enterprises and households and with it their financial solvency (Mileris 2014). At the same time, large government demand for bank credit can crowd-out the amount of funds available for private sector lending (Hamed 2017). This can impede private sector consumption and investment activities.
Current Account Balance (US$ Billion)	Decrease (-)	Increase (+)	Decrease (-)	Increase (+)	Increase (+)	Decrease (-)	A surplus can improve creditors' repayment ability as higher export revenues can improve the financial well-being of borrowers involved in the exporting sectors. The higher inflows from portfolio investments can also improve the financial sector's external liquidity (Dieterich, et al. 2018).

Source: Author

Note: For credit, foreign and sovereign risks (-) implies improve and (+) implies worsen while, for income, liquidity and solvency risks (-) implies worsen and (+) implies improve.

To ensure that the deterministic forecasts were based on independent variables with economically meaningful and statistically significant relationships with the risk indicators, the paper used univariate OLS Regressions to screen each variable against the dependent variable.[78] In the literature, this approach is called univariable prefiltering and is one of the more popular variable selection approaches in many fields of research (Martinez-Selles, et al. 2015, Heinze, Wallisch and Dunkler 2018). Even so, univariable prefiltering is not without faults, as Heinze and Dunkler (2017) note that univariable prefiltering can lead to overlooking important adjustment variables (as well as confounders[79]) needed for control in cause-and-effect models. Additionally, univariable prefiltering does not account for the casual relationships between the other independent variables. As such, there is no guarantee that independent variables that met the univariable variable selection criteria will retain their economically meaningful and statistically significant coefficients in the latter steps of the analysis (that is, when they are combined with other independent variables to estimate movements in the dependent variable). Regardless, the paper still adopts univariable prefiltering as: (i) weak predictors can increase model uncertainty; (ii) multivariable models become unstable with too low events-per-variable[80]; and (iii) the variable selection method must be appropriate for the problem at hand – which in this case is investigating which macro-economic variables drive movements within the financial sector.[81]

III.4.2.2 Deterministic Forecasting Techniques

In DSTEs, **deterministic forecasting techniques** generate the response of the key risk indicators for the financial system under the baseline and adverse scenarios. While no single technique is perfectly suited for deterministic forecasting (Ong 2014), for valid analyses, it is important to use a model that both preserves the sense of known economic relationships and also exhibits high predictive ability (Papadopoulos, Papadopoulos and Sager 2016). For this reason, while Geršl et al. (2012) showed that the CNB used ARDL and ARIMAX regressions for their DSTEs, the paper's recommendations were based on findings from ARDLs (see **Appendix III.A2**).

III.5 RESULTS AND DISCUSSION

Table III.4 presents the results of the univariate OLS regressions. Given a priori expectations, the overall fiscal balance and international and local energy market developments had the most significant coefficients. The observed nexus between the fiscal, energy and financial sectors appears to be pro-cyclical, a finding consistent with Dieterich, et al. (2018) where, *"case studies in oil-producing countries (Chad, Equatorial Guinea, and Republic of Congo) illustrated how oil price slumps can increase government domestic arrears, which translates into a deterioration of banks' balance sheets"* (Dieterich, et al. 2018). For the results that did not conform with a priori expectations, it was observed that an increase in; (i) GDP heightened credit and solvency risks; (ii) inflation decreased income, foreign exchange, liquidity and sovereign risks; (iii) the exchange rate improved credit risks; (iv) the current account balance increased credit risk; and (v) unemployment mitigated foreign exchange and sovereign risk. While these contradictions may suggest underlying issues with the variable selection process, consideration must be given to the 'traits' of the domestic environment. For instance, government-

[78] 2018 was used as the cut off point for this analysis as 2019 and 2020 observations were used to generate the out-of-sample test statistics needed to evaluate the efficacy of the dynamic stress testing approach used in the paper.

[79] Independent variables that influence both the dependent and other independent variables in a model.

[80] Some researchers argue for ten observations per independent variable (often called the 'rule of ten') and the dataset only contains 48 observations but 10 independent variables.

[81] The univariable prefiltered results can be found in Appendix III.A1.

funded Social Sector Investment Programmes and monetary policy interventions, may artificially suppress unemployment's and inflation's (respectively) natural interaction with the financial system.

Further, the energy and fiscal sector developments hinted at a pro-cyclical macro-financial system. With this in mind, the adverse univariate OLS results may be explained by Frait and Komárková's (2011) views on pro-cyclicality, the financial cycle and systemic risk. That is, at the macro level, temporary cyclical improvements in the economy (an increase in GDP or the current account balance) can fuel a substantial increase in the demand for goods and services. To capitalise on the prevailing economic conditions and expand their assets faster than their competitors, financial institutions may lower their standards for these transactions. However, the risks from these practices often reveal themselves during economic contractions when higher exchange rates compromise the value and returns from over-inflated, risky assets (raising foreign exchange, income and liquidity risks). Moreover, scarce liquidity may force banks to divest or limit their sovereign exposures. While this could mitigate sovereign risks, limiting governments' financing options may inhibit fiscal policy measures and, with it, the economic recovery effort.

Notwithstanding the preceding, given the requirements for univariable prefiltering, the independent variables for deterministic forecasting must also be statistically significant. Based on this, the t-statistics and p-values from the univariate OLS regressions showed that in most cases, economic growth, inflation, unemployment, the overall fiscal balance and the current account balance did not contribute significantly to the observed financial sector's overall performance. Instead, movements in the financial system appear to be driven largely by; developments in the international and local energy markets, and changes to the exchange rate. This may be because, **the dependency on the energy sector has made the domestic economy vulnerable to external shocks**, which as shown in Bobb and Sonnylal (2018), typically manifest themselves through foreign exchange earnings. In other words, following the domestic literature, a stable energy market, characterised by steady foreign exchange rates, is critical to fostering financially inclusive economic growth in Trinidad and Tobago.

Following the univariate OLS analysis, several specification tests were used to check the stability of the ARDL models (see **Appendix III.A2**). The diagnostic checks indicated that most models (88.5 per cent of 26) have correct functional form and residuals are serially uncorrelated and homoscedastic. Be that as it may, before assessments were made on the risk indicators' movements under the adverse scenario, out-of-sample test statistics of the baseline scenario projections were generated to evaluate the predictive power of the ARDL models[82] (see **Table III.5**). While "it is wrong to set arbitrary forecasting performance goals" (Gilliland 2010), Lewis (1982) argued that forecasting models are: (i) highly accurate when mean absolute percentage errors are less than 10; (ii) good when mean absolute percentage errors are between 10 and 20 and; (iii) reasonable when mean absolute percentage errors are between 20 and 50. With this in mind, as the highest mean absolute percentage error was 48.7, it can be concluded that all ARDLs generated credible projections.

[82] See Appendix III.A3 for the forecasting functions for each of the risk indicators of the observed financial sector.

Table III.4: The Univariate OLS Regression Coefficients of Selected Macro-Economic Indicators and Key Risk Indicators

Risk	Co-efficient	Dependent Variable									
		Real GDP Growth	Inflation Rate	Exchange Rate	WTI Crude Oil Price	Henry Hub Natural Gas Price	Natural Gas Production	Crude Oil Production	Unemployment Rate	Current Account Balance	Overall Fiscal Balance
Credit Risk	A priori Expectation	-	+	+	+/-	+/-	+/-	+/-	+	-	+/-
	Commercial Banking Sector	+	**+**	-	**+**	**+**	**-**	**-**	**+**	+	**+**
	NBFI Sector	+	**+**	-	**-**	**-**	**-**	**+**	-	+	**-**
	Long-Term Insurance Sector	+	**+**	-	**+**	**+**	**+**	**-**	**+**	+	**+**
	General Insurance Sector	**-**	-	**+**	**-**	**-**	**+**	**-**	**+**	**-**	**+**
Income Risk	A priori Expectation	+	-	-	+/-	+/-	+/-	+/-	-	+	+/-
	Commercial Banking Sector	**+**	**-**	**-**	**+**	**+**	**-**	**+**	**-**	**+**	**-**
	NBFI Sector	**+**	+	**-**	**+**	**-**	**-**	**+**	**-**	**+**	**+**
	Long-Term Insurance Sector	**+**	+	**-**	**+**	**+**	**+**	**-**	+	**+**	**+**
	General Insurance Sector	**+**	+	**-**	**+**	**+**	**+**	**+**	+	**+**	**+**
Foreign Exchange Risk	A priori Expectation	-	+	+	+/-	+/-	+/-	+/-	+	-	+/-
	Commercial Banking Sector	+	-	**+**	**+**	**-**	**+**	**-**	-	**-**	**-**
	NBFI Sector	**-**	-	**+**	**-**	**-**	**-**	**+**	-	**-**	**-**
	Long-Term Insurance Sector	+	-	**+**	**+**	**-**	**-**	**+**	-	**-**	**-**
	General Insurance Sector	**-**	-	**+**	**-**	**-**	**+**	**+**	**+**	**-**	**-**
Liquidity Risk	A priori Expectation	+	-	-	+/-	+/-	+/-	+/-	-	+	+/-
	Commercial Banking Sector	**+**	+	**-**	**+**	**+**	**-**	**+**	**-**	**+**	**+**
	NBFI Sector	-	**-**	+	**+**	**-**	**-**	**+**	**-**	-	**-**
	Long-Term Insurance Sector	**+**	+	**-**	**-**	**+**	**-**	**+**	+	**+**	**-**
	General Insurance Sector	**+**	+	**-**	**-**	**+**	**+**	**+**	**-**	**+**	**-**
Solvency Risk	A priori Expectation	+	-	-	+/-	+/-	+/-	+/-	-	+	+/-
	Commercial Banking Sector	**+**	+	**-**	**+**	**+**	**-**	**-**	**-**	**+**	**+**
	NBFI Sector	-	**-**	+	**-**	**-**	**-**	**+**	**-**	-	**-**
	Long-Term Insurance Sector	-	+	**-**	**+**	**+**	**+**	**-**	+	**+**	**+**
	General Insurance Sector	-	**-**	+	**-**	**-**	**-**	**+**	**-**	-	**-**
Sovereign Risk	A priori Expectation	-	+	+	+/-	+/-	+/-	+/-	+	-	+/-
	Commercial Banking Sector	**-**	-	**+**	**-**	**-**	**-**	**+**	-	**-**	**-**
	NBFI Sector	+	**+**	-	**+**	**-**	**-**	**+**	-	+	**-**
	Long-Term Insurance Sector	**-**	-	**+**	**-**	**-**	**-**	**+**	-	**-**	**-**
	General Insurance Sector	**-**	-	-	**-**	**-**	**-**	**+**	-	+	**+**

Source: Author's calculations

Note: For the bolded cells, the univariate OLS co-efficients' signs were consistent with a priori expectations. Also, for credit, foreign and sovereign risks (-) implies improve and (+) implies worsen while, for income, liquidity and solvency risks (-) implies worsen and (+) implies improve.

Table III.5: Out-of-Sample Test Statistics of the ARDL Baseline Scenario Projections, March 2019 – December 2020

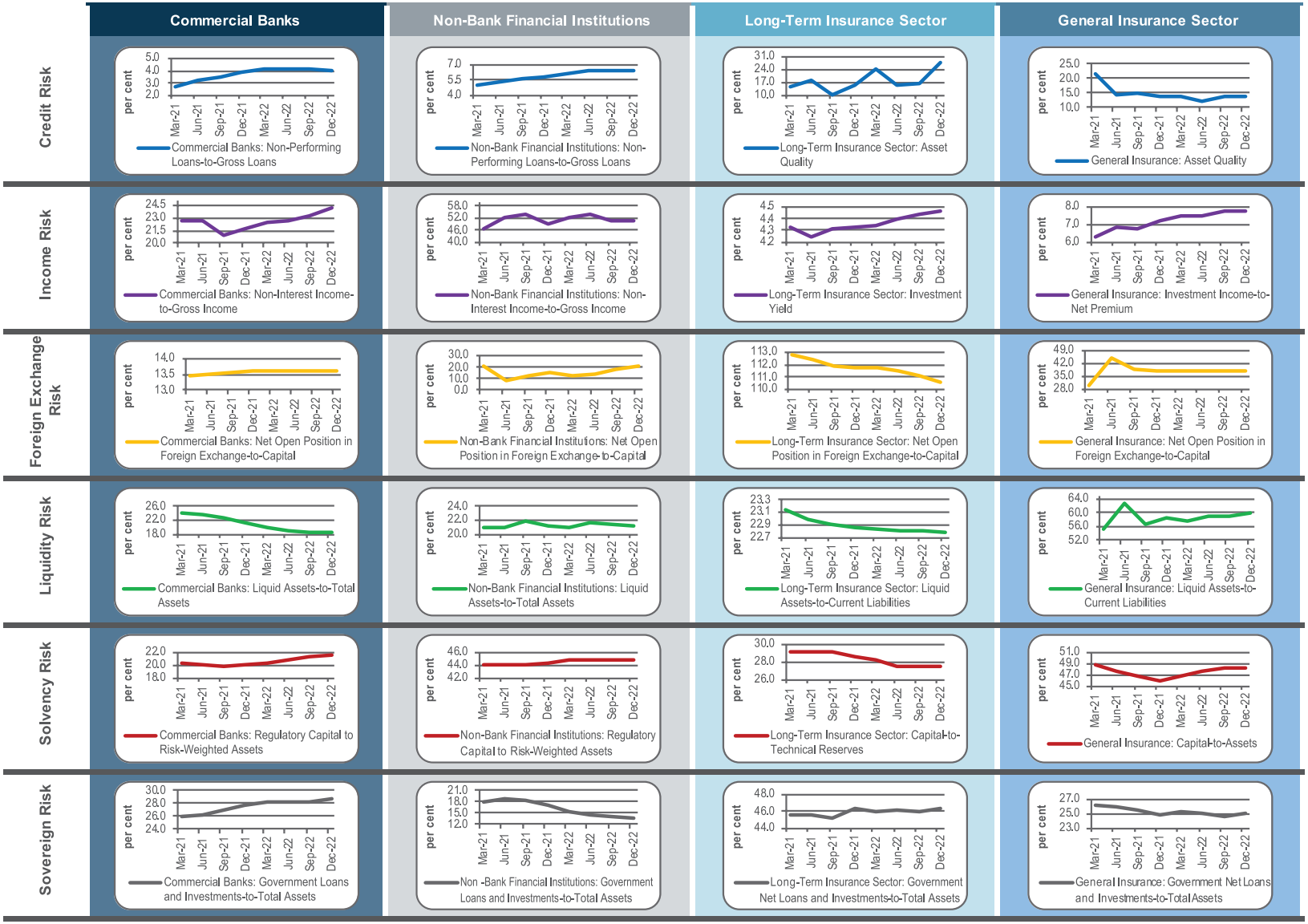
Risk	Root Mean Square Error				Mean Absolute Error				Mean Absolute Percentage Error			
	Commercial Banking Sector	NBFI Sector	Long-Term Insurance Sector	General Insurance Sector	Commercial Banking Sector	NBFI Sector	Long-Term-Insurance Sector	General Insurance Sector	Commercial Banking Sector	NBFI Sector	Long-Term Insurance Sector	General Insurance Sector
Credit	0.61	2.19	2.41	10.38	0.47	1.95	1.68	8.60	14.76	39.53	16.15	48.66
Income	7.37	7.12	0.39	0.95	6.02	6.36	0.34	0.75	16.09	12.31	6.86	11.20
Foreign Exchange	4.77	3.79	7.65	7.86	4.56	3.25	6.65	6.07	43.57	13.79	5.73	21.05
Liquidity	2.40	8.76	3.13	1.50	1.97	6.61	2.87	1.07	9.31	33.15	13.89	2.05
Solvency	2.04	6.52	4.70	5.92	1.44	4.86	4.33	5.00	7.67	9.75	14.13	11.07
Sovereign Exchange	2.54	2.35	1.38	6.27	2.12	2.11	1.07	6.25	8.33	15.70	2.34	24.01

Source: Author's calculations

Note: The lower the value of the out-of-sample test statistic the better the forecast accuracy.

Typically, benchmarks are used to evaluate whether or not a risk indicator's movement signifies an improvement or deterioration in financial stability. However, such measures depend on a risk indicator's behaviour during financial crises. While there was one noticeable period of financial stress, Trinidad and Tobago has experienced no financial crises over the period under review. As such, there are no well-defined standards or reference points for risk indicators in Trinidad and Tobago. In these cases, Worrel (2004) recommends that the analysis of risk indicators be guided by identifying changes in trends. With this in mind, Figure III.8 discusses the main findings from the adverse scenario projections based on the movements of the risk indicators:

Figure III.8: The ARDL Adverse Scenario Projections for the Key Risk Indicators of the Observed Financial System



Source: Author's calculations

Adverse macro-economic conditions worsened credit risks for all observed sectors except general insurance companies. The general insurance companies' resilience to this risk was in stark contrast to their long-term insurance counterparts (who appeared particularly vulnerable to credit risks); however, it may be explained by investment portfolio differences across these sectors. Namely, to meet their financial obligations (which are more short-term in nature), general insurance companies are likely to invest in more liquid securities, while long-term insurance companies are more likely to invest in medium-to-long term securities to meet their financial obligations (which are more long-term in nature). However, as observed over the forecast horizon, the negative effects from adverse macro-economic conditions will not dissipate overnight – over time, adverse conditions are likely to have a greater impact on long-term investment returns than on shorter-term securities. Regardless, collectively the observed financial institutions were well-positioned to cushion the impact of unorderly swings in the business cycle on their income channels.

Further, financial institutions appeared to be well insulated to foreign exchange risks – although there was a noticeable rise in the general insurance sector's NOPFXCL it does not come close to matching the highest value obtained by that variable over the period of interest (specifically, 68.1 per cent in September 2017). Even so, there were some marginal deteriorations in liquidity and solvency. Finally, commercial banks and long-term insurance companies appeared to be most susceptible to sovereign risks. However, it can be argued that this development comes around during "bad times" as, to protect investment returns, these institutions will actively seek risk-free securities – domestically, government related financial derivatives carry a 0 per cent risk weight. Also, an increase in public sector loans during "bad times" is not alarming as Baum, Caglayan and Xu (2017) found that the sovereigns will often carry out expansionary policies to promote recovery during economic downturns.

Figure III.8 showed that despite adverse economic conditions, the observed financial sectors – commercial banks, NBFIs and insurance companies – displayed high asset quality, low susceptibility to currency mismatches, stable earnings, high liquidity levels and adequate capital positions. These findings are consistent with other studies on the health of the local financial sector. Namely, *"the financial sector in Trinidad and Tobago is sound and has demonstrated resilience to the softer economic conditions"* (CBTT 2018). Notwithstanding the preceding, it is important to note that, risks from domestic macro-financial linkages may be understated as the available dataset did not allow for the observance of contagion risks from cross-border or counterparty exposures and the possible second-round effects from adverse financial sector developments. In addition to this, while the cautious approach of domestic financial institutions bodes well for their financial stability, risk indicators' movements were driven largely by developments in the international and local energy markets but, it should be noted that *"energy-led economic cycles, compounded by governance issues"* (Hilaire 2019) fueled several episodes of financial stress in Trinidad and Tobago in the 1980s. Therefore, although the domestic financial sector is currently stable, given soft economic conditions and the pro-cyclicality of financial institutions' performances – rising in times of economic boom and falling during recessionary periods – setbacks to the economic recovery effort could undermine financial stability in Trinidad and Tobago.

III.6 CONCLUSION AND RECOMMENDATIONS

The GFC has led to a lively debate over the state of research on macro-financial linkages. The regulatory community (BIS-FSB-IMF 2011) argued that the fallout from the crisis showed that financial supervisors did not pay sufficient attention to these connections in their impact assessment tests. While dynamic stress

testing has since emerged as a means for supervisors to better attune themselves with the intra-sectoral and inter-sectoral links between the real and financial sectors that can fuel systemic risks, there is an absence of a unifying framework for these regimes. This may be because DSTEs often require elaborate econometric techniques which, in-turn, demand high-quality, granular data. For less-developed countries, this information can be difficult to obtain. However, in keeping in line with international best practices, the paper established how domestic economic activity affects the financial system through an approach similar to that approved by the European Banking Authority for the CNB. Namely, domestic macro-financial linkages were determined and disentangled by using in-house projections of the external, public and real sectors to predict how key risk indicators of the banking and insurance sector move during swings in the business cycle.

The paper established that the domestic macro-financial characteristics follow Frait and Komárková's (2011) views on pro-cyclicality, the financial cycle and systemic risk. Namely, temporary cyclical improvements in the economy (for example improvements in GDP) create strong incentives for economic agents to underestimate the risks associated with their economic decisions. Actions that can fuel unobserved increases in systemic risk, as financial institutions may lower their standards, to capitalise on the higher aggregate demand and grow their assets at a faster pace than their competitors. However, when supply shocks run their course, financial imbalances materialise openly as negative spirals in economic activity force economic agents to realise that disparities in their balance sheets need to be restructured or corrected. In certain cases, this can trigger a credit freeze, excessive losses, fire sales and market illiquidity.

Notwithstanding the foregoing, deterministic forecasting must make use of statistically significant independent variables. For the observed financial sector, the t-statistics and p-values from the univariate OLS regressions showed that in most cases; economic growth, inflation, unemployment, the overall fiscal balance and the current account balance did not contribute significantly to developments in their key risk indicators. Instead, it appears that favourable energy market conditions and stable foreign exchange rates, are critical to fostering inclusive economic growth in Trinidad and Tobago. **The dependency on the energy sector has made the domestic economy vulnerable to external shocks which typically manifest through the foreign exchange and domestic prices channels** – a relationship delineated in Bobb and Sonnylal (2018).

The ARDL findings are consistent with analyses presented in other central bank reports. For example, one of the latest Financial Stability Reports from the CBTT (CBTT 2018b) states that, *"the financial sector in Trinidad and Tobago is sound and has demonstrated resilience to the softer economic conditions"*. Having said that, there may still be cause for some concern as risk indicators' movements were driven largely by developments in the international and local energy markets but, energy-led economic cycles, compounded by governance issues, fueled several episodes of financial stress in the 1980s (Hilaire 2019). In addition, there were some adverse movements in a few risk indicators. While these developments did not signal a significant deterioration in financial stability, it should be noted that: (i) long-term insurance companies appeared most susceptible to credit risk; (ii) financial institutions prefer to keep their liquidity levels high during 'bad times' and; (iii) commercial banks and long-term insurance companies will increase their exposure to the sovereign during economic downturns. The last point is particularly significant as, supporting the domestic financing needs of the sovereign will aid economic recovery efforts but, domestic sovereign debt instruments carry a risk weight of zero – that is, capital buffers do not take into account risks from financial institutions' domestic sovereign debt portfolio. In other words, there may be a risk that buffers are

not sufficient to address solvency issues for domestic financial institutions if a macro-economic shock significantly reduces the GORTT's ability to service their debt obligations – a risk that is often heightened in 'bad times'.

To address these challenges, policymakers may have to go beyond usual policy prescriptions (that is, fiscal and monetary policies). For instance, to fortify financial system resilience against sovereign risks the Basel Committee on Banking Supervision has advised banking supervisory authorities to assign a risk weight to banks' sovereign securities that is based on the health of governments – this can be derived by exploring government's; credit ratings, debt levels or fiscal revenues. Meanwhile, in cases where research suggests that financial institutions share similar exposure profiles, Dieterich, et al. (2018) advised that promoting greater financial inclusion can help with diversifying balance sheet positions and, in so doing, improve contagion risks. However, notwithstanding the benefits of the aforementioned policy recommendations, these procedures merely treat the symptoms of pro-cyclicality. Macro-prudential policies are better suited to actively limit the build-up of systemic financial risks (Gadanecz and Jayaram 2015). Thus, given the macro-financial linkages identified through the univariate OLS and ARDL models, to limit the pro-cyclical bias of the domestic financial system, macro-prudential policy in Trinidad and Tobago should consider dynamic provisioning (institutions must set aside extra capital to cover new loans in sectors deemed excessively risky) and counter-cyclical capital buffers (institutions must set aside extra capital during periods of excessive credit growth).

While there is a suite of macro-prudential tools around dynamic provisioning and counter-cyclical capital buffers are some of the more popular and far advanced policies in operation to address risks associated with pro-cyclicality. That is because they both insure against over-leveraging in 'good times' – when heightened credit demand drives up interest rates and institutions seek to capitalise on higher returns by lowering internal risk requirements – practices that often reveal themselves when the supply shock runs its course, through bank-runs and/or fire sales. Dynamic provisioning and counter-cyclical capital buffers also provide an extra capital cushion for institutions to weather 'bad times' – in some cases this buffer is sufficient enough to also support financial services, which, in-turn, can aid with on-going economic recovery efforts.

While the findings can be used to strengthen the CBTT's overall macro-prudential framework, it is important to note that risks from domestic macro-financial linkages may be understated as the available dataset did not allow for the observance of contagion risks from cross-border or counterparty exposures and the possible second-round effects of adverse financial sector developments. Therefore, despite considerable strengthening of financial supervision in recent years, the data needed to effectively align the current framework with the evolution of risks within the financial system is lagging. Significant strides in reporting and data collection are needed to improve macro-prudential supervision in Trinidad and Tobago.

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APPENDICES CHAPTER III

III.A1: Univariate OLS Regressions

Table III.6: The Univariate OLS Regression Coefficients of Selected Macro-Economic Indicators and Key Risk Indicators of the Banking Sector

Variable	Commercial Banking Sector						NBFI Sector					
	NPLs-to-Gross Loans	NII-to-Gross Income	NOPFXCL	LA-to-TA	Regulatory Capital-to-RWA	GLITA	NPLs-to-Gross Loans	NII-to-Gross Income	NOPFXCL	LA-to-TA	Regulatory Capital-to-RWA	GLITA
Real GDP Growth (%)	**0.1322**	0.1795	0.2296	**0.3460**	**0.1880**	-0.2531	0.1646	**0.7632**	-0.0047	**-0.8799**	-0.3178	0.0210
Inflation Rate (%)	**0.1457**	-0.0470	**-0.7987**	**0.2274**	0.1249	**-0.5757**	**0.2058**	0.4868	**-0.3409**	**-0.7223**	**-1.1027**	0.1212
Exchange Rate (TT$ to US$)	**-3.4269**	**-5.3001**	**18.7873**	**-9.7813**	-2.4201	**15.8431**	-3.4166	**-17.9252**	**4.6689**	**19.7137**	**26.2281**	-1.2097
WTI Crude Oil Price (US$/bbl)	**0.0412**	0.0282	0.0383	**0.0965**	**0.0595**	**-0.0769**	-0.0019	**0.1395**	0.0039	**-0.2980**	**-0.1001**	0.0236
Henry Hub Natural Gas Price (US$/mmbtu)	**0.4556**	0.4074	-1.2299	**1.2761**	0.0013	**-2.7505**	-0.5084	-1.9790	-0.1732	**-3.1959**	**-3.3801**	-0.2021
Crude Oil Production (bbl/d)	-0.0414	**0.1966**	-0.0421	0.0833	-0.0253	0.0602	**0.1332**	0.3668	**0.2004**	0.2867	0.1182	0.1152
Natural Gas Production (mmscf/d)	-0.0013	-0.1078	0.1097	-0.0646	-0.0294	-0.1285	-0.0184	**-0.3527**	-0.0487	-0.2757	-0.1181	**-0.1566**
Unemployment Rate (%)	0.2678	**-1.2080**	-0.3339	-0.0742	-0.0780	**-1.3045**	-0.5096	-1.9473	**-1.1992**	**-2.5388**	**-2.0394**	-0.5254
Current Account Balance (TT$ Million)	**0.0008**	0.0005	-0.0008	**0.0020**	**0.0009**	**-0.0023**	0.0002	0.0030	-0.0001	-0.0017	**-0.0038**	0.0009
Overall Fiscal Balance (TT$ Million)	**0.0001**	-0.0001	-0.0002	0.0002	0.0001	-0.0003	0.0000	0.0004	-0.0001	-0.0005	-0.0004	-0.0001

Source: Author's calculations

Note: Bolded cells indicate statistical significance at, at least, the 10 per cent level.

Table III.7: The Univariate OLS Regression Coefficients of Selected Macro-Economic Indicators and Key Risk Indicators of the Insurance Sector

Variable	Long-Term-Insurance Sector						General Insurance Sector					
	Asset Quality	**Investment Yield**	**NOPFXCL**	**LA-to-CL**	**Capital-to-TR**	**GNLITA**	**Asset Quality**	**II-to-NP**	**NOPFXCL**	**LA-to-CL**	**Capital-to-Assets**	**GNLITA**
Real GDP Growth (%)	0.1028	0.0288	0.0188	0.2420	-0.0237	-0.2312	**-0.1956**	**0.1694**	0.1917	-0.0249	-0.1224	**-0.1632**
Inflation Rate (%)	**0.3704**	**0.0898**	**0.4269**	**-1.3069**	**0.3971**	**-0.6971**	-0.0854	0.0555	0.1703	-0.2395	**-0.1682**	**-0.2608**
Exchange Rate (TT$ to US$)	**-8.0288**	**-2.2888**	**-19.5967**	**26.3445**	**-8.5663**	**20.4419**	**3.2857**	-1.6295	**-13.2853**	**11.0151**	2.3011	**6.3174**
WTI Crude Oil Price (US$/bbl)	**0.0473**	**0.0110**	-0.0119	0.0509	0.0034	**-0.0742**	**-0.0342**	**0.0417**	-0.0547	-0.0359	**-0.0357**	**-0.0345**
Henry Hub Natural Gas Price (US$/mmbtu)	**2.1748**	**0.5389**	0.0461	**-6.1707**	**2.0315**	**-3.2165**	-0.0898	**0.5609**	0.4469	**-2.0303**	-0.7455	**-0.7117**
Crude Oil Production (bbl/d)	-0.1192	-0.0242	0.0900	0.3042	-0.0706	0.0217	**-0.1417**	0.0071	**0.4484**	0.0983	0.0927	0.0476
Natural Gas Production (mmscf/d)	0.1171	**0.0346**	-0.1286	-0.3994	**0.1237**	-0.1001	0.0252	0.0400	0.0269	0.0510	**-0.1106**	-0.0572
Unemployment Rate (%)	**1.2616**	**0.3351**	0.3604	**-3.8606**	**1.3955**	**-1.3731**	**0.3953**	0.1152	-0.8260	1.0385	**-0.8411**	**-0.6407**
Current Account Balance (TT$ Million)	**0.0013**	0.0003	0.0007	-0.0022	0.0004	**-0.0027**	**-0.0010**	**0.0009**	0.0004	-0.0011	-0.0005	**-0.0009**
Overall Fiscal Balance (TT$ Million)	0.0002	0.0001	0.0000	-0.0009	0.0002	-0.0003	0.0000	0.0001	-0.0003	-0.0005	-0.0001	-0.0001

Source: Author's calculations

Note: Bolded cells indicate statistical significance at, at least, the 10 per cent level.

III.A2: ARDL

IIIA2 ARDL

ARDLs are Ordinary Least Square (OLS) regressions that include lags of both the dependent and independent variables among its list of regressors (Greene 2008). The ARDL model used to investigate domestic macro-financial linkages in this paper is identified below in Equation III.4:

Equation III.4
ARDL Model

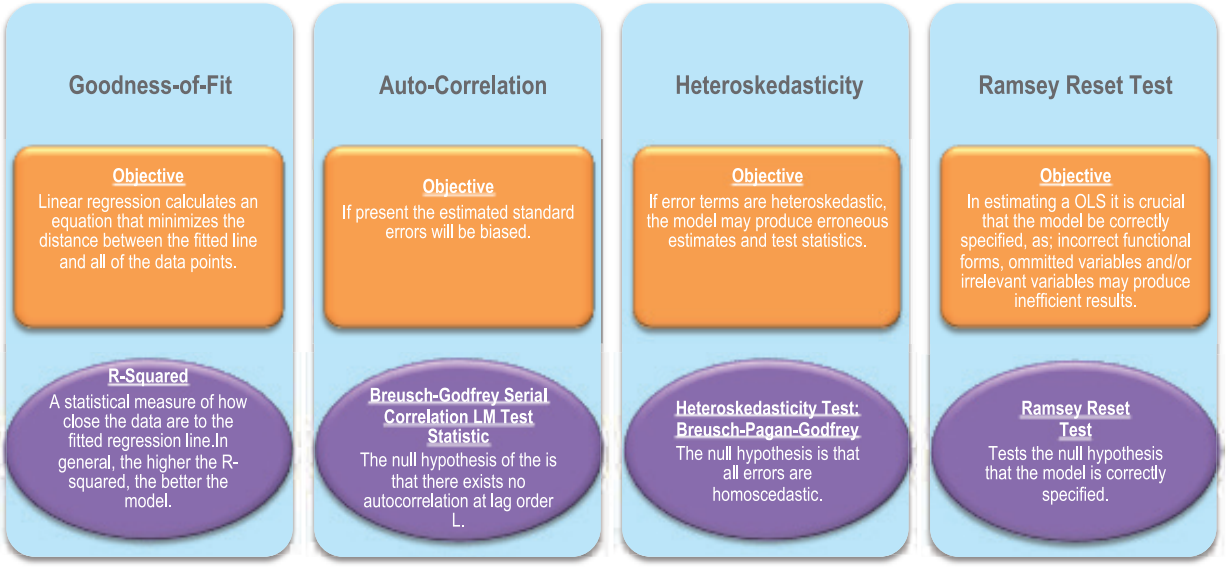
$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \Psi_i y_{t-i} + \sum_{j=1}^{k} \sum_{l_j=0}^{q_j} \beta_{j,l_j} x_{j,t-l_j} + \varepsilon_t$$

Where:

- y_t is the dependent variable (the risk indicators of the observed financial sectors).
- x_t is the list of independent variables – specifically, Real GDP Growth (y-o-y, %); Inflation Rate (%); Exchange Rate (TT$ to US$); WTI Crude Oil Price (US$/bbl); Henry Hub Natural Gas Price (US$/mmbtu); Natural Gas Production (mmscf/d); Crude Oil Production (bbl/d); Unemployment Rate (%); Current Account Balance (TT$ Million) and; Overall Fiscal Balance (TT$ Million).
- α_0 is the constant term. α_1, Ψ_i and $\beta_{j,lj}$ are respectively the coefficients associated with a linear trend, lags of y_t and lags of the k independent variables x_{jt} for j =1,…,k. ε_t is the white noise processes (that is, $\varepsilon_t \sim N(0,\Omega)$).

III.A2.1: ARDL Specification Test Results

Figure III.9: ARDL Statistical Adequacy Checks



Source: Author

Note: The **orange** rectangles discuss the objective of the specification test while the **purple** ovals describe the test statistic for the specification test.

Table III.8: ARDL Statistical Adequacy Test Results

Financial Sector	Risk	R-Squared Test Statistic	Breusch-Godfrey Serial Correlation LM Test Statistic		Heteroskedasticity Test: Breusch-Pagan-Godfrey		Ramsey Reset Test Statistic	
			f-statistic	p-value	f-statistic	p-value	t-statistic	p-value
Commercial Banking	Credit	0.96	**3.23**	**0.05**	**0.89**	**0.57**	3.82	0.00
	Income	0.71	**0.31**	**0.74**	**0.56**	**0.85**	**1.97**	**0.06**
	Liquidity	0.93	**0.60**	**0.56**	**0.49**	**0.94**	**0.62**	**0.54**
	Foreign Exchange	0.64	**0.73**	**0.49**	**5.32**	**0.01**	**0.94**	**0.35**
	Solvency	0.77	**1.72**	**0.19**	**2.19**	**0.07**	**0.62**	**0.54**
	Sovereign	0.95	**1.52**	**0.23**	**0.66**	**0.77**	**0.53**	**0.60**
NBFIs	Credit	0.56	**0.85**	**0.44**	**2.97**	**0.01**	**0.66**	**0.51**
	Income	0.89	**0.10**	**0.90**	**0.57**	**0.86**	3.89	0.00
	Liquidity	0.59	**0.45**	**0.64**	**0.57**	**0.81**	**0.39**	**0.70**
	Foreign Exchange	0.78	**0.43**	**0.66**	**0.65**	**0.75**	**1.22**	**0.23**
	Solvency	0.88	**2.13**	**0.13**	**1.32**	**0.26**	**0.47**	**0.64**
	Sovereign	0.34	**0.17**	**0.85**	**1.01**	**0.40**	**0.15**	**0.88**
Long-Term Insurance	Credit	0.96	**1.38**	**0.28**	**1.16**	**0.36**	**0.89**	**0.39**
	Income	0.96	**0.94**	**0.40**	**0.64**	**0.77**	**1.40**	**0.17**
	Liquidity	0.86	**0.97**	**0.39**	**0.11**	**0.90**	**0.06**	**0.96**
	Foreign Exchange	0.87	**0.29**	**0.75**	**1.60**	**0.17**	**1.89**	**0.07**
	Solvency	0.85	**1.06**	**0.36**	3.83	0.00	**1.57**	**0.12**
	Sovereign	0.97	**1.85**	**0.18**	**0.45**	**0.95**	**0.58**	**0.57**
General Insurance	Credit	0.98	**4.42**	**0.05**	**1.86**	**0.14**	**0.55**	**0.60**
	Income	0.87	**3.35**	**0.05**	**3.02**	**0.01**	**0.18**	**0.86**
	Liquidity	0.82	**0.63**	**0.54**	**1.03**	**0.45**	**0.15**	**0.88**
	Foreign Exchange	0.21	**0.07**	**0.93**	**1.31**	**0.28**	**1.60**	**0.12**
	Solvency	0.71	**0.71**	**0.50**	**1.05**	**0.43**	**0.66**	**0.51**
	Sovereign	0.92	**0.45**	**0.64**	**1.33**	**0.25**	**0.24**	**0.81**

Source: Author's Calculations

Note: Bold cells imply that the null hypothesis was significant at, at least, the 10 per cent level. Instances where low R-Squared statistics were realised or the null hypothesis was rejected may have resulted due to the small sample size (recall that the sample size for this study was 48 and, some researchers argue for ten observations per independent variable but 10 independent variables were used for this study).

III.A3: Forecasting Functions

Table III.9: ARDL Forecasting Functions

Sector	Risk	Independent Variables Used for the Deterministic Forecasting Techniques
Commercial Banking	Credit	Inflation Rate (%),WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Overall Fiscal Balance (TT$ Million)Henry Hub Natural Gas Price (US$/mmbtu), Natural Gas Production (mmscf/d)
	Income	Exchange Rate (TT$ to US$), Crude Oil Production (bbl/d) and Unemployment Rate (%)Henry Hub Natural Gas Price (US$/mmbtu)
	Foreign Exchange	Exchange Rate (TT$ to US$)Henry Hub Natural Gas Price (US$/mmbtu), Natural Gas Production (mmscf/d), Inflation Rate (%)
	Liquidity	Real GDP Growth (y-o-y, %), Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Crude Oil Production (bbl/d)WTI Crude Oil Price (US$/bbl), Natural Gas Production (mmscf/d), Exchange Rate (TT$ to US$)
	Solvency	Real GDP Growth (y-o-y, %), WTI Crude Oil Price (US$/bbl) and Current Account BalanceCrude Oil Production (bbl/d),Henry Hub Natural Gas Price (US$/mmbtu)
	Sovereign	Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Current Account Balance (TT$ Million)WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Overall Fiscal Balance (TT$ Million)
NBFI	Credit	Inflation Rate (%) and Crude Oil Production (bbl/d)Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d)
	Income	Real GDP Growth (y-o-y, %), Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl) and Natural Gas Production (mmscf/d)WTI Crude Oil Price (US$/bbl)
	Foreign Exchange	Real GDP Growth (y-o-y, %), Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl) and Henry Hub Natural Gas Price (US$/mmbtu)Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d)
	Liquidity	Inflation Rate (%),Crude Oil Production (bbl/d) and Unemployment Rate (%)Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Unemployment Rate (%)
	Solvency	Inflation Rate (%),WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Unemployment Rate (%)WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d)
	Sovereign	Natural Gas Production (mmscf/d)Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d)

Table III.9: ARDL Forecasting Functions (Continued)

Sector	Risk	Independent Variables Used for the Deterministic Forecasting Techniques
Long-Term Insurance	Credit	Inflation Rate (%),WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Unemployment Rate (%)WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Overall Fiscal Balance (TT$ Million), Exchange Rate (TT$ to US$), Current Account Balance (TT$ Million)
	Income	Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Natural Gas Production (mmscf/d)WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Current Account Balance (TT$ Million)
	Foreign Exchange	Exchange Rate (TT$ to US$) and Henry Hub Natural Gas Price (US$/mmbtu)Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Unemployment Rate (%), Inflation Rate (%), Exchange Rate (TT$ to US$), Current Account Balance (TT$ Million)
	Liquidity	Exchange Rate (TT$ to US$)Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Exchange Rate (TT$ to US$), Current Account Balance (TT$ Million), Overall Fiscal Balance (TT$ Million)
	Solvency	Exchange Rate (TT$ to US$), Henry Hub Natural Gas Price (US$/mmbtu) and Natural Gas Production (mmscf/d)Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Real GDP Growth (%), Exchange Rate (TT$ to US$), Current Account Balance (TT$ Million)
	Sovereign	Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Current Account Balance (TT$ Million)WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Overall Fiscal Balance (TT$ Million), Exchange Rate (TT$ to US$), Current Account Balance (TT$ Million)
General Insurance	Credit	Real GDP Growth (y-o-y, %), Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl), Crude Oil Production (bbl/d), Unemployment Rate (%) and Current Account Balance (TT$ Million) WTI Crude Oil Price (US$/bbl)
	Income	Real GDP Growth (y-o-y, %), Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Current Account Balance (TT$ Million)WTI Crude Oil Price (US$/bbl),Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Current Account Balance (%)
	Foreign Exchange	Exchange Rate (TT$ to US$) and Henry Hub Natural Gas Price (US$/mmbtu)Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Inflation Rate (%), Exchange Rate (TT$ to US$)
	Liquidity	Exchange Rate (TT$ to US$) and Crude Oil Production (bbl/d)Exchange Rate (TT$ to US$)
	Solvency	Inflation Rate (%),WTI Crude Oil Price (US$/bbl), Natural Gas Production (mmscf/d) and Unemployment Rate (%)Henry Hub Natural Gas Price (US$/mmbtu), Natural Gas Production (mmscf/d)
	Sovereign	Real GDP Growth (y-o-y, %), Exchange Rate (TT$ to US$), WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu) and Current Account Balance (TT$ Million)WTI Crude Oil Price (US$/bbl), Henry Hub Natural Gas Price (US$/mmbtu), Crude Oil Production (bbl/d), Natural Gas Production (mmscf/d), Overall Fiscal Balance (TT$ Million), Exchange Rate (TT$ to US$), Inflation Rate (%), Unemployment Rate (%)

Source: Author

CHAPTER III
END

CHAPTER IV
ESTIMATING THE EFFECTS OF FINANCIAL SYSTEM STRESS ON GROSS DOMESTIC PRODUCT

Yannick Melville

ABSTRACT

This study investigates the effects of financial stress on economic growth in Trinidad and Tobago over the period 2003 to 2020. Episodes of financial stress were identified by condensing ten macro-financial variables, which captured vital aspects of financial stress, into a composite financial stress index (FSI). By comparing movements in the FSI alongside those in the domestic output gap, the study discovered that Trinidad and Tobago experienced only one episode of financial stress during the period of review. While real economic activity contracted by approximately 4.4 per cent during the known period of financial stress, there were three downturns in the output gap. Therefore, we conclude, as in other noted research, "financial stress is often, but not always a precursor to an economic slowdown or recession" (Cardarelli, Elekdag and Lall 2009). Nevertheless, given the robustness of the findings from the domestic FSI, this early warning indicator can prove useful in guiding the deployment of the appropriate policy measures needed for the continued promotion of financial and economic stability in Trinidad and Tobago.

IV.1 INTRODUCTION

Some researchers describe financial stress as a by-product of dysfunctions within financial markets (Sandahl et al., 2011), while others define it as *"systemic risk which has materialised"* (Louzis and Vouldis 2013). Although there is no consensus on the definition, it has been well documented that recent crises were preceded by exorbitant levels of financial stress. Moreover, financial stress-related crises have led to significant, persistent reductions in real economic activity. For example, the United States Treasury Department estimated that the Global Financial Crisis (GFC) cost Americans 8.8 million jobs and US$ 19.2 trillion (USDT 2012). These incidents underscored the need to develop indicators that accurately measure financial stress for policymakers – who require timely information on market strains to develop appropriate policy responses.

There exists a great variety of indicators measuring stress in individual market segments. For instance: (i) the volatility in stock options; (ii) credit default swap spreads; and (iii) cumulative equity valuation losses have long been used by international regulators, such as the Bank for International Settlements (BIS), for assessing the overall stress level in the financial system caused by financial frictions (Kremer 2016). Although these individual indicators provide useful information, the voluminous amount of existing stress measures complicates the task of inferring whether the stress observed in a market segment is of an idiosyncratic or of a more systemic nature. One way to circumvent this dilemma is to synthesise all of the information from the many individual stress measures into a composite indicator of financial stress, or "Financial Stress Index". These indices *"quantify the current stress level in the financial system by compressing a certain number of individual stress indicators into a*

single statistic" (Kremer 2016). It has become a popular metric in recent years as the causal relationship between finance and growth has compelled interest in measuring the overall stress level in the financial system –to assess imminent macro-economic risks and appropriate policy counteractions.

To support its economy, Trinidad and Tobago rely heavily on its oil and gas sector (Indar 2019) – which, as of June 2020, accounted for 36.1 per cent of the Gross Domestic Product (GDP). In fact, as of June 2020, the domestic financial system was found to be the 6th largest contributor to the nation's GDP – it accounted for only 8.9 per cent of GDP. At first glance, these statistics suggest that the negative spill-over effects from stress in the domestic financial system would be manageable. However, recall that the financial sector facilitates the transfer of some of the real and financial resources between the energy companies and the government. Additionally, financial stress has had a significant impact on Trinidad and Tobago's macroeconomy as the 2009 collapse of a major local and regional financial institution caused an approximate loss of 17 per cent of GDP (Hilaire 2018). This financial stress event also prompted several legislative changes to improve financial supervision. However, care must be taken in designing a framework to foster financial stability, as *"financial stress is often, but not always a precursor to an economic slowdown or recession"* (Cardarelli, Elekdag and Lall 2009). With this in mind, the paper aims to address the following research questions; in recent years, how many episodes of financial stress have Trinidad and Tobago experienced? How many of those cases were followed by an economic slowdown or outright recession? Furthermore, what policies or instruments can be used to treat these risks?

In its attempt to answer the above questions, Section IV.2 reviews the literature guiding how the analysis of financial stress and its impact on economic growth is conducted. Section IV.3 provides a historical overview of the domestic macro-financial environment. Section IV.4 describes how composite indicators are constructed and presents the data and methodology utilised, while Section IV.5 discusses the results of the model. The paper concludes in Section IV.6 with recommendations for future work.

IV.2 LITERATURE REVIEW

Hakkio and Keeton (2009), who surveyed the empirical literature to summarise the key symptoms of financial stress, define financial stress as *"an interruption to the normal functioning of financial markets"*. Economists tend to associate certain key phenomena with this definition for financial stress (Balakrishnan, et al. 2009); heightened uncertainty, increased risk aversion and large expected financial losses. However, as heightened uncertainty can encourage creditors (or borrowers) to be more pragmatic about their lending practices (or asset purchasing decisions), financial stress can depress output by accentuating downswings in consumption and investment (Siņenko, Titarenko and Āriņš 2012, Hubrich and Tetlow 2014). Noteworthy empirical studies on the link between financial stress and economic activity are highlighted in the rest of this section.

In Cardarelli, et al. (2009) financial strains were detected by condensing several macro-financial variables – that captured key aspects of financial stress – into a single composite measure through variance-weighted averaging. Using this composite indicator of financial stress or FSI, Cardarelli, et al. (2009) identified 'episodes of financial stress' as any period where the FSI exceeded its long-term trend by more than one standard deviation. These events were compared against country-specific output gaps[83] to identify: (i) how often economic slowdowns were preceded by financial stress; (ii) the magnitude of the decline in GDP during periods of financial stress and; (iii) how long it took these countries to recover from an episode of financial stress. Using this

[83] The output gap (or business cycle) is an economic measure of the difference between the actual output of an economy and its potential output (IMF 2013). To measure potential output researchers often apply a standard HP filter to Gross Domestic Product (GDP).

approach, Cardarelli et al. (2009) found that out of the 113 financial stress episodes that affected 17 advanced economies between 1980 and 2008, 58 were followed by a significant slowdown in economic activity.

Although the views of economists on the 'best' approach for constructing FSIs differ quite considerably (Kliesen, Owyang and Vermann 2012), several studies on the empirical regularities between financial stress and the real economy recommend using vector autoregressive (VAR) models for this type of analysis. For instance, Cevik, et al. (2013) relied on principal component analysis (PCA) to generate a FSI for Turkey. Using an unrestricted VAR and a series of leading indicators developed by the Central Bank of the Republic of Turkey, Cevik, et al. (2013) found that higher financial stress can have detrimental effects on the Turkish economy. Meanwhile, Horváth and Malega (2017) explored the advantages of a: cumulative density function weighted, equal variance weighted, and PCA weighted FSI for the Czech Republic. Although the values produced from the three weighting methods differed somewhat, using a VAR Horváth and Malega (2017) found that they all conveyed he same message, an increase in financial stress will undermine real economic activity.

Cevik, et al. (2013) and Horváth and Malega (2017) presented an easily reproducible means for analysing how financial stress can impact economic growth. However, as EWIs are meant to guide the deployment of macro-prudential tools, some researchers (Blaise and Kaushik 2015) advised that econometric investigations on financial stress must be carried out in such a way that it allows the suggestion of instruments that: (i) can be used to remedy financial imbalances and; (ii) complement the existing policy regime. Mazol (2019) for instance, used an Autoregressive Distributed Lag (ARDL) model and a Belarusian FSI (which was constructed via PCA) to show that *"price stability is not a sufficient condition to support financial stability."* Simultaneously, as financial stress had a large negative long-run effect on real economic activity in Belarus, to avoid the latent risks associated with acting too late, Mazol (2019) proposed that the National Bank of Belarus augment their monetary policy tool-kit with complementary macro-prudential instruments. Meanwhile, using an Austrian FSI based on: best subset selection mechanisms; Kalman filter-based expected maximisation algorithms and; model averaging techniques Eidenberger et al. (2013) found that, to mitigate the systemic risks associated with the build-up of financial stress between 1998 and 2014, policymakers should have considered macro-prudential tools that addressed; excessive credit growth, contagion risk and market risk.

In other circles, researchers have used FSIs and statistical or econometric regressions to help policymakers refine their macro-prudential policy framework. For instance, while PCA was used by Chatterjee et al. (2017) to construct a FSI for the United Kingdom (UK), from March 1971 to June 2016, Area Under Receiver Operating Characteristic Curves (AUROC)[84] were used to generate the weights for the various market-based indicators of financial stress. The addition of AUROC weights allowed Chatterjee et al. (2017) to tweak their FSI to be more 'risk averse' (low level of Type I errors and Type II errors) or 'risk neutral' (low to medium level of Type I errors and Type II errors).[85] Chatterjee et al.'s (2017) approach was well received as it allows policymakers to apply some level of discretion in their use and application of EWIs as "mechanical rules cannot accommodate the special circumstances and unanticipated events that characterise real world policymaking" (Banque De France 2014). Alternatively, using spreads from money and bond markets, volatility estimates from equity and foreign-exchange markets and information on established episodes of financial stress, Juks and Melander (2012) developed lower and upper thresholds for Sveriges Riskbank's FSI[86] to guide the calibration of the Bank for International Settlement's recommended Counter-cyclical Capital Buffer (CCB) tool[87] – for Sweden from 2001 to

[84] The AUROC summarises the accuracy of a model to predict financial crises by quantifying the degree of Type I (that is the number of times the model fails to identify a 'true' crisis) and Type II errors (that is the number of times the model identifies a 'false' crisis).

[85] Chatterjee, et al. (2017) were able to use an AUROC as there were three well established financial crises in the UK over their period of review.

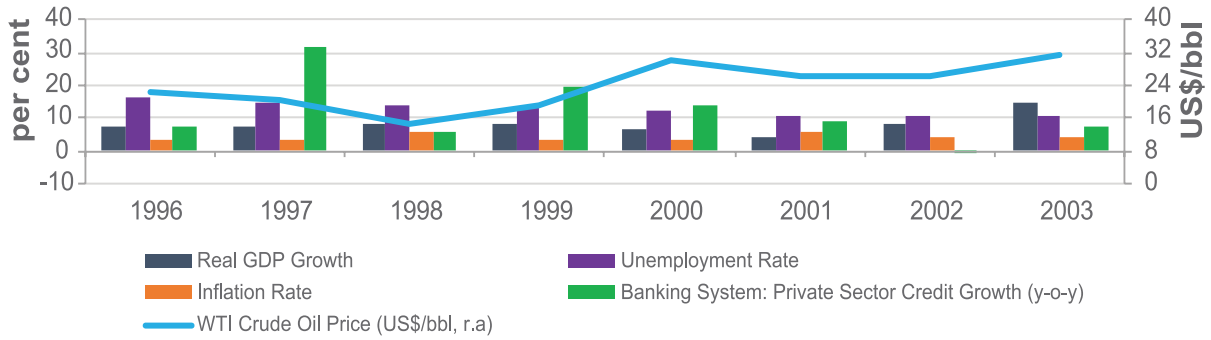
[86] An equally weighted index based on indicators that captured typical funding costs banks, companies and households meet in the financial market (Sandahl, et al. 2011).

2011. This study predates the European Systemic Risk Board's (ESRB) guidance for setting rates for a CCB – specifically, buffer decisions should be based on a specific set of variables, including measures that indicate general systemic stress in the financial system (ESRB 2014).

IV.3 BACKGROUND

The major indicators (Figure IV.1) all pointed to healthy performance of the Trinidad and Tobago economy between 1996 and 2003. Real GDP growth increased at an average rate of 8 per cent – due in part to the coming on stream of the liquefied natural gas plants and the Titan Methanol plant. The improvements in economic activity translated into higher levels of workforce participation, as evidenced by annual improvements in the unemployment rate. Still, inflation remained subdued. To stimulate demand, monetary policies were loosened – this stance was also part of the Central Bank of Trinidad and Tobago's (CBTT) plan to de-emphasise direct monetary instruments and reduce intermediation costs.[88] While the accommodative conditions supported a sustained period of high credit growth, it should be noted that loans extended by the banking system (is comprised of 8 commercial banks and 16 non-banking financial institutions) contracted in 2002. Although, this may be because *"the parliamentary stalemate resulting from the general elections of December 2001 seemed to have prompted consumers and businesses to postpone some spending plans"* (CBTT 2002), *"during the first quarter of 2002, there was a public outcry against the range and level of bank service fees"* (Forde, et al. 2010). The discontent expressed reached to such an extent that: (i) the Bankers Association of Trinidad & Tobago printed an advertisement (on December 13, 2002) acknowledging customer concerns and pledging to an independent review of their schedule of fees; (ii) the Ministry of Legal Affairs and the CBTT put plans in place to hire a consultant to determine how banking fees impacted customers, and (iii) banks removed six "nuisance" fees. While *"the public outcry of 2002 had been the latest in a series of complaints and general dissatisfaction with the level of bank services, nuisance fees, and other charges"* (Forde, et al. 2010), it is telling that the drop in loans came about in a period where displeasure with banking services was well documented.

Figure IV.1: Selected Indicators of Macro-Financial Activity (1996 – 2003)



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

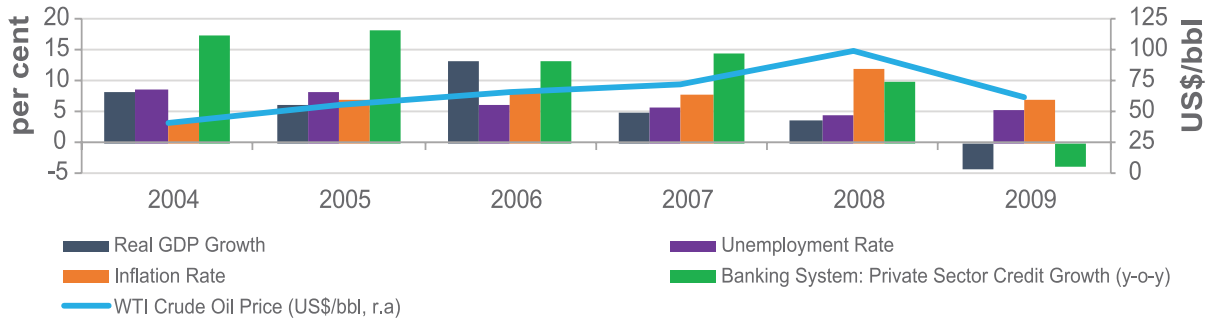
Note: y-o-y stands for year-on-year while r.a stands for right axis.

[87] The CCB refers to the additional capital an institution is required to hold during periods of excessive credit growth (associated with the build-up of systemic risk) in order to protect the system from risks materialised in a downturn.

[88] The CBTT implemented an indirect monetary policy framework based on the use of the Repurchase ('repo') rate – the rate that the CBTT charges commercial banks for borrowing funds on an overnight basis (CBTT 2009).

Between 2004 and 2008 **(Figure IV.2)**, the Trinidad and Tobago economy maintained its path of robust economic growth with real GDP increasing at an average rate of 7.1 per cent. Growth continued to be fuelled by the energy companies as the scope of the sector widened following: (i) the expansion of the Atlantic LNG Trains; (ii) the construction of two ammonia plants; (iii) the start-up of the M5000 Methanol plant; and (iv) a resurgence in oil prices (which grew at an annual average rate of 26.7 per cent). Favourable economic conditions buoyed labour market developments as reflected by successive falls in the unemployment rate as well as reports that employers had to pay higher wages in order to attract and retain staff (CBTT 2007). While inflation was kept under control in previous years, inflationary pressures intensified from 2006 as a result of agricultural supply shocks in foreign markets. In fact, by 2008, the inflation rate reached double-digit figures. To subdue inflationary pressures, the CBTT deployed its entire gamut of policy instruments to tighten monetary conditions.[89] Even so, despite a more restrained credit environment, private sector credit by the banking system grew at an annual average rate between 2004 and 2008 at 14.5 per cent. In fact, credit growth did not register a single negative value (since 2002) until 2009. However, this was more because economic growth contracted for the first time since 1993 (real GDP growth was -1.5 per cent then), as in January 2009 Trinidad and Tobago experienced the collapse of a major local and regional financial conglomerate, the CL Financial Group. *"In total, the CL Financial Group then controlled over TT$100 billion of assets in more than 50 companies"* (Hilaire 2018). Although there was no immediate fallout, following the collapse of CL Financial, in respect to unemployment, given the systemic reach of the institutions involved, there were concerns throughout 2009 that economic stability in Trinidad and Tobago was at risk. Substantial financial injections were used by the CBTT and the Government of the Republic of Trinidad and Tobago (GORTT) to mitigate potential systemic risks from the collapse in CL Financial. More specifically, *"Government's "bail out" arrangements aimed, among other things, at correcting the financial conditions of CLICO, BAT and CIB …. the Government provided approximately TT$24 billion to the various entities covered by the Agreement, equivalent then to around 17% of the country's GDP"* (Hilaire 2018).[90]

Figure IV.2: Selected Indicators of Macro-Financial Activity (2004 – 2009)



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

[89] For instance, in 2008, the CBTT: (i) increased the repo rate on three occasions; (ii) raised commercial banks' cash reserve requirement ratio on three occasions; and (iii) made more intensive use of open market operations (utilising treasury bills and notes totalling TT$5.4 billion) (CBTT 2009a).

[90] CLICO stands for Colonial Life Insurance Company (Trinidad) Limited. BAT stands for British American Insurance Company (Trinidad) Limited. CIB stands for CLICO Investment Bank.

GORTT and CBTT intervention helped to limit the contagion effects from the collapse of CL Financial, as economic growth rebounded in 2010 **(Figure IV.3)** despite unplanned shutdowns of the M5000 methanol plant (in April), the Atlas methanol plant (in June) and the Pointe-à-Pierre refinery (in August) as well as production challenges at mature oil fields. However, over the years, these kinds of incidents increased and soon maintenance works and maturing fields fuelled lower output of crude oil and natural gas (CBTT 2014). Given the significance of the energy sector to Trinidad and Tobago, the fall in production could have had significant damaging knock-on effects for the rest of the economy. However, the CBTT had adopted an accommodative monetary policy stance[91] between 2010 and 2014 to support a sustained level of domestic economy activity. This was recognised as inflation remained relatively steady and the unemployment rate improved from 5.9 per cent in 2010 to 3.3 per cent in 2014. In fact, credit growth gradually improved over the years as economic agents' confidence in the recovery effort grew.

At the end of 2014, the Organisation of Petroleum Exporting Countries decided to cut oil prices by raising their production quotas. This, alongside a fall in economic activity in crucial energy-intensive emerging market countries (IMF 2016), fuelled a 54 per cent drop **(see Figure IV.4**) in oil prices between 2014 and 2016. The substantial fall in oil prices had significant economic consequences for Trinidad and Tobago – for example, *"between September 2015 and March 2016, 29 companies announced job cuts which displaced close to 3,000 workers"* (CBTT 2016a). Consequently, while budgetary revisions cushioned some of the impacts of the trade shock, the domestic economy contracted in 2016 and 2017. There was some rebound in GDP growth in 2018 (0.1 per cent), following an increase in natural gas production – from the coming on-stream of several large natural gas projects. However, depressed non-energy sector activity suggests that the recovery may not yet be fully entrenched (CBTT 2019). Also, due to the weaknesses in the real sector, credit demand waned. What is more, the COVID-19 pandemic has had a significant negative impact on Trinidad and Tobago's economic performance. Preliminary estimates (from the IMF World Economic Outlook Database for October 2020) predict that GDP may have contracted in 2020 by 5.7 per cent. At the same time, there were significant reports of job losses (for instance, retrenchment notices filed with the Ministry of Labour revealed that between July and November 2020, 1,728 persons were retrenched). Although inflation remained subdued monetary policy centred on supporting economic activity as the repo rate fell by 150 basis points (to 3.5 per cent) and the primary reserve requirement (on commercial bank deposits) fell from 17 per cent to 14 per cent. However, despite the monetary interventions, *"generally lower demand"* saw private sector credit contract by 0.9 per cent (CBTT 2021).

IV.4 DATA AND METHODOLOGY

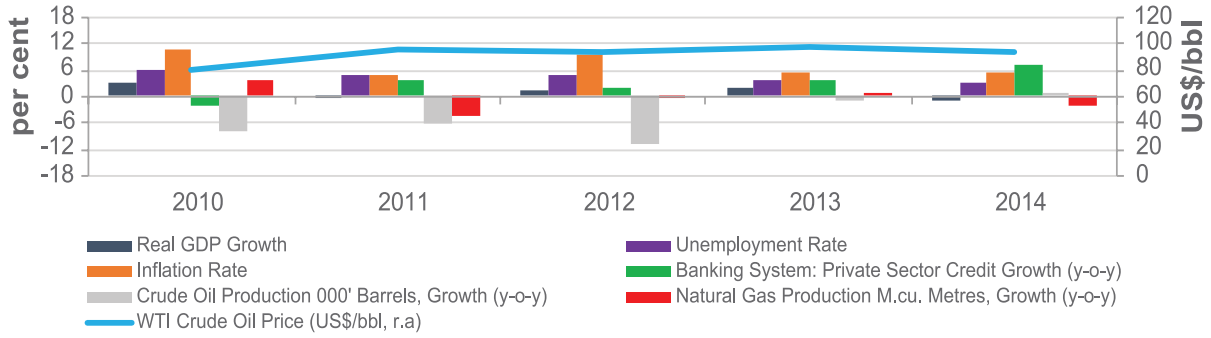
Although there is no consensus on the 'best' method for constructing FSIs, given that a host of variables are used to construct these indices, the paper follows Cevik et al. (2013) and Mazol (2019) which used PCA, a statistical procedure that operates on the notion that a large interrelated data set can be reduced to fewer latent-variables or sub-indices which, in-turn, can be aggregated into a single index (Joseph , Babin, et al. 2010).

IV.4.1 Constructing a Domestic FSI

Figure IV.5 outlines the framework that was used to construct a domestic FSI or FSI^{TT}.

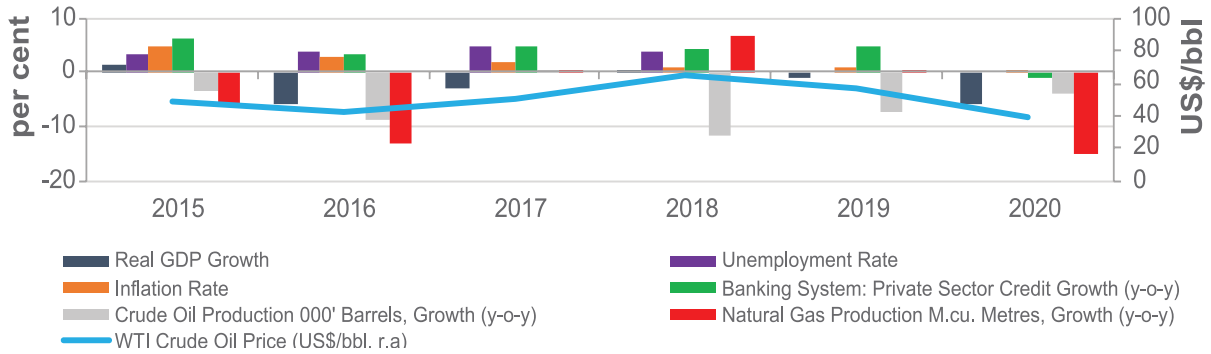
[91] The repo rate fell from 5.25 per cent in 2009 to 3.75 per cent in 2010. Although it reached only 3.25 per cent in 2014, it reached as low as 2.75 per cent between 2010 and 2014.

Figure IV.3: Selected Indicators of Macro-Economic Activity (2010 – 2014)



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

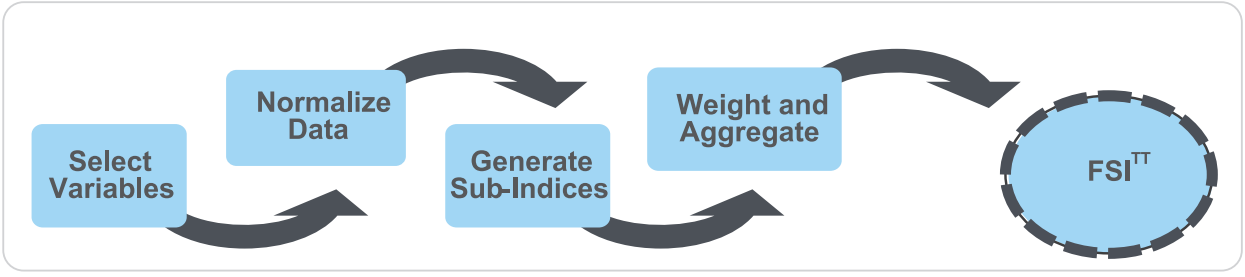
Figure IV.4: Selected Indicators of Macro-Economic Activity (2014 – 2020)



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

Note: The 2020 value for real GDP growth is the 2020 estimate for real GDP growth for Trinidad and Tobago in the IMF's World Economic Outlook Database for October 2020.

Figure IV.5: Steps Followed to Construct the FSI^{TT}



Sources: Adapted from Organisation for Economic Co-operation and Development, OECD (2008)

IV.4.1.1 Variable Selection

While stress events differ by country and composition, Hakkio and Keeton (2009) identified several common economic characteristics of financial stress. Namely:

- Increased uncertainty about asset prices or the behaviour of investors – can be measured by implied or realised volatility.
- Increased asymmetric information – this can worsen during stress events as asset prices may become volatile – can be measured by increases in credit or funding spreads.
- Decreased willingness to hold risky assets – investors may cling to "safe assets" to help protect their financial positions – can be measured by increases in safe asset holdings/ valuations.
- Decreased willingness to hold illiquid assets – given the uncertain conditions, investors may be reluctant to hold illiquid assets in anticipation of unexpected cash needs – can be measured by increases in liquid assets.

There are no financial indicators that fully capture any of these characteristics of financial stress (Monin 2019). Fortunately, Kliesen, et al.'s (2012) review on international FSIs notes the indicators that researchers used to construct their own national FSIs. Based on this information, **Table IV.1** identifies the domestic financial variables best suited for use in constructing a FSI for Trinidad and Tobago between December 2003 and December, 2020[92].

IV..4.1.2 Normalisation

The Z-Score standardisation (normalisation) technique was applied to ensure that all variables possessed similar measurement units to 'avoid adding up apples and pears' (Nardo, Saisana, et al. 2005). The literature advises the use of this method, when PCA is being employed, to ensure that each variable attained a mean of zero and variance of one. The variance of one ensured that each variable contributed one unit of variance to the total variance and that total variance was equated to the number of observed variables to be analysed (Baxter 1995).

IV.4.1.3 Generate Sub-Indices and Weighting and Aggregation

Principal components are based on the premise that if the variances, covariances or correlations between p random variables of a vector (x) are of interest, the best approach is to estimate the smallest set of m components that best represent or preserve most of the information in the dataset (Jollife 2002). In deciding on how many principal components to extract, the researcher should combine conceptual foundation with empirical evidence (Joseph, et al. 2010). Accordingly, the literature draws reference to the following methods or criterion to ensure that meaningful components are being extracted:

- Correlation Matrix Determinant: Applying PCA analysis to a correlation matrix with low intercorrelations will require nearly as many components as there are variables. On the other hand, applying PCA analysis on variables that exude extreme intercorrelation indicate variables should be combined or otherwise eliminated prior to PCA. Both conditions defeat the purpose of PCA and as such call for the researcher to ensure dataset contains suitable levels of multicollinearity (extent by which a variable can be explained by other variables within the dataset). One simple heuristic that is used to ensure adequate levels of multi-collinearity is to check that the determinant of the correlation matrix is greater than 0.00001.

[92] The period of analysis was based on data availability.

Table IV.1: Financial Stability Index Construction – Variables

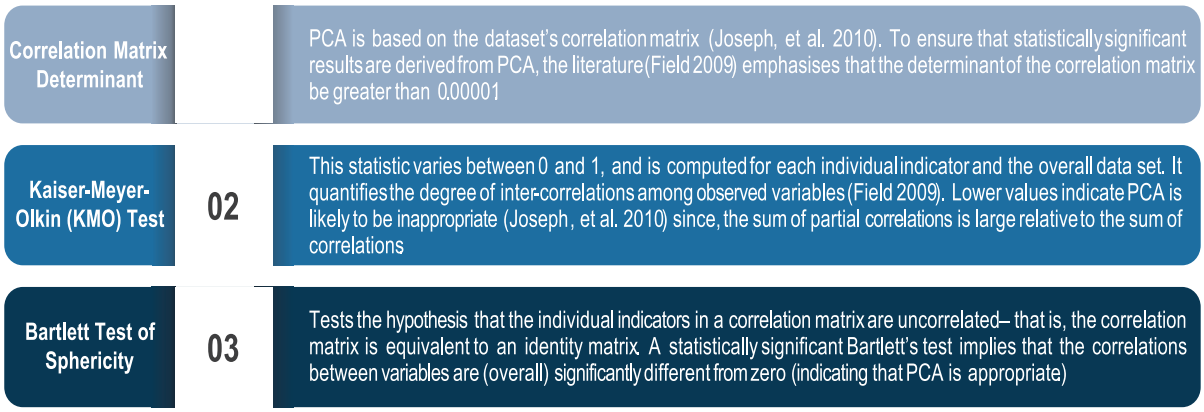
Variable	Reason for Inclusion	Characteristic of Financial Stress that the Variable Captures
Banking System: Capital Adequacy Ratio (CAR)	*"Capital adequacy and availability ultimately determine the robustness of financial institutions to withstand shocks to their balance sheets" (IMF 2006).*	● Decreased willingness to hold risky assets.
Insurance Sector Assets to GDP (IAGDP)	*"The financial crisis put the insurance sector on the map as a source of systemic financial risk" (IMF 2016).*	● Increased uncertainty about asset prices or the behaviour of investors. ● Decreased willingness to hold risky assets.
Pension Fund Assets to GDP (PAGDP)	*"The potential role of pension funds in generating macro-economic or systemic risk depends on at least two crucial factors. One is the size of the pension sector. The smaller this sector is relative to the economy or the financial sector, the smaller both types of risk" (Beetsma, Vos and Wanningen 2016).*	● Increased uncertainty about asset prices or the behaviour of investors. ● Decreased willingness to hold risky assets.
Commercial Banks: Foreign Currency Assets to Foreign Currency Liabilities (CFCATFL)	*"The widespread holding of assets and liabilities in a foreign currency, is viewed as both a constraint on monetary policy and a threat to financial stability in many emerging markets" (Brown, Haas and Sokolov 2013).*	● Decreased willingness to hold risky assets.
Trinidad and Tobago Stock Exchange: Market Turnover Value, growth (GMTVALUE)	*A negative link between stock market capitalisation and financialisation would capture a substitution effect between banking intermediation and direct financing … inducing a negative correlation between stock market capitalisation and financial instability" (Creel, Hubert and Labondance 2015).*	● Increased uncertainty about asset prices or the behaviour of investors. ● Decreased willingness to hold risky assets.
Banking System: Non-Performing Loans to Gross Loans (NPL)	*"…NPLs crowd out new lending, eroding both the profitability and solvency of banks. When high NPL levels affect a sufficiently large number of banks, the financial system stops functioning normally" (Baudino and Yun 2017).*	● Increased asymmetric information.
Private Sector Credit to GDP (CGDP)	*"Statistical tests confirm that financial turmoil is more likely to be followed by economic slowdown or outright recession when it is preceded by a more rapid build-up in house prices and credit" (IMF 2008a).*	● Decreased willingness to hold risky assets.
Commercial Banks: Non-Core Liabilities (NCL)	*"The proportion of banks' noncore liabilities might serve as a useful indicator of the financial cycle's stage and the banking system's degree of vulnerability to a downturn of the financial cycle" (Adrian and Shin 2011).*	● Increased uncertainty about asset prices or the behaviour of investors. ● Decreased willingness to hold risky assets.
Gross Public Sector Debt to GDP (GDEBT)	*"High leverage is recognised to feed financial instability as it increases the risk of and vulnerability to a crisis in the event of a triggering shock" (Ramsay and Sarlin 2015).*	● Increased uncertainty about asset prices or the behaviour of investors. ● Decreased willingness to hold risky assets.
Commercial Banks: Interest Rate Spread (IRS)	*"… a positive change in interest rate spread decelerates banking efficiency in the long run" (Shayanewako and Tsegaye 2018).*	● Increased asymmetric information.

Source: Adapted from several empirical studies

- The Bartlett's test of sphericity: Tests the null hypothesis that the individual indicators in a correlation matrix are uncorrelated – correlation matrix is equivalent to an identity matrix (that is variables are not correlated). While a statistically significant Bartlett's test implies that the correlations between variables are (overall) significantly different from zero (indicating component analysis is appropriate), results are heavily dependent on sample sizes (OECD 2008). Therefore, a significant result does not necessarily justify the application of PCA. This highly sensitive nature of Bartlett's test has resulted in complementing this measure with the Kaiser-Meyer-Oklin statistic (Nardo, et al. 2005, Field 2009, Joseph, et al. 2010).
- Kaiser-Guttman Criterion: The Kaiser-Guttman or Latent Root criterion advocates for retaining those components with eigenvalues (latent roots) greater than 1. It *"is based on the idea that eigenvalues represent the amount of variation explained by a factor and that an eigenvalue of 1 represents a substantial amount of variation"* (Field 2009). This method appears to be accurate when the resulting communalities (in PCA communality refers to the per cent of variance for an observed variable accounted for by all of the extracted components) are all greater than 0.7.

The aforementioned methods were summarised in **Figure IV.6**:

Figure IV.6: The Three Pre-Conditions for PCA



Source: Adapted from Field (2009), Joseph, et al. (2010), Tate (2011) and Baptista (2014)

Once the dataset met these pre-conditions, sub-indices were generated, weighted and then aggregated into the FSI^{TT} by adhering to the following outlined in **Figure IV.7**:

Figure IV.7: Basic Assumptions of Composite Index construction under PCA

Sub-index Extraction

The Cattell (Scree plot) criterion and Kaiser-Guttman criterion were used to ensure that meaningful sub-indices are extracted. The Scree plot depicts the latent roots against the number of components in their order of extraction (Field 2009) – the shape of the resulting curve is used to evaluate the cut-off. The Kaiser-Guttman criterion on the other hand, is based on the idea of retaining those factors with eigenvalues (latent roots) greater than one (Joseph, et al. 2010). Both the Scree plot and the Kaiser-Guttman criterion called for the extraction of three components.

Rotation

By default, the first sub-index explains most of the variation in the dataset, while the second sub-index explains most of that remaining variation and so on (Joseph, et al. 2010). Rotation is used to correct the uneven spread of variance to make more pronounced sub-indices. While the paper used EQUAMAX rotation primarily as a compromise between the commonly used QUARTIMAX and VARIMAX rotations, it should be noted that EQUAMAX spreads variances more equally across the extracted components to simplify sub-index construction (Sass and Schmitt 2010).

Populating Sub-indices

After identifying all of the significant loadings, the next step involves populating the sub-indices. Following the technical literature (Nicoletti, Scarpetta and Boylaud 2000, Nardo, et al. 2005, Krishnan 2011), under PCA composite indices should be derived with factor scores. Factor scores combine all of the individual variables that load onto the sub-index into a single composite observation for the period under review.

Aggregation

Aggregation involves the summation of the normalized, weighted sub-indices at each point in time, t: $FSI^{TT}=[(\beta_1)\times(SI_{t1})]+[(\beta_2)\times(SI_{t2})]+\ldots+[(\beta_m)\times(SI_{mt})]$. Here; FSI^{TT} represents the composite index, t represents the time period under study, m represents the $1 \ldots p$ number of extracted sub-indices, SI represents the sub-index factor scores attached to m and β represents the weight (under PCA, weights are the proportion of total variance explained by extracted components).

Source: Adapted from Nicoletti, Scarpetta and Boylaud (2000), Nardo, et al. (2005), Field (2009) and Joseph, et al. (2010)

Given that there are no well-defined periods of financial stress in Trinidad and Tobago, over the period under review, benchmarks or thresholds for the FSI^{TT} would depend on the predisposed inclinations of the researcher. To ensure against this bias and produce a consistent measure of financial stress, the 'aggregated' FSI^{TT} observations were transformed using a cumulative distribution function (CDF)[93] to allow the FSI^{TT} to assume values between 0 (low financial stress) and 1 (very high financial stress). Following this adjustment, the paper assumes that:

- When $0<FSI^{TT}\leq 0.2$ there are **'low'** levels of financial stress.
- When $0.2<FSI^{TT}\leq 0.4$ there are **'moderate'** levels of financial stress.
- When $0.4<FSI^{TT}\leq 0.6$ there are **'elevated'** levels of financial stress.
- When $0.6<FSI^{TT}\leq 0.8$ there are **'high'** levels of financial stress.
- When $0.8<FSI^{TT}\leq 1.0$ there are **'very high'** levels of financial stress.

[93] In Sinenko et al (2012) and Dumičić (2014) cumulative distribution function (CDF) were used to improve the interpretability of their composite indices.

It should be noted that these assumptions are not a comprehensive assessment of risks to economic activity arising from financial stress. Instead, it is based on using a simple average to establish five 'threat levels' for a variable that can only assume values between 0 and 1. The adjustments allow the FSI^{TT} to complement research on financial stability heat maps in the recent Financial Stability Reports for Trinidad and Tobago.

IV.4.2 Financial Stress and Economic Activity – Cardarelli, et al (2009)

The impact of financial stress on the domestic economy was evaluated in a manner similar to Cardarelli, et al. (2009). That is, the paper defined a financial stress episode as any period where the FSI^{TT} exceeded its long-term trend (derived by applying the HP filter to the series of interest) by more than one standard deviation and compared them against Trinidad and Tobago's output gap to evaluate; (i) how often economic slowdowns coincided with episodes of financial stress and (ii) the change in real economic activity during slowdowns preceded by episodes of financial stress.

IV.4.3 Linkages Between Financial Stress and Real Economic Activity – Cevik, et al. (2013)

A VAR provides a systematic way to capture information from the inter-relationships observed across individual time series. More importantly, VARs allow for impulse response functions – systems that trace the effects of a one-time shock (a one-unit increase) in an independent variable on the future values of the dependent variable. These functions will be used to estimate and evaluate the empirical linkages between financial stress and real economic activity. The VAR model used in this study can be represented as follows:

Equation IV.1
VAR Model

$$Zy_t = W + \Gamma(L)y_{t-1} + \varepsilon_t$$

Where:

- y_t is the vector of n endogenous variables (is the list of independent variables – specifically, the FSI^{TT}/Real GDP Growth (y-o-y, %); Unemployment Rate (%); Inflation Rate (end-of-period, %); and Natural Gas Production (million cubic feet per day, y-o-y growth, %).
- Z is a $n \times n$ matrix of contemporaneous coefficients of y_t;
- $\Gamma(L)$ is the $n \times n$ matrix of lag operator polynomials which captures the lags of the endogenous variables; and
- ε_t is the $n \times 1$ vector of white noise processes (that is, $\varepsilon_t \sim N(0,\Omega)$).

Table IV.2 lists the a priori assumptions and reasons why the independent variables in Equation IV.1 were used.

Table IV.2: A Priori Expectations

Variable**	Reasons for Inclusion	A Priori Expectation Adverse Shock to FSI^{TT}*
Real GDP Growth Rate (y-o-y, %) **(GDP)**	Higher economic activity can; raise incomes, improve loan repayment capacities and increase liquidity buffers within the financial sector (Adebola, Yusoff and Dahalan 2011, Rasmidatta 2011, Moussa 2015).	Worsen (-)
FSI^{TT} **(FSI)**	Financial stress can depress output by accentuating downswings in consumption and investment (Siņenko, Titarenko and Āriņš 2012, Hubrich and Tetlow 2014).	Not applicable
Unemployment Rate (%) **(UNEM)**	Is negatively correlated with household debt, loan repayment ability and financial sector liquidity (Steffen, Hackethal, & Tyrell, 2010).	Worsen (+)
Inflation Rate (end-of-period, %) **(INFLATION)**	Inflation reduces the interest earned on savings and investments, especially low-interest accounts. Left unchecked, it can erode investment value over time and significantly reduce a portfolio's future value or real return (Rutgers 2016).	Worsen (+)
Natural Gas Production (million cubic feet per day (mmcf/d)) **(NGAS)**	Natural gas has surpassed oil as Trinidad and Tobago's most important economic resource (TTEITI 2015). Nevertheless, Maino, Imam and Ojima (2013) and IMF (2018) found that government spending, augmented by activities in the energy sector, may raise businesses' and households' incomes but, the new found optimism can encourage overspending which may reveal itself over time in the form of rising loan defaults.	Worsen (-)

Sources: Various empirical studies

Note: *The FSI ranges from 0 (low financial stress) to 1 (very high financial stress). Therefore, an increase in the FSI signals a worsening of financial stress levels while a decrease in the FSI signals improvement in financial stress levels.

IV.5 RESULTS AND DISCUSSION

Once all statistical conditions were met[94], from the PCA, the Trinidad and Tobago Financial Stability Index was set as a combination of the weighted factor scores of three extracted sub-indices (see Appendix IV.A1), 'Financing', 'Risk Management' and 'Capital' (Sub-Index One, Two and Three). Collectively, these sub-indices accounted for 84 per cent of the total variance in the data however, it should be noted that 'Financing' makes up 57 per cent of the extracted variance. This was expected as, as of December 2020, loans make up 47 per cent of banking system total assets while investments make up 85 per cent of insurance and pension fund investments. Sub-Index One therefore, focuses on credit and interest rate risks. On the other hand, Sub-Index Two (which accounted for 29 per cent of the extracted model's variance) was defined as 'Risk Management' as CAR and NPL were the main drivers of developments within that sub-index and the values for these variables are dependent on the techniques and/or models used to manage the risks that an institution faces in their day-to-day operations. A similar approach was used to define Sub-Index Three 'Capital' (which accounted for the remaining 14 per cent of the extracted model's variance) where, GMTVALUE displayed the highest correlation statistic. It should be noted that all of the variables that exhibited strong correlation, shared a positive, symmetric relationship with the extracted sub-indices. In other words, ultimately, for each sub-index, an increase in its core variables fuelled an increase in financial stress.

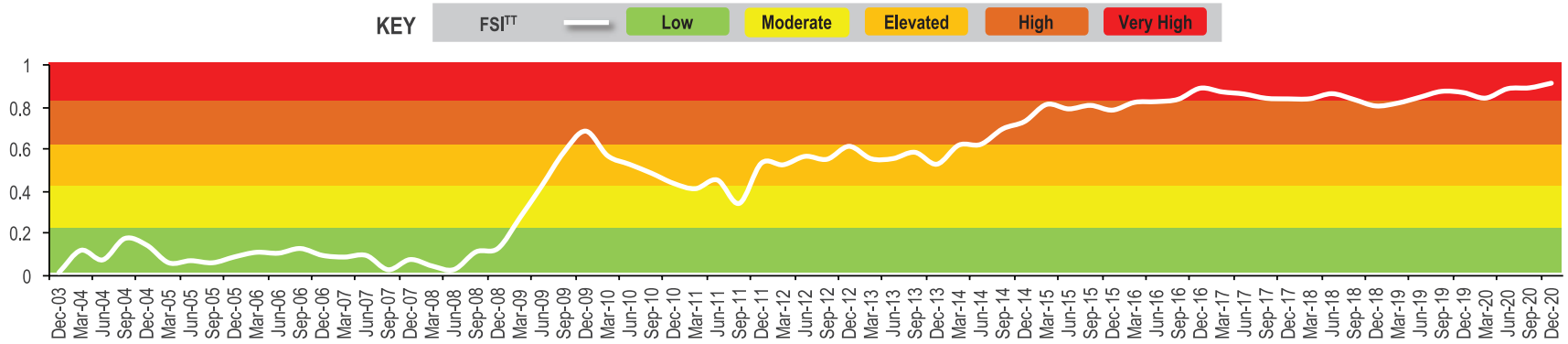
To address the research questions, emphasis was placed on evaluating whether the FSI^{TT} produced signals that were both consistent with the theoretical literature and the macro-financial environment of Trinidad and Tobago. For the most part, **Figure IV.8** illustrates that movements in the FSI^{TT} coincided nicely with major known events. More specifically, 2008 was the last year of low concentrations of financial stress as sustained periods of economic expansion on the back of high energy prices, fuelled strong credit demand and persistent liquidity overhangs (Moody's 2007, IMF 2008b), vulnerabilities that manifested themselves in 2009 – financial stress levels were **high** – with the collapse of a major financial institution, the CL Financial Group. Although policy interventions by the GORTT sought to contain the slowdown in real GDP growth and limit the contagion effects from this systemic event, financial stress levels remained **elevated** as, *"the overall climate of uncertainty regarding business and employment prospects prompted private companies and individuals to deleverage"* (CBTT 2009b). Between 2010 and 2015, policy-makers ramped up their efforts[95] to stimulate economic activity however, the improvement was not realised (financial stress levels fluctuated between **elevated** and **high**) as: rising loan delinquency ratios (CBTT 2010); limited investment opportunities (CBTT 2012); prolonged production stoppages (CBTT 2014a); and low energy prices weighed down growth prospects. Between 2016 and 2019, financial stress levels were **very high** due in part to; large scale restructuring exercises; several wage and salary freezes; and increased government borrowing (IMF 2018, CBTT 2019). As of December 2020, financial stress is still **very high**, as COVID-19 containment restrictions have had a significant negative impact on Trinidad and Tobago's economic performance. For instance, preliminary estimates (from the IMF World Economic Outlook Database for October 2020) predict that GDP may have contracted in 2020 by 5.7 per cent. At the same time, there were significant reports of job losses (for instance, retrenchment notices filed with the Ministry of Labour revealed that between July and November 2020, 1,728 persons were retrenched) and business closures.[96]

[94] Please see the Appendix IV.A1 for more information.

[95] For example, the CBTT's main monetary policy instrument, the repurchase agreement (repo rate), fell by 500 basis points between 2008 (8.75 per cent) and 2013 (2.75 per cent) in a bid to revive credit growth.

[96] The T&T Chamber of Industry and Commerce estimates that at least 1,000 businesses closed their doors since T&T's first COVID-19 case one year ago. Estimates from other business chambers suggest that 25 per cent of businesses in San Fernando and the environs have been closed permanently, while ten per cent of businesses in the Sangre Grande area have closed their doors (John-Lall 2021).

Figure IV.8: The Financial Stress Index for Trinidad and Tobago (December 2003 to December 2020)



Key Developments

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
The surge in liquefied natural gas (LNG) production boosted activity in the non-energy sector.	Two new petrochemical plants were established.	Alongside strong commodity prices, the operations of BHP Billiton and Atlantic LNG increased energy sector production.	High energy prices and increased output levels bolstered economic activity.	The pace of economic growth started to fuel inflationary pressures.	Strong domestic demand and rising food prices fuelled inflationary pressures restricting economic activity.	Collapse of a large local and regional conglomerate, CL Financial.	The subdued economic climate led to an increase in loan delinquency ratios (non-performing loans to gross loans increased by 58 per cent).	Liquidity surged in the financial system as: (i) businesses were hesitant to increase indebtedness and; (ii) there were limited investment	Energy sector production declined due to maturing fields and rising upstream costs.	Two major natural gas offshore installations underwent maintenance works. This negatively impacted energy sector production volumes.	Strong oil supply and weak global demand fuelled a sharp fall in oil prices.	Fuel prices and corporate taxes were raised while the list of 'vatable' items was increased.	29 companies announced job cuts and several employers proposed to freezes wages for 2017-2020.	Several establishments tried to consolidate their expenditure by retrenching staff or offering Voluntary Separation Packages.	Petrotrin, the country's largest oil producer, underwent a massive restructuring exercise to bring the State-owned company back to profitability.	Gas prices suffered as warmer than-normal winter temperature (in the US) reduced the need for natural gas heating.	COVID-19 pandemic has had a significant negative impact on Trinidad and Tobago's economic performance.

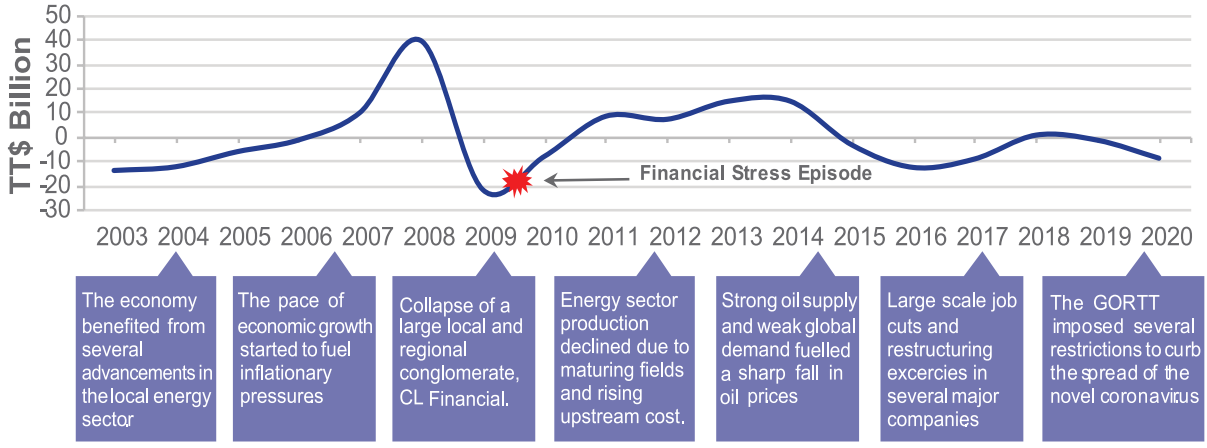
Source: Adapted from several CBTT, GORTT and IMF publications

Note: Due to the use of Z-score standardisation, the FSI^{TT} will have negative values. Consequently, as in Sinenko et al (2012) and Dumičić (2014), for illustrative purposes the FSI^{TT} was transformed using the cumulative distribution function (CDF) in Microsoft Excel. Following this transformation, the FSI^{TT} assumes values between 0 (low financial stress) and 1 (very high financial stress) which enables a more intuitive interpretation of the results. Please note that the ovals (●) in the 'Key Developments' section of Figure 8 give an average assessment of financial stress over that year.

The evaluation of major macro-financial events in **Figure IV.8** revealed that swings in macro-financial conditions appear to coincide well with movements in the FSI^{TT}. While this development bodes well for the robustness of the FSI^{TT}, given the macroeconomic consequences of financial stress, the paper focuses on the effects of financial stress on GDP rather than the precise events behind periods of financial stress. The next step therefore involved isolating episodes of financial stress, and evaluating the impact of these episodes on economic activity.

Using the standard settings for annual data under the HP filter[97], between 2003 and 2020[98], Trinidad and Tobago experienced three downturns[99] in the output gap and one episode of financial stress **(see Figure IV.9)**. The period of financial stress coincided with the 2009 collapse of CL Financial and the resulting downturn (from 2009 to 2010) caused Trinidad and Tobago's real GDP growth to contract by 0.5 per cent (on average). Although this may seem insignificant, it is important to note that several arrangements were made to limit the contagion effects from the collapse of CL Financial. During downturns outside periods of financial stress, Trinidad and Tobago's economy grew by 3.1 per cent (on average). Moreover, in 2009, real GDP growth contracted by 4.4 per cent. While this is particularly significant, over the period of review, Trinidad and Tobago's biggest contraction in real GDP growth occurred in 2016[100] (-5.6 per cent), at a time when *"twenty-nine companies announced job cuts which displaced close to 3,000 workers"* (CBTT 2016b). As in Cardarelli, et al. (2009), this development demonstrates that *"financial stress is often, but not always a precursor to an economic slowdown or recession"*. However, given the fall in GDP in 2009, there is a *"higher likelihood that stress in the financial system will lead to more severe economic downturns"* (Cardarelli, et al. 2009). For this reason, and the continued support of financial and economic stability, policymakers need to consider current policy instruments' effectiveness at treating the macro-economic risks associated with financial stress.

Figure IV.9: Episodes of Financial Turbulence and the Output Gap (2003 to 2020)



Source: Author

[97] The technical literature (Ravn and Uhlig 2002) suggest that the smoothing parameter for the HP filter (that is, lambda) be set according to the expected duration of the average cycle and the frequency of observation. Therefore, as in Choudhary, et al. (2013) lambda was set to 100.

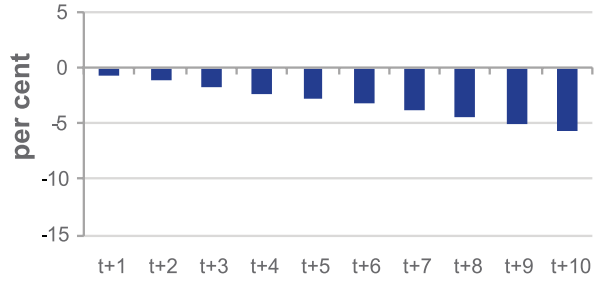
[98] At the time of writing this paper, there are no official domestic estimates for Trinidad and Tobago's 2019 GDP.

[99] Any period where the output gap is below the growth trend (that is, below the zero line).

[100] Recall that the 2020 statistic for GDP for Trinidad and Tobago is an estimate by the IMF.

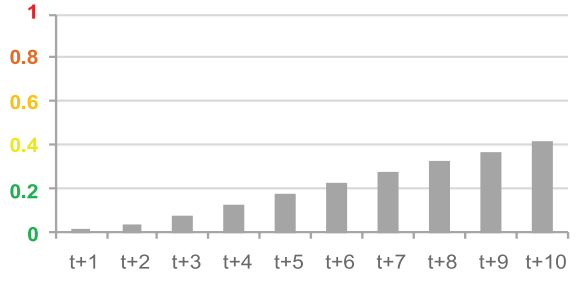
Following Cevik, et al. (2013) a VAR was used to disentangle the possible linkages between the FSI^{TT} and real GDP growth (%). Stationarity tests were used to evade the problem of spurious regression[101] while, robustness and specification tests[102]: (i) showed that the models contained homoscedastic error terms that were free from autocorrelation and; (ii) confirmed that financial stress Granger-causes real GDP growth. While the lack of dual-causality may be of some concern, what is of interest here is the effects of one-time abnormal but plausible spikes in financial stress on economic growth. As demonstrated in **Figure IV.9**, real GDP's response to an increase in the FSI^{TT} is mainly consistent with that from the cyclical analysis (in terms of magnitude and direction). Moreover, **Figure IV.9** demonstrates that a decrease in GDP will fuel a rise in financial stress. This finding is particularly significant as, collectively **Figures IV.10** and **IV.11** suggest that financial stress and economic activity share a self-reinforcing negative relationship. A pernicious feedback loop that, without the proper policy interventions, can tip the domestic economy into a state of economic and financial stagnation.

Figure IV.10 Real GDP Growth's Response to an Increase in Financial Stress



Source: EViews' Output

Figure IV.11 FSI^{TT}s' Response to a Decrease in Real GDP Growth*



Source: EViews' Output

Note: * The FSI^{TT}s response to a negative shock in GDP was acquired by multiplying its IRF results by -1. As noted in Ravn (2012) the impulse response to a positive shock is the mirror image of the response to a negative shock (of the same type and size). Finally, the numbers on the left-hand y-axis are colour-coded to represent a; '**low**', '**moderate**', '**elevated**', '**high**' or '**very high**' level of financial stress.

[101] See Appendix IV.A2 for the unit root test results.
[102] The robustness and specification test results can be found in Appendix IV.A3.

Following Cardarelli, et al.'s (2009) approach for evaluating the real impact of financial stress for Trinidad and Tobago, past evidence shows that whenever the FSI^{TT} exceeds its long-term trend by more than 30 decimal points financial stress will fuel an immediate downturn in the business cycle via a 4.4 per cent contraction in GDP. This finding is particularly significant as Cevik, et al.'s (2013) framework showed that domestic policymakers need to be aware that the feedback mechanisms between financial stress and economic activity can spark a self-reinforcing downward spiral in economic and financial stability. Even so, this domestic definition of a financial stress episode should not be used as a hard and fast rule for policy intervention as Cardarelli, et al.'s (2009) approach is based on cyclical analysis and a variables' trend is not static. It will fluctuate with the passing of time. As such it is difficult to ascertain what exact movements in the FSI^{TT} should be flagged as a sign of impending economic contraction. To gain further insights from the FSI^{TT}, work must be done on deriving lower and upper thresholds for this EWI, as was done in Sweden by Juks and Melander (2012). At the same time, it should be noted that the paper may be underestimating the real impact of a financial stress event as, while the downturn from the episode of financial stress lasted only one year, there were significant financial interventions by the GORTT and CBTT over the period in question (2009). Additionally, *"no two financial crises are the same"* (EC 2010).

IV.6 CONCLUSION AND POLICY IMPLICATIONS AND RECOMMENDATIONS

PCA was used to condense ten variables, which capture specific features of the domestic financial market during previous episodes of financial instability, into a quantitative benchmark on the intensity of stress in domestic financial markets (that is, the FSI^{TT}). By comparing movements in the FSI^{TT} alongside those in the domestic output gap, the study discovered that between December 2003 and December 2020, Trinidad and Tobago experienced one episode of financial stress. While real economic activity contracted by approximately 4.4 per cent during the known period of financial stress, there were three downturns in the output gap. Further, Trinidad and Tobago's biggest contraction in real GDP growth occurred in 2016 (-5.6 per cent), at a time when *"twenty-nine companies announced job cuts which displaced close to 3,000 workers"* (CBTT 2016)b). As in Cardarelli, et al. (2009), these findings demonstrated that *"financial stress is often, but not always a precursor to an economic slowdown or recession"*. Simultaneously, the EWI properties of the FSI^{TT} should not be ignored as Cevik, et al.'s (2013) VAR framework showed that there exists pernicious feedback mechanisms between financial stress and economic activity that can spark a self-reinforcing downward spiral in economic and financial stability.

Financial stress influence on economic activity demonstrated the need for tools to effectively treat and contain the build-up of systemic risks. While monetary policy will have an important role to play in this regard, there will be limits to the extent to which the main policy instruments can be used to counter financial stress as the repo rate and open market Treasury bill issuances are adjusted to address concerns related to price stability. With this in mind, and given the financial stability risks from acting too late (that is, inaction bias), the paper puts forward a macro-prudential policy measure that could be used to complement domestic monetary policy efforts, the Reserve Requirement Ratio (financial institutions must deposit a fraction of their prescribed liabilities at the country's Central Bank).

The Reserve Requirement Ratio (RRR) is a monetary policy tool that has been re-purposed to contain the build-up of liquidity and credit risks as it can be; (i) raised to constrict credit growth by reducing the number of resources available for lending and; (ii) lowered to inject liquidity into the financial system to help limit boom-

to-bust cycles in financial markets – these findings were corroborated in a study by Melville and Persad (2019) on the macro-prudential benefits of a RRR regime in Trinidad and Tobago. That said, despite the purported benefits of the RRR, no single macro-prudential tool is meant to be a 'one-size-fits-all' approach for treating financial stress. In addition to this, despite considerable strengthening of financial supervision in recent years, improvements in data collection are needed as, notwithstanding the salient benefits of the findings from the FSI^{TT}, the paper was unable to develop a definitive quantitative benchmark for the index as most documented periods of financial instability laid outside of the available datasets.

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APPENDICES CHAPTER IV

IV.A1: Principal Component Analysis – Statistical Adequacy Test Results

Table IV.3: Correlation Matrix

Variable	NCL	CAR	CFASFL	IRS	PAGDP	GDEBT	IAGDP	NPL	CGDP	MTVA
NCL		0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.06
CAR	0.00		0.00	0.12	0.11	0.27	0.50	0.00	0.04	0.46
CFASFL	0.00	0.00		0.03	0.00	0.00	0.00	0.00	0.00	0.16
IRS	0.48	0.12	0.03		0.00	0.00	0.00	0.00	0.01	0.13
PAGDP	0.00	0.11	0.00	0.00		0.00	0.00	0.43	0.00	0.17
GDEBT	0.00	0.27	0.00	0.00	0.00		0.00	0.50	0.00	0.18
IAGDP	0.00	0.50	0.00	0.00	0.00	0.00		0.09	0.00	0.35
NPL	0.00	0.00	0.00	0.00	0.43	0.50	0.09		0.03	0.25
CGDP	0.00	0.04	0.00	0.01	0.00	0.00	0.00	0.03		0.06
MTVA	0.06	0.46	0.16	0.13	0.17	0.18	0.35	0.25	0.06	
Determinant = 0.00002										

Source: Statistical Package for Social Sciences Output

Table IV.4: KMO and Bartlett's Test

Test	Test Statistic
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.70
Bartlett's Test of Sphericity	702.18***

Source: Statistical Package for Social Sciences Output

Note: *, **, *** indicates the rejection of the null hypothesis at 10, 5 and 1 per cent levels of significance respectively.

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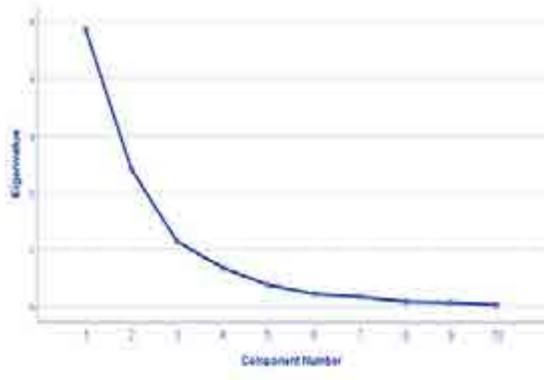
Figure IV.12 Cattell Scree Plot



Source: Statistical Package for Social Sciences Output

Table IV.5: Kaiser-Guttman Criterion

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.85	48.50	48.50	4.85	48.50	48.50	4.75	47.49	47.49
2	2.41	24.12	72.62	2.41	24.12	72.62	2.45	24.49	71.99
3	1.14	11.35	83.98	1.14	11.35	83.98	1.20	11.99	83.98
4	0.68	6.76	90.73						
5	0.37	3.73	94.46						
6	0.22	2.19	96.65						
7	0.17	1.65	98.30						
8	0.08	0.80	99.10						
9	0.06	0.62	99.72						
10	0.03	0.28	100.00						

Source: Statistical Package for Social Sciences Output

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Table IV.6: EQUAMAX Rotated Factor Matrix

Variable	Financing	Risk Management	Capital and Interest
NCL	0.72		
CAR		0.90	
CFASFL	0.74		
IRS			
PAGDP	0.96		
GDEBT	0.96		
IAGDP	0.91		
NPL		0.90	
CGDP	0.84		
MTVA			**-0.86**

Source: Statistical Package for Social Sciences Output

Note: To ensure consistency with international best practices, the rotated components were named according to the variables with statistically significant loadings. Also, factor Loadings of less than 0.45 were excluded to enhance the naming of rotated factor components.

APPENDICES CHAPTER IV

IV.A2 Unit Root Test Results

Unit root testing showed that all variables, with the exception of 'Natural Gas Production (million cubic feet per day (mmcf/d)', were stationary at first difference **(Table IV.7)**. Real GDP growth and the FSI^{TT} were not first differenced so as to retain the informative properties of this variable.

Table IV.7: Unit Root Tests

Variable	Augmented Dickey Fuller Unit test		Phillips Perron test		Kwiatkowski-Phillips-Schmidt-Shin test	
	Test statistic	Level	Test statistic	Level	Test statistic	Level
FSI^{TT}	-4.18	I(1)	-8.28	I(1)	0.05	I(1)
Real GDP Growth Rate (y-o-y, %)	-3.16	I(0)	-3.12	I(0)	0.08	I(1)
Unemployment Rate (%)	-0.73	I(1)	-2.39	I(0)	0.20	I(1)
Inflation Rate (%)	-6.94	I(1)	-7.37	I(1)	0.19	I(1)
Natural Gas Production (million cubic feet per day (mmcf/d)	-9.00	I(1)	-9.01	I(1)	0.27	I(0)

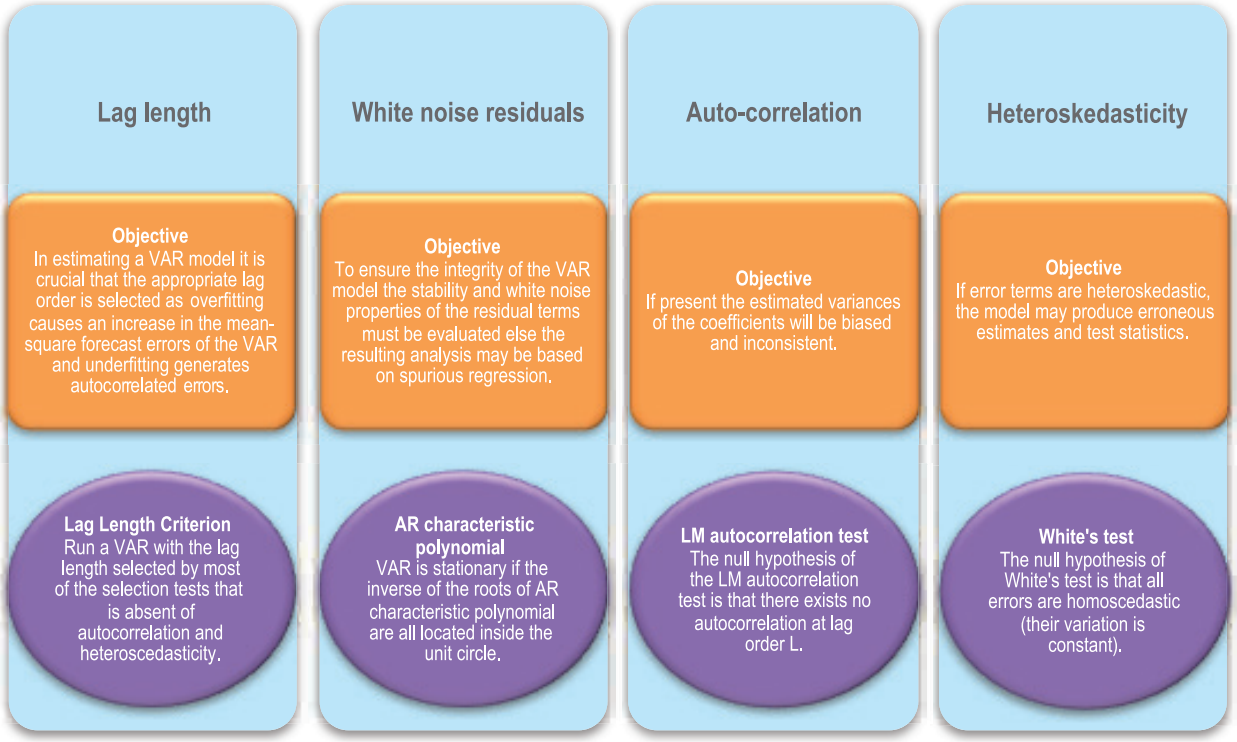
Source: EViews Output

Note: All "Test Statistics" were rejected at the 5 per cent level of significance.

APPENDICES CHAPTER IV

IV.A3 VAR Specification Test Results

Figure IV.13: VAR Statistical Adequacy Checks



Source: EViews Manuals and (Lütkepohl 2007)

Note: The **orange** rectangles discuss the objective of the specification test while the **purple** ovals describe the test statistic for the specification test.

APPENDICES CHAPTER IV

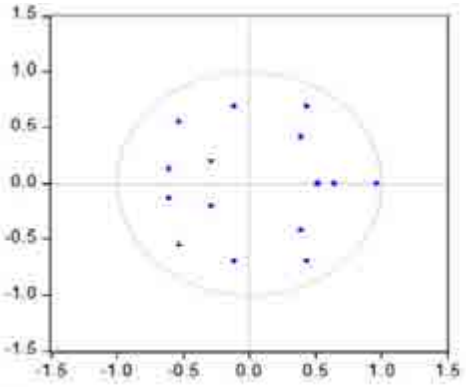
Table IV.8: VAR Lag Length Selection Test

Lag Length	LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	492982.70	27.30	27.48	27.37	492982.70
1	7204.00	23.07	**24.14**	**23.49**	7204.00
2	7124.44	23.04	25.01	23.80	7124.44
3*	6388.97	22.87	25.74	23.99	6388.97
4	**5269.50**	22.58	26.34	24.04	**5269.50**
5	5493.68	**22.44**	27.10	24.25	5493.68
6	7710.05	22.48	28.04	24.64	7710.05

Source: EViews Output

Note: Bold cells refer to the lag length selected by the criterion. Given that the literature suggests different criteria for estimating the maximum lag lengths a common way to overcome this problem, is to run a VAR with the lag length (selected by most of the selections tests) that is absent of autocorrelation and heteroscedasticity (Lütkepohl, 2007). Against this background, the cells with an asterisk indicate what lag length was used.

Figure IV.14: VAR White Noise Residuals



Source: EViews Output

APPENDICES CHAPTER IV

Table IV.9: Auto-Correlation VAR Results

Lag	LM-Stat	Prob
1	38.32	0.04
2	**26.67**	**0.37**
3	**25.80**	**0.42**
4	43.08	0.01
5	**29.62**	**0.24**
6	**23.50**	**0.55**
7	**24.56**	**0.49**
8	**26.29**	**0.39**
9	**35.37**	**0.08**
10	**28.70**	**0.28**
11	**17.87**	**0.85**
12	**25.57**	**0.43**

Source: EViews Output

Note: Bold cells refer to no autocorrelation for the associated probability of greater than 5 per cent.

Table IV.10: Heteroskedasticity VAR results

Chi-sq	P-value	Decision
440.91	0.61	Do not reject H^0

Source: EViews Output

Note: The p-value was greater than 5 per cent. Thus, the null hypothesis of homoscedastic error terms was accepted.

CHAPTER IV
END

CHAPTER V
THE IMPACT OF ECONOMIC UNCERTAINTY ON CREDIT CONDITIONS

Yannick Melville and Nikkita Persad

ABSTRACT

The paper explores the relationship between economic uncertainty and the performance of the banking sector through the development of an economic policy uncertainty index for Trinidad and Tobago. Using event studies as the primary research method, the index combines the equally weighted standardised frequencies of newspaper articles from the Express and the Guardian which relate to economic policy uncertainty in Trinidad and Tobago. In keeping with the financial stability mandate of the Central Bank of Trinidad and Tobago, the index is used to explore the linkages between economic uncertainty and credit growth in the banking system. The results suggest that a rise in economic uncertainty will: (i) contract lending from the commercial banking sector; (ii) increase the amount of credit extended by the non-banking sector and; (iii) erode non-bank's liquidity and capital buffers. This paper therefore serves as a useful starting point for reviving measurement of economic uncertainty in Trinidad and Tobago and analysis of its effect on macro-financial conditions.

V.1 INTRODUCTION

Economic uncertainty could be defined as a situation in which individuals do not have perfect knowledge about the current state of the economy (ECB 2016). In this environment, their ability to forecast the likelihood of future events comes into question. Consequently, economic agents often postpone decisions to await better information. This 'wait and see' behaviour can drive down consumption and with it credit demand. However, one of the key messages from the 2007 sub-prime mortgage crisis in the United States (US) was that disruptions in credit markets can turn a mild downturn into an economic recession. To help circumvent these imbalances and provide useful support for macroprudential analysis, researchers turned their attention towards investigating the link between economic uncertainty and credit growth.

The study of the interaction between uncertainty and economic behaviour dates back to some of the earliest contributions to modern economics, such as Malthus (1836), Marx (1894) and Keynes (1936). These seminal works laid the foundation for the theoretical linkages between uncertainty and the real sector. However, disentangling these interactions has been the subject of speculation, as uncertainty by its nature is an unobservable concept (Hassett and Sullivan 2015). As such, there is much debate about the most suitable proxy for its assessment. For instance, some researchers use the volatility in stock market returns to gauge market expectations (Moore 2016) while others rely on forecast dispersion (Ferrara, Lhuissier and Tripier 2017), media coverage (Baker, Bloom and Davis 2013) and/or confidence indices (Zarnowitz 1983). Although there is no substantial evidence on the most effective channel for disentangling this concept (Bordo, Duca and Koch

2016, Coşar and Şahinöz 2018), regulators rely heavily on the signalling properties of these types of indicators to fashion policy responses (Drehmann and Juselius 2013).

For instance, in Trinidad and Tobago, indices on economic agents' perceptions on current and future economic conditions have been used to inform policy decisions of the Central Bank. However, the production of these measures of economic uncertainty were discontinued due to capacity constraints. Nevertheless, to help contain the possible systemic risks from build-ups in market uncertainty, regulators need prudent and reliable sentiment indicators. Therefore, to aid policy makers in deploying the appropriate credit risk mitigating measures for a rise in economic uncertainty, the paper aims to address the following research questions: (i) how to best capture economic uncertainty in Trinidad and Tobago?; (ii) how does economic uncertainty affect domestic credit growth? and; (iii) what are the driving factors behind this relationship?

To address these questions, the remainder of the paper is organised as follows. Section V.2 reviews the literature guiding how the analysis of economic uncertainty and its impact on credit growth is conducted. Section V.3 looks at the indicators that were used previously to gauge uncertainty in Trinidad and Tobago. Section V.4 describes how economic uncertainty indices are constructed and presents the data and methodology utilised to address the research questions, while Section V.5 discusses the results of the model. The paper concludes in Section V.6 with recommendations for future work.

V.2 LITERATURE REVIEW

Initially, studies quantified uncertainty by the variance between experts' point forecasts (Zarnowitz 1983). Although this measure proved to be a reliable starting point for the analysis of the economic impacts of uncertainty (Chuliá, Guillén and Uribe 2015): (i) it is not entirely clear if this approach accurately captures public's expectations of the economy (Jurado, Ludvigson and Ng 2013) and; (ii) forecasts always carry some level of error (Rich, Song and Tracy 2012). With this in mind, economists have tried to establish more refined measures of uncertainty. These estimations fall into one of three broad categories (Moore 2016): conditional volatility of macro-financial variables; stock market volatility and; the appearance of 'uncertainty related' key words in the print media.

Volatility refers to the degree of unpredictable fluctuations of a variable over time (Ruiz, Guillamón and Gabaldón 2012). In other words, it involves evaluating the deviation between the values of an economic variable and its equilibrium value. The theoretical debate on volatility and economic uncertainty was pioneered by Henry (1974) and Bernanke (1983). Specifically, these studies argued that the volatility in energy markets can cause firms to postpone irreversible investment decisions while consumers may be incentivised to postpone the purchase of durable goods and increase precautionary savings. This was proven by Elder et.al (2010) and Bredin et al. (2010) where a Generalized Autoregressive Conditional Heteroskedasticity (GARCH)-in-mean model was used to estimate the volatility of oil prices so as to investigate the relationship between economic uncertainty and Gross Domestic Product (GDP) for the Group of Seven (G7).

Financial based uncertainty can be linked to the volatility in stock and bond market returns (Jurado, Ludvigson and Ng 2013). One of the most widely used measures of financial-based uncertainty in the empirical literature is the VIX Index (Baker, Bloom and Davis 2015). Constructed by the Chicago Board of Option Exchange (CBOE) in January 1993, the VIX Index was originally designed to measure the market's expectation of 30-day volatility implied by at-the-money S&P 100

Index option prices. However, it soon became the premier benchmark for stock market volatility in the US, featuring regularly in the Wall Street Journal and other key financial reports, where it is often referred to as the 'fear gauge'. In 2003, the CBOE alongside Goldman Sachs, updated the methodology for the VIX Index. It is now based on the S&P 500 Index (SPX)[103] and estimates expected volatility by aggregating the weighted prices of SPX 'puts' and 'calls' over a wide range of strike prices. This new methodology transformed the VIX Index into a practical standard for trading and hedging volatility (CBOE 2019). Even so, care should be taken in using equity-based measures of economic uncertainty as these statistics only cover publicly traded firms (Davis, et al. 2007) and, more than anything else, economic policy uncertainty (EPU) has been at the heart of recent major uncertainty shocks that have affected the global economy.[104]

To account for the influence these types of events can have on economic uncertainty, Baker, Bloom and Davis (2013) used the newspaper coverage frequency technique. More specifically, by counting the number of occurrences of specific words or a sequence of words in certain newspapers in a given country, Baker, Bloom and Davis (2013) developed monthly EPU Indices for some of the G-20 countries. Typically, to be included in the count, the publication should simultaneously contain at least one word referring to economy (for example "economy" or "economics"), policy (for example "deficit" or "central bank" or "taxes") and uncertainty (for example "uncertain" or "uncertainty"). While the Baker, Bloom and Davis (2013) method has been well received, due to the size of newspaper's internet archives and the level of human effort needed to collect and tabulate this information, there has been some concern that the approach can be quite time consuming and susceptible to skill-based errors (that is, slips and mistakes) (Arbatli, et al. 2017). To circumvent these challenges, researchers have leveraged recent advances in statistical software for 'big data' to capture such information. For instance, Tobback, et al. (2018) generated an EPU Index for Belgium, from January 2000 to December 2013, by applying two text-mining algorithms to a data set of approximately 210,000 articles (extracted using a Java-based web crawler). The first algorithm, modality annotation, counted the number of articles that used EPU related terms while the second algorithm, support vector machines, predicted whether or not the article did in fact address EPU related developments. Saltzman and Yung (2018) on the other hand developed an EPU Index for the US by using Amenity Analytics's text mining engine to develop a natural language processing model (a combination of a vector machine classifier, deterministic algorithms and graph pattern rules). Their system extracted EPU related terms from the Federal Reserve Beige Books between 1970 and 2018. Nevertheless, despite the purported benefits of data mining, a (2017) survey of nearly 70 information technology (IT) business executives and managers by International Data Group (IDG), found that 78 per cent of respondents struggle to find the right data mining strategy or solution for their stakeholders. More specifically 38 per cent of the respondents said that data mining tools are not intuitive or conducive to self-service while 31 per cent admitted that their human resources lack the skill sets needed to leverage the available tools.

As regulators work to close gaps in their macro prudential supervision frameworks, the linkages between credit risks and economic uncertainty has received much attention from the regulatory, academic and banking communities post-global financial crisis. For instance, in Whyte (2010) an autoregressive distributed lag (ARDL) model discovered that uncertainty – the standard deviation of the 180-day treasury bill – has a negative effect on bank lending in Jamaica (only in the short-run). Meanwhile, Bordo, Duca and Koch (2016) and Ferrara and Guérin (2016) used the EPU Index and VIX Index (respectively) to explore the impact of economic uncertainty on credit growth. In both studies, IRFs showed that: (i) lagged changes in the EPU Index are negatively and significantly linked to the growth rate

[103] The core index for US equities (CBOE 2019).
[104] Ranging from suspicions of currency manipulation in China to the Brexit situation.

of bank lending in the US; (ii) economic uncertainty is a highly significant determinant of loan growth for larger-sized banks; and (iii) the negative effect of economic policy uncertainty on bank lending growth is smaller in magnitude for more highly capitalised banks.

As a small, hydrocarbon-based state with relatively underdeveloped capital markets, gauging economic uncertainty could be challenging as available and relevant data to make such inquiries may be sparse. At the same time, where government is a major catalyst for economic activity, information asymmetries could stymie private sector activity through the economic uncertainty channel. As such, despite the many caveats associated with measurement of economic uncertainty, the exercise is invaluable as a tool to guide policymakers.

V.3 BACKGROUND

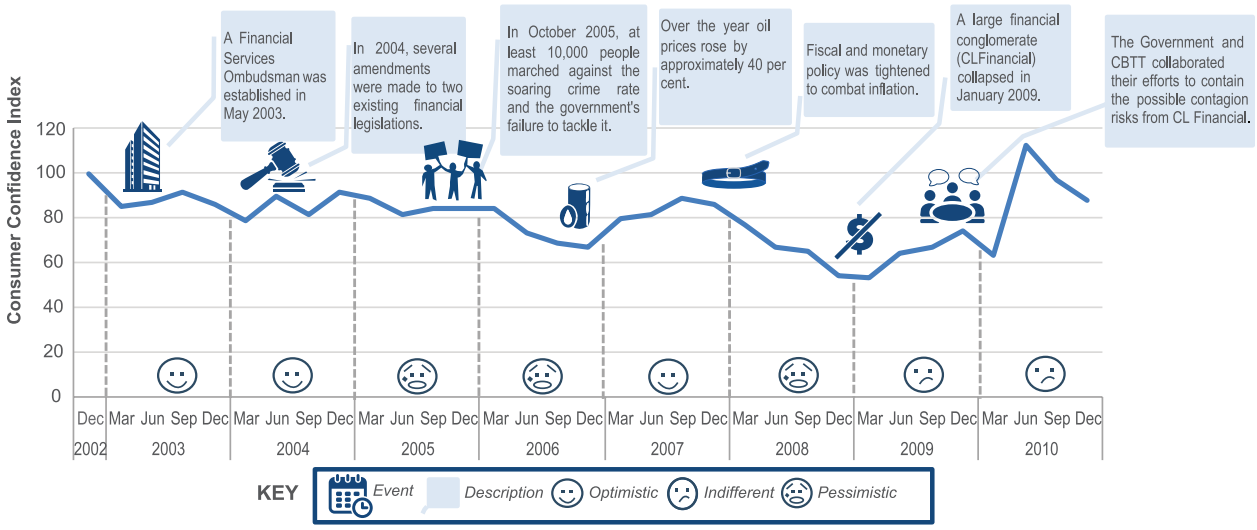
In Trinidad and Tobago, surveys by the Central Bank of Trinidad and Tobago (CBTT) and private bodies were used to gauge households, businesses and labour market participants' perceptions on current and future economic conditions. The results of these assessments were used to forge confidence indices (CI) – an indirect indication of the level of uncertainty in an economy. Although CIs were often factored into the policymaking process, their production has since been discontinued. The CIs that were produced domestically are documented below.

V.3.1 Republic Bank/Market Facts and Opinions (2002 – 2010)

The consumer confidence index (CCI) by Republic Bank/Market Facts and Opinions (RBL/MFO) was based on the University of Michigan Consumer Sentiment Index (UMSCI). Published in 1946, the UMSCI is one of the most well-known market sentiment indices in the United States (Sergeant, Lugay and Dookie 2011). It used survey information[105], collected from telephone interviews, to estimate how individuals viewed prospects for: (i) their own financial situation; (ii) the economy over the near term and; (iii) the economy over the long term. This framework was adopted for the RBL/MFO CCI however, for Trinidad and Tobago, surveys were conducted door-to-door with a randomly selected nationally representative sample of 500 households over the broad areas of Tobago and North East, North West, Central and South Trinidad (that is, the five main regions of Trinidad and Tobago). The RBL/MFO CCI was published during the period 2002 - 2010 **(see Figure V.1)**.

[105] These observations were then aggregated as a single composite index using a basic formula, $UMSCI_t = \sum_{j=1}^{r}\left(P_{jt}^{f} - P_{jt}^{u}\right)100 + 100$, where: r is the number of questions in the questionnaire; P_j^f is the sample proportion giving favorable replies to the *jth* question at time t and; P_{jt}^u the sample proportion giving unfavorable replies to the *jth* question at time t.

Figure V.1: The RBL/MFO CCI



Source: Adapted from Sergeant, Lugay and Dookie (2011) and RBL/MFO

Note: Some studies (for instance; Bram and Ludvigson (1998) and Ludvigson (2004)) use the CCI's observation in the first time period that the index is calculated for (in this case March 2002) as their benchmark. Others (for instance; Kloet (2013) and Ipsos (2018)) use the trend of the CSI over several months – not a comparison of this month to the same month last year – as their benchmark. The latter was used for this paper.

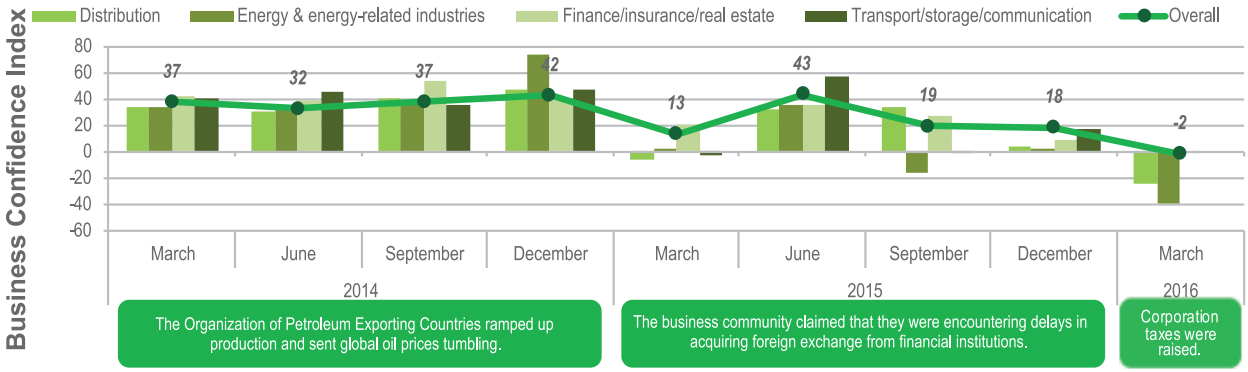
V.3.2 Central Bank of Trinidad and Tobago (March 2014 – March 2016)

From 2014, the CBTT constructed indices to measure consumer, business and labour market sentiment. These indices were announced on a quarterly basis from March 2014 to March 2016. The methodology for these indices are laid out below.

Business Confidence Index

The CBTT, alongside the Arthur Lok Jack Global School of Business (ALJGSB), produced the Business Confidence Index (BCI) from March 2014 to March 2016. It gauged the sentiments of the business community given their assessments of current market conditions and outlook for the immediate future (CBTT 2014b). This information was collected using Business Confidence Surveys (BCS), questionnaires that were disseminated to business executives (from 200 firms) operating in the major economic sectors **(Figure V.2)** across the five broad regions in Trinidad and Tobago. Among other things, the BCS covered; a firm's financial operations, the outlook for investments, productive activity and constraints to business.

Figure V.2: The ALJGSB and CBTT BCI by Sector[106]



Source: Adapted from ALJGSB and CBTT

Note: The ALJGSB and CBTT BCI was constructed as a diffusion index[107]. It ranged between -100 and +100 where: (i) a positive BCI indicated that businessmen had an optimistic outlook and; (ii) a negative BCI indicated that businessmen had a pessimistic outlook.

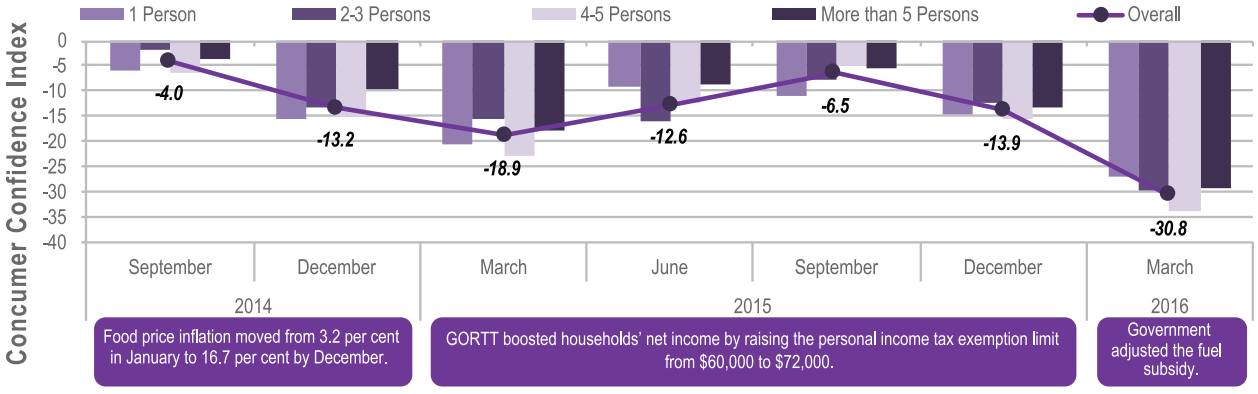
[106] While 23 economic sectors were explored in deriving the BCI, Figure 2 only displays the BCI from those sectors that made up the majority share (74 per cent) of GDP as was indicated in the Government of the Republic of Trinidad and Tobago's (GORTT) 2016 Review of the Economy.

[107] A diffusion index is a method of summarizing the common tendency or co-movement of a group of statistical series (Valavanis 1957). It follows the formula, $CI = p - n$, where p is the percentage of positive responses and n is the percentage of negative responses to questions about past, current and expected or future market conditions.

Consumer Confidence Index

The CBTT CCI was produced from September 2014 to March 2016. It gauged households **(Figure V.3)** sentiments on the current and future state of the economy (CBTT 2014c). The index was based on the information collected from a questionnaire, the Consumer Confidence Survey. Respondents (650 persons) were selected on the basis of randomly generated phone numbers, across the five broad districts in Trinidad and Tobago and questions focused on individuals' opinion on the past, current and future state of the economy, cost of living and financial circumstances.

Figure V.3: The CBTT CCI by Household Size



Source: Adapted from CBTT

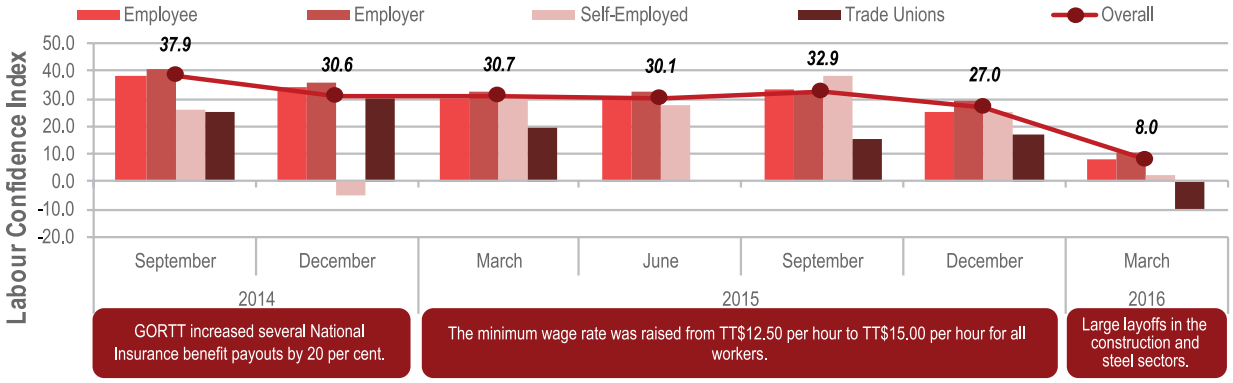
Note: The CBTT CCI was constructed as a diffusion index. It ranged between -100 and +100 where: (i) a positive CCI indicated that households had an optimistic outlook and; (ii) a negative CCI indicated that households had a pessimistic outlook.

Labour Confidence Index

The CBTT Labour Confidence Index (LCI) was produced from September 2014 to March 2016. It gauged employees, employers, the self-employed and trade unions **(Figure V.4)** sentiment of current and future labour market conditions (CBTT 2014d). This information was collected from a Labour Confidence Survey (LCS).

The LCS was conducted by phone and respondents (approximately 450 individuals) were selected randomly and in accordance with the distribution of the labour force across; economic sectors, firm size and the five broad regions in Trinidad and Tobago. Survey participants were questioned on past, current and future expectations of; job security, wages and salaries, health and safety, and productivity.

Figure V.4: The CBTT LCI by Group



Source: Adapted from CBTT

Note: The CBTT LCI was constructed as a diffusion index. It ranged between -100 and +100 where: (i) a positive LCI indicated that participants had an optimistic outlook and (ii) a negative LCI indicated that participants had a pessimistic outlook.

V.4 DATA AND METHODOLOGY

The empirical assessments outlined in the literature review did not prescribe a particular method for estimating economic uncertainty as measurements might vary based on the information that is readily available.

V.4.1 Methodology

As discussed in Section V.3, CIs have been discontinued for some time in Trinidad and Tobago. Additionally: (i) there are no official national forecasts; (ii) fiscal and monetary policies[108] have been influenced by many factors (implying that no single economic indicator tells the complete story of Trinidad and Tobago) and; (iii) *"the capital market is largely underdeveloped"* (GORTT 2017). With this in mind, based on the requirements for the study, the paper used a mixed methods approach. The qualitative aspect centred on event analysis – in line with the newspaper-based approach by Baker, Bloom and Davis (2013) to estimate economic uncertainty. Quantitatively, the information from the newspapers is used to construct an index of economic uncertainty.

V.4.1.1 Data

Newspapers provide a platform to convey peoples' views on major societal, political, and economic developments (Hopkins, Kim and Kim 2017). This coverage has the potential to influence the public's response to these issues and events (Kellstedt 2003). Consequently, the media plays a crucial role in the formation of public opinion. It is against this background that Baker, Bloom and Davis (2013) assume that newspaper reports on economic policy uncertainty reflect society's awareness of developments in this area of concern.

In Baker, Bloom and Davis (2013), only the most circulated newspapers were included in their policy-related measure of economic uncertainty. This way, the EPU Index reflects the frequency of articles in leading newspapers (for Trinidad and Tobago this would be the Express, Guardian and Newsday[109]) that contain the following terms in **Table V.1**.

Table V.1: Term Sets for the EPU Index

ECONOMIC		POLICY		UNCERTAINTY	
• Economic	• Economy	• Deficit	• Gove rn	• Uncertain	• Uncertainty
		• Gove rnment	• Gove rnmental		
		• Legislation	• Policy		
		• Political	• Regulation		
		• Surplus	• Tax		

Source: Adapted from Baker, Bloom and Dav s (2013), Tobback, et al. (2014) and Arbatli et, al (2017)

[108] This is demonstrated in the most recent policy announcements (what specifically) by the GORTT (2018) and the CBTT (2018a).
[109] Newsday articles could not be included into a local EPU Index as the newspaper's search engine does not store articles by their publication date.

Notwithstanding its widespread use and acceptance, there remain some important issues regarding the construction of the EPU Index by Baker, Bloom and Davis (2013). This is best demonstrated in Tobback et, al. (2014) where, *"the major issue arising when using this methodology is the fact that there is no selection on the subject of articles"*. In other words, every article that meets the search criteria (including articles in which the journalist states that there is no economic policy uncertainty) is added to the EPU Index. With this in mind, the methodology by Baker, Bloom and Davis (2013) may be prone to both Type I (that is the number of times the EPU Index fails to identify 'true' instances of uncertainty) and Type II errors (that is the number of times the EPU Index identifies 'false' instances of uncertainty).

To address this concern, the paper followed Arbatli et, al (2017) in that, each article included in the EPU Index satisfied two requirements: (i) the article met the search criteria in **Table V.1** and; (ii) the article addressed or captured economic policy uncertainty related issues. Even so, this 'human audit' cannot guarantee the complete absence of Type I and Type II errors given concerns of *"marketization, tabloidization/sensationalism, fragmentation, and a decline in professional ethics"* (Storr 2016). With this in mind, the reliability of the EPU Index for Trinidad and Tobago (EPU^{TT} Index) was evaluated by comparing its results – the EPU^{TT} Index is calibrated quarterly from March 2009[110] to September 2020 – with earlier known measures of economic uncertainty **(see Appendix A1)**.

V.4.1.2 Methodology

Following Baker, Bloom and Davis (2013) the 'raw number' of EPU articles were divided by the total number of articles, in that newspaper over that quarter, to derive the relative frequency of articles that meet the EPU Index criterion. These 'scaled counts' were then normalised by dividing each observation in that series by the standard deviation for that series. This process adjusted for differences in article volume across newspapers - and across time - allowing the 'normalised counts' to be aggregated. Aggregation was achieved using a simple average. This ensured that each newspaper received equal weight in determining the movements of the overall EPU^{TT} Index, eliminating any selection bias or preferences. That said, due to the normalisation process, the values for the EPU^{TT} Index did not fall into a well-defined range. This meant that, benchmarks or thresholds would depend on the predisposed inclinations of the researcher. To ensure against this bias and ensure a consistent measure of uncertainty over time, the 'aggregated' EPU^{TT} Index observations were transformed using a cumulative distribution function (CDF)[111] to allow the EPU^{TT} Index to assume values between 0 (low economic uncertainty) and 1 (very high economic uncertainty). Following this adjustment, the paper assumes that:

- When $0<EPU^{TT}$ Index≤ 0.2 there are **'low'** levels of economic uncertainty.
- When $0.2<EPU^{TT}$ Index≤ 0.4 there are **'moderate'** levels of economic uncertainty.
- When $0.4<EPU^{TT}$ Index≤ 0.6 there are **'elevated'** levels of economic uncertainty.
- When $0.6<EPU^{TT}$ Index≤ 0.8 there are **'high'** levels of economic uncertainty.
- When $0.8<EPU^{TT}$ Index≤ 1.0 there are **'very high'** levels of economic uncertainty.

V.4.2 Estimating the link between economic uncertainty and credit growth

The second stage of the study established how economic uncertainty affected domestic credit growth and the driving factors behind this relationship. In the empirical literature, this was achieved through VAR analysis. For this paper, the principles and assumptions of this approach are laid out below.

[110] The earliest article that meets the above mentioned criterion for the EPU Index dates back to January 2009.
[111] In Sinenko et al (2012) and Dumičić (2014) cumulative distribution function (CDF) were used to improve the interpretability of their composite indices.

V.4.2.1 Data

Consistent with the period covered by the EPU[TT] Index, the VAR covers March 2009 to September 2020. As in Bordo, Duca and Koch (2016) the key credit indicators were: (i) credit growth at the institution and system levels (that is, non-banks, commercial banks and banking system[112]) and; (ii) credit growth by economic sector (that is, public sector, households and businesses). Finally, to capture the key determinants of credit market conditions the banking sector specific indicators outlined in **Table V.2** were used – the variable selection process was guided by the CAMELS framework for banking stability.[113]

[112] The banking system consists of commercial banks and non-banks.

[113] CAMELS – (C)apital adequacy; (A)ssets; (M)anagement Capability; (E)arnings and Profitability; (L)iquidity; (S)ensitivity (to Market Risk) – is a rating system that assesses the strength of a bank by highlighting the various factors which contribute to overall bank stability.

Table V.1: Term Sets for the EPU Index

Category	Variable	Definition	Reasons for Inclusion	
			Reason 1	Reason 2
Capital Adequacy	**Regulatory Capital to Risk Weighted Assets (above prudential requirements)**	Calculated as total regulatory capital divided by risk-weighted assets less prudential requirements. It measures the capital adequacy of deposit takers (IMF 2006).	●Capital adequacy ratio requirements will influence the availability of loanable funds (IMF 2006).	●*"The negative impact of EPU on bank loan growth is significantly smaller as bank capitalization increases" (Bordo, Duca and Koch 2016).*
Asset Quality	**Non-Performing Loans-to-Gross Loans**	When a borrower has not made regular payments for at least 90 days, the loan is considered to be non-performing. The non-performing loan ratio, is calculated by dividing the total value of these non-performing loans to the total value of outstanding loans that the bank holds.	● Rapid credit growth may lead to adverse selection (which is often associated with reduced credit quality).	●"*Uncertain economic prospects, the high default risk and the difficulty of assessing the soundness of each debtor generate adverse selection and aversion to rising risk among banks, which thus adopt policies of lending restrictions*" (Cucinelli 2015).
Management	**Interest Margin-to-Gross Income**	In Dincer, et al. (2011) management soundness was proxied using data on margins, income, and expenses. A common indicator that possesses all these properties is the interest margin-to-gross income ratio. This profitability ratio measures the amount of net interest income (interest income minus interest expenses) against gross income.	● Interest margin-to-gross income shares a positive relationship with credit growth.	● "*The effect of heightened uncertainty on the portfolio of risk-averse bank is a greater share of safe assets; risk-averse banks smooth out their profit across states of nature by increasing their riskless bonds holding motivated by precautionary considerations, specifically, to ensure the stability of the profit aiming at avoiding the possible realisation of critically high level of defaults rate*" (Pirozhkova 2017)
Earnings and Profitability	**Return on Equity**	Reveals how much profit a company generated with shareholders' funds (Tharshiga, Subramaniam and Anandasayanan 2016).	●Credit has a positive correlation with banks' return on equity (Saeed and Zahid 2016).	
Liquidity	**Liquid Assets-to-Total Assets**	A ratio of a financial institution's liquid assets to their total liabilities.	● Liquidity affects banks' ability to provide loans (FDIC 2015).	●*"The sensitivity of bank loan growth to economic policy uncertainty to vary with the relative liquidity of assets across banks" (Bordo, Duca and Koch 2016).*
Sensitivity (to Market Risk)	**Net Open Position in Foreign Exchange-to-Capital**	This indicator examines the overall resilience to exchange rate movements. It is calculated by dividing the total assets in foreign currency (minus the total liabilities in foreign currency) by total equity or net worth.	● Foreign currency exposure (which can be estimated using banks' net open position in foreign exchange to capital) is often a concern for small, open economies. Economic uncertainty also increases exchange rate volatility.	● *"Loss-facing banks in response cut back credit to firms, including to those without FX exposure to begin with" (Abbassi and Bräuning 2019).*

Source: Authors

Note: FX stands for foreign exchange.

V.4.1.2 Methodology

The paper used a standard reduced form VAR (Equation 1) to model the dynamic feedback mechanisms between economic uncertainty and credit growth. This framework provides a systematic way to capture information from the inter-relationships observed across individual time series. More importantly VARs allow for IRFs – systems that trace the effects of a one-time shock (a one unit increase) in an independent variable on the future values of the dependent variable.

Equation V.1
VAR Model

$$Zy_t = W + \Gamma(L)y_{t-1} + \varepsilon_t$$

Where:

- y_t is the vector of n endogenous variables.
- Z is a $n \times n$ matrix of contemporaneous coefficients of y_t;
- W denotes the $n \times 1$ vector of constant;
- $\Gamma(L)$ is the $n \times n$ matrix of lag operator polynomials of the endogenous variables;
- ε_t is the $n \times 1$ vector of white noise processes (that is, $\varepsilon_t \sim N(0,\Omega)$).

Accumulated generalised IRFs were used as: (i) most of the endogenous variables were non-stationary[114] **(see Appendix A2)** or I(1) and; (ii) to limit researcher interference as much as possible.

V.5 RESULTS AND DISCUSSION

Based on the methodology employed, the EPU^{TT} Index was set as a combination of the equally weighted standardised frequencies of newspaper articles from the Express and the Guardian on pertinent EPU related developments in Trinidad and Tobago. To address this paper's research questions, emphasis was first placed on evaluating whether or not the EPU^{TT} Index produced signals that were both consistent with theoretical underpinnings identified throughout the literature and the macro-financial environment of Trinidad and Tobago. **Figure V.5** illustrates that movements in the EPU^{TT} Index broadly coincided with major known events. More specifically, uncertainty was '**moderate**' in 2009 as significant policy interventions by the Government and Central Bank limited possible systemic risks from the collapse of a major financial conglomerate, the CL Financial Group. Even so, the ruling party (the People's National Movement) lost to the People's Partnership in the May 2010 general elections. A changing of the guards, inter alia, helped economic uncertainty to remain '**moderate**' in 2010 however, as indicated in the "Notable Developments" section of **Figure V.3**, violent crime[115] was becoming a macro-critical area of concern. In fact, sentiments on national security worsened (economic uncertainty was '**elevated**' in 2011 and 2012) following a limited state of emergency (in 2011) and the resignation of key officials in the police force (in 2012). The Government was able to arrest some of the slide in public confidence – 2013 ended with '**moderate**' economic uncertainty – as several wage collective agreements were settled.

In 2014, economic uncertainty remained 'moderate' as business and labour markets were cautiously optimistic **(Figure V.1)**. Even so, there was a noticeable rise in the EPU^{TT} Index at the end of 2014 as the Organization of Petroleum Exporting Countries decided to raise production quotas, effectively suppressing crude oil prices. Although the September 2015 general elections helped to address some concerns in the public arena (which culminated into another switch in government, this time from the People's Partnership to the People's National Movement), 2015 ended with '**elevated**'

[114] Standard IRF analysis facilitates discussion of non-stationary variables through cumulating the responses. This "has the effect of smoothing the spikiness of the differenced variables, making inference more comfortable" (Royane 2011).

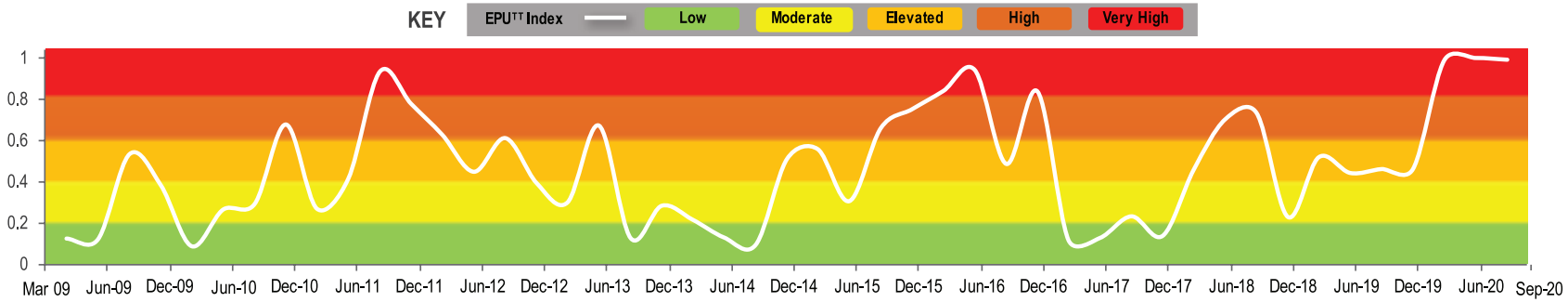
[115] According to data from the Central Statistical Office, 'reports to the police (excluding offences against traffic laws) – serious crimes' rose by 7.8 per cent between 2008 (20,566 reports were recorded) and 2009 (22,170 reports were recorded).

uncertainty as the slide in oil prices worsened[116]. The new Government made several budgetary adjustments to address the projected shortfall in fiscal revenues. Still, *"between September 2015 and March 2016, twenty-nine companies announced job cuts which displaced close to 3,000 workers"* (CBTT 2016)[117] and several employers proposed to freeze wages for 2017 – 2020. In light of the following, economic uncertainty fluctuated between '**moderate**' and '**very high**' levels over 2016. Even so, public sentiments improved vastly in 2017, as the energy sector benefited from increased natural gas production from two major gas projects the (Trinidad Onshore Compression Project and bpTT's Juniper platform).

The pendulum swung again in the ensuing years. Trinidad and Tobago recorded '**elevated**' levels of economic uncertainty in 2018 and 2019, respectively, as the Government implemented a restructuring[118] exercise at Petrotrin (the largest domestic integrated oil producer) and; (ii) segments of society expressed concerns about several pieces of legislation. Sentiments worsened considerably over 2020 (economic uncertainty rose to '**very high**' levels), when Trinidad and Tobago recorded its first case of COVID-19 (on March 12 2020). Although the Government introduced a range of containment measures to prevent community transmission, news of COVID-19 was met with several documented incidents of panic buying. To alleviate public anxieties and reinforce measures to contain the spread of COVID-19, the Government imposed a 'Stay-at-Home' Order, which required all non-essential businesses and schools to shut down their operations on March 30, 2020. The EPUTT Index suggests that uncertainty conditions remain '**very high**' as the country progresses through the various stages towards normalisation.

[116] The global price of WTI Crude ended 2015 at $US 37.2 per barrel.
[117] CBTT. 2016. "Economic Bulletin." Central Bank of Trinidad and Tobago.
[118] Approximately, 4,800 employees were retrenched.

Figure V.5: The Quarterly EPUTT Index



NOTABLE DEVELOPMENTS

2009
The Government and Central Bank intervened to help limit contagion risks from CL Financial.

2010
The Government revised the Property Tax Act, issued a Homeowners Tax Credit allowance and increased senior citizen pension grants.

2011
A state of emergency was called to tackle the rise in serious crimes.

2012
The Commissioner of Police (COP) and Deputy COP re-signed following growing criticism on national security.

2013
The Government settled several collective agreements across the Energy, Finance, Distribution and Transport sectors.

2014
While confidence indices suggested general confidence in the outlook of the economy, uncertainty rose in the latter half of 2014 as strong oil supply fuelled a sharp fall in oil prices.

2015
The Government supplemented the shortfall in fiscal energy revenues by; raising fuel prices, hiking corporate taxes and increasing the amount of 'vatable' items.

2016
29 companies announced downsizing and several employers proposed to freezes wages for 2017 - 2020.

2017
The energy sector benefitted from two gas projects (the Trinidad Onshore Compression project and the Juniper project).

2018
The board of the state-owned oil company announced their intentions to restructure the company. Over the next few months a clear resolution strategy was outlined – and implemented – to the public.

2019
The general public expressed their concerns on: the Unexplained Wealth Bill; changes to the Freedom of Information Act; and the demonetization of cotton 100$ bill notes and introduction of a polymer note.

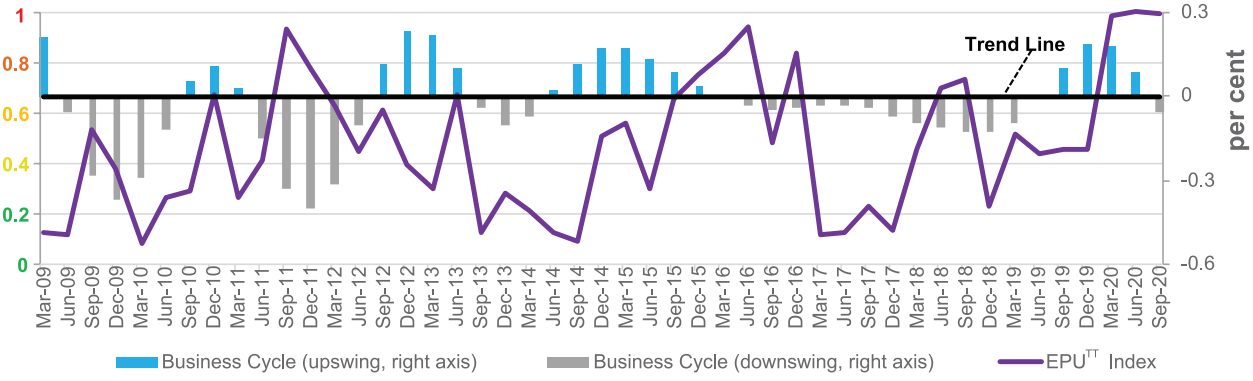
2020
The first domestic COVID-19 case was recorded on March 12. To slow the spread of COVID-19, non-essential activates were prohibited from March 30. From May 12, certain restrictions were eased on a phased basis however, following an uptick in COVID-19 infections, restrictions were re-introduced from August 17.

Source: Authors

Note: The colour of the ● in the "Summary Boxes" section of Figure 5 gives the assessment ('**low**', '**moderate**', '**elevated**', '**high**' or '**very high**') on the average level of economic uncertainty during that year.

Another way to evaluate the EPU Index involves observing how it moves alongside business cycle fluctuations (the oscillatory movements in economic activity) as swings in economic activity may stem partly from changes in public confidence (Leduc 2010). **Figure V.6** demonstrates several instances where the EPU^{TT} Index moved in-line with economic theory on public confidence and the business cycle.[119] More specifically, 'good times' (that is, the business cycle upswings between September 2012 and December 2015 in **Figure V.6)** coincided largely with '**low**' to '**moderate**' periods of economic uncertainty as economic booms are often characterised by waves of optimism and the view that the economy is entering a new era of high economic activity (Leduc 2010). While, 'bad times' (business cycle downswings) can cast doubts on a country's future causing economic uncertainty to be '**elevated**', if economic weakness is prolonged pessimism can become entrenched and self-reinforcing raising economic uncertainty to '**high**' or '**very high**' levels (Bonciani 2015). This was best demonstrated between June 2011 and June 2012 (as well as between December 2015 and December 2016) where economic uncertainty fluctuated between '**elevated**' and '**high**' levels following a sudden slowdown in the business cycle.

Figure V.6: Economic Uncertainty and the Business Cycle



Source: Author

Note: The business cycle is set as a combination of the short-term cycles in: GDP at current prices; the inflation rate and; the spot price of WTI oil between March 1992 and December 2020. Also, the business cycle is in an **upswing** (downswing) when economic activity is above (below) its long-term trend (that is, the **Trend Line**). Finally, the numbers on the left hand y-axis are colour-coded to represent a; '**low**', '**moderate**', '**elevated**', '**high**' or '**very high**' level of economic uncertainty.

[119] While the EPU^{TT} Index shared a low correlation (-0.05) with the business cycle, the statistic is negative. Implying that when the business cycle increases (decreases) economic uncertainty is falling (rising). Moreover, reviewing the data, this relationship was observed 43 per cent of the time over the period of interest.

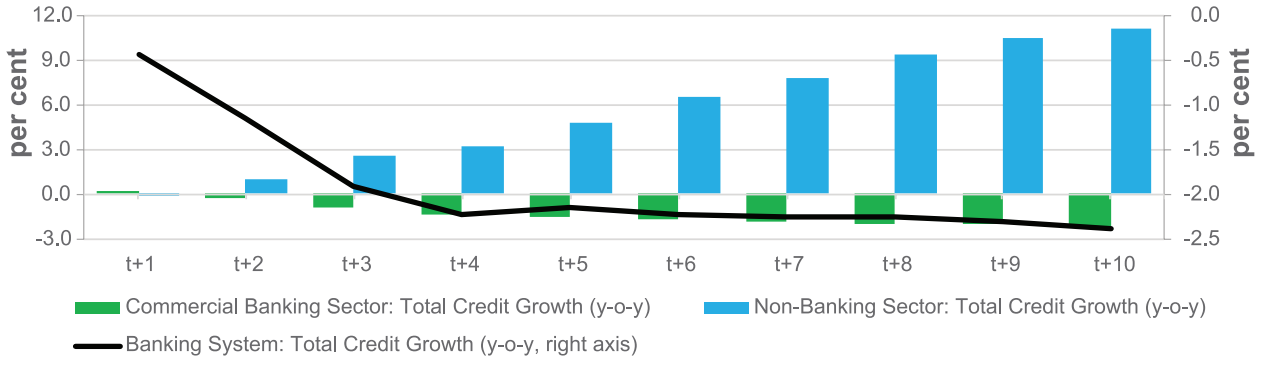
Following **Figures V.5** and **V.6**, the EPU^{TT} Index produced signals that were both consistent with the literature and the macro-financial environment of Trinidad and Tobago. With this in mind, the rest of this section addresses the paper's remaining research questions: (i) how does economic uncertainty affect domestic credit growth? and; (ii) what are the driving factors behind this relationship. This assessment was carried out by investigating the factors that drive credit expansion. Typically, these fall broadly into one of two categories; supply-side or demand-side effects. The supply-side, focuses on measures that reflect financial institutions' balance-sheet strength (these statistics influence their willingness to extend credit) while the demand side looks at idiosyncratic shifts in the macro-environment that can influence borrowers' decision to seek credit. For this paper, the selected supply-side measures included; regulatory capital to risk weighted assets (above prudential requirements), non-performing loans-to-gross loans, interest margin-to-gross income, return on equity, liquid assets-to-total assets and net open position in foreign exchange-to-capital while the selected demand-side measure was the EPU^{TT} Index. These were entered into a VAR model to investigate credit growth's response to one-off shocks in economic uncertainty.

From **Figure V.7**, the IRFs[120] suggest that the banking system adopts a very conservative stance in the supply of credit during periods of heightened economic uncertainty as commercial banks, which dominate lending activities[121], curtail credit growth when there is a rise in the perceived risks from unstable market conditions. At the same time, the IRF for the non-banking sector demonstrated that economic uncertainty does not necessarily reduce the demand for credit as, when faced with volatile conditions, economic agents tend to seek 'emergency loans' to help smooth income gaps or kick-start their recovery efforts. Moreover, given commercial banks unwillingness to extend credit and non-banks' small asset size[122], the non-banking sector may be more willing to meet economic agents' financial demands as they are faced with an opportunity to raise their asset base at a faster pace than their competitors.

Based on the findings from **Figure V.7** there may be some concern that the non-banking sector may be exposed to unwarranted credit risks as economic uncertainty is regularly associated with economic downturns – which can undermine borrower's repayment capacity. However, **Figure V.8** shows that a significant proportion of these loans are made to the public sector who *"remains an attractive investment, given its … strong track record of repayment"* (CBTT 2019). In fact, an increase in public sector loans during periods of high economic uncertainty is consistent with Baum, Caglayan and Xu (2017) who found that the sovereign will often carry out expansionary policies to fight pessimism and promote recovery during economic downturns.

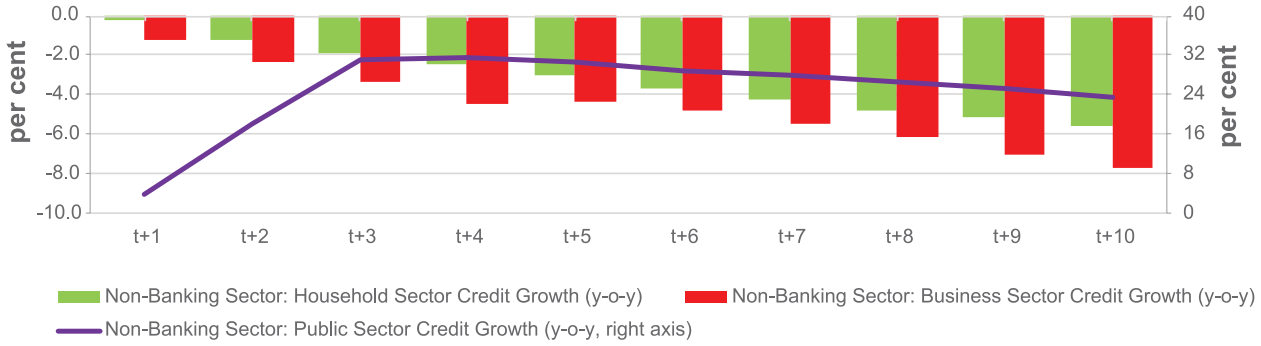
[120] See Appendix A3 for all VAR statistical adequacy test results.
[121] On average commercial banks accounted for 93.2 per cent of the loans made over the period of review.
[122] On average non-banks accounted for only 6.8 per cent of the loans made over that period of review.

Figure V.7: Response of Total Credit Growth (by Entity) to a Rise in Uncertainty



Source: EViews Output

Figure V.8: Response of Non-Banking Sector Credit Growth (by Economic Sector) to a Rise in Uncertainty

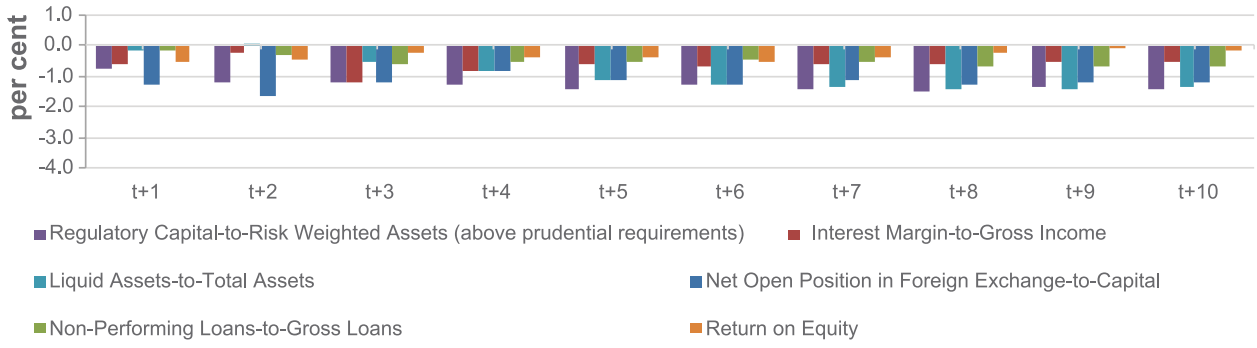


Source: EViews Output

Notwithstanding the government's policy stance, the financial needs of the public sector can put a strain on non-banks **(Figure V.9)**. More specifically, stability indicators indicated that, despite the increase in loans, an increase in economic uncertainty dampens earnings and profitability as depressed economic conditions hamper debt repayment capacities. Additionally, to meet the financial demands from the public sector non-banks will reduce their liquidity. However, when there are less available financial resources, credit to the private sector may not be readily forthcoming **(Figure V.8)**. Additionally, the reduction in liquidity can heighten institutions' sensitivity to market risks and/or hamper their ability to withstand systemic shocks (as captured by the IRF for 'Non-Banking Sector: Capital to Risk Weighted Assets' in **(Figure V.9)** as loans that are extended during 'bad times' typically carry higher risk weights. What's more, **Figure V.9** may be overestimating the health of the non-banking sector as current regulations: (i) do not set limits on the level of exposure to the domestic sovereign and; (ii) apply a zero-risk weight[123] for claims that are fully guaranteed by the Government of Trinidad and Tobago[124]. However, recent developments have called such practices into question. For instance, the regulatory framework in the European Union (EU) allowed for widespread use of zero risk weights for sovereign debt but, when several Eurozone member states were unable to repay their government debt the EU plunged into a negative spiral of economic activity from 2009 to 2012 as European banks incurred losses of up to €1 trillion (ESRB 2015).

Notwithstanding the foregoing, there may be some notion that the financial stability risks from economic uncertainty are limited as, from 2008 to 2019, the non-banking sector made up, on average, only 4.2 per cent of total financial system assets. However, the global financial crisis demonstrated that a sector can turn into a powerful propagator of shocks that can subvert macro-economic stability. This was also observed in Trinidad and Tobago in 2009, when the collapse of a major local and regional financial conglomerate cost the domestic economy approximately $24 billion or 17 per cent of its GDP (Hilaire 2018).

Figure V.9: Response of Non-Banking Sector Stability Indicators



Source: EViews Output

[123] Zero risk weights are often applied to government securities or debt instruments as they are viewed as having little to no risk of going into default (Lenarčič, Mevis and Siklós 2016).

[124] On May 18 2020, the CBTT announced that the "Financial Institutions (Capital Adequacy) Regulations, 2020" were promulgated (CBTT 2020). These Regulations, inter alia, phased out Basel I and introduced Basel II/III rules. While the "Policy Proposals for the Implementation of the Basel II/III Capital Frameworks by the Central Bank of Trinidad and Tobago: Phase 1- Minimum Capital Requirements" mentioned that claims on public sector enterprises "will attract a risk weight of 20 per cent a 0 per cent risk weight will still be applied to claims on the Government of Trinidad and Tobago (CBTT 2018b).

V.6 CONCLUSION AND POLICY IMPLICATIONS AND RECOMMENDATIONS

In the local context, surveys were used to capture the sentiments of consumers, businesses and labour market participants. These expectations were used to fashion sectorial CIs or proxies of economic uncertainty. However, the production of such indices have since been discontinued, but research by the CBTT has since focused on the exploration of early warning indicators for the financial sector given their key role in the choice of macroprudential instruments aimed at containing systemic risk and safeguarding financial stability. In light of this, the paper advances a simpler and more cost effective approach to gauging economic uncertainty in Trinidad and Tobago by adopting Baker, Bloom and Davis's (2013) event analysis approach for the computation of EPU Indices.

The EPU^{TT} Index was set as a combination of the equally weighted standardised frequencies of newspaper articles from the Express and the Guardian on pertinent developments in economic policy uncertainty in Trinidad and Tobago. The index coincided well with major events that were assumed to contribute to heightened uncertainty over the period of interest. In addition to this, the EPU^{TT} Index produced signals that were consistent with the theoretical and empirical literature.

On one hand, the IRFs suggest that the banking system curtails credit supply when there is an increase in economic uncertainty as commercial banks, the dominant industry, reduce their lending activities over these periods. On the other hand, the IRF for the non-banking sector showed that there would still be a demand for loans as economic agents try to stabilise their financial positions over this period of economic volatility. Further, in an attempt to grow their assets at a faster pace than their competitors, non-banks will be incentivised to fill the lending gaps left by the commercial banking sector. While risk-taking is a natural part of a market economy, economic uncertainty is regularly associated with economic downturns, which can undermine borrower's repayment capacity and by extension the financial stability of the non-banking sector. That said, a significant proportion of these loans go to the public sector as governments will often carry out expansionary policies to fight pessimism and promote recovery during economic downturns (Baum, Caglayan and Xu 2017).

Baum, Caglayan and Xu (2017) argue that the rise in credit growth comes from institutions' preference for 'risk-free' assets during subdued economic and financial conditions. However, it should be noted that, some international and regional developments have demonstrated that 'risk-free' government securities may fuel conditions for systemic risk accumulation. As *"the domestic sovereign remains an attractive investment, given its … strong track record of repayment"* (CBTT 2019), current indicators do not point towards any expected solvency issues in the short-term. At the same time, sovereign-led crises have demonstrated the need for more pragmatic public sector exposure risk weights for the banking system. While the "Promulgation of the Financial Institutions (Capital Adequacy) Regulations, 2020" (CBTT 2020) has improved banking system resilience by enforcing specific aspects of international banking standards (specifically Basel II and Basel III), government backed claims still carry a 0 per cent risk weight. Therefore, going forward there are two main regulatory measures that could be considered or possibly combined to address financial system sovereign exposures in Trinidad and Tobago. Firstly, a **revision of risk weights is imperative**. It is advised that policymakers begin to assign a non-zero risk weight to domestic sovereign securities. This rate needs to be or should be adjusted based on the changing economic environment and could consider the health of governments based on a set criteria (for example credit ratings, level of current government debt or fiscal revenues to public sector debt). Secondly, a **tighter**

'large exposure' regime is required. Policymakers should consider removing (partially or fully) the sovereign exception to the large exposure provision, or basing public sector credit concentration limits on the long-term averages of sovereign ratings. This could reduce the preference for sovereign securities as the domestic financing needs of the public sector can curb credit to the private sector. Still, notwithstanding the potential financial stability benefits from adopting these recommendations, care must be taken in revising regulatory considerations as, for example, excessive exposure limits may force banks to divest sovereign exposures which can in turn increase governments' financing costs and inhibit fiscal policy measures thereby prolonging pessimism and with it the recovery effort (Andritzky, et al. 2016).

Although this paper only demonstrated how periods of uncertainty can influence banks' risk appetite, the EPU^{TT} Index can also be used to explore the channels through which financial instability may impair macroeconomic stability. While this can aid with the CBTT's macroprudential surveillance efforts, further improvements to support the reliability of the index are required as the EPU^{TT} Index only included observations from two out of the three leading newspaper in the nation. Such actions may require collaboration with the relevant stakeholders such as the National Archives of Trinidad and Tobago who, among other things, possess records of most of the newspapers published in Trinidad and Tobago. Nevertheless, it should be noted that due to the complexity and many interlinkages of financial systems, as well as the tendency for risks to mutate or time lags between risks materialising, one single indicator is not sufficient to provide guidance on systemic risks.

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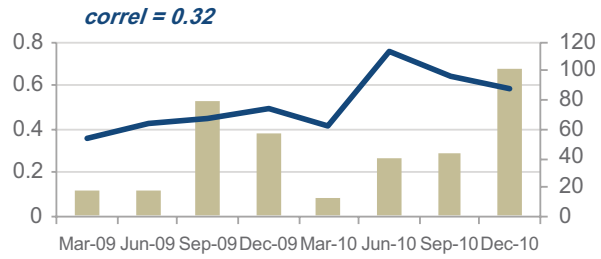
APPENDICES CHAPTER V

V.A1: Evaluating the Reliability of the EPU^{TT} Index

V.A1: Evaluating the Reliability of the EPUTT Index

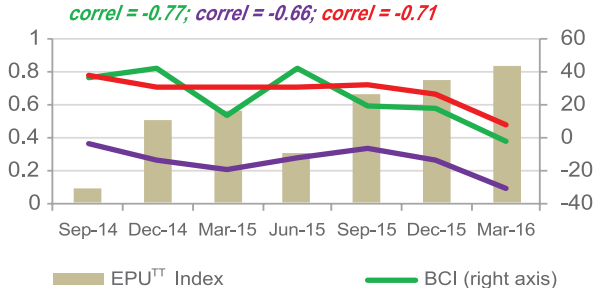
The EPU^{TT} Index was compared against other measures of uncertainty in Trinidad and Tobago – that is, the RBL/MFO's CCI and the CBTT's BCI, CCI and LCI – to evaluate its reliability. This was accomplished through assessing the sign and magnitude of their correlation coefficients (CC) with the EPU^{TT} Index. All of the CBTT CIs have a negative CC **(see Figure 10** and **Figure 11)** – this correctly implies that confidence has a negative relationship with uncertainty. Additionally, the CBTT's BCI, CCI and LCI have high CCs – this suggests a strong relationship between confidence and uncertainty. Notwithstanding these developments, the RBL/MFO's CCI has a low, positive CC with the EPU^{TT} Index. This may indicate that conceptual differences between the two measures – interpretations, samples (households versus readership) and index construction – may be undermining the strength of the relationship between these two variables.

Figure V.10 The EPUTT Index and RBL/MFO CCI



Source: Authors

Figure V.11 The EPUTT Index, BCI, CCI and LCI



Source: Authors

APPENDICES CHAPTER V (CONTINUED)

V.A2: Unit Root Tests

V.A2: Unit Root Tests

This paper incorporates stationary variables in all models. Stationarity evades the problem of spurious regression and enable hypothesis testing to be performed using the standard *t* and *F* distributions. All indicators, except for the credit growth variables and the EPU^{TT} Index[125], were *differenced* to the level that was recommended by at least two of the three traditional unit root tests.

Table V.3: Unit Root Test Results

Variables		Augmented Dickey Fuller Unit Test		Phillips Perron Test		Kwiatkowski-Phillips-Schmidt-Shin Test	
		Test statistic	Level	Test statistic	Level	Test statistic	Level
Regulatory Capital to Risk Weighted Assets (above prudential requirements)	Non-Banking Sector	-7.65	I(1)	-9.72	I(1)	0.37	I(1)
	Commercial Banking Sector	-7.95	I(1)	-7.93	I(1)	0.32	I(0)
	Banking System	-7.53	I(1)	-7.55	I(1)	0.19	I(1)
Non-Performing Loans-to-Gross Loans	Non-Banking Sector	-3.77	I(0)	-3.56	I(0)	0.17	I(0)
	Commercial Banking Sector	-7.68	I(1)	-7.60	I(1)	0.22	I(1)
	Banking System	-7.27	I(1)	-7.24	I(1)	0.26	I(1)
Interest Margin-to-Gross Income	Non-Banking Sector	-8.32	I(1)	-8.33	I(1)	0.24	I(0)
	Commercial Banking Sector	-7.45	I(1)	-7.50	I(1)	0.16	I(0)
	Banking System	-7.14	I(1)	-7.15	I(1)	0.17	I(0)
Return on Equity	Non-Banking Sector	-3.89	I(0)	-3.64	I(0)	0.13	I(0)
	Commercial Banking Sector	-2.96	I(0)	-2.96	I(0)	0.15	I(0)
	Banking System	-3.13	I(0)	-3.14	I(0)	0.14	I(0)
Liquid Assets-to-Total Assets	Non-Banking Sector	-3.41	I(0)	-3.41	I(0)	0.16	I(1)
	Commercial Banking Sector	-7.12	I(1)	-7.13	I(1)	0.17	I(1)
	Banking System	-7.05	I(1)	-7.06	I(1)	0.44	I(1)
Net Open Position in Foreign Exchange-to-Capital	Non-Banking Sector	-8.68	I(1)	-3.56	I(0)	0.62	I(1)
	Commercial Banking Sector	-3.13	I(0)	-3.07	I(0)	0.39	I(0)
	Banking System	-8.68	I(1)	-10.12	I(1)	0.26	I(2)

Source: EViews Output

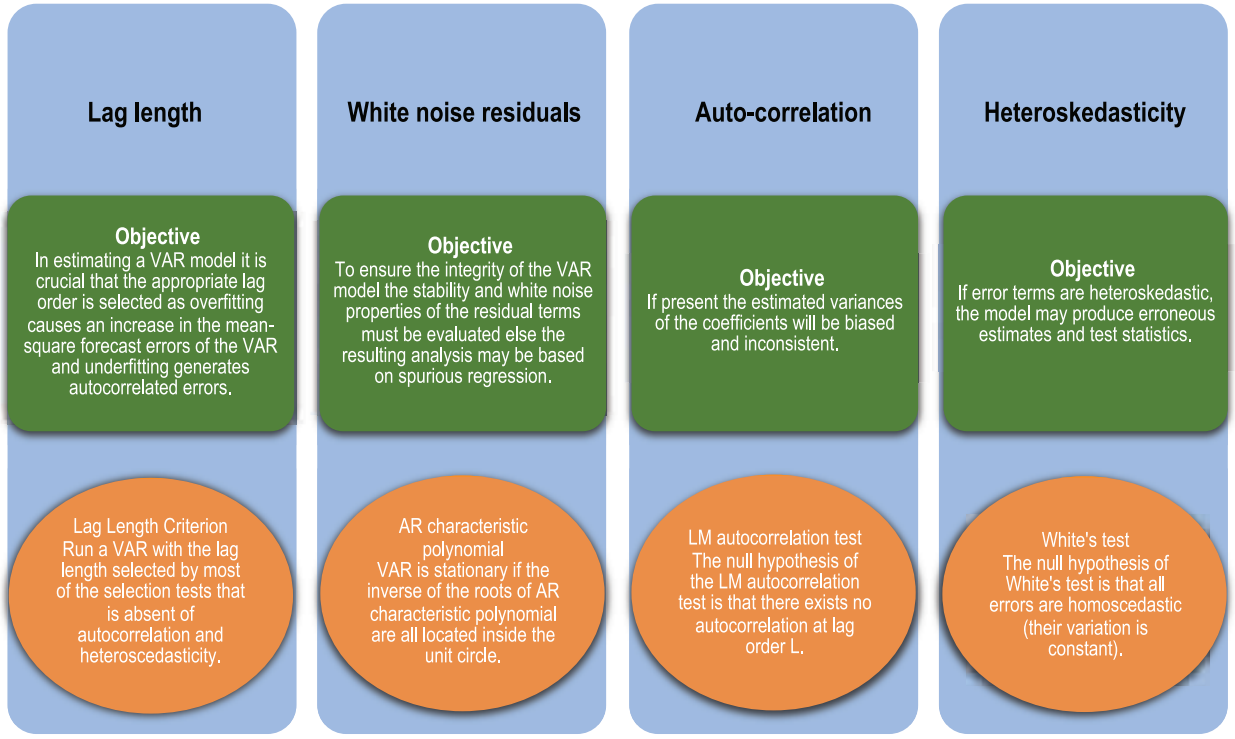
Note: All 'Test Statistics' were rejected at the 5 per cent level of significance.

[125] This was done to retain the informative properties of these variables in the models.

APPENDICES CHAPTER V (CONTINUED)

V.A3: VAR Model Specification Tests

Figure V.12: VAR Statistical Adequacy Checks



Source: EViews Manuals and (Lütkepohl 2007)

Note: Green rectangles discuss the objective of the specification test; Orange ovals describe the test statistic or index for the specification test.

APPENDICES CHAPTER V (CONTINUED)

Table V.4: VAR Lag Length Selection Tests

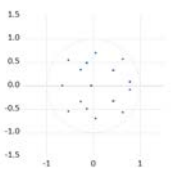
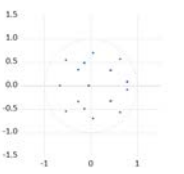
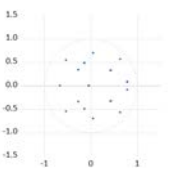
Key Variable	Lag Length	LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion	Lag Length Used in the Paper
Banking System Credit Growth	4	**88.13**	**14.36**	**20.98**	31.90	**24.98**	2
Commercial Banking Sector Credit Growth	4	70.61	**180.55**	**23.51**	34.43	**27.51**	2
Non-Banking Sector Credit Growth	4	**104.53**	**2397.13**	**26.54**	**37.35**	**30.53**	2
Commercial Banking Sector: Public Sector Credit Growth	4	**87.52**	**18868915**	**35.07**	45.99	**39.07**	2
Commercial Banking Sector: Business Sector Credit Growth	4	**91.40**	**9194.72**	**27.44**	**38.36**	**31.44**	2
Commercial Banking Sector: Household Sector Credit Growth	4	64.22	**147909.9**	**30.22**	41.14	**34.22**	2

Source: EViews Output

Note: The bold cells in the table refer to the lag length chosen by the lag length selection criterion. In estimating a VAR model it is crucial that the appropriate lag order is selected. Given that the literature suggests different criteria for estimating the maximum lag lengths a common way to overcome this problem, is to run a VAR with the lag length (selected by most of the selections tests) that is absent of autocorrelation and heteroscedasticity (Lutkepohl, 2005).

APPENDICES CHAPTER V (CONTINUED)

Figure V.13: VAR White Noise Residuals

Banking System Credit Growth	Commercial Banking Sector Credit Growth	Non-Banking Sector Credit Growth	Non-Banking Sector: Public Sector Credit Growth	Non-Banking Sector: Business Sector Credit Growth	Non-Banking Sector: Household Sector Credit Growth
					

Source: EViews Output

APPENDICES CHAPTER V (CONTINUED)

Table V.5: Auto-Correlation VAR Results

Key Variable	Lags	LM-Stat	Prob
Banking System Credit Growth	**1**	**62.04**	**0.55**
	2	**63.71**	**0.49**
	3	**51.72**	**0.87**
	4	**77.19**	**0.12**
Commercial Banking Sector Credit Growth	**1**	**60.47**	**0.60**
	2	**58.10**	**0.68**
	3	**55.43**	**0.77**
	4	**75.20**	**0.16**
Non-Banking Sector Credit Growth	1	88.14	0.02
	2	**74.39**	**0.18**
	3	87.80	0.03
	4	**66.52**	**0.39**
Non-Banking Sector: Public Sector Credit Growth	**1**	**66.54**	**0.39**
	2	95.28	0.01
	3	**66.39**	**0.39**
	4	**65.33**	**0.43**
Non-Banking Sector: Non-Financial Corporate Sector Credit Growth	1	98.76	0.00
	2	85.16	0.04
	3	**68.80**	**0.32**
	4	**60.50**	**0.60**
Non-Banking Sector: Household Sector Credit Growth	**1**	**82.77**	**0.06**
	2	91.88	0.01
	3	**83.80**	**0.05**
	4	**58.87**	**0.66**

Source: EViews Output

Note: Bold cells refer to no autocorrelation for the associated probability of greater than 5 per cent.

APPENDICES CHAPTER V (CONTINUED)

Table V.6: Heteroskedasticity VAR Results

Key Variable	Chi-sq	P-value	Decision
Banking System Credit Growth	1172.37	0.33	Do not reject H^0
Commercial Banking Sector Credit Growth	1197.63	0.17	Do not reject H^0
Non-Banking Sector Credit Growth	1165.95	0.38	Do not reject H^0
Commercial Banking Sector: Public Sector Credit Growth	1169.53	0.35	Do not reject H^0
Commercial Banking Sector: Non-Financial Corporate Sector Credit Growth	1166.79	0.37	Do not reject H^0
Commercial Banking Sector: Household Sector Credit Growth	1190.69	0.21	Do not reject H^0

Source: EViews Output

Note: The p-value was greater than 5 per cent. Thus the null hypothesis of homoscedastic error terms was accepted.