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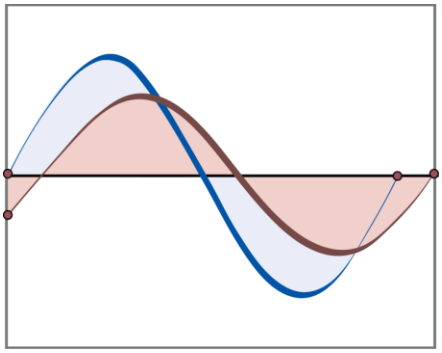

WP 04/2019 September 2019

The Impact of External Conditions on a Small Open Economy: A Structural-VAR Approach for Trinidad and Tobago

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Abstract

This paper investigates the extent to which external conditions affect the growth performance of Trinidad and Tobago for the period 1971-2014. Proxies used for external conditions include Gross Domestic Product (GDP) from Trinidad and Tobago's largest trading partner (US), the ratio of capital inflows to CARICOM member-states as a share of their collective GDP, and crude oil prices. The paper explores how these external conditions help to explain Trinidad and Tobago's growth path over the past four decades. An open economy structural vector autoregressive (SVAR) model with block exogeneity assumption was utilised. The results from the structural impulse response functions reveal that crude oil prices have a positive significant influence on domestic GDP growth, government revenue, and domestic prices while external financial conditions had a negative impact on government debt. Summarily, we find that the external environment has a sizable impact on the macroeconomic performance of the small, open economy of Trinidad and Tobago.

JEL Classification Numbers: C22; E32; F41

Keywords: external shocks; small open economy; Structural VAR model; block exogeneity; Trinidad and Tobago

The Impact of External Conditions on a Small Open Economy: A Structural-VAR Approach for Trinidad and Tobago

Karen A. Roopnarine, Darcelle Bowrin, and Susan Ramirez[1]

1.0 Introduction

Caribbean economies can be characterised as small-sized, highly indebted, poorly diversified, and potentially vulnerable to large business cycle swings that originate from the external environment (Mercer-Blackman 2012). Historically, it is the combination of domestic policies and outside shocks which account for the volatility in growth patterns in the Caribbean region. The literature is replete with studies which find that industrialised countries exert a strong influence on the growth levels of small open developing economies[2].

This paper aims to examine the impact of external conditions on the output performance of Trinidad and Tobago as distinct from the influence of domestic factors. Izquierdo *et al.* (2008) have emphasised that to conduct a proper assessment of the macroeconomic performance of a country, the effects of external factors should be filtered out. In this light, our paper seeks to show how external shocks impact fluctuations in the business cycle compared with the impact of domestic shocks.

The external environment has undergone several changes which have impacted hydrocarbon producers and exporters in the Latin American and Caribbean region (ECLAC 2017). Several adjustments in the global economy following the 2008-2009 financial crisis have changed the characteristics of the current economic cycle. According to the Economic Commission for Latin America and the Caribbean (ECLAC 2017), *"the current cycle and the prevailing external context pose major challenges in terms of navigating the short-run conditions and returning to growth in the region in the medium and long terms".* Major economies have experienced a weaker pace of growth, which is expected to slow further in keeping with a more modest long-term growth potential. The new dynamics of the global economy, including heightened geopolitical tensions, the reciprocal imposition of trade tariffs between the US and China, the tightening of financial conditions (cross-border lending has declined as large US and European banks have retreated from foreign markets), slower productivity growth, relatively low commodity prices, the possible imminent withdrawal of the United Kingdom from the European Union (Brexit), and the normalisation of the monetary policy stance in the US could intensify existing vulnerabilities and give rise to new ones.

Trinidad and Tobago is the largest crude oil and natural gas producer in the Caribbean. Despite this, it is relatively small in terms of its contribution to global activity. The country's dependence on the extraction of hydrocarbons has increased over one hundred years. However, over the last twenty-five years, given the changing composition of energy production and exports, Trinidad and Tobago has shifted from a mostly oil-based economy to a more natural gas-based economy. Similar to other small and highly open commodity export-oriented economies, international

[1] The authors would like to thank members of the Research Department of the Central Bank of Trinidad and Tobago for their comments received at the department's Discussion Series held on June 6th 2019, and Shane Lowe, who was the discussant for the paper at the Central Bank of Barbados' 39th Annual Review Seminar, held July 24-26, 2019.

[2] See *inter alia* Buckle, Kirkham, McLellan and Sharma (2007), Nizamani, Gilal, Khushik, Shah and Abid (2017) and Zaidi and Karim (2012).

commodity prices and the degree of synchronisation with major trading partners are key determinants of the growth pattern in Trinidad and Tobago.

To our knowledge, studies that assess the effect of foreign shocks on Trinidad and Tobago which take into account more than one external influence, have mostly been within the context of a larger grouping, such as, the Caribbean or Latin America. For instance, Fuentes, Melgarejo, and Mercer-Blackman (2015) analysed economic growth patterns for six Caribbean countries (including Trinidad and Tobago) using data from 1962 to 2011 based on their dependence on the major trading partner and the price of the main commodity export. For Trinidad and Tobago, positive and significant effects were found for real US Gross Domestic Product (GDP) growth and changes in oil prices, while the natural gas price effect was ambiguous. Other recent examples of multi-country studies to analyse the impact of outside forces on growth which include Trinidad and Tobago are Gruss, Nabar and Poplawski-Ribeiro (2018), Gruss (2014) and Mercer-Blackman and Melgarejo (2013).

Our paper adds to the existing literature on the impact of global activity on growth in Trinidad and Tobago in two main ways. First, this paper differs in its empirical methodology from previous Latin American and Caribbean studies. Instead of estimating a vector autoregressive (VAR) model or Vector Error Correction Model[3] (VECM), we use a recursive block exogenous zero-restricted open economy structural vector autoregressive (SVAR) model. The usefulness of estimating an SVAR (instead of an unrestricted VAR) model with block exogeneity assumption, is that we can eliminate feedback effects such that domestic shocks have zero effect on the exogenous foreign variables. Further, the SVAR model allows for the inclusion of more than one or two global variables simultaneously with domestic variables in a single-country model. Along the lines of Osterholm and Zettelmeyer (2007), Izquierdo, Romero and Talvi (2008), and Gruss, Nabar and Poplawski-Ribeiro (2018), we analyse country-specific external shocks in three broad categories that capture the influence of external demand, external financial conditions, and commodity prices on domestic GDP growth, all at the same time. Second, the influence of external conditions is examined over forty-three years from 1971 to 2014[4] as well as in two distinct time periods that characterise the pre- and post-financial and trade liberalisation[5] eras.

The results of this study should prove useful, given the new global paradigm. An understanding of the response of domestic macroeconomic variables to external shocks would better guide policy decision-making to help bring about sustainable economic growth. For instance, over the entire period under review, we found that crude oil prices had a strong influence on all the domestic macroeconomic variables considered. However, post-liberalisation crude oil prices no longer had a statistically significant influence on domestic GDP, whereas US GDP and regional financial conditions had a positive impact on domestic output. Additionally, a one-time shock to crude oil prices only had a statistically significant effect in the short-run concerning government revenue post-liberalisation. As the country diversified its hydrocarbon sector away from oil exploration to natural gas and petrochemicals in the post-liberalisation era, the economy became more resilient to oil price volatility.

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[3] For instance Calvo, Leiderm and Reinhart (1993), Izuuierdo, Romero and Talvi (2008),

[4] Previous studies on Trinidad and Tobago include Edwards and Woolford (2018), whose period of analysis was 2001-2017; 1980-2014 for Fuentes, Melgarejo and Mercer-Blackman (2015); and 2007-2017 for Rahaman (2018).

[5] Hereafter, liberalisation refers to both trade and financial liberalisation. The country underwent a period of macroeconomic stabilization and structural adjustment, which began in the mid-1990s. The series of policy changes that occurred are discussed in more detail in Section 3 (Stylised Facts) of the paper.

The rest of the paper is structured as follows. Section II reviews the literature related to the macroeconomic effects of external shocks citing the methodology used and the region examined with particular emphasis on emerging markets and developing economies. Section III provides an overview of Trinidad and Tobago's growth performance over the period 1970-2014 and the role external factors have had in shaping the business cycle. Section IV details the data and methodology used, while section V discusses the results, and section VI concludes the paper and provides some policy recommendations.

2.0 Literature Review

Calderón *et al.* (2004) sought to evaluate the influence of external conditions and international integration (trade and financial integration) on the growth performance for 76 countries[6] over the period 1970-2000. The authors employed the generalised method of moments (GMM) for dynamic models of panel data developed by Arellano and Bond (1991) and Arellano and Bover (1995). The dependent variable of interest was economic growth, measured by the average rate of real per capita GDP growth. The explanatory variables included proxies of trade and financial openness, measures of various external shocks[7], interaction terms, and other control variables. It was found that both trade and financial openness were positively related to economic growth. The authors concluded that increases in favourable terms of trade, positive growth in trade partners, and capital flows to the region produce a rise in economic growth. It was also found that greater trade openness dampens the growth effect of trade-related shocks while intensifying the effect of final market shocks. Conversely, greater financial openness increases the growth effect of trade-related shocks while attenuating the impact of regional capital inflows on financial market shocks. Summarily, this study showed that both trade and financial openness are beneficial to economic growth.

It is well known that economic developments in advanced economies affect the growth patterns in emerging economies. In a 2014 paper, the International Monetary Fund (IMF) sought to investigate the extent of such effects. It was assumed that most emerging markets are small, open economies and that global economic conditions are exogenous to growth (at least on impact). Hence, the extent to which these economies are exposed to global shocks depends on cross-border linkages and domestic policies. The authors used a standard SVAR model to quantify the effect on growth arising from external shocks[8,9]. The IMF concluded that changes in external conditions have important effects for growth in emerging market economies. For instance, an unexpected increase in the US growth raises emerging markets' growth on impact, and growth remains positive over the short-term, in spite of the increases in the global interest rates. Growth in the US also spurred growth in the Euro Area and China but, unlike the case with emerging markets, growth was reduced by tighter external financing conditions. External factors such as,

[6] These comprised 22 industrial economies, 21 Latin American and Caribbean countries (including Trinidad and Tobago), 8 East Asian and the Pacific economies, 7 Middle East and North African countries, 3 South Asian countries, and 15 Sub-Saharan African economies.

[7] This study looked at four types of foreign shocks: terms of trade changes, trading partners' GDP growth, changes in international real interest rates, and net regional capital inflows.

[8] The external variables used were: the US real GDP growth, US inflation as measured by the CPI, the 10-year US Treasury bond rate, the composite emerging market economy bond yield and the economy specific terms-of-trade growth. The domestic variables include the domestic real GDP growth, domestic consumer price inflation, the rate of appreciation of the economy's real exchange rate against the US dollar, and the domestic short-term interest rate.

[9] The model is estimated individually for each economy using quarterly data from Q1:1998 to Q4:2013. The sample included 16 of the largest emerging economies, accounting for three-quarters of the output of all emerging market and developing economies in purchasing-power-parity terms.

external demand, financing costs, and terms of trade induced significant fluctuations in growth in emerging market economies, explaining approximately half of the variance in their growth. The influence was as much as or sometimes more than internal factors over the past 15 years.

Gruss *et al.* (2018) investigated how country-specific external demand, external financial conditions, and terms of trade affect medium-term growth in emerging market and developing economies (EMDEs). The authors estimated a standard fixed-effects panel growth regression over the period 1970-2014 for a broad unbalanced sample of more than 80 economies. The dependent variable of medium-term rate of growth was captured as the average annual growth rate of real GDP per capita per five-year non-overlapping interval. The results showed that all three external conditions had economically and statistically significant effects on medium-term growth in EMDEs (Gruss *et al.*, 2018). More specifically, an increase in the rate of growth of domestic absorption in trading partners (that is, external demand) was associated with increases in medium-term growth – approximately 20 per cent of the average annual growth rate of GDP per capita in the sample. Also, an increase in the ratio of capital flows to GDP (external financial conditions) and commodity terms of trade increased medium-term growth. Finally, the authors concluded that the impact of external conditions on growth in EMDEs varies by the type of economy. For instance, medium-term growth outcomes of commodity exporters were particularly influenced by windfalls in terms of trade, while favourable changes to external demand and financial conditions impacted growth positively across the entire sample of EMDEs (Gruss *et al.*, 2018).

Osterholm and Zettelmeyer (2007) used a mean-adjusted Bayesian vector autoregression (BVAR) model with "informative priors" on steady state values to analyse the effect of real and financial external conditions on the growth of six Latin American countries for the 1994-2006 period. The most important external shocks to Latin American growth were identified as: i) external demand {represented by a slowdown in US and global GDP growth}; ii) international commodity price shocks {represented by declines of the commodity price index for the region}; and iii) a tightening of global financial conditions (proxied by rising US treasury bill rates and the spread for high-yielding US corporate bonds). The main findings were that external shocks account for a significant proportion (between 50 and 60 per cent) of the variation in GDP, with financial conditions accounting for more than half of the variation. The authors also assessed the sustainability of economic growth in Latin America in the event of a deterioration in external conditions. While lower external (global) growth had a minor impact, the impact of a slowdown in US growth was significantly larger given the direct trade and financial connections between the US and Latin America. Commodity price shocks are also a major channel through which the region can be negatively affected. However, Osterholm and Zettelmeyer acknowledged that Latin America's susceptibility to external shocks after 2006 would have been lessened by the improvements made in two specific areas – namely the monetary policy environment and public debt.

Izquierdo *et al.* (2008) analysed the relevance of the direct impact of external factors on the output performance over the period 1991-2006 in the seven largest Latin American countries in terms of GDP[10]. The empirical methodology employed was a restricted VECM for an index that captures output behaviour of the typical Latin American country. The variables included: a GDP index (a simple average of indices corresponding to the seven largest Latin American and Caribbean (LAC) countries); an index of average industrial production in G7 countries; an index of regional terms of trade; the return on 10-year US T-bonds; and the spread in high yield bonds over US T-bonds. The authors

[10] These seven countries included: Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. These countries account for 93 per cent of the Latin America's GDP.

concluded that external factors account for large and significant differences in growth performance fluctuations in Latin America. Additionally, it was found that a reversal in external financial conditions had a large (negative) impact on Latin American GDP.

Mercer-Blackman and Melgarejo (2013) identified three specific types of external vulnerabilities for Caribbean economies, including the impact of trading partners, changes in the output of advanced economies, and commodity price changes. The six Caribbean countries[11] in this study were significantly impacted by global conditions because of the relatively small size of their economies, the magnitude of their trading partners (the US, UK, EU, and CARICOM market), their lack of economic diversification, and their highly open nature. Using VECM and time series analysis, the authors found that for the three tourism-dependent economies (the Bahamas, Barbados, and Jamaica), US GDP and oil prices explained the variation in output. Gold prices and EU GDP accounted for output changes in two of the commodity-exporting countries (Guyana and Suriname), while oil prices explained the change in economic performance for one commodity exporter (Trinidad and Tobago). The impact of external conditions on real GDP of these Caribbean economies was particularly severe during the 2007-2011 global recession. A comparison of actual GDP growth rates for these countries with a baseline 'no recession' scenario based on IMF projections from April 2008, revealed sharp output losses for all economies, which have not yet been recovered. The output losses were worse for the tourism-dependent economies, and ranged between 16 and 22 percentage points of GDP. Cumulative fiscal revenue losses were also estimated to be high and resulted in larger fiscal deficits and debt accumulation, particularly for Trinidad and Tobago and Jamaica. A simulation analysis also showed the inability of these economies to withstand another global recession or a negative shock of a similar magnitude in quick succession.

Using a VECM model, Lorde *et al.* (2009) investigated the macroeconomic effects of oil price fluctuations and volatility on the Trinidad and Tobago economy over the period 1966-2005. Specifically, the authors examined the impact of oil price fluctuations on GDP, government revenue, government consumption, gross investment, net exports and the price level in Trinidad and Tobago. Causality tests indicated that oil prices affect output (GDP) and government revenue, while government revenue Granger causes net exports, government consumption, and average prices. The impulse response functions revealed that following a positive oil price shock, output falls within the first two years followed by a positive and growing response over the medium-term. Meanwhile, gross investment, government consumption, government revenue, and the average price level rise following an oil price shock. Meanwhile, a jump is observed in the value of net exports, which becomes a deficit by the fourth year, indicative of the presence of 'Dutch' disease (Lorde *et al.* 2009). Overall, it was found that the price of oil is a major determinant of economic activity in the domestic economy, indicating that policymakers should be cognisant of this when effecting policy decisions and changes. Notably, the authors concluded that government revenue is a key channel through which oil prices affect the macro economy in the short-run, which is expected since the government is the main receiver of windfall energy revenues. Lastly, given that the authors looked at both the shocks to oil prices and oil price volatility, it was revealed that shocks to the oil price had a greater impact on the variables in the model, when compared to shocks to the volatility in oil prices.

In general, studies that examine the impact of external shocks on Trinidad and Tobago mainly use world commodity prices as the sole measure of external vulnerability given the economy's dependence on the energy sector. A more recent study by Rahaman (2018) showed that a negative oil price shock adversely affected the terms of trade but did

[11] These countries included: the Bahamas, Barbados, Jamaica, Guyana, Suriname, and Trinidad and Tobago.

not show a relationship with the real effective exchange rate. In a similar vein, Edwards and Woolford (2018), using data for the period 2001-2017, constructed an energy price index comprising West Texas Intermediate (WTI) crude oil prices and Henry Hub natural gas prices to show the combined effects of international price shocks on a "price-taking" economy such as Trinidad and Tobago and to distil the implications for an increasing role for monetary policy. Our current study adds to the empirical literature on Trinidad and Tobago by including three different variables (proxies for external demand, external financing conditions, and commodity prices) to model Trinidad and Tobago's external environment.

3.0 Stylised Facts

Trinidad and Tobago's growth performance, as measured by increases in real GDP, in the last four decades (1970-2014) can be divided into 4 distinct periods of high (boom) and low (bust) activity. A period of high growth occurred from 1970 up until 1982 and was followed by recessionary conditions in the next ten years between 1983 and 1993[12]. In the subsequent fourteen-year period of 1994-2008, the economy recovered and expanded but thereafter suffered declining levels of economic activity from 2009 (Figure 1).

Given that Trinidad and Tobago is an oil-exporting economy, energy price fluctuations have been largely responsible for the country's uneven economic performance (Artana *et al.* 2007)[13]. Periods of favourable macroeconomic conditions and GDP growth have coincided with high petroleum prices while periods of subdued activity have occurred in a low oil price environment. Artana *et al.* (2007) note that when oil prices quadrupled during the period 1974-1982, economic growth expanded rapidly and when they collapsed in the 1980s, so too did growth which plunged into negative territory. Artana *et al.* (2007) stated that, historically (1950s-mid-2000), the correlation between oil prices and economic growth is very high, around 80 per cent[14].

In the first period of analysis (1970-1982), Trinidad and Tobago experienced a rapid increase in its growth rate as a rise in earnings from the oil sector resulted in significantly higher fiscal revenues, which facilitated an expansion of government expenditure. From 1974 – one year after the first oil shock – to 1981, the country witnessed booming economic conditions and exceptionally high growth rates which peaked at 10.2 per cent in 1978 and 10.4 per cent in 1980. The spike in world petroleum prices caused a terms of trade shock and a large improvement in exports. The growth rate of the economy increased from an average of 2.9 per cent in the 1970-1975 period to an average of 6.9 per cent between 1976 and 1982. The energy sector's contribution to GDP increased from just under one-quarter of total output from 1970-1973 to almost 40 per cent in the period 1974-1982.

[12] This division is similar to that used by Fuentes, Melgarejo and Mercer-Blackman (2015) who tested for endogenous breakpoints in LAC economies over the period 1962-2011 and identified one structural break in 1983 for Trinidad and Tobago. Gruss, Nabar and Poplawski-Ribeiro (2018) identified 1982 as a reversal episode and 1996 and 2001 as persistent acceleration episodes (defined as accelerations without reversals or a banking crisis occurring in the previous or subsequent three years). In a study of business cycles in the English-speaking Caribbean, Craigwell and Maurin (2012) determined the turning points for peak periods as 1982:Q2, 1991:Q3 and 2008:Q2 and the turning points for the depressions as 1989:Q2 and 1993:Q2.

[13] They find that for Trinidad and Tobago, "economic cycles also have a peculiar shape, with large amplitudes and long recovery periods".

[14] Based on our current study, for the period 1971-2014 the correlation between (log) oil prices and economic growth was 'moderate' at 51 per cent.

The structural break that occurred in 1983 was triggered by a combination of external factors and poor economic policies. With the collapse of oil prices in 1982, the terms of trade and the level of exports deteriorated sharply, the foreign exchange reserves were depleted and the external debt became unserviceable. A period of macroeconomic stabilisation and structural adjustment followed from 1994 to 2008. During these years, a major developmental strategy was undertaken, which entailed the diversification of the hydrocarbon sector as Trinidad and Tobago transitioned into a gas-based economy[15]. Some of the other economic and structural reforms included trade and financial liberalisation, which entailed a change in the exchange rate regime, the elimination of controls on current and capital transactions, the removal of import controls, the reduction of the external tariff, the elimination of selective credit and interest rate controls, and investment initiatives designed to encourage foreign direct investment (FDI).

The strong economic growth that occurred between 1994 and 2008 was largely attributed to the rapid expansion of energy sector output, particularly related to the sale of products from gas-based industries (LNG, fertilisers, and methanol) on the global markets. The contribution of the petroleum industry increased from 25 per cent of GDP during the 1983-1993 period to 34 per cent between 1994 and 2008. At the same time, the prices of Trinidad and Tobago's major energy exports – crude oil, natural gas, and petrochemicals – remained relatively robust in international commodity markets. With the shift to gas-based exports, the economy had become more resilient to the volatility in petroleum prices, which accelerated from an annual average of US$25 per barrel of oil (WTI) during 1994-2003 to US$100 in 2008.

In 2009, Trinidad and Tobago faced three simultaneous shocks – the global financial crisis, the end of the country's third energy boom, and the eruption of the CLICO crisis[16]. The price of WTI crude oil declined by 38 per cent to average US$62 per barrel in 2009 and domestic real GDP declined sharply, bringing to an end fourteen successive years of economic growth. In 2010, WTI prices improved significantly to average US$80 per barrel and continued to strengthen between 2011 and 2014 at an average of US$95 per barrel. Natural gas prices, however, never recovered to the pre-crisis levels. After declining from US$8.70 per million British thermal units (mmbtu) in 2008 to US$4.00 in 2009, the Henry Hub natural gas price averaged US$4.20 between 2010-2011, collapsed to US$2.75 in 2012 and increased to US$4.37 in 2014. Real GDP growth fluctuated between -0.6 per cent and 3.3 per cent between 2010 and 2014 as the economy struggled to regain the composure experienced in the pre-international crisis era when GDP averaged over 8 per cent annually (2000-2007).

The vulnerability of GDP growth to external shocks also depends on the concentration or diversity of export markets. While Trinidad and Tobago's trading partners are wide-ranging and export market access is diverse, the dominant partner remains the United States, followed by the Caribbean and to a lesser extent the European Community (Figure 2). Exports to the US increased from an annual average of 40 per cent of total exports in the period 1997-2002 to 58 per cent from 2003-2007. With the downturn in the economy in the period 2009-2014, exports to the US fell back to an average of 45 per cent. Given the importance of the US market to Trinidad and Tobago's exports, the volatility of US economic activity therefore has a direct bearing on the Trinidad and Tobago economy. Growth

[15] Trinidad and Tobago became the largest exporter of LNG to North America and by mid-2003 became the 5th largest producer of LNG in the world.

[16] The CLICO crisis refers to the collapse in 2009 of the largest conglomerate in Trinidad and Tobago, the CL Financial Group of companies.

patterns for Trinidad and Tobago and the US were generally in sync over the period 1971-2014[17]. Over the period 1971-2014, the correlation between Trinidad and Tobago's real GDP growth and US GDP growth was "very strong", estimated at 89 per cent. The greatest similarity in GDP accelerations and decelerations occurred between 1994 and 2004, when the share of exports to the US was the largest. The relationship is weakest during the period 1983-1986 as the effect of the oil price shock and domestic factors far outstripped the effect of economic expansion in the US.

The Caribbean region[18] is the second most important export market for Trinidad and Tobago. Therefore, external shocks (capital flows and remittances) to primary Caribbean trading partners impact Trinidad and Tobago's economic performance. During Trinidad and Tobago's economic boom (1994-2008), when GDP growth averaged 7.1 per cent, capital flows to the region accelerated, on average, by 20.8 per cent (Figure 3). With the slowdown in economic activity in almost all Caribbean countries following the global economic crisis of 2008-09, Trinidad and Tobago's Caribbean exports were more than halved in 2009 as energy exports declined by 65 per cent and non-energy exports by 17 per cent. During the period 2009-2014, the average growth rate of capital flows to the Caribbean region (excluding Trinidad and Tobago) was -5.6 per cent. Simultaneously, Trinidad and Tobago's exports to the Caribbean declined to an average of 15 per cent of total exports.

[17] Fuentes, Melgarejo and Mercer-Blackman (2015) find that the US GDP affect is short-term lasting up to eight years and lessening afterwards.

[18] Trinidad and Tobago's exports to the Caribbean accounted for 22 per cent of total exports between 1994 and 2008. This calculation includes the following Caribbean countries: Jamaica; Barbados; Belize; Bahamas; ECCB except Anguilla; Haiti; and Suriname.

Figure 1: WTI Oil Prices and Real GDP Growth Rates in Trinidad and Tobago

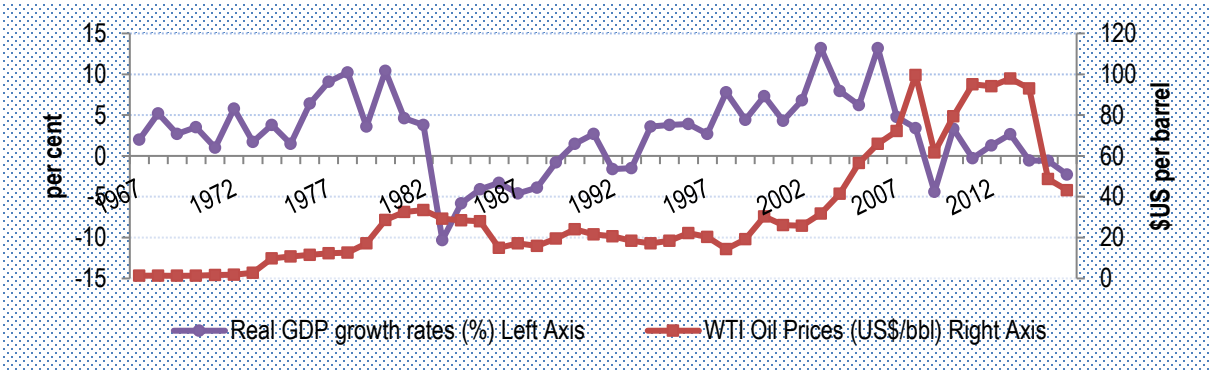


Figure 2: External Demand: Export Market Access (Share of Total Exports)

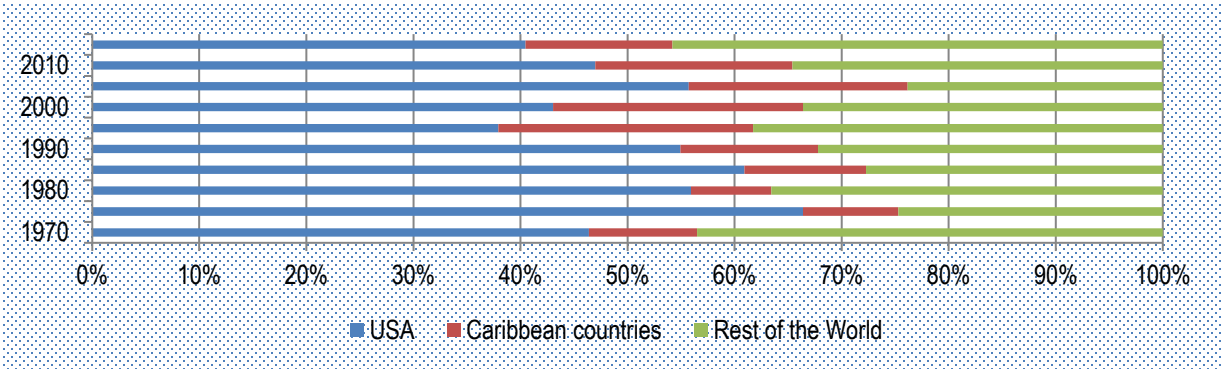
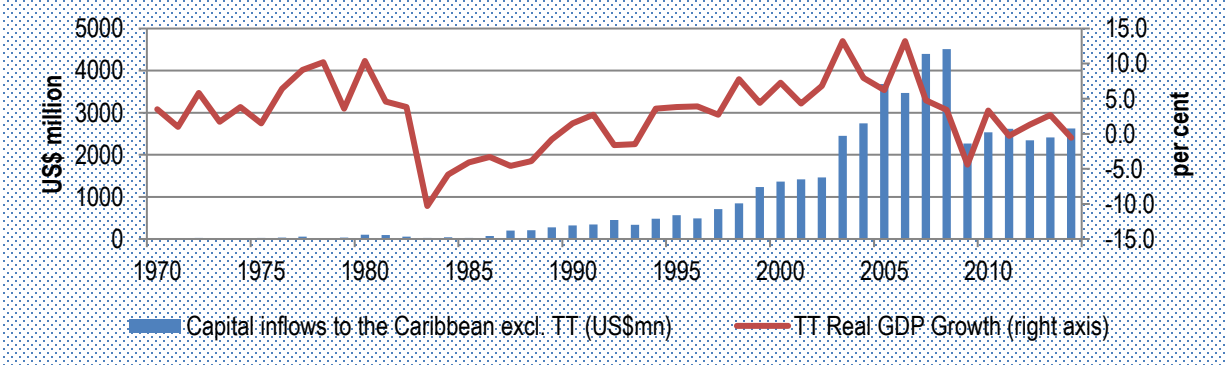


Figure 3: External Financial Conditions and Real GDP Growth in Trinidad and Tobago



Sources: Central Statistical Office, Central Bank of Trinidad and Tobago, Bloomberg, and US Bureau of Economic Analysis.

4.0 Data and Methodology

4.1 Data

This study encapsulates the time period 1971 to 2014 using annual data, and therefore investigates the impact over a 43-year time period. Annual data for all variables was used as (official) quarterly GDP for Trinidad and Tobago is not available. Data was sourced from the International Monetary Fund's International Financial Statistics (IFS) Database, the Central Statistical Office of Trinidad and Tobago, and the InflationData.com website. All variables, with the exception of the inflation rate, were transformed into natural logs for incorporation in the model[19].

Bourne (2008) stated that the occurrence of business cycles in Caribbean countries was due to "*external economic variables such as aggregate income and demand in the major trading partner economies, financial capital flows, domestic fiscal policy and natural hazard events*". For the current study, the external variables were chosen to capture some of these factors. First, given that Trinidad and Tobago is an energy-based economy, we chose to incorporate WTI prices. Second, US GDP was used as a proxy to capture external demand. The US is Trinidad and Tobago's largest trading partner, accounting for, on average, 51.2 per cent of all exports over the period under review. Third, a regional external financial conditions index was used as a proxy of external financing. Notably, gross capital flows to the Caribbean region is highly correlated (0.84) with Trinidad and Tobago's real GDP growth.

The regional external financial conditions index was computed following previous works by Gruss *et al.* (2018) and Blanchard *et al.* (2015), and is "*a quantity-based measure of capital flows to peer economies[20] as a share of their aggregate GDP*". This captures fluctuations in the availability of diverse financial flows as opposed to using price-based proxies based on a narrower set of global interest rates (Gruss *et al.*, 2018). Direct investments and portfolio investment (net incurrence of liabilities) were aggregated to arrive at total gross capital flows and this was taken as a percentage of the total GDP for all countries (except Trinidad and Tobago) in the year prior, as depicted in the formula below:

$$External\ financial\ condition = \frac{\sum_{i \in \Theta_{\setminus j}} K\_inflow_{i,t}}{\sum_{i \in \Theta_{\setminus j}} GDP_{i,t-1}} \qquad [1]$$

where $K\_inflow_{i,t}$ represents gross inflows to economy i; $GDP_{i,t-1}$ is GDP of economy i (in USD); and $\Theta_{\setminus j}$ is the set of all related economies in the region excluding Trinidad and Tobago. By excluding the capital flows to Trinidad and Tobago from the index and aggregating the capital flows to the rest of the region, the regional external financial conditions index should capture those push factors that are exogenous to Trinidad and Tobago (Gruss *et al.* 2018).

For our purposes, the variables are divided into two blocks: the external variables block and the domestic variables block. The external block consists of the inflation-adjusted West Texas Intermediate (WTI) crude oil price, *[WTI*],* (US$ per barrel); US real GDP, *[USGDP*];* and the regional external financial conditions index, *[EFCI*].* Meanwhile, the domestic block comprises domestic real GDP, *[TTGDP]*; rate of inflation, *[CPI];* total government revenue as a share of GDP, *[GovtRevenue];* and total public debt (domestic and external debt) as a share of GDP, *[GovtDebt].*

[19] See Appendix A.1 for descriptive statistics.

[20] Peer economies were defined to be members of CARICOM and specifically included: Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, and Suriname.

One dummy variable was incorporated in the model to represent capital restrictions – this value was set to 1 over the years 1971 to 1992 and changed to 0 for the rest of the time period since the exchange rate was liberalised in 1993.

4.2 Methodology

In order to analyse the dynamic interaction among the external conditions and domestic macroeconomic variables, an SVAR model with block exogeneity assumption was used. The SVAR model relies on economic theory to impose restrictions on the contemporaneous causal relationships among the variables, which makes the SVAR model preferable over the standard unrestricted VAR to study the response of external shocks on the domestic economy. Meanwhile, the use of the block exogeneity restrictions has become popular in developing SVAR models for small open economies when modelling international economic linkages. The block exogeneity restrictions mean that dependent variables in the domestic economy are completely absent from the equations in the external block; this implies that external variables can influence the domestic variables contemporaneously, but the domestic variables will have no effect on the external variables. This follows naturally from the small open economy assumption for the economy of Trinidad and Tobago.

The economy of Trinidad and Tobago can be represented by the underlying SVAR model as:

$$Ay_t = C(L)y_{t-1} + B\varepsilon_t \qquad [2]$$

where A is a square matrix that captures the structural contemporaneous relationships among the macroeconomic variables, y_t is a vector of macroeconomic variables, C is a polynomial function of order p, L is the lag operator, and ε_t is a vector of structural innovations.

However, this structural equation cannot be estimated directly due to identification issues. Instead, we estimate an unrestricted VAR of the form:

$$y_t = A^{-1}C(L)y_{t-1} + A^{-1}B\varepsilon_t \qquad [3]$$

where

$$e_t = A^{-1}B\varepsilon_t \qquad [4]$$

is the reduced form VAR residual which can be estimated from the data.

By imposing structure on the A and B matrices in equation [4], we impose restrictions on the structural VAR in equation [2]. In this purely recursive SVAR model, the elements of A above the diagonal of the matrix are all set equal to zero. Equation [5] indicates the set of restrictions that we imposed on the contemporaneous parameters of the SVAR model for the economy of Trinidad and Tobago. The coefficients on the diagonal of the A matrix are normalised to unity, while the number of zero restrictions on the coefficients is 22, so our model is over-identified with 1 degree of freedom.

$$e_t = A^{-1}\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} . B \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} \end{bmatrix} . \varepsilon_t \begin{bmatrix} WTI_t^* \\ USGDP_t^* \\ EFCI_t^* \\ GovtRevenue_t \\ CPI_t \\ GovtDebt_t \\ TTGDP_t \end{bmatrix}$$

[5]

The above system [6] contains seven variables divided into two blocks – the 'external block' and 'domestic block'. The first three variables relate to the external environment (crude oil prices, external demand captured by US GDP, and a regional financial conditions index). Oil prices are set ahead of all variables to represent that crude oil prices are exogenous in the model[21]. Given that Trinidad and Tobago is a commodity exporter of energy-related products, oil prices are assumed to contemporaneously affect all variables in the system. Regarding the external block, we also assume that real oil prices are not contemporaneously affected by the other external shocks (Allegret *et al.*, 2012). Domestic variables are assumed not to contemporaneously affect foreign variables due to the fact that the Trinidad and Tobago economy is very small and therefore highly unlikely to have any substantial impact on foreign variables. Restrictions in equation [5] indicate that all variables, both external and domestic, are assumed to contemporaneously affect domestic real GDP.

In terms of lag selection, we departed from the standard optimal lag length tests and used a common alternative, as was suggested by Lüktephol (2005), instead. We estimated the VAR using the optimal lag length that was absent of autocorrelation and heteroscedasticity. The stability of the model was assessed using the eigenvalues of the companion matrix of the VAR model – if all the eigenvalues are inside the unit circle, the model is stable.

The dynamic analysis from the SVAR model was conducted through Impulse Response Functions (IRF) and Forecast Error Variance Decomposition (FEVD). Pearsan and Shin (1998) suggested the use of Generalised Impulse Response Functions (GIRF) as it does not depend on the ordering of the variables. However, our study used the Structural Impulse Response Functions (SIRF) as these take into account the contemporaneous order of the restrictions in the model, which implies that the SIRF are more robust than the GIRF. Structural impulse response functions were used to measure the *accumulated* response to structural one standard deviation of the external variables on current and future values of domestic macroeconomic variables. We also estimated a 5-period-ahead (5 years) variance decomposition of domestic macroeconomic variables for Trinidad and Tobago.

5.0 Results and Discussion

The time series properties and the model selection procedure including lag length criteria, serial correlation Lagrange Multiplier (LM) test, and stability test, showed that the SVAR model of lag length two is valid and stable[22]. The AIC and FPE, which have better properties in small samples, suggested a VAR model with 3 lags; however, as suggested

[21] The authors acknowledge that a limitation of the use of a recursive SVAR is that the ordering of the variables determines the causal structure of the model and this identification assumption is not testable.

[22] See Appendix Tables A.1 to A.5 for results of these model diagnostic tests.

by Lüktephol (2005), we chose a VAR model with two lags instead to ensure no serial autocorrelation and heteroscedasticity among the residuals. The estimation results of the SVAR model (see Appendix A.6) showed that the probability value of the log likelihood ratio (LR) test for the validity of the over-identifying restrictions was 0.3389, implying that the null hypothesis of additional restrictions is valid and cannot be rejected at all conventional levels of significance.

The pairwise Pearson's correlation coefficient for the external variables indicates that there is a weak correlation between crude oil prices and US GDP (0.18), and crude oil prices and external financial conditions (0.25), which suggests that each external variable potentially exerts separate influences from each other. Thus, the external environment that Trinidad and Tobago faces comprises a complex mix of factors that do not always impact the domestic economy in the same manner. Although the external financial conditions index and US GDP are highly correlated (0.83) with each other, we chose to retain both variables in our model given their separate significance in capturing external demand and the increased importance of financial flows to the economy post-liberalisation in 1993.

The *accumulated* SIRFs from the SVAR model for 5 years ahead based on the full sample (1971-2014) are presented in Appendix Table A.7[23]. Domestic real GDP responds positively over the medium term to an increase in oil prices, but it is only statistically significant in the short-term. The positive impact on domestic GDP due to an increase in oil prices is expected given that Trinidad and Tobago is a commodity exporter of energy-related products, including crude oil. The impact on government revenue is a sustained increase over the medium term and is statistically significant. Lorde *et al.* (2009) also noted that government revenue is a key channel through which oil prices affect Trinidad and Tobago's macroeconomy as the government is the main receiver of the windfall energy revenues. The response of domestic prices is statistically significant over the medium term and highlights that world oil prices have substantial pass-through effects on domestic prices in Trinidad and Tobago. Lastly, the response of government debt to an increase in international oil prices is negative. This result is not surprising given the positive relationship between oil prices and government revenue – as oil prices increase, so too does government revenue, thus dampening the need to access debt financing.

The responses of domestic output and government revenue to a one-time increase in US real GDP are not statistically significant. This outcome is in keeping with previous work by Fuentes *et al.* (2015) who found the degree of correlation between the co-movements of GDP for the US and Trinidad and Tobago over 1950-2010 to be low (0.52)[24]. Meanwhile, domestic prices respond negatively to an increase in US real GDP; the negative pass-through effect of an increase in US GDP on domestic prices lasts for three years until the negative effect tapers off. Meanwhile, government debt increases in response to a one-off increase in US GDP. However, this increase is only statistically significant in the short run (that is, the first three years).

For a one-time positive shock in the regional financial conditions index, (recall that this index aims to capture the capital flow push factors that are exogenous to Trinidad and Tobago) domestic output, government revenue, and domestic prices respond positively, although these responses are not statistically significant. Meanwhile,

[23] A note on the stability of the system/model – most of the domestic variables converge to zero after 15 years. What are presented in Appendix Table A.7 are the accumulated structural impulses up to 5 years ahead.

[24] The measure used was the index of concordance, which is a correlation coefficient that quantified the extent to which both economies were in the same state of either contraction or expansion.

government debt decreases in response to a one-time increase in the EFCI, and this response is statistically significant.

Pre-liberalisation (1971-1993) vs. Post-liberalisation (1994-2014)

i. Structural Impulse Response Functions

An analysis of the periods pertaining to pre- and post-liberalisation was performed to determine if the effect of the external environment on the domestic economy differed. Appendix Table A.8 and Appendix Table A.9 show the *accumulated* SIRFs for the pre- and post-liberalisation periods[25]. Pre-1993, a shock to crude oil prices had a statistically significant effect on all domestic variables with the expected sign – for example, a one-time shock in crude oil prices increased domestic output, government revenue, and domestic inflation while it had a negative effect on government debt.

In comparison to the latter years, a shock to crude oil prices no longer had a statistically significant effect on domestic output, inflation, and government debt. This result also holds when the model is run replacing crude oil prices with natural gas prices (Appendix Table A.10). Trinidad and Tobago first exported liquefied natural gas in May 1999 and exports would have been minimal at the time. The sale prices of Trinidad and Tobago's LNG exports are usually negotiated based on fixed and guaranteed LNG contract prices, whereas our model used spot LNG prices. Fuentes *et al.* (2015) also failed to establish a long-run (co-integrating) relationship between domestic real GDP and natural gas prices. They postulated that the relationship between natural gas prices and GDP was not straightforward. Although the country earns revenue through the export of natural gas, natural gas is also a key input in fertilisers, which the country also exports. Natural gas would therefore have been considered as a cost in the measurement of GDP (Fuentes *et al.* 2015). The result of our model including natural gas prices showed that a one-time shock to US GDP and the regional external financial conditions index had significant positive impacts on domestic output. Notably, natural gas prices are highly correlated with both US GDP and the regional external financial conditions index (0.73 and 0.91, respectively).

However, during the post-liberalisation period, a shock to crude oil prices had only statistical significance in the short run with respect to government revenue – government revenue increases for three years before the effect starts to lose significance and begins to decline. Although it appears that oil prices lose significance post-liberalisation, Trinidad and Tobago's GDP growth would have also been affected by the shifting mix away from crude oil to natural gas production. Notably, over the period 1994 to 2014, the production of crude oil had declined by 38 per cent, while natural gas production increased by over 500 per cent over the same period.

During the pre-liberalisation years, a shock to US GDP had no statistically significant impact on domestic GDP. On the other hand, post-liberalisation, a shock to US GDP had a statistically significant positive effect on domestic output. During the 1970s and early 1980s, the spike in oil prices, which led to a downturn in the US economy, had the opposite effect for oil-exporting Trinidad and Tobago, which experienced rapid economic growth. However, as the country diversified its hydrocarbon sector in natural gas and petrochemicals, the US became a lucrative market

[25] Given the short dataset used, when the sample was split between pre- and post-liberalisation, we ran a SVAR with 1 lag instead to estimate the SIRFs.

for these exports. The greatest synchronisation between US real GDP growth and TT real GDP growth occurred between 1994 and 2004 (post-liberalisation years) when the share of exports to the US was the largest. Over both time periods, a one-time shock to US GDP did not significantly impact government revenue while its impact on domestic inflation was statistically significant. Meanwhile, pre-liberalisation, a shock to US GDP resulted in an increase in government debt over the medium-term whereas there was no impact on debt during the post-liberalisation years.

External financial conditions had no impact on any of the domestic macroeconomic variables during the pre-liberalisation period. This result was the same for government revenue and domestic inflation in the post-liberalisation period. However, post-liberalisation, a shock to external financial conditions led to a statistically significant positive effect on domestic output and a negative statistically significant impact on government debt.

ii. Variance Decompositions

Appendix Table A.11 and Appendix Table A.12 highlight the forecast error variance decompositions for both pre- and post-liberalisation time periods. Concerning domestic output, overall, the external variables explain a greater proportion of the forecast error for both time periods, ranging between 60-86 per cent pre-1993 and 19-74 per cent post-1994. Among the external variables, crude oil prices became less important in explaining the forecast error in domestic output during the post-liberalisation period, moving from 80 per cent (pre-liberalisation) to less than 20 per cent (post-liberalisation) in the 5th year. The effect of US GDP over the medium-term became more important post-liberalisation, accounting for less than 2 per cent of the forecast error in domestic GDP pre-1993 to over 45 per cent post-1994.

The overall contribution of the external factors in explaining the variation in government revenue remained the same (just under 50 per cent) during the two time periods. However, crude oil prices and US GDP became less important post-1994, while external financial conditions gained more prominence, moving from accounting for 2.5 per cent of the variance in government revenue to 15.0 per cent in the post-1994 time period.

US GDP has a greater pass-through effect on domestic prices post-liberalisation, accounting for only 9 per cent of the variance in inflation pre-1993 compared with 34 per cent post-1994. External financial conditions also gained importance post-liberalisation, increasing to 8.2 per cent, up from 5.7 per cent pre-1993. Overall, the contribution of the external variables in explaining the variations in domestic prices increased post-liberalisation.

During both time periods analysed, the overall contribution of external conditions in explaining the variations in government debt was relatively the same, ranging between 50 and 80 per cent over the forecast horizon. However, the relative importance of crude oil prices was markedly lower post-liberalisation, accounting for less than 20 per cent of the variation in government debt compared with 65 per cent prior to liberalisation. Conversely, the relative contribution of external financial conditions in explaining the variation in government debt increased substantially, from 2.6 per cent pre-1993 to 50.6 per cent post-1994.

6.0 Conclusion and Policy Recommendations

It is important to investigate how Trinidad and Tobago's ability to withstand the influence of external factors has changed. As Trinidad and Tobago pursues a more sustainable growth path, the country should be particularly sensitive to changes occurring in the global environment. The aim of this paper was to analyse the impact of external conditions on the performance of several key domestic macroeconomic variables for Trinidad and Tobago as distinct from the influence of domestic factors.

This research adds to the existing literature in several ways. Firstly, we examined the impact of external shocks on a small open economy by using the now-popular structural VAR (SVAR) model with block exogeneity assumption. SVAR models allow for the inclusion of more than one or two external variables simultaneously with domestic variables in a single-country model; our model included three external variables – commodity prices (WTI prices); external demand (US GDP); and external (regional) financial conditions. The block exogeneity assumption permits external variables to influence the domestic variables, while the domestic variables have no effect on the external variables. This follows naturally from the small open economy assumption for the economy of Trinidad and Tobago. Secondly, the analysis spanned the past four decades, and the results were analysed over two distinct periods – pre- and post-financial and trade liberalisation.

In general, the results indicate that shocks to the external environment have meaningful effects on domestic macroeconomic variables for Trinidad and Tobago. Notably, the relative importance of the external variables has changed over time. For instance, pre-liberalisation, world oil prices had the most influence on domestic GDP, whereas, post-liberalisation, US GDP and regional financial conditions had greater influence on domestic GDP. Further, the increased importance of the external financial environment is highlighted in terms of its negative impact on government debt in the medium-term. The results from this current study are similar to previous works showing that world oil prices and external demand have significant impacts on domestic macroeconomic variables of small open economies (see, for example, Fuentes *et al.*, 2015 and Lorde *et al.*, 2009).

With respect to central banking, in several small open economies, economic and financial integration have forced monetary policy frameworks to transform as faster transmission of shocks, especially through financial channels is now the norm (Mihaljek, 2011). Our results for Trinidad and Tobago show the heightened importance of external financing conditions post-liberalisation on both the country's GDP growth and government debt. Given that economic and financial linkages have become stronger, there has been greater synchronisation of business cycles across advanced and small open economies. This has complicated how key macroeconomic variables, like inflation and growth, are forecasted and also introduces an additional objective to monetary policy – the evaluation of financial stability risks. It is now up to policymakers in small open economies to keep abreast of these changes occurring outside of their countries' borders to maintain economic stability and sustainability at home.

The results of this study re-emphasise the importance of external factors when analysing fluctuations in the business cycles of small open economies like Trinidad and Tobago. For such small open economies, the evaluation of domestic policies needs to take into account the impact of the external environment, otherwise, substantial misjudgement may occur. The true impact of domestic (micro and macro) policies on GDP growth can only be appraised by first filtering out the effects of external factors. Failure to take into account the external environment may lead to inaccurate policy prescriptions (Izquiero *et al.* 2008). For example, for any assessment of the strength of a small open economy's fiscal stance and/or the burden of public debt, relevant external factors (like commodity

prices and external financing conditions), should be considered. Hence, the calculation of structural fiscal balances and structural levels of public debt should be used for fiscal policy decision-making as actual levels of fiscal balances and public debt may be misleading (Izquiero *et al.* 2008). In short, the structural fiscal balance measure could be used as a target of fiscal policy in small open economies to filter out the transitory effects of shocks emanating from the external environment.

Summarily, policymakers (both monetary and fiscal) need to take into account the movement in international energy commodity prices, the degree of synchronisation with major trading partners as well as external financial conditions, as these are all critical determinants of growth for Trinidad and Tobago.

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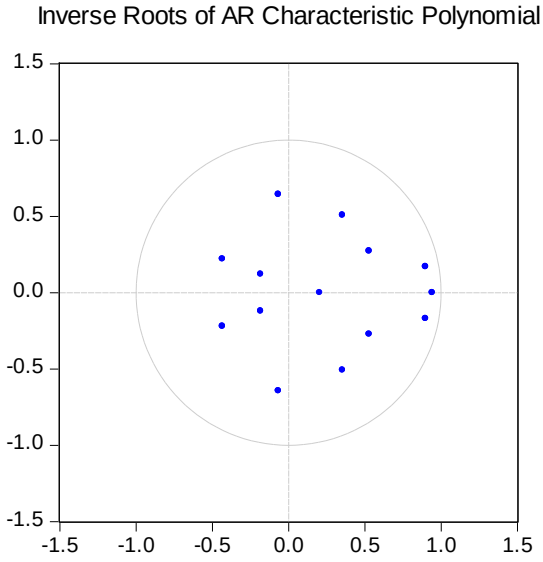
Appendix

A.1 Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	No. of Observations
WTI (log)	3.861	3.862	4.712	2.884	0.506	44
US_GDP (log)	2.298	2.298	2.840	1.639	0.375	44
External Financial Conditions Index	3.149	1.890	10.837	0.000	3.130	44
Government Revenue (% of GDP)	3.373	3.404	3.704	2.929	0.173	44
Inflation Rate	9.018	8.150	22.000	1.300	4.683	44
Total Government Debt (% of GDP)	3.201	3.201	4.081	2.313	0.561	44
Real GDP (log)	10.687	10.519	11.463	10.028	0.466	44

A.2a Stability Test



A.2b Stability Test

Roots of Characteristic Polynomial
Endogenous variables: LWTI LUS_GDP EFCI LREV RPI LDEBT LRGDP
Exogenous variables: C CAP_CTRL
Lag specification: 1 2
Date: 05/04/19 Time: 13:04

Root	Modulus
0.942666	0.942666
0.898276 - 0.170282i	0.914274
0.898276 + 0.170282i	0.914274
-0.066063 - 0.644266i	0.647644
-0.066063 + 0.644266i	0.647644
0.353985 - 0.507352i	0.618637
0.353985 + 0.507352i	0.618637
0.528027 - 0.273014i	0.594432
0.528027 + 0.273014i	0.594432
-0.433346 - 0.219654i	0.485836
-0.433346 + 0.219654i	0.485836
-0.181344 - 0.120504i	0.217731
-0.181344 + 0.120504i	0.217731
0.204612	0.204612

No root lies outside the unit circle.
VAR satisfies the stability condition.

A.3 Test for Lag Length

VAR Lag Order Selection Criteria
Endogenous variables: LWTI LUS_GDP EFCI LREV RPI LDEBT LRGDP
Exogenous variables: C CAP_CTRL
Date: 05/09/19 Time: 17:02
Sample: 1971 2014
Included observations: 41

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-60.80643	NA	9.07e-08	3.649094	4.234216	3.862163
1	157.5173	340.7980	2.47e-11	-4.610600	-1.977550*	-3.651788*
2	202.0084	54.25750	3.97e-11	-4.390656	0.290322	-2.686102
3	279.6952	68.21273*	2.01e-11*	-5.790008*	0.938897	-3.339711

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

Although AIC and FPE, which have better properties in small samples, suggest a VAR(3) model, we chose a VAR model with 2 lags instead to ensure no serial autocorrelation and heteroscedasticity among the residuals.

A.4 Test for Serial Correlation

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 05/02/19 Time: 18:07
Sample: 1971 2014
Included observations: 42

Lags	LM-Stat	Prob
1	79.75116	0.0036
2	58.61802	0.1633
3	50.11897	0.4288
4	39.80069	0.8228

Probs from chi-square with 49 df.

A.5 Test for Heteroskedasticity – VAR(2)

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 05/02/19 Time: 18:09
Sample: 1971 2014
Included observations: 42

Joint test:

Chi-sq	df	Prob.
820.3596	812	0.4117

A.6 Estimated Results of the SVAR Model: Full Sample

Structural VAR Estimates
Date: 05/08/19 Time: 15:26
Sample (adjusted): 1973 2014
Included observations: 42 after adjustments
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 20 iterations
Structural VAR is over-identified (1 degrees of freedom)

Model: Ae = Bu where E[uu']=I
Restriction Type: short-run pattern matrix

A =

1	0	0	0	0	0	0
C(1)	1	0	0	0	0	0
C(2)	0	1	0	0	0	0
C(3)	C(7)	C(11)	1	0	0	0
C(4)	C(8)	C(12)	C(15)	1	0	0
C(5)	C(9)	C(13)	C(16)	C(18)	1	0
C(6)	C(10)	C(14)	C(17)	C(19)	C(20)	1

B =

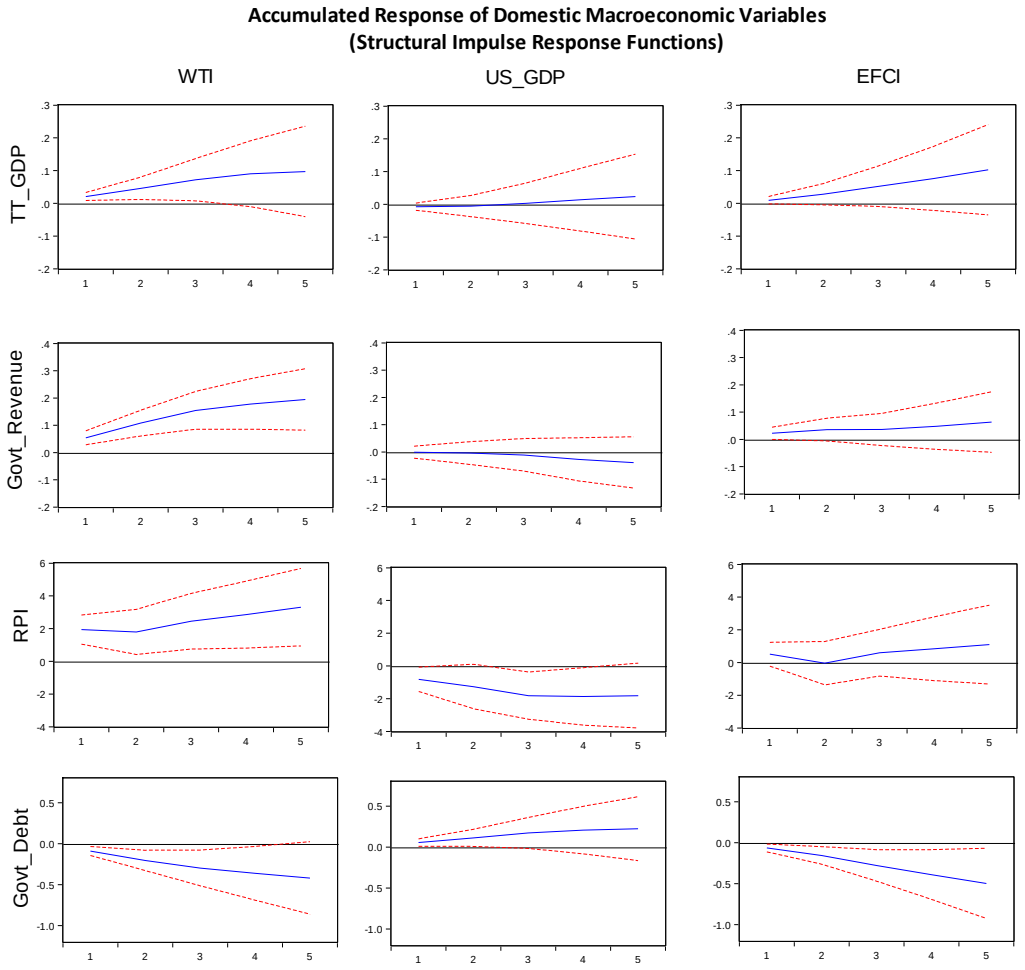
C(21)	0	0	0	0	0	0
0	C(22)	0	0	0	0	0
0	0	C(23)	0	0	0	0
0	0	0	C(24)	0	0	0
0	0	0	0	C(25)	0	0
0	0	0	0	0	C(26)	0
0	0	0	0	0	0	C(27)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.015771	0.013703	1.150954	0.2498
C(2)	-1.590719	0.722826	-2.200695	0.0278
C(3)	-0.213219	0.054390	-3.920217	0.0001
C(4)	-7.238153	2.086901	-3.468373	0.0005
C(5)	0.173293	0.144792	1.196838	0.2314
C(6)	-0.089316	0.029356	-3.042536	0.0023
C(7)	0.054773	0.571920	0.095771	0.9237
C(8)	42.58192	18.77836	2.267606	0.0234
C(9)	-2.522490	1.216995	-2.072720	0.0382
C(10)	0.269281	0.254743	1.057071	0.2905
C(11)	-0.021762	0.010842	-2.007238	0.0447
C(12)	-0.472162	0.372624	-1.267127	0.2051

C(13)	0.056226	0.023226	2.420872	0.0155
C(14)	-0.004723	0.004943	-0.955550	0.3393
C(15)	-1.278139	5.065824	-0.252306	0.8008
C(16)	0.149788	0.310121	0.482999	0.6291
C(17)	0.017673	0.062001	0.285045	0.7756
C(18)	0.008113	0.009439	0.859521	0.3901
C(19)	0.005798	0.001898	3.054290	0.0023
C(20)	0.122713	0.030764	3.988868	0.0001
C(21)	0.216053	0.023573	9.165151	0.0000
C(22)	0.019186	0.002093	9.165151	0.0000
C(23)	1.012090	0.110428	9.165151	0.0000
C(24)	0.071113	0.007759	9.165151	0.0000
C(25)	2.334657	0.254732	9.165151	0.0000
C(26)	0.142815	0.015582	9.165151	0.0000
C(27)	0.028473	0.003107	9.165151	0.0000

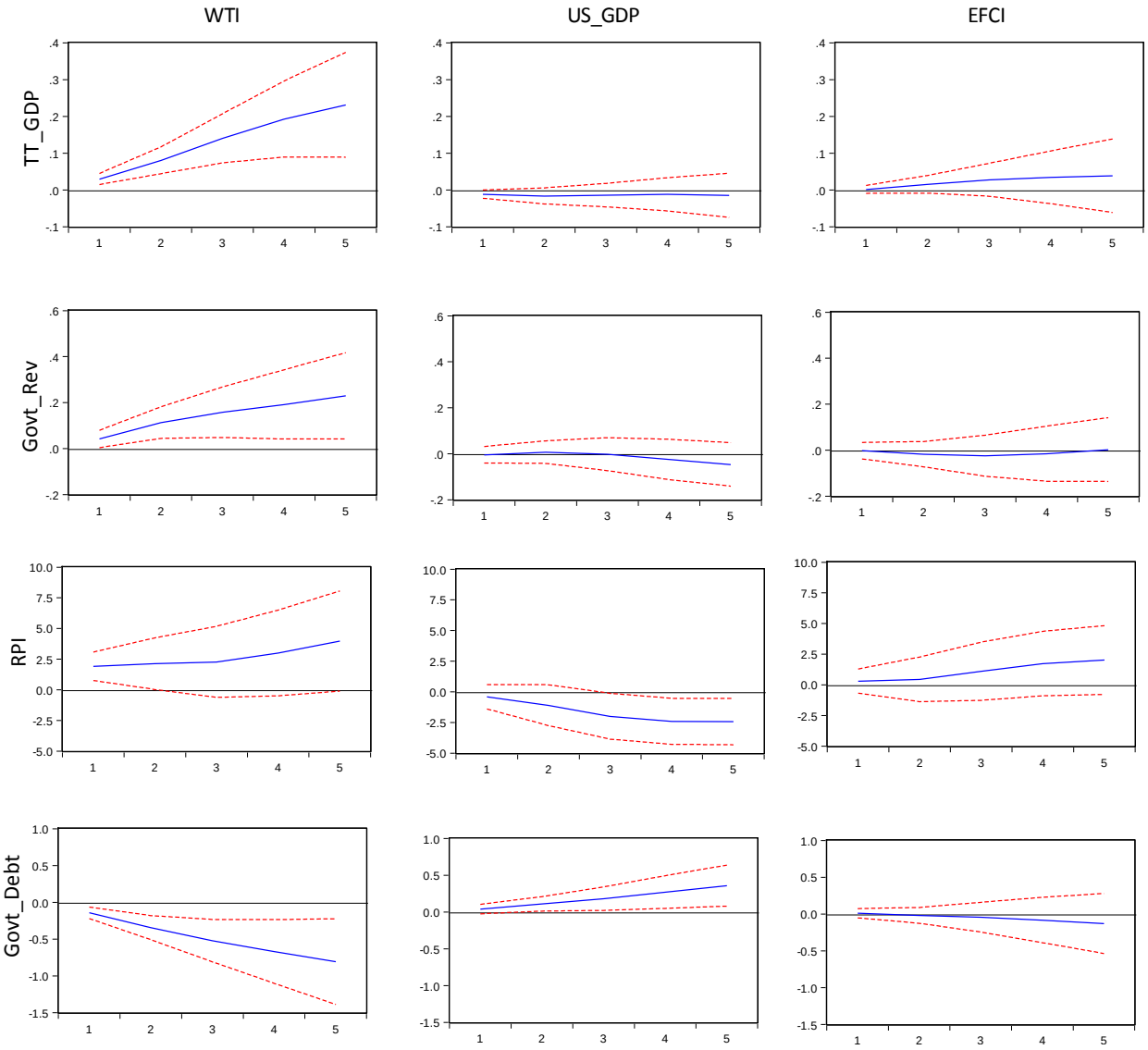
Log likelihood	119.3562		
LR test for over-identification:			
Chi-square(1)	0.914485	Probability	0.3389

A.7 Structural Impulse Response Functions – Full Sample



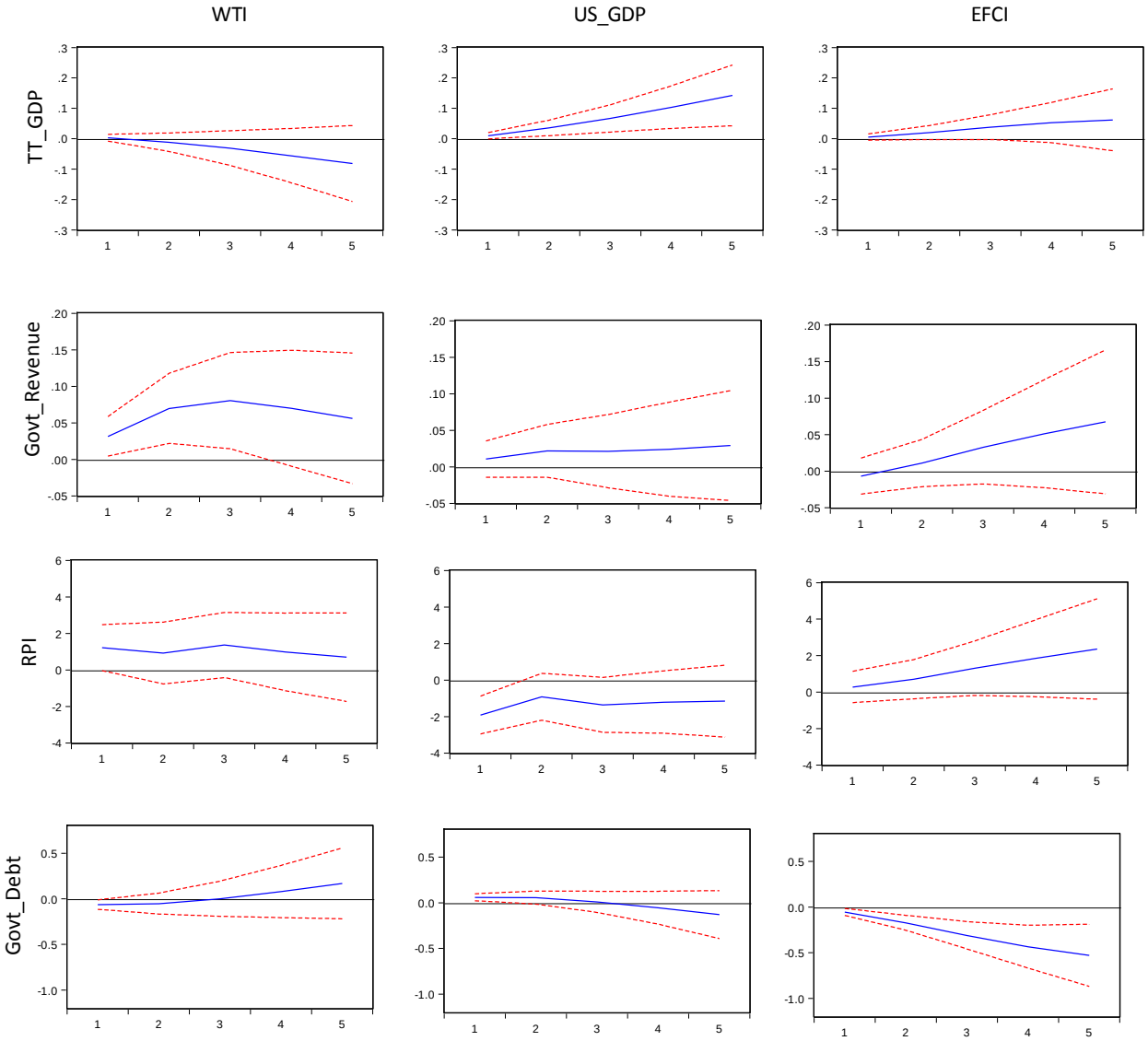
A.8 Structural Impulse Response Functions – Pre-liberalisation

Accumulated Response of Domestic Macroeconomic Variables: 1971-1993
(Structural Impulse Response Functions)

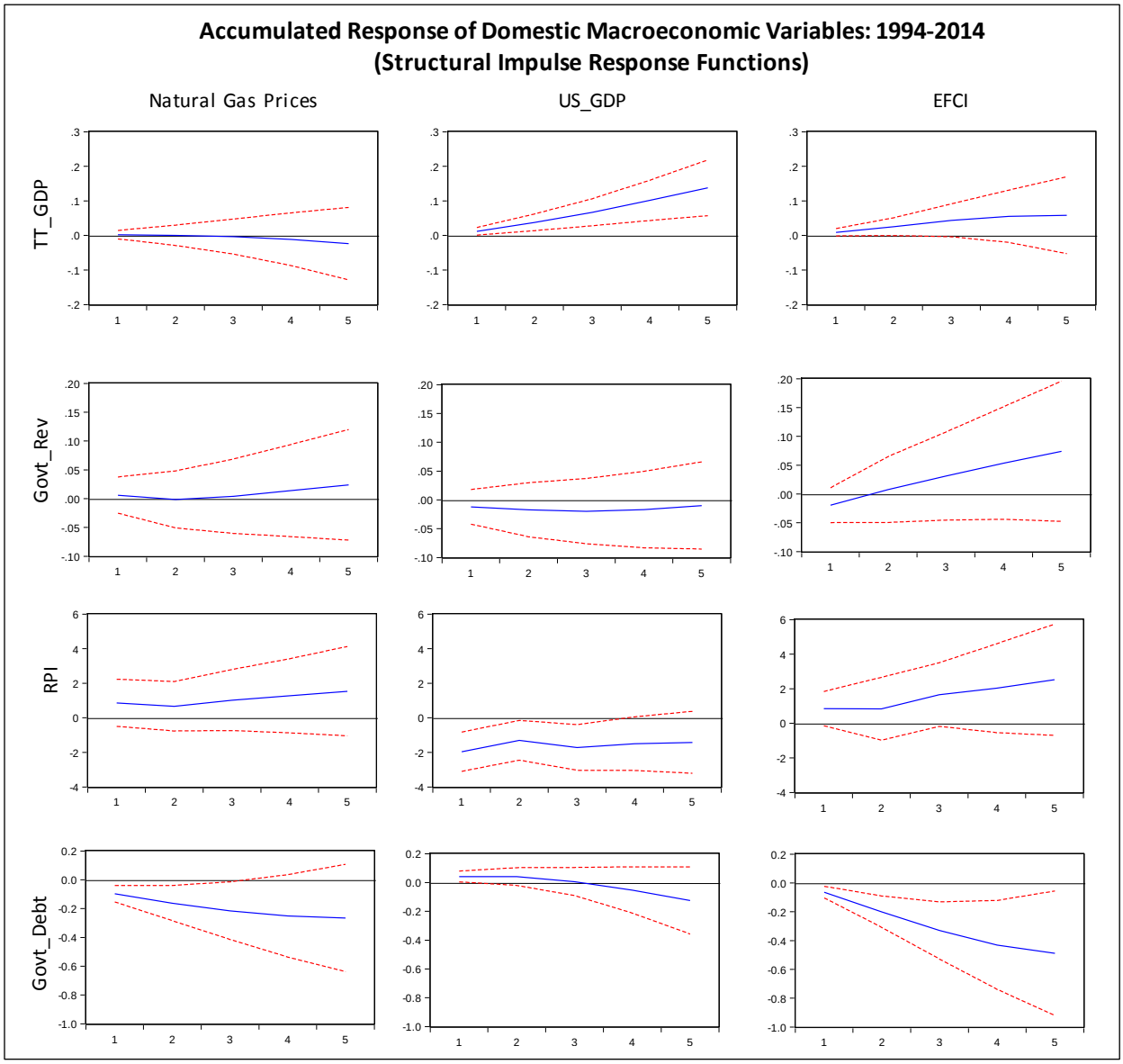


A.9 Structural Impulse Response Functions – Post-liberalisation

Accumulated Response of Domestic Macroeconomic Variables: 1994-2014
(Structural Impulse Response Functions)

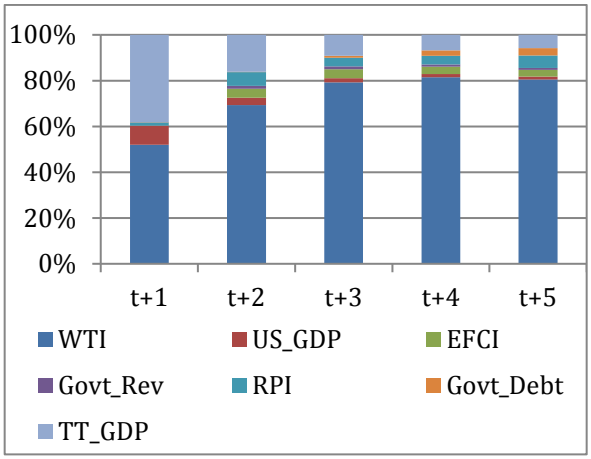


A.10 Structural Impulse Response Functions (1994-2014) including Natural Gas Prices

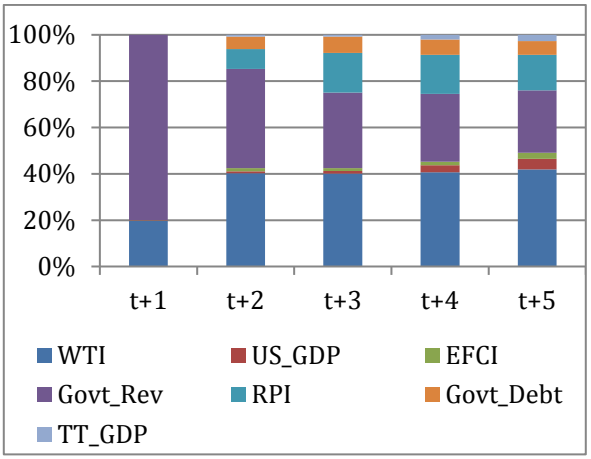


A.11: Forecast Error Variance Decomposition for Domestic Macroeconomic Variables
(1971-1993)

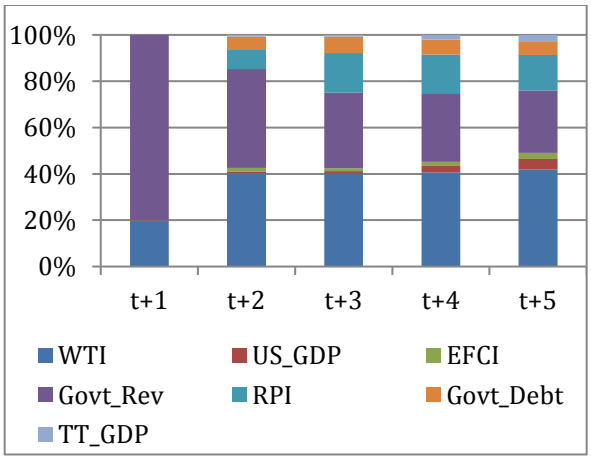
Variance Decomposition of TT_GDP



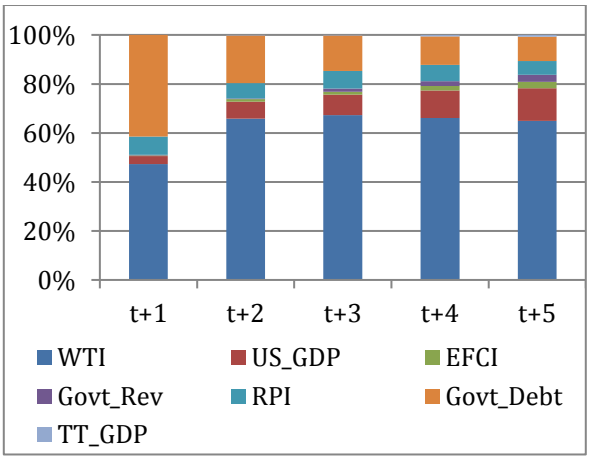
Variance Decomposition of Gov't Revenue



Variance Decomposition of RPI

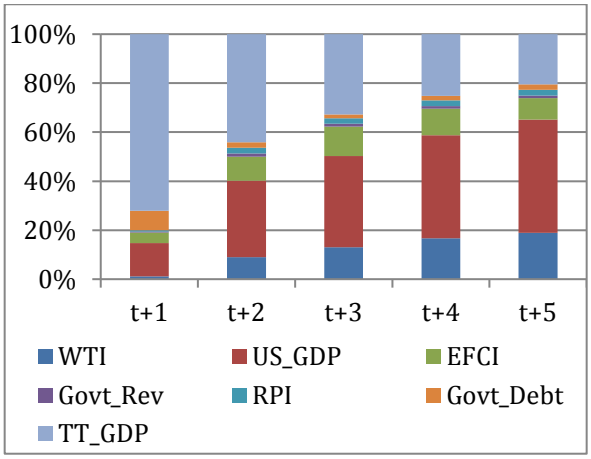


Variance Decomposition of Gov't Debt

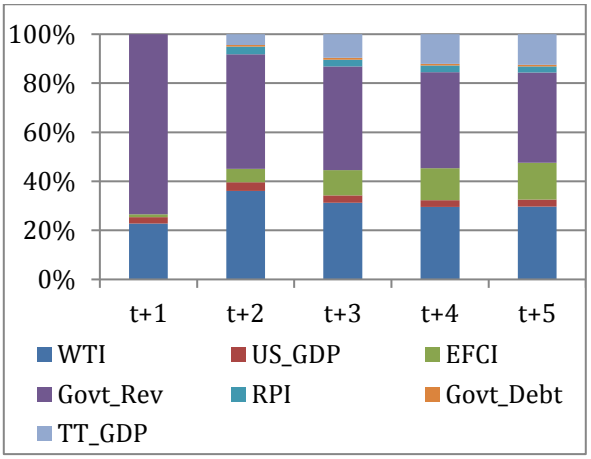


A.12: Forecast Error Variance Decomposition for Domestic Macroeconomic Variables
(1994-2014)

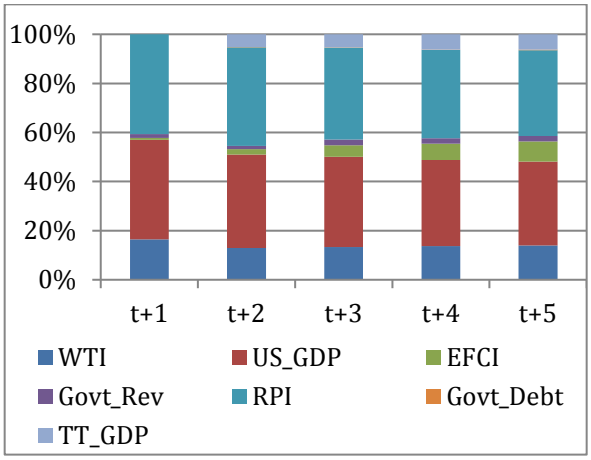
Variance Decomposition of TT_GDP



Variance Decomposition of Gov't Revenue



Variance Decomposition of RPI



Variance Decomposition of Gov't Debt