The relationship between international commodity price shocks and macroeconomic variables in Suriname

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Abstract

This paper examines the relation between international commodity price shocks and macroeconomic variables in Suriname. The study uses a Structural Vector Autoregression (SVAR) model with annual data from 1980-2018. Results from the impulse response functions and variance decomposition analysis indeed points at commodity price shocks having a significant impact on the macroeconomic performance of Suriname. A positive prices shock was found to significantly increase the country's export earnings, government revenues, real GDP and broad money. On the other hand, inflation rate decreases due to an appreciation in the real exchange rate. Furthermore, the paper establish that commodity prices shock are directly transmitted to the economy via the external trade balance and fiscal channel. A proper management of the stabilization fund, which can contribute in to smoothing government expenditure and diversification of the export basket to reduce the mineral-dependence are recommended to achieve sustainable macroeconomic stability.

Keywords: Commodity price shocks, Asymmetric effect, Structural Vector autoregressive, Impulse respond function and Variance Decomposition.

1. Introduction

Suriname, a small open commodity-export-based country, is slowly recovering from an economic recession. The country experienced a triple commodity shock when oil and gold prices collapsed and bauxite mining, that had underpinned the economy for a century, came to end in 2015. The economy contracted by 3.4 percent in 2015 and 5.6 percent in 2016, which is a major turning point from the average growth of 5.0 percent the country experienced during favorable commodity prices (Canuto, 2016). Suriname also endured large fiscal and external imbalances as government revenues and export earnings depleted. A devaluation of the exchange rate by approximately 21.5 percent in 2015 was a first step to stabilize the foreign exchange market. In May 2016, the government switch to a completely free-floating exchange-rate system. Inflation accelerated around 52 percent in 2016 cost by higher utility tariffs and exchange rate depreciation. To restore macroeconomic stability, the Surinamese government requested a Stand-By Agreement (SBA) from the International Monetary Funds (IMF) in 2016 (IMF, 2016).

This study focuses on bringing into perspective the relationship between international commodity prices movements and Surinamese macroeconomic performances using data for the period 1975-2018. Execution of the analysis is done by shedding light on the responses of various macroeconomic indicators to international commodity price shocks within a Structural Vector Autoregression (SVAR) framework. A commodity price shocks is defined as a sudden increase or decrease in commodity prices Wakeford (2016). In this study, a commodity price shock refers to a sudden increase in international commodity prices. The relevance of this study lies in the fact that Suriname depends heavily on mining and mining-linked manufacturing for economic growth, which will further increase if indeed the State Oil Company succeed in striking on oil. Since the results of the study can reveal the impact international commodity price movements has on the macroeconomic performances of the country and trace out the channel through which these price shocks are released into the country, the outcomes can serve policy makers in formulating thoughtful policy that would help shielding the economy from the high volatility of commodity prices.

This research contributes by adding to the previous work of Dijck, Dijkstra, de Jong, Martin and Vos (2000). In this early work, Dijck et al (2000) concluded that Suriname's economic performances has co-movements with the price cycles of its main exporting commodities, thereby

hampering sustainable growth and development. The study adds to the existing literature by adopting a quantitative approach that enables more substantiated policy recommendations and helps identifying the main channels through which commodity price shocks are been transmitted. Another contribution is the use of a country specific commodity index that captures international price movements of the main commodities in the export basket of the country during the study time span.

In general, results from the Impulse response function and the Variance decomposition method indicates that commodity price shocks have a significant impact on the selected macro-economy indicators in Suriname. Especially on export earnings, government revenue, money supply and real exchange rate. Conversely, the study found a weak relationship in the case of real GDP and consumption price index.

The remainder of the paper proceeds as follows. Section 2 presents some stylized facts of the Surinamese economy. In section 3 the empirical framework is set out while section 4 assesses the dataset and the research methodology. Section 5 presents the results, and section 6 covers the conclusion and policy recommendation.

2. Literature review

2.1 Theoretical review

A very large body of empirical work are in support of a negative link between abundance of natural resources and economic performance, also known as the "natural resource curse theory" (e.g., Auty, 1986; Sachs and Warner, 1995 and Rosser, 2006). As these resources, themselves are not inherently detrimental to economic development, several explanations have been offered towards explaining the natural resource curse puzzle. Early studies such as the work of Corden and Neary (1982) and Sachs and Warner (1995) link the negative correlation between natural resource abundance and economic performances with the crowding out of the non-resource sector by the natural resource sector, the so called "Dutch disease effect". This crowding-out logic forms the basis of Sachs & Warner's model.

On the other hand, Lane and Tornell (1999) explained the phenomenon of the resource curse in a rent-seeking model. This model emphasized the role of power groups and institutional framework has that contributes to distortionary redistributive activities (rent- seeking behavior) which causes economies to experience lower economic growth. In the institutions model, the need for good institutions and low level of corruption is stress out to escape the natural curse. Cabrales and Hauk (2011) and Gylfason, Tryggvi and Gylfi (1999), accentuated the importance of human capital in fostering economic growth. Resource-rich countries tend to have less human capital accumulation as policymakers often neglect the developing of their human resources. Beck (2011), Hattendorff (2014) and recently Mlachila and Ouedraogo (2017), pointed that in most resource rich developing countries natural resource impede or hinders the development of the financial system, which is a crucial growth factor.

The negative link between natural resource abundance and economic performances is also explained via the commodity price shock channel. It is often the case that the macroeconomic performance in most commodity-dependent developing countries tend to have co-movement with the international commodity price cycles of the resources they are exporting. This holds because of their intensive dependence on these natural resources. Economic activity and external and fiscal balances deteriorate during commodity price downswings, while improving during price upswings. With weak institutional functioning and a lack of good governance in most of these countries, external price shocks outcomes can have long-term consequences for sustainable growth and can steer these countries off their development path (Kose and Riezman, 2001 and Torvik, 2002). It is therefore that Bangara and Dunne (2018) postulated in their study that commodity price movements can function as an early warning signal for potential instability in the macro-economy. In this paper the commodity price shock channel is used to address the relationship between natural resource abundance and economic performances, in particular macroeconomic performances.

2.2 Empirical review

The focus on the link between commodity prices and economic performances intensified after the oil price shock of 1973-1974. Not surprisingly, that the majority of empirical studies related to this topic have manly focus on the oil price–economic growth relationship. For example, in the pioneering work, Hamilton (1983) and Mork (1989) both concluded that oil price shocks had an impact on the USA GDP. The authors used a VAR model with several macroeconomic variables

such as real GNP, unemployment rate, import prices and money supply (M1). Mork (1989), further indicated that the impact of increasing oil prices on GNP growth was negative and significant, while the impact of negative prices was insignificantly and smaller. The outcome thus points that the impact of oil price shocks on the economic performances of the USA was asymmetric.

While the majority of the literature has focused on the US experienced, there is also a growing body of work on other regions. In the case of the OECD countries, Jimenez-Rodriguez (2008) concludes that in the UK, responses to oil price shocks are similar to those in the US, but in other countries, the evidence is not as clear. Cuñado and Perez de Gracia (2005), analyzed the case of Japan, Singapore, South Korea, Malaysia, Thailand, and the Philippines and highlighted the negative impact of an oil price shock throughout the period of 1975–2002 had on output and inflation. The empirical strategy takes into account only positive changes in the price of oil, recognizing the asymmetry of price shocks effects that most of the literature discusses.

On the other hand, the literature on net commodity exporting countries, especially developing countries, is still under researched. Among the scanty studies, is the work of Eltony and Al-Awadi (2001) who examined the impact of oil price shocks on seven key macroeconomic variables for Kuwait. The study used several VAR models (VAR, VECM and SVAR) with quarterly data over 1948: Q1-1998: Q4. Strong causality was found among the variables in consideration. The authors further noted the importance of oil price shocks on government expenditures, which had a significant impact on economic activity in Kuwait. An oil price increases was found to have a positive impact on government expenditure, both current and capital.

Farzanegan and Markwardt (2009), based on a VAR, concluded that oil price shocks had a positive impact on industrial production and inflation in Iran since 1975. Moreover, they disentangle between positive and negative shocks, highlighting that negative price shocks have an adverse effect on industrial production, but an upsurge of inflation. The rise in inflation was due to a decreasing output and increase in the government's deficit that was financed by the Central Bank that leads to an expansion of the monetary base and the money supply according. They also found evidence for the presence of Dutch Disease, based on the positive and statistically significant response of the exchange rate (appreciation) to a positive oil price shock.

Using a structural vector autoregression (SVAR) approach on quarterly Malawian data (1980:1 to 2012:4), Bangara and Dunne (2018) established that a positive tobacco price shock had a

significant positive impact on the country's gross domestic product, decreasing consumer prices and inducing real exchange rate appreciation. The results are robust to alternative specifications of a SVAR on difference stationary data and cointegrating VAR. The cointegrating VAR confirms the existence of a long run-relationship among the variables and causality that runs from tobacco prices to macroeconomic variables.

In the Caribbean region: Lorde et al. (2009) examined the impact of oil price fluctuations on Trinidad and Tobago from 1966 to 2005 using an Vector Error Correction Model (VECM) with several macro-variables such as Gross Domestic Product, government revenue, government consumption, gross investment and net exports and CPI. Based on the impulse response functions an oil price increase was found to have a positive effect on government revenue, gross investment, net export, government consumption and CPI, while output responded negatively in the first two years. This negative response is explained by the fear of investors for the uncertainy environment created by the sudden increase in oil price, which postponed their investment decision. On the other hand, the response of the macroeconomic variables to the oil price volatility was smaller compared to an increase in oil price.

Roach (2014) examined the impact of oil shocks on key Jamaican macroeconomic variables including real GDP, inflation, the nominal exchange rate, the current account balance and interest rates. The results indicate that oil price shocks largely do not have a permanent effect on the Jamaican economy. Furthermore, the findings suggest that an oil shock emanating from an increase in global aggregate demand generally precedes an improvement in the domestic economy while demand shocks associated with precautionary holdings of oil (oil-specific demand shocks) and oil supply shocks generally result in a deterioration in domestic macroeconomic variables.

In the case of Suriname, Dijck et al (2001) analyzed the performances of the country during the commodity boom and bust periods during the 90's. The author established that Suriname's economic performances tends to co-move with the boom – bust price cycle. Dijck et al (2001) indicated that the amplifications of the boom and bust periods are due to government reaction. He stated that during both transition years 1991 and 1998 when the economy transitioned from a boom to a bust period, the government adopted expansionary fiscal policies, which not only amplified the internal and external imbalances, but also exacerbated the ensuing slump.

3. Stylized Facts: Suriname and its commodity dependency

Suriname's mineral resource wealth consists of deposits of gold, oil, and bauxite. At present, only gold and oil are extracted after the US-based historical partner Alcoa stopped production of bauxite in 2015. Since its independence in 1975, many attempts to adopt a strategic development model that would result in the diversification of the economy did not neutralize the dominance of the mining sector. Mining and mining-linked manufacturing remains the most important export income earner of the country. The dependence constitutes one of the main impediments for sustainable and inclusive development of Suriname. It undermines the creation of an adequate macroeconomic framework to counter exogenous shocks generated by volatile international commodity markets.

Figure 1 and 2 displays the country's commodity dependency, measured by the contribution of the mining and quarrying share in total export in goods and services, nominal GDP and total government revenue. During the period of review, the share of mining and quarrying in total export in goods and services ranged from 55 percent to 96 percent while its share in nominal GDP was in the range of 1.4 percent to 10.1 percent.

Figure 2: Mining and Quarrying share in total export of goods and services and in nominal GDP (1990-2018)

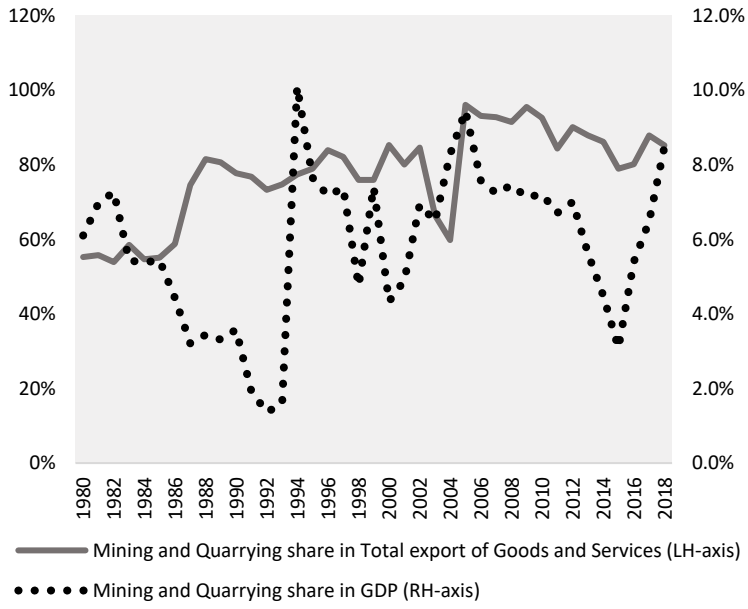
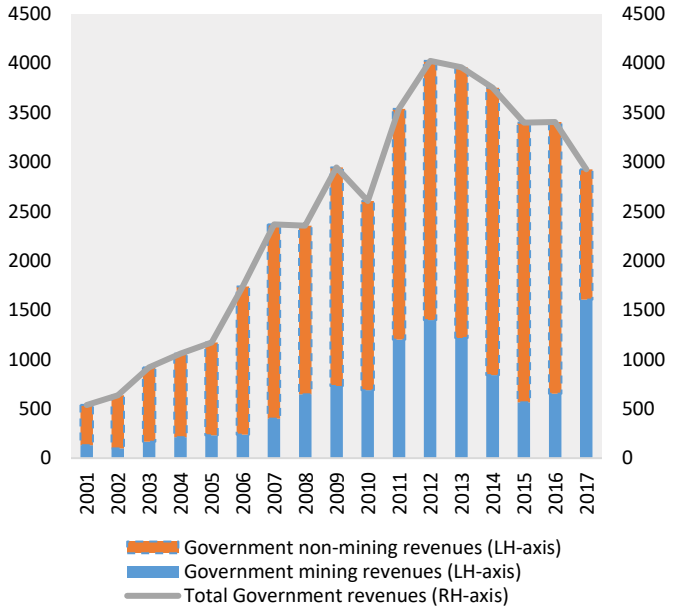


Figure 1: Overview of government revenue (2001-2017)



Source: Central Bank of Suriname

The government mining revenues ranges from SRD 100.6 mln up to 1607.0 mln. The wide ranges in the contribution clearly signify the volatility in mining and quarrying earnings the country is subjected to due to volatile international commodity prices.

The co-movements of macroeconomic performances with the international price cycles of the commodity the country produces can be grasp when analyzing the country's economic performance during boom-bust periods in the international prices. The relatively depressed periods of commodity prices, clearly reflect a spiral of macroeconomic instability. On the other hand, the periods showing an upsurge in commodity prices show significant economic performance (see Table 1).

Table 1: Commodity prices and Selected Macroeconomic Indicators

Variables	1992-1994	1995-1997	2004-2012	2013-2016
	(average)	(average)	(average)	(average)
Alumina price (US$ per ton)	1528.81	1831.86	2244.84	1703.69
Real WTI Crude oil price (US$ per barrel)	22.21	22.71	74.83	67.74
Real LME Gold price (US$ per troy oz)*	…	…	933.27	1242.37
Real GDP growth	-0.79	2.23	4.97	-1.44
Current Account Balance in % of GDP	7.8	-3.58	4.27	-7.69
Inflation	289.6	18.5	8.72	20.5
Money supply in % of GDP	82.42	44.66	47.08	62.9
Government balance in % of GDP	-7.71	0.02	-0.38	-7.01

Source: Central Bank of Suriname

*Although gold mining started since 1718, it had long been dominated by small-scale mining operations. The sector's contribution to the economy at that time was marginal. However, with the emergence of large-scale gold mining, started in 2004 by Rosebel Gold Mines N.V. (RGM), the sector's contribution to GDP rose from 2% in 2000 to 8.8% in 2004. This the reason gold prices are only presented for the second boom-bust period.

Commodity slump periods (1992-1994 and 2013-2016) were typically followed by a decrease in export revenues that eventually resulting in a trade deficit. As export revenue decreases, the level of foreign-exchange receipts reduces, thereby affecting the stock of international reserves negatively. Because Suriname is a more importing base country, the decreased supply of foreign exchange will causes the exchange rate to depreciate, since demand will surpass supply. This causes the domestic price level to increase. As mining company's profit declines their contribution

to government revenue also decreases, causing a significant drop in government revenue. As government spending that ultimately results in fiscal deficits. Rather than adjusting to the external shock, the government often adopted highly expansionary fiscal policies. Consequently, this widens the fiscal deficits further. These large fiscal deficits, often monetized by the Central Bank, caused a rapid increase of the domestic money supply. A growing money supply enlarged a flight into foreign exchange, since periods of economic downturn, accompanied by exchange rate increases, often triggered a loss of confidence in the domestic currency. As a result, pressure in the exchange market intensifies which exacerbates inflationary pressures. The increase in inflation normally reduces aggregate demand thereby causing output to decline.

During commodity booming periods (1995-1997 and 2004-2014), the economy experience the reverse effects as describe above. Positive commodity price shocks increases export revenues increasing the level of foreign inflows. This strengthens the country's stock of international reserves. Moreover, with the increase inflow of foreign exchange, the demand for foreign currency for goods and services imports is met. The increased supply of foreign exchange also causes appreciation pressures to the real exchange rate. Higher government revenue stemming from a commodity-boom, reduces fiscal deficit, which in tandem with exchange rate stability reduces inflation. Most of the time the government will spend a substantial fraction of its increased income to civil servants salary, transfers and subsidies on goods and services. The low inflation rate and these government spending's triggers aggregate demand thereby affecting output positively.

4. Data and Research Methodology

4.1 Details about the domestic variables

Various macroeconomic indicators are selected to conduct the analysis. Following Bangara and Dunne (2018), we selected the consumer price index (cpi) with base year 2010 to capture the response of inflation to commodity price shock. The real gross domestic product (rgdp) measured as the country's GDP at 2010 constant prices, real exports (rexp), real government revenue (rgvr), real money supply (rm2) and the real exchange rate (rer). All variables with the exception of real exchange rate are transformed in to their natural logarithm (see, Appendix 1, Figure 1 for a

graphical presentation of the data). The dataset is retrieves from the Statistical Compendium (2013) and statistical tables from the Central Bank of Suriname.

4.2 The Research Methodology

In assessing the relationship between international commodity price shocks and the macroeconomic performances of Suriname, along the lines of Deaton and Miller (1996), Cashin, Cespedes, and Sahay (2004) and Spatafora and Tytell (2009) a country specific commodity price index was constructed. The index is based on the main mining commodities Suriname exported during 1975-1980.

The methodology used in constructing the country specific commodity price index is straightforward: First, the relevant commodities to build the index are selected. During the study period alumina, oil and gold had a large share in the commodity export basket of Suriname, the index is based upon the commodity prices of these resources. It is worth mentioning that international prices rather than domestic prices (export value of a product divided by export volumes) are used[1].

Secondly, certain weights are attributed on each individual price. Even though Deaton and Miller (1996) are in favor of using fixed weights to obtain an exogenous variable that is sensitive to price rather than quantity movements, this study adopts a somewhat different approach. The main disadvantage of using fixed weights is that it does not take into account changes in the decomposition of the commodity production matrix, as the weights remains constant over time. This can be a major constrain especially in the case of Suriname. For example, with an average share of more than 90 percent in the commodity export basket, bauxite and aluminum were the main commodity the country exported during the 70's, 80's and the 90's. However, after 2004 the share depleted to an average of 30 percent[2]. By neglecting these decomposition changes, some commodities can erroneously be over weighted and others underweighted, thereby effecting the decomposition of the commodity price index.

[1] The used of international prices is preferred in this study since Cashin, Cespedes and Sahay (2002) stated that movements in these prices are exogenous to the behavior of especially small open developing countries. The small share most developing countries have in the world commodity markets gives them negligible long-term market power in the markets for their commodity export products. These countries are therefore characterize to be price takers.

To take into account these structural shifts, the assigned weights are set to vary over time. Applying this method however, imposes other challenges. Commodity price indices with time varying weights of which the weights are calculated based on the method of export value share in total commodity export basket, are likely to be endogenous to domestic economic conditions. For example, a production shock as well as economic policies and institutions significantly influence terms of trade and thus effect weights. To minimize these domestic impacts, the assigned weights are calculated based on a five-year averages[3] of trade values, which smooths price fluctuation. In this manner changes in the price index are set to be more as a result of variations in commodity prices rather than changes in for example export volumes. The country specific commodity price index has the following structure:

$$COMPI = \sum_{J=n}^{J} P_{j,t} \ * \ \gamma_{i,j,t}$$

Where $P_{j,t}$, is the real international price of commodity j at time t in U.S dollar[4] and $\gamma_{i,j,t}$ is the weighted item, with the following structure:

$$\gamma_{i,j,t} = \frac{x_{j,t}}{\sum_{j=3}^{j} x_{j,t}}$$

Where $x_{i,j,t}$ denotes the export value of commodity j between t and $t+5$; $\sum_{j=1}^{j} x_{j,t}$ represent average export value of the selected commodity in the export basket between t and $t+5$[5]. the constructed commodity price index is presented in Appendix figure 1.

To properly capture the dynamic relationship between commodity price shocks and the selected macroeconomic indicators, the study uses a structural vector autoregression ((henceforth, SVAR) model proposed by Sims (1980). Most previous studies, both country specific and cross-country studies, have used SVARs to assess the relationship between commodity price shocks and macroeconomic indicators. The advantage of the SVAR over the other classes of vector autoregressive models is that they are easy to use, and are often more successful in predictions

[3] A five-year average was arbitrary selected. The study of Gruss (2014) uses a three-year rolling average method.
[4] The real international prices are taken from the International Monetary Fund Commodity Price System database. The prices are deflated using the International Monetary Fund Manufacturing Unit Value index (MUV).
[5] Data on the export value of the selected commodities is extracted from Central Bank of Suriname database.

than complex simultaneous models (Bahovec and Erjavec, 2009). Also contrary to the standard VAR model, the impact of purely exogenous shocks can be extracted from a SVAR model.

The empirical SVAR model can be expressed by the following structural form:

$$A_0 Y_t = \lambda_0 + \sum_{i=1}^{P} A_i Y_{t-p} + \tau + \vartheta_t \qquad equation\ (1)$$

Where, A_0 represent a 6×6 matrix of structural coefficients, which describes the contemporaneous relationship among the variables, Y_t is a 6×1 vector of endogenous variables: [$lrcpri_t$, $lrexp_t$, $lrgovr_t$, $lrgdp_t$, $lrm2_t$ $drer_t$, $lcpi_t$]. λ_0 is a 6×1 vector of constants; A_i, are 6×6 autoregressive coefficient matrices related to the endogenous variables and p represent the selected optimal lag length. τ, is a vector containing a set of dummy variables which are incorporated to capture possible breaks that are due to economic disturbances. ϑ_t, is a 6×1 vector structural disturbance which are assumed to be normally distributed with a constant variance-covariance matrix, $\sum_{\vartheta} = E[\vartheta\vartheta']$.

Since the structural shocks of $equation$ 1 are unobserved components, the structural parameters and the residuals are not estimable. In order to estimate the structural model, it needs to be transformed into a reduced-form representation. By pre-multiplying both side of the SVAR representation by ${A_0}^{-1}$ the reduced-form VAR is obtained and has the following structure:

$$Y_t = \psi_0 + \sum_{i=1}^{P} B_i Y_{t-p} + \xi + \varepsilon_t \qquad equation\ (2)$$

Where, $\psi_0 = {A_0}^{-1}\lambda_0$, $B_i = {A_0}^{-1}A_i$, $\xi = {A_0}^{-1}\tau$ and $\varepsilon_t = {A_0}^{-1}\vartheta_t$. With the last expression, the errors of the reduced-from VAR are brought into relation with the structural shocks ϑ_t. Also, the errors of the reduced-from VAR are set to be a linear combination of the structural shocks.

4.2.1 Identification scheme

To identify the structural parameters with the estimates of the reduced form VAR it is necessary that the number of parameters in the SVAR equals the number of estimated parameters in the reduced-form VAR. The reduced-from VAR produces $pk^2 + \frac{k^2+k}{2}$ parameters while $k^2 + pk^2 +$

$\frac{k^2+k}{2}$ parameters can be obtained from the structural VAR. A necessary condition for exact identification of the SVAR is to restrict k^2, which is equivalent as setting restriction on matrix A_0. However, to meet the condition of exact identification it is required that no more than $\frac{1}{2}(k^2-k)$ restrictions are place on A_0. In our case we have a 7 variable model; therefore, we need 21 additional restrictions to estimate the model.

For the identification, following Farzanegan and Markwardt (2009), Iwayemi and Fowowe (2011) and Bangara and Dunne (2018), we used a non-recursive identification schemes to impose restrictions on the contemporaneous structural parameters. Thus, we only made short-run restrictions. Equation 3 below depicts a summary of the set of restrictions.

$$\begin{bmatrix} \varepsilon_{rcpri\ i,t} \\ \varepsilon_{rexp\ i,t} \\ \varepsilon_{rgovr\ i,t} \\ \varepsilon_{rgdp\ i,t} \\ \varepsilon_{rm2\ i,t} \\ \varepsilon_{rer\ i,t} \\ \varepsilon_{cpi\ i,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 & 0 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & 1 & b_{45} & 0 & b_{46} \\ b_{51} & 0 & b_{53} & 0 & 1 & 0 & b_{56} \\ b_{61} & b_{62} & b_{63} & 0 & b_{65} & 1 & 0 \\ b_{71} & b_{72} & b_{73} & b_{74} & b_{75} & b_{76} & 1 \end{bmatrix} \times \begin{bmatrix} \vartheta_{rcpri\ i,t} \\ \vartheta_{rexp\ i,t} \\ \vartheta_{rgovr\ i,t} \\ \vartheta_{rgdp\ i,t} \\ \vartheta_{rm2\ i,t} \\ \vartheta_{rer\ i,t} \\ \vartheta_{cpi\ i,t} \end{bmatrix} \qquad equation\ (3)$$

Where: $\vartheta_{rcpri}, \vartheta_{rexp}, \vartheta_{rgovr}, \vartheta_{rgdp}, \vartheta_{rm2}, \vartheta_{rer}, \vartheta_{cpri}$ Are the structural disturbances, that is, real commodity price index, real export revenue, real government revenue, real GDP, real M2, real interest rate and CPI shocks respectively, while $\varepsilon_{rcpri}, \varepsilon_{rexp}, \varepsilon_{rgovr}, \varepsilon_{rgdp}, \varepsilon_{rm2}, \varepsilon_{rer}, \varepsilon_{cpi}$ are the residuals from the reduced from equation.

The set of restrictions can be explained as follows: Firstly, as Suriname is a price taker, in line with the small country assumption it is assumed that the country specific commodity price index cannot contemporaneously be influenced by the domestic variables. The commodity price index is therefore restricted to enter the system as the most exogenous variable.

The second and third equation in the matrix represent the export and government revenue equation respectively. Empirical studies[6] indicated that due to their high dependency on commodity revenues, commodity price shocks typically generates volatility in export and fiscal revenues of highly depending developing commodity-exporting based countries. As Suriname's export basket

[6] See for example a recent study of Hernaiz, Miller and Pedroni (2018).

is mainly commodity based, a commodity price shock is expected to immediately affect the level of export and fiscal revenues. In view of this, we imposed restrictions such that export revenue is only affected by a commodity price shock while government revenue is affected by a commodity price and export shock.

Equation fourth is the output function, and is assumed to be affected by the commodity price shock index and export revenue. The fifth equation is the money equation that relates to a money demand function and is assumed to be contemporaneously affected by real income, inflation rate and for the interest of the study commodity price index. The real exchange rate is included in the SVAR system to reflect the response of the foreign exchange market. It is assumed that the real exchange rate is contemporaneously affected by the commodity price index and export revenue. Finally, inflation rate is contemporaneous affected by all variables in the system.

4.2.2 Impulse response functions and Variance decompositions

Once the structural model has been identified and estimated, the effects of the structural shock ε_t can be investigated through impulse response analysis. The impulse response analysis are often more informative than the structural parameter estimates themselves. In the concept of a SVAR an impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables.

Furthermore, The Variance Decomposition (VDC) method is employed to determine the relative importance of a commodity price shocks towards explaining the behavior of the selected macroeconomic variables. Thus, the VDC shows how much variation in the selected macroeconomic indicators is due to price shocks.

5. Discussion of Results

5.1 Preliminary data analysis and results

Before proceeding to the estimation of the SVAR, a preliminary analysis of the data is required. First, graphical representation of the series is used to provide a reference point for examine the relationships among the series that basic statistical methods may uncover in the later section (see, Figure A.1 in Appendix.). By eyeballing the data we observed that most of the series are trending, implying that these series may not be stationary. Furthermore, some series may contain some break points.

For a proper examination of the time series property of stationarity, we test for unit roots using two standard tests—the augmented Dickey–Fuller (ADF) test by Dickey and Fuller (1979, 1981) and the Philips and Perron (PP) test by Philips and Perron (1988). Under the ADF and the PP test, the series is assumed nonstationary. Hence, failing to reject the null hypothesis implies that the series has a unit root. Since standard unit root tests have reduced power if they are applied to a time series with a structural break, the unit root test by the Zivot and Andrews (1992) break-point test) is employed is used. Results from the basic unit root tests shows that: The commodity Price index had no unit root in level, whereas all the other variables were integrated in order one. In addition, the Zivot and Andrews break-point test indicated breakpoints in the data at 1993 and 2016[7] (see Table A.1 in Appendix). To counter for these breakpoints we constructed impulse dummy variables.

Furthermore, the AIC lag-length selection criteria choose two lag as an optimal lag, while the SBC hinted one lag as optimal (see Table A.2 in Appendix). Since we prefer a parsimonious model, the result of the SBC criteria was preferable than the AIC. However, when conducting an autocorrelation test, correlation among the disturbances of the system was present in the case of one lag but not for the second lag. Based on the preliminary outcomes the SVAR system was estimated using two lag with all variables in first difference of logarithm with the exception of real exchange rate. We also added two time dummy variables (1993 and 2016) to assimilate the identified breaks in the data. The stability test and the diagnostic tests are presented in figure A.2 and Table A.4 in the appendix. The model passes all the formal tests. In the short-run causality runs mostly from commodity prices to real export earnings, government revenue, money supply and CPI (see appendix Table A.3).

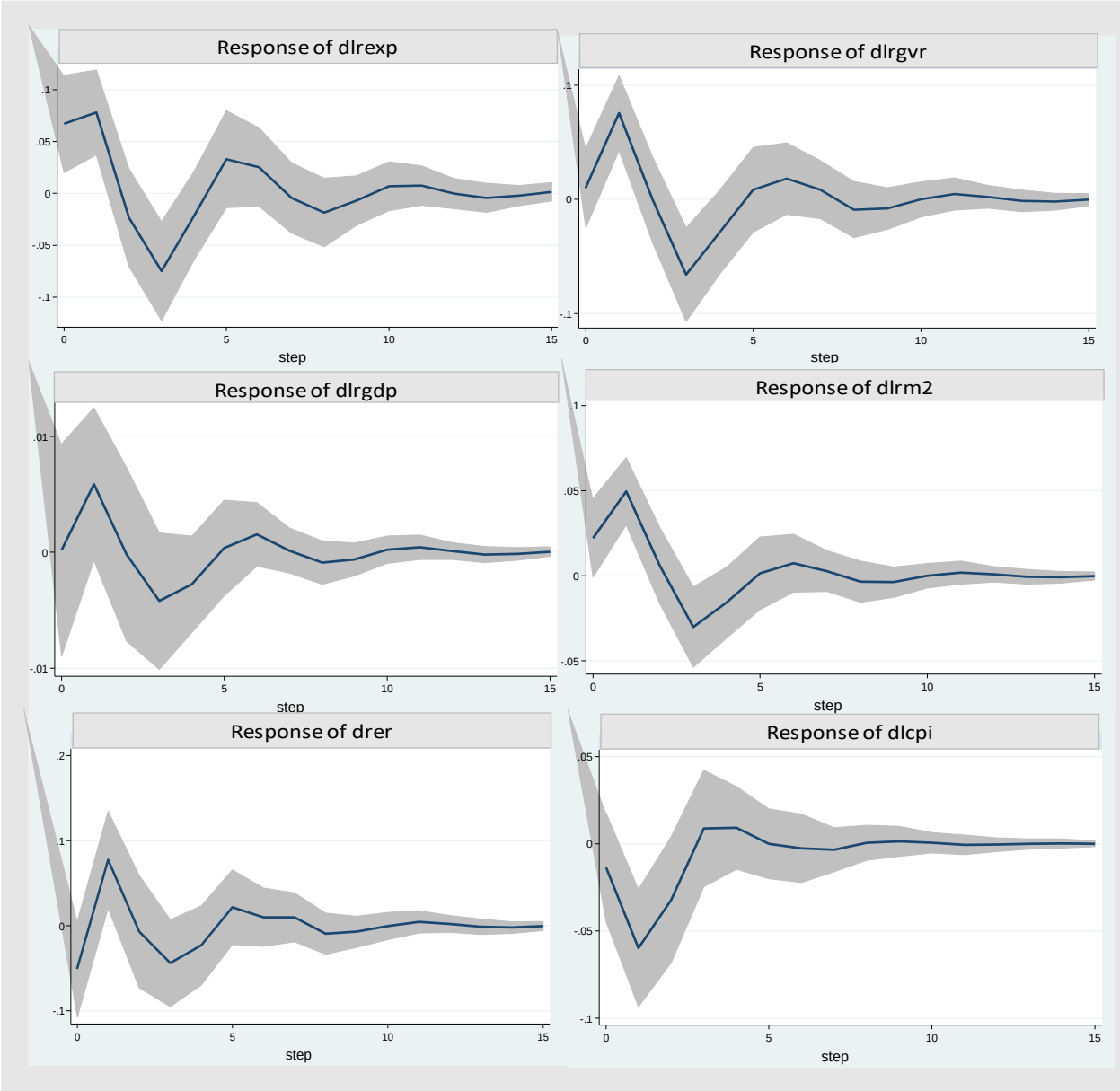
6.2 Impulse Response Functions

After estimating the proper model that meets all the necessarily requirements, we proceeded by generating the impulse responses. The outcome is reported in Figure 1 below and shows the response of the selected variables to a one standard deviation shock to the country specific commodity price index. The grey lines represent the intervals of two standard deviations, while the blue lines represent the impulse function. Since the focus is on the responses of the selected

[7] In 1993 the multiple exchange rates were unified, causing the exchange rate to increase by more than 2000%. In 2016 the exchange rate depreciated by more than 50%.

macro-economic indicators to a commodity price shock, we only reported these impulse response functions. Results from LR test with a p-value of 0.177, indicated that the restrictions placed on the A and B matrix of the SVAR are appropriated.

Figure 1: Impact of a one standard deviation structural RCPRI shock



Source: Author own computation

The responses of the selected macro indicators are all in line with our expectations and the findings of Dijck et al (2001) and Bangara and Dunne (2018). The response of export revenue to a

commodity prices shock is shown in the first panel. In line with Dijck et al (2001) we found that export response positively to a commodity price shock. The response is also statistically significant. It is shown that a one percent price increase upsurges export revenues by 0.80 percentage point in the and finally dies out after the 12th year. The result implies that a positive commodity price shock leads to an improvement of Suriname's export in the first two years. This is not surprisingly, as it is common for commodity depending producing countries to experience an increase in exports income when commodity prices are high.

The second panel displays the effects of a commodity price shock on government revenue. The results indicate that a percentage point increase in prices, results in an increases of government revenue by approximately 0.02 percentage point in the first years. The impact picks at 0.08 percentage point in the third year and dies out after the eight year. As prices increases, the value of the mining firm's output increases as well. These firms are able to pay the government much more tax and royalties, thereby increasing government revenues.

The third panel provides the impulse response of real GDP to a positive price shock. A positive price shock results in an increase in real GDP of about 0.02 percentage point in the first year. Thereafter, GDP starts to fall and soon reached the original level of impact in the 12th year. The impact on real GDP is marginal, which can be explained by the relatively small contribution of the mining and quarrying sector in GDP.

As expected, the spur in the economy reflected by an increase in GDP can trigger more demand for money. Even though in Suriname the mining sector does not have a direct link with the financial sector, at the back of a growing economy with increase spending in particular from the government side, the demand for money also increases. The fourth panel indeed indicate a significant positive response of the money supply. In the initial year, the money supply increases by 0.02 percentage points up to 0.05 percent in the third year.

The impulse response of the real exchange rate in panel shows that a price shock induces the exchange rate to appreciate, which gives evidence of the existence of "Dutch Disease". In the initial year, the real exchange rate falls by 0.06 percentage point. After the 3th year, it starts to increase and dies out in after the 12th year. The appreciation is the result of an access inflow of foreign currency, caused by an increase in export.

Common in small open economy is that movements in the exchange rate have great implication for the development of domestic prices. The stability in the exchange rate market indeed caused a decline in the domestic price level of 0.02 percentage points as depicted in the last panel. The consumption price index, however, starts to increase after 4th years, which might be due to increase spending that is mostly present during commodity booming periods.

6.3 Variance Decomposition analyses

In addition to the impulse responses, we examine the forecast error variance decomposition of the selected macro-economic indicators. The results of the variance decompositions of the SVAR are reported in Figure 2 below.

The variance decomposition is a tool to indicate the amount of information each variable contributes to the other variables in the autoregression. It quantify how important each shock is in explaining the variation in each of the variables in the system. Within the short run period, that is 5 years, variation in real export is mostly due to its own shock. Commodity price shocks has the second largest contribution and ranges between 29.29% and 30.06%. The significant contribution of commodity price shocks is validated on the bases of the large share of mining and quarrying share in total export in goods and services.

Variation in government revenue are primarily due to its own shock. Commodity price shock has the second largest contribution that is between 0.53 % and 14.74%. The outcome is not surprisingly given the significant share of mining revenues in total government revenue.

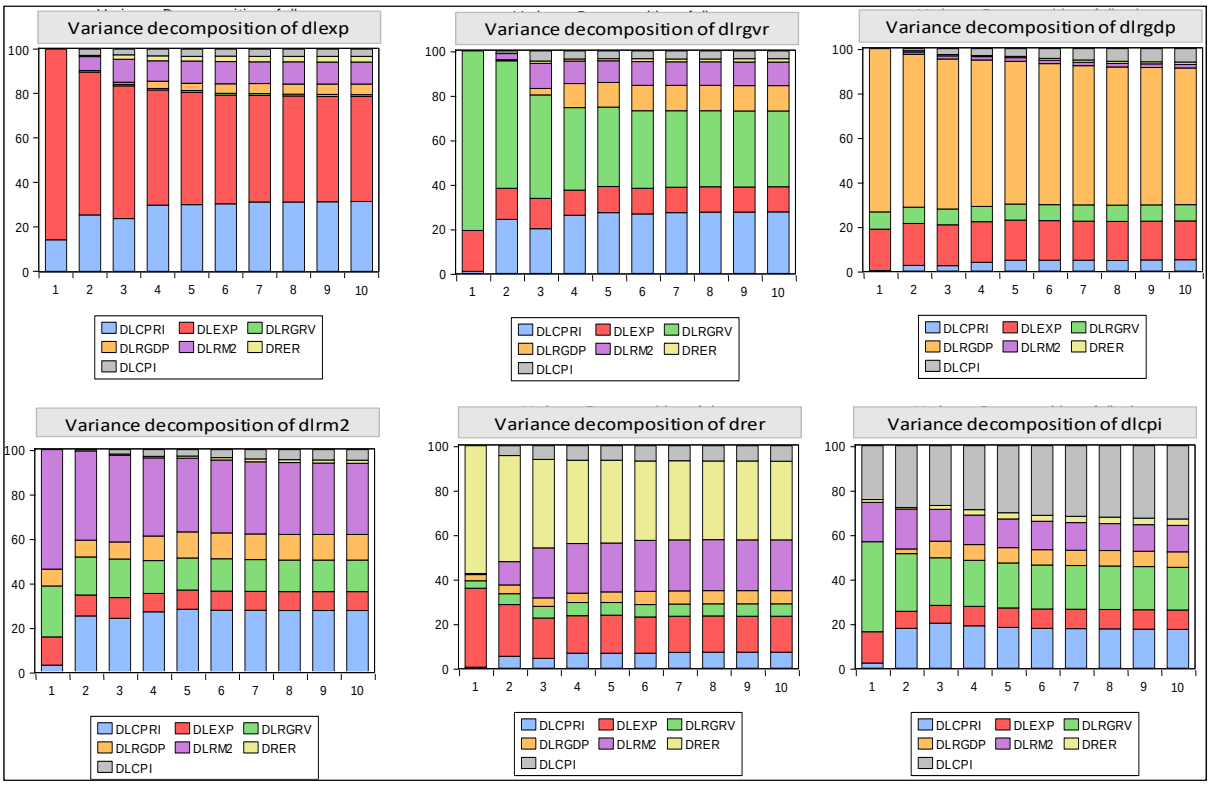
Variation in real GDP comes mostly from its own shock followed by a shock in government revenue and a shock in export. The contribution of a commodity price shock to variation in real GDP is very small, ranging between 0.24% and 1.98. On the other hand, Variation in real money supply is mostly due by its own shock followed by a shock in commodity prices. The variation ranges between 1.93 and 16.87%.

Real exchange rate variations are mostly due to its own shock followed by a shock in export. The country had a fixed exchange rate regime this made foreign earnings from exports a primarily source to defend the exchange rate. A shock to the commodity price index generates variation in the real exchange rate of between 6.01% and 7.10%.

Lastly, variation in inflation measured by percentage changes of the consumer price index is due to its own shock followed by a shock in government revenue. The variation in commodity price index ranging between 0.30% and 7.37%.

Based on these results it can be concluded that: Among the macroeconomic variables, a commodity price shocks brings about the most variation in export revenue, government revenue, money supply and real exchange rate. The variation in GDP and consumption index is marginal. In terms of the transmission mechanism, commodity price shocks are transmitted through the terms of trade fiscal and monetary policy channel

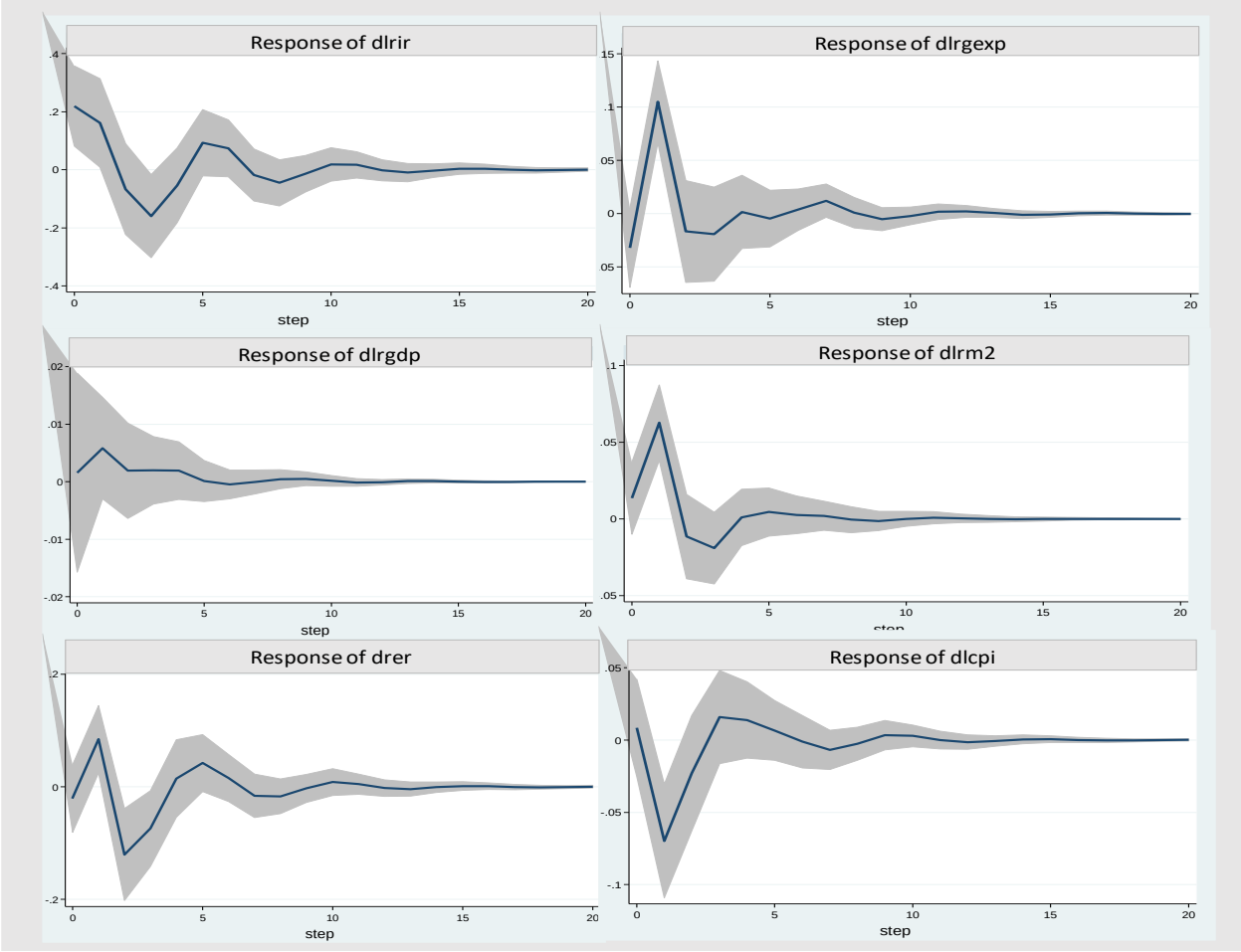
Figure 2: Variance Decomposition of the macroeconomic variables



Source: Author own computation

As a robustness checked, the ldrexp variable is replaced with the log difference of real international reserves (dlrir) variable and the variable dlrgvr is replaced with the log difference of real government expenditure. The model passes the stability and the diagnostic tests (see appendix figure A.2 and Table A.4). Results from the impulse response functions presented in figure 3, shows that the outcomes of the base model are robust. The responses of the macro-economic variables are similar to that of the base model. As expected international reserves response positive to a shock in prices. Government expenditure increases significantly following a price shock in the second period. Compering the magnitudes of the government revenue response to the response of government expenditure, a commodity price shock increases government spending more than government revenue. This might point to pro-cyclical response of the government during commodity price booming periods, which is in line with the findings of Dijck et al (2000).

Figure 3: Impact of a one standard deviation structural RCPRI shock for robustness check



Source: Author own computation.

7. Conclusion and Policy recommendation

The primary objective of this study is to analyze the dynamic relationship between commodity price shocks and macroeconomic variables in Suriname. The analysis was conducted using a SVAR approach with annual data from 1980-2018. In general, the IRF and the VDC method suggested a strong relationship between the commodity price shocks and the selected macro-economy indicators in Suriname. This was especially the case for export revenue, government revenue, money supply and real exchange rate. Conversely, the study detected a weaker relationship in the case of real GDP and consumption price index.

The policy implication of the obtained results are that since government revenue, money supply, real exchange rate and export were found to be very sensitive to commodity price shocks, thoughtful fiscal and monetary policy has to be conducted during commodity boom periods as well as periods of commodity busts. Several empirical studies proved that a Sovereign Wealth Fund (SWF) could be very effective in stabilizing government finances in commodity-based economies. The approved Savings- and Stabilization Fund Suriname Law (SSFS), which mandates the government to save commodity windfalls, is a significant step towards minimizing the vulnerability and mineral-dependence of the fiscal budget. It also contributes in smoothing fiscal expenditure. However, we do recommend for its proper management. Many countries with SWFs often struggle to manage their wealth funds properly.

On the other hand, diversification of the economy, and therefore the export basket, is essential to eliminate pro-cycle effects stemming from commodity price volatility. By successfully accomplishing these tasks, Suriname increases its ability to experience sustainable macroeconomic stability, which is fundamental for economic development.

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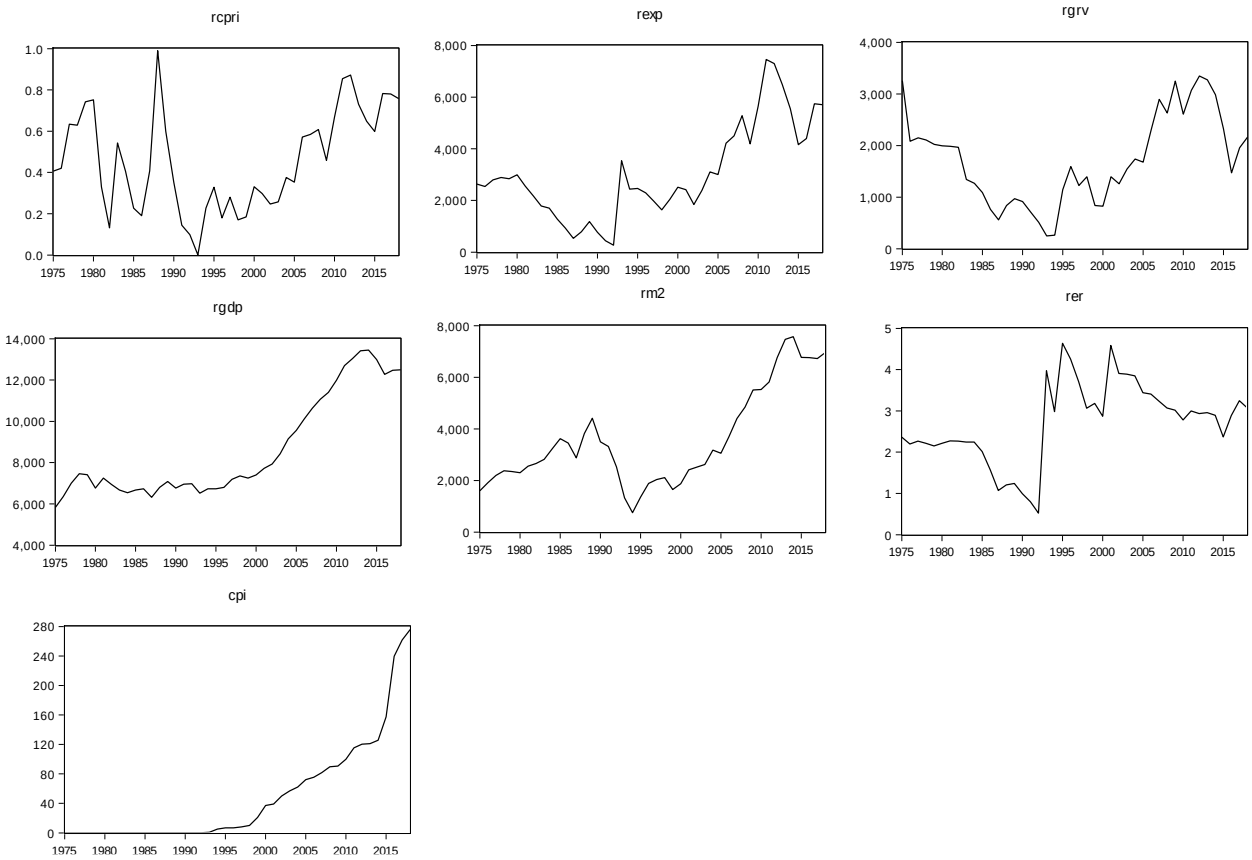
Appendix

Figure A.1: Graphical view of the selected macroeconomic variables (1975-2018)



Source: Author own computation

Table A.1. Unit Root test results

	ADF				PP			
	Level		First difference		Level		First difference	
	None	Intercept	None	Intercept	None	Intercept	None	Intercept
LCPRI	0.005***	0.002***	0.000***	0.000***	0.009***	0.002***	0.00***	0.00***
LREXP	0.700	0.306	0.000***	0.000***	0.834	0.352	0.000***	0.000***
LRGR	0.555	0.273	0.000***	0.000***	0.549	0.248	0.000***	0.000***
LRGDP	0.889	0.942	0.006***	0.058*	0.989	0.881	0.000***	0.000***
LRM2	0.912	0.501	0.000***	0.000***	0.908	0.596	0.000***	0.001***
RER	0.570	0.125	0.000***	0.000***	0.494	0.136	0.000***	0.000***
LCPI	0.562	0.810	0.004***	0.009***	0.634	0.864	0.005***	0.014**

Source: Author own computation. * indicates no rejection of Ho at 10% significance level, ** indicates no rejection of Ho at 5% significance level and *** indicates no rejection of Ho at 1% significance

Table A.2. Number of Lag Selection from SVAR Estimates

Model I			Model II		
Lag	AIC	SBIC	Lag	AIC	SBIC
0	-1.873	-0.995	0	0.145	1.022
1	-5.328	-2.403*	1	-3.178*	-0.252*
2	-5.897*	-0.923	2	-3.157	1.815

Source: Authors own computation. Note: * indicates lag order selected by the criterion.

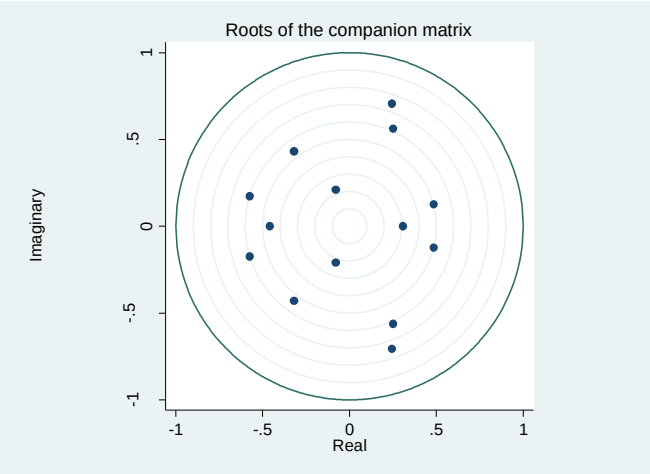
Table A.3. Short-run causality test

Model I			Model II		
Hypothesis	x^2 statistics	P-value	Hypothesis	x^2 statistics	P-value
DLCPR ⇏ DLEXP	13.937	0.001***	DLCPR ⇏ DLRIR	1.726	0.422
DLCPRI ⇏ DLRGR	22.818	0.000***	DLCPRI ⇏ DLRGEXP	12.279	0.002
DLCPRI ⇏ DLRGDP	1.450	0.484	DLCPRI ⇏ DLRGDP	1.671	0.434
DLCPRI ⇏ DLRM2	20.043	0.000***	DLCPRI ⇏ DLRM2	14.796	0.001***
DLCPRI ⇏ DRER	.81419	0.666	DLCPRI ⇏ DRER	1.767	0.413
DLCPRI ⇏ DLCPI	1.762	0.184	DLCPRI ⇏ DLCPI	6.1765	0.046**

Source: Authors own compotation. Note: * indicates no rejection of Ho at 10% significance level, ** indicates no rejection of Ho at 5% significance level and *** indicates no rejection of Ho at 1% significance

Figure A.2: Stability test

Model 1



Model 2

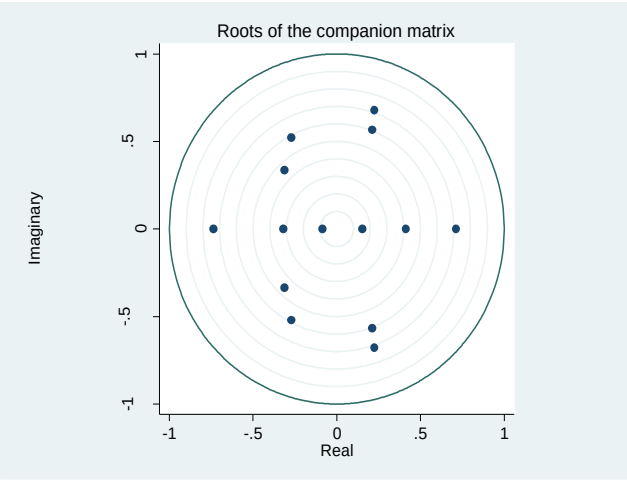


Table A.4: Diagnostic tests

Test	H_0	Coefficient	p-value	Test	H_0	Coefficient	p-value
Model I				**Model II**			
LM Serial correlation test	No autocorrelation at lag order	44.7261	0.646***	LM Serial correlation test	No autocorrelation at lag order	52.6871	0.33342 ***
Jarqua Bera Normality test	Residuals are multivariate normal distribution	31.363	0.004	Jarqua Bera Normality test	Residuals are multivariate normal distribution	35.491	0.001

Source: Authors own compotation. Note: * indicates no rejection of Ho at 10% significance level, ** indicates no rejection of Ho at 5% significance level and *** indicates no rejection of Ho at 1% significance