Journal of Economics Library
www.kspjournals.org
Volume 6 December 2019 Issue 4

Constructing a monthly GDP indicator for Suriname

By Sailesh A. BHAGHOE [a†]
& Karel ECKHORST [b]

Abstract. Advancements in data collection and data processing techniques revolutionized access to higher frequency data. A large body of literature focusses on these higher frequency data in advanced economies. In contrast, small less-developed economies often lack adequate and reliable databases of high-frequency economic indicators. We construct a monthly GDP indicator, using a well-established statistical methodology. To monitor the quality of the indicator, we treat it as an in-sample forecast with respect to December observation of GDP for 2012 -2018. The results show that the constructed monthly GDP indicator is reliable and therefore its methodology applicable in many small developing countries.
Keywords. Monthly GDP indicator, GDP.
JEL. C51, E30, E32.

1. Introduction

In many countries in the Western Hemisphere, Annual and quarterly GDP are widely used economic statistics to measure the evolution of economic activity. However, these statistics do not capture movements at a higher frequency dimension. Beside this fact, many countries, notably in the Caribbean region do not produce QGDP, Manuelito (2015). Suriname located in South America is not an exception. Nowadays, advancements in data collection and data processing techniques revolutionized access and availability of high frequency data in developing countries. These advances make it now possible to compile a simple monthly indicatorto track economic activity in an early stage. In light of this, we propose a synthetic economic indicator for Suriname, implemented in a simple way with a well-established statistical methodology. The relevancy for constructing such an indicator stems from the highly volatile business cycles and the lack of a timely indicator to monitor these cycles.

The case for Suriname

Suriname is a small developing economy. Its real GDP value added contracted by more than 50% from 2012 to 2018, largely due to external shocks. Economic activity is driven by mining-related activities such as

[a†] Central Bank of Suriname, Paramaribo, Waterkant 20, Suriname.
☎. +597 473741 (2241) ✉. sbhaghoe@cbvs.sr
[b] World Bank Group. Advisor to the Executive Director of Brazil, Columbia, Dominican Republic, Ecuador, Haiti, Panama, Philippines, Suriname, and Trinidad & Tobago.
☎. +1(202) 4580089 ✉. keckhorst@worldbank.org

gold and oil. Cyclicality in the price of gold and oil systematically disrupt the business cycle, makes it highly volatile. Gold and oil prices came sequentially under pressure (Appendix I, graph 1&2), plunging the economy into a recession (graph 3, 4&5). The absence of a timely GDP indicator disguises the assessment of the evolving state of the economy on higher frequency. To fil in this gap, the Central Bank of Suriname started with the collection of monthly data in early 2013. With these data, we construct a monthly GDP indicator with a well-established statistical method. In general, we follow, Statistics Netherlands (2013) to construct the indicator[2].

In developed economies, however, such indicators are highly valued, especially after the financial and economic crisis in the turn of the 21st century. Small less-developed economies in the Caribbean region often lack such GDP indicators. Certain countries that do have monthly indicators cannot update them on a timely basis and thus move back to rely on QGDP, if this is well constructed and available. A monthly indicator is accurate in tracking changes in economic activity. Its compilation is, however, less comprehensive than QGDP, but it is preferable as a business cycle indicator (Bloem *et al.*, 2001).

These indicators are very useful to construct econometric models for index of leading Indicators following the models provided by Marcellino (2006) and Aroba, Diebold & Scotti (2009), among others. This index is valuable into forecasting the GDP indicator further into the future. However, the first step to construct it is to have optimal access to a reliable monthly indicator. This research contributes to the body of knowledge in the Caribbean, when it comes to constructing a monthly GDP indicator.

2. The case in the Caribbean

Almost all of the studies recorded, so far, that elaborated on the development ofa monthly indicator in the Caribbean were based on econometric methods such as that of Stock & Watson (1989,1991). These were good models but not used frequently. These models were valued primarily in academic settings. What is of paramount importance is a model framework that is not costly, developed in a simple way and easy to update. Most importantly, that central banks are willing to use the model framework. Most Caribbean studies acknowledged this fact, but conducted years ago. We provide a summary of those studies.

Jordan & Howard (2015) show that systematically predicting the state of the Caribbean economies would contribute to macroeconomic policy management. Theodore (2011) showed that central banks in the Caribbean developed indicators at higher frequency, but it was problematic to keep them updated rendering them only academic value at best but very little

[2] Statistics Netherlands (2013) constructed a monthly GDP indicator from the supply side of the economy following Cuche & Hess (2000) and Mitchell *et al.* (2005). Using data from the national accounts, they applied the Chow – Lin method (1971).

practical value. Male (2011) showed that the frequency of business cycles in the Caribbean are significantly higher than those of the advanced economies urging the need to have access to monthly indicators. Graigwell & Maurin (2007) analyzed the business cycles of the Barbadian economy and concluded that access to a system of indicators at higher frequency will contribute to better economic policy. Cotrie *et al.*, (2008) constructed coincident and leading indicators for tracking business cycle in Barbados, using the proposed model of Stock & Watson (1989, 1991) and Mongardini & Saadi-Sedik (2003). The indicators reflected well on the business cycles, but lacked practical value. In a later study, Cotrie *et al.*, (2009) concluded that leading indicators are indispensable to reflect on the volatile business cycles and to support economic policy in the Caribbean. The absence of such indicators in the Caribbean urged the need to systematically collect monthly data on a timely manner by all Caribbean countries. These studies show how important it is to have access to monthly indicators, taking into account the high volatility in business cycles in the Caribbean, using Suriname as a case study.

3. Statistical methodology

The model of Stock & Watson (1989, 1991) isstill widely used today for constructing indicators with high frequency data. The availability of high frequency data even on weekly and daily basis permits the development of more accurate models for tracking real activity.

Aroba, Diebold & Scotti (2009) developed a dynamic factor model that permits filtering for assessing the evolving state of the economy. A non-model based method is easier to build, easier to explain and easier to interpret compared to model-based indicators. The following is an illustration of developing a monthly indicator with a well-established statistical method by the Conference Board (2001).

Each component in the monthly indicator is denoted as x_{it}. The month-to-month percentage changes (spc) are computed as $x_{it\_spc} = 200 * (x_{it} - x_{it-1)/}(x_{it} + x_{it+1})$. This specification treats positive and negative changes symmetrically. When it shows a one percent increase followed by a one percent decrease, the level of X returned to its original value. For each indicator x_{it_spc} a volatility measure, v_t, is computed as the inverse of its standard deviation $(1/v_t)$. Each variable x_{it_spc} is adjusted to balance the volatility of the components, the standardization factor is $s_t = \frac{v_t}{\sum_i v_t}$. The standardized components, $m_{it} = s_i x_{it\_spc}$, are summed together with weights, yielding $m_t = \sum_i m_{it}$. The composite coincident index (CCI) level is

$$CCI_t = CCI_{t-1} * (200 + m_t)/(200 - m_t)$$

To construct a monthly indicator, a large set of survey data is required from all sectors in the economy. These data are aggregegated into usable

indexes. The aggregation of a large set of micro datais mathematically espressed as

$$\sum_{i=1}^{N} p_i^t \, q_i^t = P^t Q^t \text{ for } t \; is \; 1, 2, 3, \ldots, T \quad (1)$$

P^t represents all prices ($p_1^t, p_1^t, \ldots, p_N^t$) and Q^t represents all quantities (($q_1^t, q_1^t, \ldots, q_N^t$). In general, the Laspeyres, Paasche and Fisher methods are common to construct representable indexes with P^t and Q^t on a fixed and chained approach. The following is an illustration of the UN Statistical Division (2010) for estimating the Index of Industrial Production (IIP).

Laspeyres index

The Laspeyres volume index uses the volumes in the reference or base period, usually denoted with a (0). It uses an arithmetic mean.

$$L_t = \frac{\sum_{i=1} P_{i,0} Q_{i,1}}{\sum_{i=1} P_{i,0} Q_{i,0}} = \sum_i \left(w_{i,0} \frac{Q_{i,t}}{Q_{i,0}} \right) \quad (2)$$

Paasche Index

The Paasche index uses the volumes in the current period (t). It uses a harmonic mean instead of an arithmetic mean.

$$P_t = \frac{\sum_{i=1} P_{i,t} Q_{i,t}}{\sum_{i=1} P_{i,t} Q_{i,0}} = \frac{1}{\sum_i \left(w_{i,t} \frac{Q_{i,0}}{Q_{i,t}} \right)} \quad (3)$$

Fisher index

The Fisher volume index is obtained by taking a geometric mean of the Laspeyres index and the Paasche index for the same period.

$$F_t = [L_t * P_t]^{1/2} \quad (4)$$

$P_{i,o}$ is the prices of products in the base period, $Q_{i,0}$ and $Q_{i,t}$ are the volumes in the base and current periods, $w_{i,0}$ is the relative share of each product group in the equation. The products are classified according to ISIC[3].

4. Data and methodology

4.1. Data

The Central Bank of Suriname collaborated with the General Bureau of Statistics (GBS) to design questionnaires to collect monthly data. The data of particular interest for the monthly indicator are turnovers of key players, and production and employment statistics. The survey captures only key respondents that are primarily Limited Liability Companies (LLCs). The

[3] International Standard Industrial Classification of All Economic Activities (UN Statistical Division, 2002).

sample contains about 200 key companies that covers approximately 94% of economic activity. Data collected from the Ministry of Agriculture, Ministry of Finance and Foundation for Forest Management and Production Control contributed to a reliable GDP indicator. We also used annual reports of companies and data from the Automated System for Customs Data.

4.2. Methodology

This section outlines the statistical procedures for constructing the monthly GDP indicator.

Step 1: The large quantity of survey data is organized, arranged and aggregated in an accounting frame work using formula (2). Each time series is adjusted for seasonality with Tramo-Seats or X-12-Arima, see Gómez & Maravall (2000). We use the guidelines of Eurostat (2015) for seasonal adjusting the time series.

Step 2: The reported nominal turnovers are converted with a corresponding deflator into real values. We use as deflators the building material price indices and consumer price indices obtained from the GBS. For missing values, we use corresponding extrapolators from trading partners. The real turnovers are then used to form product groups in each sector$i$.

$$Vol^{V_j}(T_i) = \frac{Val^{V_j}(T_i)}{p^{I_j}(T_i)} \tag{5}$$

$Vol^{V_j}(T_i)$ is the volume in period T_i for product j,$Val^{V_j}(T_i)$ is the value in period T_i for product j and $p^{I_j}(T_i)$ is the best available deflator for product j in corresponding period.

Step 3: For each product group we estimate a weighted index by using the aggregated nominal turn overs and production volumes, if available. We use 2011 as base year, since data reporting was initiated in early 2013.

$$w_j^{2011} = {W_j(T_0)}\Big/{\sum_{j \in K} W_j(T_0)} \tag{6}$$

$W_j(T_0)$ is the value of product$j$ in the base year (2011); $\sum_{j \in K} W_j(T_0)$ is the value of all products that must balance to $\sum_{j \in K} wj = 1$.

Step 4: Now that we have obtained weighted indexes of each product group, we then form weighted indexes for each sector $i$in the economy based on the grouping of ISIC. We apply the Laspeyres formula (2) to construct those indexes.

Step 5: Now that we have a synthetic monthly indicator system, we update the system every month as new data become available. We utilized a customized version of the chain-linked method that is used in the construction of the IIP by the UN Statistical Division (2010).

$$L_{t=} \sum_i (W_{i,t-1} \frac{Q_{i,t}}{Q_{i,t-1}}) * \sum_i (W_{i,t-2} \frac{Q_{i,t-1}}{Q_{i,t-2}}) * \ldots * \sum_i (W_{i,0} \frac{Q_{i,1}}{Q_{i,0}}) * 100 \quad (7)$$

$W_{i,t}$ is the relative share, derived from nominal turnovers, for sector i at time t,$Q_{i,0}$ and $Q_{i,1}$ are the aggregated volume indexes for sector $i$inthe base period and at time t, respectively. This equation combines all the volume indexes of a sector to form the sector i index. Whenever updates are available, it is included in the volume index for the sector. The aggregated volume indexes updated with new data are then combined with the shares of each sector to estimate the growth rate of the total economy. Finally, the calculation of the 12-months moving average growth rates takes place.

It is the rate of change of 12 months in year (t) expressed with respect to the 12 months in the previous year ($t-12$). These calculated rates provide insights in the performance of each sector i and of the total economy.

Step 6: Benchmarking

We utilize the real gross value added of GDP as benchmark. Point of departure is that the constructed indicator is reliable enough to track the annual changes of GDP in the correct direction. We treat the December figure of the GDP indicator as an in-sample forecast against the annual GDP to verify the level of variances between the two indicators for 2012-2018.

Evaluation Statistics

We use the following statistics to evaluate the reliability of the monthly indicator with respect to annual GDP growth for the sample period (2012 - 2018). To make the evaluation of its reliability possible, we treat the growth rates of the GDP indicator as in-sample forecasts against the actual GDP growth at end year. We use the RMSE and the MAE because those are the most used statistical method for evaluating variances in a set of times series, Vee & Gonpot (2011). We also estimate the Theils' U- Statistic to test the accuracy of the monthly indicator. The Theil inequality coefficient always lies between 0 and 1, where 0 indicates a perfect fit.

Root Mean Squared Error (RMSE): $\sqrt{\frac{1}{T}\sum_{t=1}^{T}(GDPgr_t^2 - monthly\ gr_t^2)^2}$ (8)

$GDPgr_t^2$ is the actual variance of GDP growth, $monthly\ gr_t^2$ for $t = 1, \ldots, T$ is the hypothetical estimated conditional variance of the monthly indicator. To evaluate its reliability we treat is as to be an in-sample forecast, Franses & Dijk (1996) and Hung-Chung *et al.* (2009).

Mean Absolute Error (MAE): $\frac{1}{T}\sum_{t=1}^{T}|GDPgr_t^2 - monthly\ gr_t^2|$ (9)

Theil's U-statistic: $U = \left(\frac{(\sum_{t=1}^{T-1} mont\ hlygr_{t+1} - GDPgr_{t+1})^2}{\sum_{t=1}^{T-1}(GDPgr_{t+1})^2}\right)^{1/2}$ (10)

The *monthly* gr_{t+1} is treated as relative change of in-sample forecast to allow for reliability check of the monthly indicator and $GDP\ gr_{t+1}$is treated as the actual relative change, see Diebold & Lopez (1995).

5. Results

This section presents the reliability of the constructed monthly GDP indicator.

Figure 1 displays the growth rates of the monthly GDP indicator of December. Figure 2 contains the growth rates of the monthly indicator and annual GDP and shows that there is less variation between the two time series. Figure 3 shows the estimated growth of the monthly GDP indicator. Since we treat the annualized monthly growth rates to be a simple in-sample forecast to conduct a reliability test, we estimate three common evaluation statistics RMSE, MAE and Theil's U-statistic. The RMSE is close to 1.756, the MAE is close to 1.514 and the Theil's U-statistic is close to 0.859 for the sample period, hence establishing the monthly GDP indicator a reliable statistic.

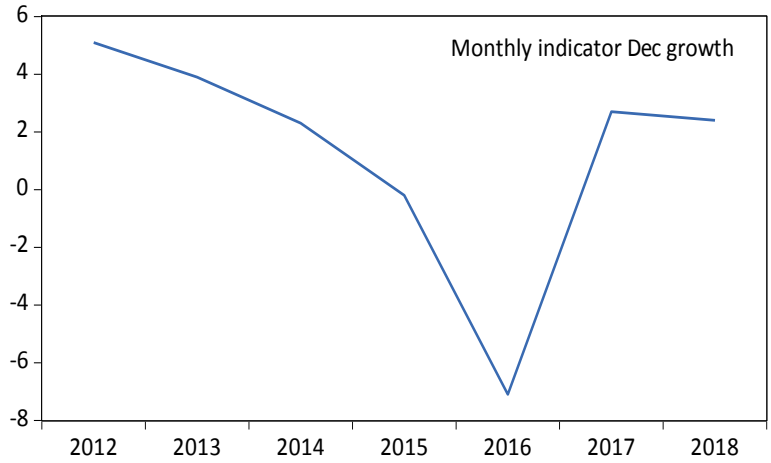


Figure 1. *Monthly GDP indicator growth of the Central Bank of Suriname*
Source: Central Bank of Suriname

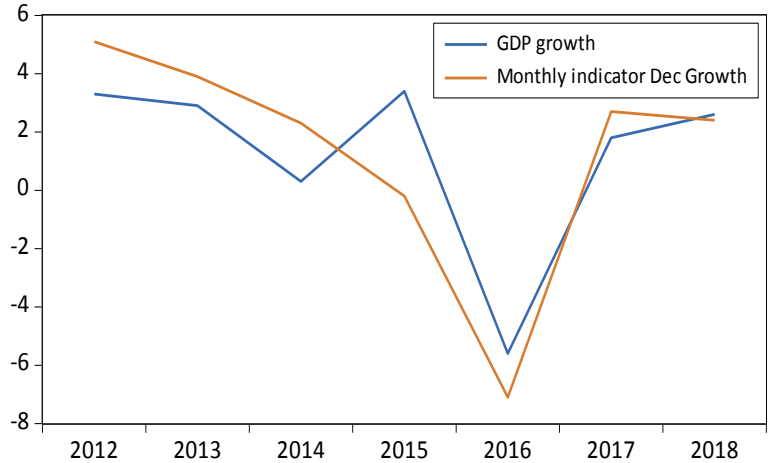


Figure 2. *GDP growth vs. monthly GDP indicator growth, December month*
Sources: Central Bank of Suriname and General Bureau of Statistics

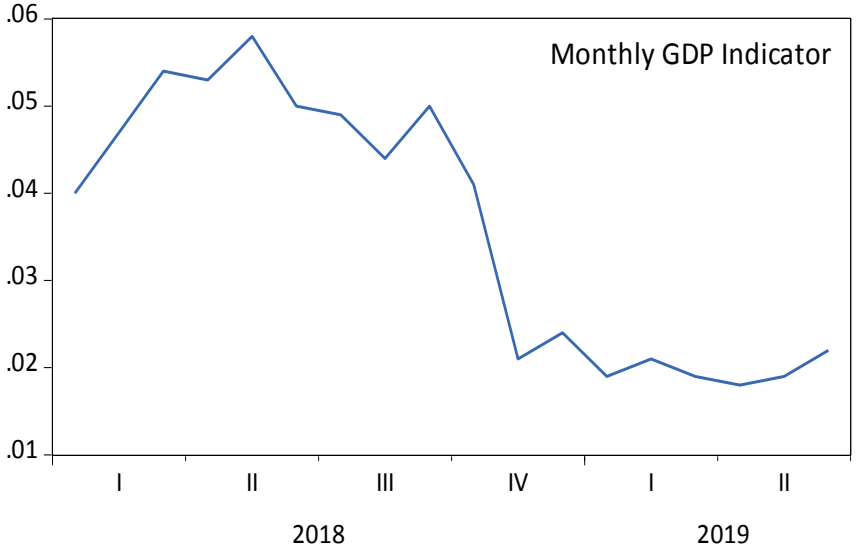


Figure 3. *Monthly GDP indicator, 12-month moving average growth (2018-2019m6)*
Source: Central bank of Suriname

This graph indicates that the monthly indicator provides economic data way ahead of real GDP, which is available until 2018. The monthly indicator growth rates are reliable as indicated by its construction, based on a well-established statistical method and by the estimated values of the RMSE, MAE, and Theil's U-statistic. In Appendix II, we present the 12-month moving average growth rates of major components of the monthly GDP indicator (2012-2019m6).

6. Conclusions

We simply estimate a monthly GDP indicator constructed with a well-established statistical method, namely Layspeyres. We use survey data collected by the Central Bank of Suriname, which is representative for the total economy. We also used technical reports of the Bank on the construction of the monthly GDP indicator. We test the estimated monthly GDP indicator on its reliability to tract the state of the economy in advance relative to that of annual GDP. Since monthly data are available from 2011, we set the test sample at 2012-2018. We treat the monthly-annualized growth rates as to be in-sample forecast against annual GDP. Hence, this advancement allow us to construct evaluation statistics such as RMSE, MAE and Theil's U-statistic. These test statistics indicate that the variations in the monthly GDP indicator with respect to the variations of annual GDP growth is negligible, hence rendering the monthly GDP indicator a well-established statistic. Besides performing this quantitative test, the IMF and other institutions always use this indicator to benchmark their forecast. Another aspect that render the monthly GDP indicator a reliable statistic is that the Bank publishes the figures on its website regularly[4].

[4] [Retrieved from].

We show the merits of developing a monthly GDP indicator with survey data such as turnovers of key companies and data from secondary sources that are accessible without too many efforts. The approach that we show is easy to implement and recommendable for central banks in small developing economies. Nowadays, advancements in data collection and data processing techniques revolutionized access to higher frequency data.

7. Recommendation

A more detailed analysis of the business cycles requires the construction of econometric models with the monthly GDP indicator, see Marcellino (2006) and Aroba, Diebold & Scotti (2009).

Appendix I

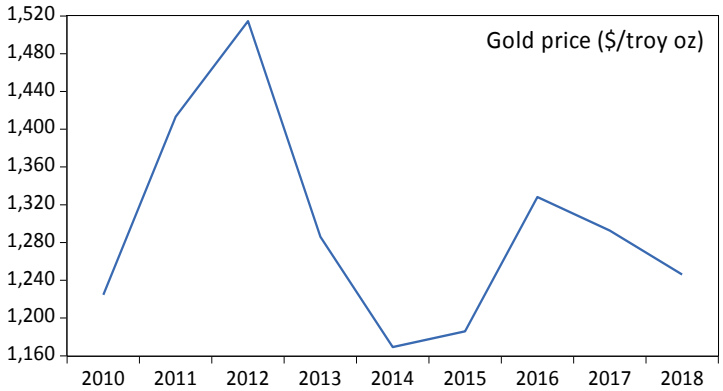


Figure 1. *Gold price, The World Bank*

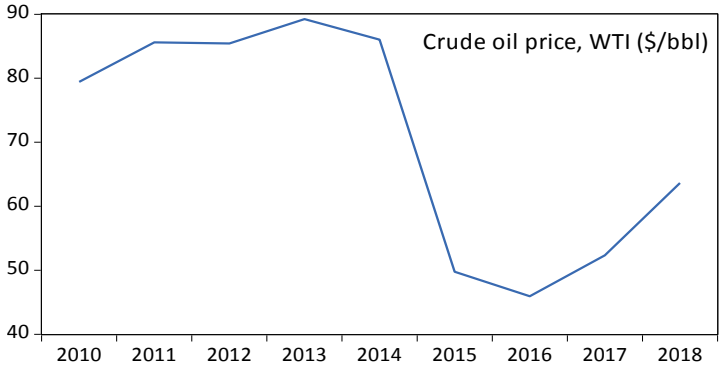


Figure 2. *Crude oilprice (WTI), The World Bank*

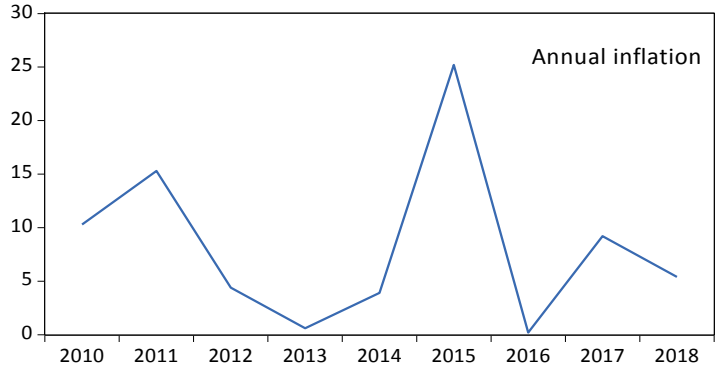


Figure 3. *Changes in the annual inflation, Suriname*

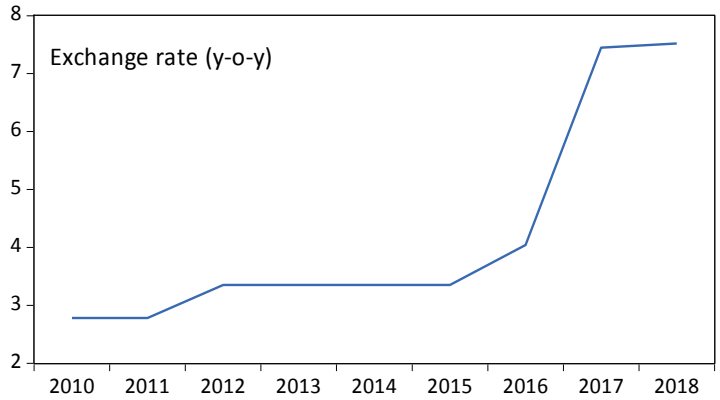


Figure 4. *Official exchange rate, Suriname*

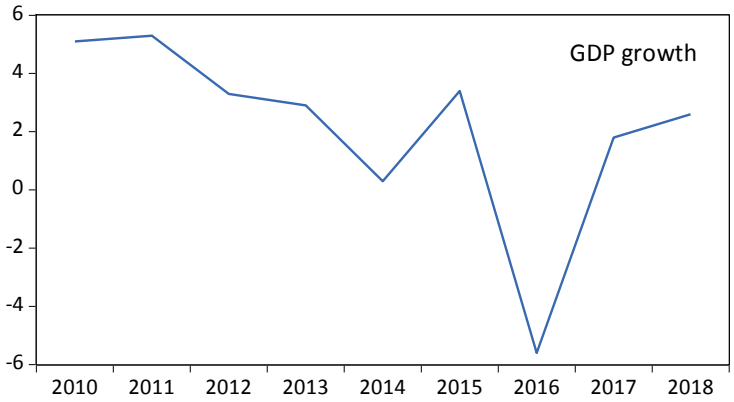
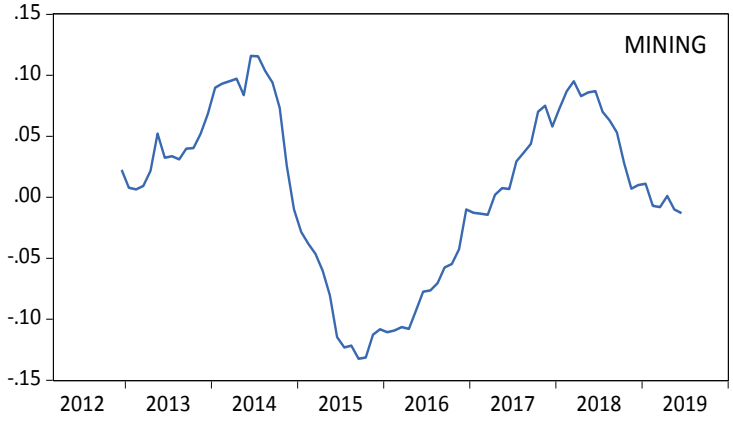


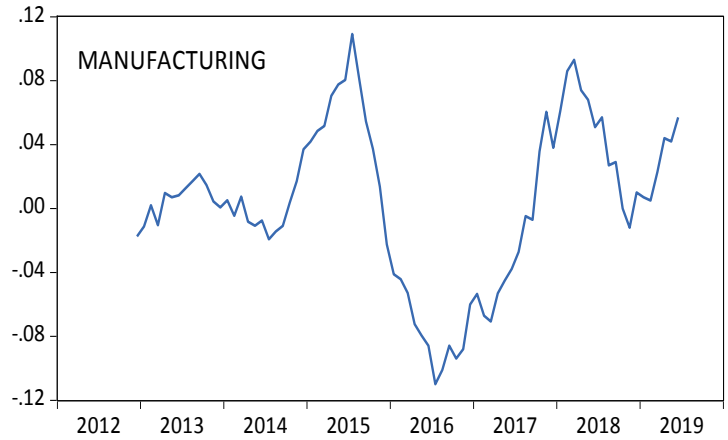
Figure 5. *GDP growth, Suriname*

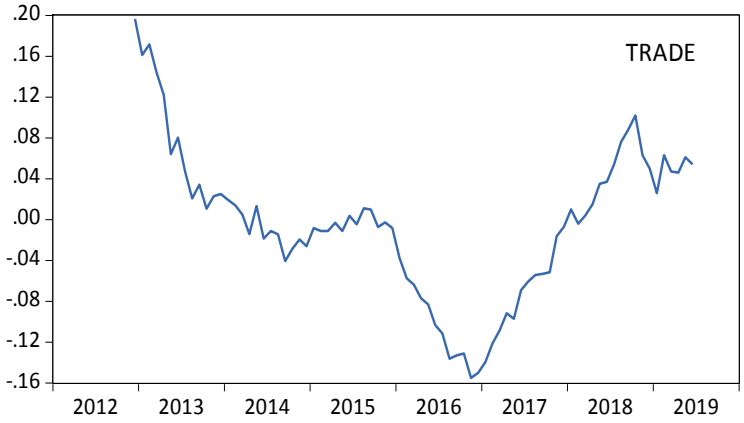
Large fluctuations in the price of gold and oil affects the economy. These effects often cause recessionary pressures, which renders the monthly GDP indicator to be an important statistic for the central bank to monitor economic activity.

Appendix II

These figures, seasonally adjusted, provide economic data up to date after the last publication of annual GDP 2018. We present the major component of economic activity.







References

Alwyn, J., & Stacia, H. (2005). The potency of economic and financial indicators in predicting economic recessions in the Caribbean. *Bridgetown: Central Bank of Barbados*. [Retrieved from].

Aruoba, A.B., Diebold, F.X., & Scotti, C. (2009). Real time measurement of business conditions. *Journal of Business & Economic Statistics*, 27(4), 417-427. doi. 10.1198/jbes.2009.07205

Bloem, A.M., Dippelsman, R.J., & Mæhle, N.O. (2001). *Quarterly National Accounts Manual.* Washington, D.C.: *International Monetary Fund*. [Retrieved from].

Chow, G.C., & Lin, A.L. (1971). Best linear unbiased interpolation, distribution and extrapolation of time series by related series, *The Review of Economics and Statistics*, 53(4), 372-375. doi. 10.2307/1928739

Cotrie, G., Craigwell, R., & Maurin, A. (2007). A sectoral analysis of Barbados` GDP business cycle. Bridgetown: *Central Bank of Barbados*. [Retrieved from].

Cotrie, G., Craigwell, R., & Maurin, A. (2008). Estimating indexes of coincident and leading indicators for Barbados. Bridgetown: *Central Bank of Barbados*. [Retrieved from].

Cotrie, G., Craigwell, R., & Maurin, A. (2009). A review of leading composite indicators: making a case for their use in Caribbean economies. Bridgetown: *Central Bank of Barbados*. [Retrieved from].

Cuche, N.A. & Hess, M.K. (2000). Estimating monthly GDP in a general Kalman filter framework: evidence from Switzerland, *Economic and Financial Modelling*, Winter 2000. [Retrieved from].

Diebold, F.X. & Lopez, J.A. (1995) Modeling volatility dynamics. *In*, K. Hoover, (Ed.), *Macroeconometrics: Developments, Tensions and Prospects*, (pp.427-466), Kluwer Academic Press, Boston.

European Union. (2015). *Eurostat Manuals and Guidelines on Seasonal Adjustment.* Luxembourg: Author.

Franses, P.H. & Dijk, D.V. (1996) Forecasting stock market volatility using (non-linear) GARCH Models. *Journal of Forecasting*, 15(3), 229-235. doi. 10.1002/(SICI)1099-131X(199604)15:3<229::AID-FOR620>3.0.CO;2-3

Gómez, V. & Maravall, A. (1998). *Automatic Modeling Methods for Univariate Series*. Spain: Banco de Espaňa.

Gómez, V & Maravall, A. (2000). *Seasonal Adjustment and Signal Extraction in Economic Time Series*. Spain: Banco de Espaňa.

Hung-Chung, L., Yen-Hsien, L. & Ming-Chih, L. (2009) Forecasting China stock markets volatility via GARCH models under skewed-GED distribution. *Journal of Money, Investment and Banking*, 7, 542-547.

Manuelito, S. (2015). The use of high frequency indicators in short-term forecasting models: the case of Latin America and the Caribbean countries. Santiago: Economic Commission for Latin America and the Caribbean. [Retrieved from].

Marcellino, M. (2006). *Handbook for Economic Forecasting, Volume 1*. Elsevier B.V. doi. 10.1016/S1574-0706(05)01016-5

Mitchell, J., Smith, R.J., Weale, M.R., Wright, S., & Salazar, E.L. (2005). An indicator of monthly GDP and an early estimate of quarterly GDP growth, *The Economic Journal*, 115(501), F108- F129. doi. 10.1111/j.0013-0133.2005.00974.x

Mongardini, J., & Saadi-Sedik, T. (2003). Estimating indexes of coincident and leading indicators: an application to Jordan. Washington, D.C.: International Monetary Fund. [Retrieved from].

Statistics Netherlands (2013). *Towards a Monthly Indicator of Economic Growth*. The Hague: Author.

Stock, J.H., & Watson, M.W. (1989). New indexes of coincident and leading economic indicators. *in* O.J. Blanchard & S. Fischer, *NBER Macroeconomics Annual 1989,* (pp.351-409), NBER.

Stock, J.H., & Watson, M.W. (1991). A procedure for predicting recessions with leading indicators. *NBER Working Paper*, No.4014. doi. 10.3386/w4014

The Conference Board. (2001). *Business Cycle Indicators Handbook*. New York: Author.

Theodore, C. (2011). The usefulness of evolutionary early warning indicators for emerging economies ahead of macroeconomic crises: conventional methods. [Retrieved from].

United Nations. (2002). *International Standard Industrial Classification of All Economic Activities*. New York: Author.

United Nations. (2010). *International Recommendations for the Index of Industrial Production.* New York: Author.

Vee, D., Ng, C., Gonpot, P.N., & Sookia, N. (2011) Forecasting volatility of USD/MUR exchange rate using a GARCH (1,1) model with GED and student's-t errors. *University of Mauritius Research Journal*, 17, 1-14. doi. 10.4314/umrj.v17i1.70728