



Identifying Nigeria's Business Cycle Chronology

Sule Ya'u Hayewa¹, Bashir Usman Abubakar² and Hussaina Sanusi³

¹Department of Management Sciences, Rabi'u Musa Kwankwaso College of Advanced and Remedial Studies, Jos Road, Kano.

²Department of General Studies, Jigawa State Institute of Information and Technology, Kazaure.

³Department of Economics and Development Studies, Federal University Dutse-Ma.

Keywords:

BBQ algorithm
Business cycle
Business cycle chronology
Business cycle turning points

JEL Classification: D21

Corresponding author

Sule Ya'u Hayewa
suleyauhaewa@gmail.co
Tel: +2348022591018

Abstract

This study provides an accurate chronology of the reference dates of the turning point in Nigeria's business cycle, employing the quarterly Harding and Pagan (2002) procedures of Bry–Boschan Quarterly(BBQ) algorithm for the period 2010Q1–2020Q4. The empirical application identifies three complete cycles in the Nigeria's reference cycle from 2010 to 2020. The three pronounced recessions by the National Bureau of Statistics in the period from 2010 to 2020, namely the recessions of 2011, 2016 and 2020 are equally identified. Reference dates established for the peaks includes 2011Q1, 2015Q4 and 2019Q4, and for the troughs 2011Q3, 2017Q1 and 2020Q2. These are the dates from the three reference cycle phases. The dates complement the pronouncements by the National Bureau of Statistics and can be used by both the academics and policy-makers for reference of the Nigeria's economic cycle.

1. Introduction

Business cycles which are found in the aggregate economic activity of nations are widely used as a basis for describing and understanding the state of the economy (Holm, 2016). A deep understanding of the cyclical fluctuations is relevant for both academic analysis and policy making aimed at smoothing the economic cycles (Gehring & Mayer, 2021). Given its importance, a number countries have, in the last

years, created business cycle dating committees to establish and maintain a historical chronology of the dates of the business cycles turning points used for reference in the business cycles of the economies. Despite the interest, however, a similar practice does not exist for Nigeria. The National Bureau of Statistics (NBS) in Nigeria publishes data on the country's economic position, it does not date the turning point of the business cycle in the country and there exist no

official dating method of the cycle. Thus, the overall goal of this study is to establish the chronology of the business cycle for reference in the business cycle of the Nigerian economy.

The study employs the quarterly Harding and Pagan (2002) procedures of Bry—Boschan dating algorithm, BBQ algorithm, for the period 2010Q1—2020Q4. The paper is organized as follows. Section 2 reviews the literature on business cycle reference point's identification. Section 3 describes the methodology and data for the study. In section 4, the empirical analysis is presented. Lastly, Section 5 is the conclusion and recommendations.

2. Literature review

The identification of business cycle chronology can be traced back from the seminal papers of Fisher (1925) and Burns and Mitchell (1946). These authors were the first to analyze the mechanisms by which output alternates between states of expansion and contraction and to study the effect of their duration on the transition probabilities between those states. From their various researchers applying different methods of identifying business cycle chronology for instance Bavaria (2021) used non – parametric approach in investigation of the business cycle and growth rate cycle chronology of the Indian economy by identifying the peaks and troughs in the quarterly released real GDP time series. The results reveal that the Indian economy witnessed three classical contractions and nine growth rate deceleration phases between April 1996 and March 2021. Other business cycle features, namely, duration, amplitude and sharpness are also derived. The results confirmed the existence of long expansions and short contractions as per the classical approach. The growth rate cycle of India, however, displays symmetric nature with similar duration, amplitude and sharpness being observed in acceleration as well as deceleration phases. Further, this study makes an attempt to contribute to the dating methodology by

highlighting the defects in them and thereby proposing modifications to rectify the defects.

Pacella (2021) studied the business cycle dating formulated by the CEPR committee for the euro area. He first compares recessions as defined by the CEPR to those obtained using alternative methodologies (e.g. Bry-Boschan algorithm) and he found that the CEPR dating is not fully in line with other dating rules that are based only on GDP dynamics, thus confirming that the committee considers a broader set of variables. He also evaluated the classification of economic activity in recessions and expansions; the underlying business cycle is either based on a single variable or estimated as a latent factor that captures the co-movements of several macroeconomic series. He found that the CEPR chronology is more consistent with the estimated common factor than with what is implied by methods solely based on GDP. Finally, he analyzed which real variables drive the classification of economic activity by the CEPR and he found that the properties of the CEPR chronology are mainly related to the dynamics of demand components, especially final consumption, and employment. Introducing a Business Cycle Indicator to compile a transparent and reliable chronology of past business cycle turning points for Germany, Gehringer and Mayer (2021) applied the statistical method of Principal Component Analysis, based on information from 20 economic time series. They found that, the Business Cycle Indicator grasps the development of the broader economic activity and has several advantages over a business cycle assessment based on quarterly series of Gross Domestic Product.

Laubscher (2020) traced the history of South African business cycles, from 1970 to 2017, focusing on the interaction between long-run growth and short-run cyclical change. He established that, developments during the mid-1970s, and at the time of the 1994 political transition, were important dividing lines. Key

changes in the South African business cycle, during the post-2009 period, are also identified. The extent to which these cyclical changes will have a bearing on the country's long-term economic evolution remains uncertain. Soybilgen (2020) used dynamic factors and neural network models to identify current and past states of the US business cycle and he found that neural network model identifies turning points quite accurately and very quickly in real time. While Rua (2017) used a non-parametric approach in dating the Portuguese business cycle and he found that a non-parametric approach embedding the NBER's business cycle dating procedure, a monthly business cycle chronology is provided and its robustness is assessed resorting to a large data set. Also Pandey et al (2017) used the Christiano-Fitzgerald (CF) filter and the Bry-Boschan algorithm approaches to presents a chronology of Indian business cycles in the post- reform period. They found three periods of recession. The first recession was from 1999-Q4 to 2003-Q1. The second recession was from 2007-Q2 to 2009-Q3. The third recession ran from 2011-Q2 till 2012-Q4. These results are robust to the choice of filter and to the choice of the business cycle indicator. But Giusto and Piger (2017) used Learning Vector Quantization (LVQ) in Identifying business cycle turning points in real time in United State. In another dimension Doz and Petronevich (2016) used Markov-switching dynamic factor model that allows for a more timely estimation of turning points in identifying dating business cycle turning points for the French economy by applying both one-step and two-step estimation approaches to French. Their findings revealed that both methods give qualitatively similar results and agree with the OECD dating of recessions on a sample of monthly data covering the period 1993 to 2014. The two-step method is more precise in determining the beginnings and ends of recessions as given by the OECD. Both methods indicate additional downturns in the

French economy that were too short to enter the OECD chronology.

Castro (2015) used Markov-switching vector autoregressive model in identify a chronology for the Portuguese business cycle and test for the presence of duration dependence in the respective phases of expansion and contraction. His finding found evidence of positive duration dependence in contractions, but not in expansions, especially when employment is added to the model. Bismans and Le Roux (2013) used Markov-switching model in examining dating of business cycle in South Africa and their results found that chronology for the South African classical and growth cycles, using a quarterly algorithm is established. Furthermore, Application from non-parametric procedure yields six complete cycles over the period 1960-2011. But Chauvet and Piger (2008) used both nonparametric algorithm and parametric Markov-switching dynamic-factor model in a comparison of the real-time performance of business cycle dating methods in U.S. and found that that both approaches would have accurately identified the NBER business cycle chronology had they been in use over the past 30 years, with the Markov-switching model most closely matching the NBER dates. They also found that, both approaches, and particularly the Markov-switching model, yielded significant improvement over the NBER in the speed with which business cycle troughs were identified.

Chauvet and Piger (2002) used statistical regime-switching (Markov-switching) model to identify turning points in U.S. economic activity in real time and they found that the entire post-war sample, provide a chronology of business cycle peak and trough dates very close to that produced by the National Bureau of Economic Research (NBER). They also found that, the models provide systematic improvement over the NBER in the speed at which turning points are identified. Importantly, the models achieve this with few instances of "false positives." Overall, the evidence suggests that the regime-switching

model could be a useful supplement to the NBER Business Cycle Dating Committee for establishing turning point dates. The model appears to capture the features of the NBER chronology in an accurate, timely way, and does so in a transparent and consistent fashion.

From the aforementioned literature none of them indemnified Nigerian business cycle chronology. To the best of our knowledge this is the first paper tries to identify the business cycle chorology in Nigeria

3. Methodology

The standard BBQ algorithm developed by Harding and Pagan (2002) for identifying the reference cycle turning point dates is used in the empirical application. Burns and Mitchel (1946) put forward that reference cycle turning point dates can be identified by searching for clusters in specific cycle turning point dates around periods of recoveries and declines. In practice, to achieve this, a number of algorithms and models have been developed over the past years to identify the turning point dates such as the monthly Bryand Boschan (1971), the quarterly Harding and Pagan (2002) and modified by Morley and Piger (2006), Stock and Watson (2014), Harding and Pagan (2016) and Camacho, Gadea and Gomez-Loscoc (2021) among others. However, the standard BBQ algorithm has still remained the benchmark algorithm for dating business cycle turning points in a single time series.

The Harding and Pagan's (2002) BBQ algorithm, a quarterly approximation of the monthly Bry and Boschan (1971) algorithm, is among the widely accepted algorithms for locating business cycle turning points. A useful implementation of the algorithm which follows a number steps is summarized and modified below in Morley and Piger (2006):

Step 1: Establish, using the log level of quarterly real GDP(y_t), candidate dates of peaks and troughs as local

maxima and minima in the data such that a peak occurs at time t if:

$$\begin{aligned} y_{t-2} - y_t &< 0; \quad y_{t-1} - y_t < 0; \\ y_{t+1} - y_t &< 0; \\ y_{t+2} - y_t &< 0, \end{aligned}$$

and a trough occurs at time t if:

$$\begin{aligned} y_{t-2} - y_t &> 0; \quad y_{t-1} - y_t > 0; \\ y_{t+1} - y_t &> 0; \\ y_{t+2} - y_t &> 0, \end{aligned}$$

Step 2: The turning points are then censored to ensure that all the peaks and troughs alternate. In the case of two consecutive peaks (troughs), eliminate the peak (trough) with the lower (higher) value of y_t .

Step 3: The turning points are ones more censored to ensure that each business cycle phase (peak-to-trough and trough-to-peak) lasts a minimum of two quarters, while each complete business cycle (peak-to-peak and trough-to-trough) lasts a minimum of five quarters.

Morley and Piger (2006) optimized the threshold values that indicate turning points to modify the BBQ algorithm in step 1. The modified BBQ algorithm differs from BBQ in that the threshold parameters that signal turning points are allowed to deviate from 0. The thresholds are also allowed to vary from peak to trough and on different sides of the turning points. Thus, restating Step 1 of the BBQ algorithm as follows:

Step 1: Using the log level of quarterly real GDP(y_t), establish candidate dates of peaks and troughs as local maxima and minima in the data such that a peak occurs at time t if:

$$y_{t-2} - y_t < \alpha_1; \quad y_{t-1} - y_t < \alpha_1; \quad y_{t+1} - y_t < \alpha_2; \quad y_{t+2} - y_t < \alpha_2,$$

and a trough occurs at time t if:

$$y_{t-2} - y_t > \alpha_3; \quad y_{t-1} - y_t > \alpha_3; \quad y_{t+1} - y_t > \alpha_4; \quad y_{t+2} - y_t > \alpha_4,$$

The values of the α_i 's, for $i = 1, \dots, 4$, are conducted via a grid search between -0.005 and $+0.005$. Bracke (2011) provides the module for implementation of the algorithm in Stata statistical package.

3.1 Data

Nigeria's Quarterly real GDP from Central Bank of Nigeria database over the period from 2010:Q1—2020:Q4 is used for the empirical

application to identify dates of the turning point. GDP is the most commonly used single measure of a country's overall economic activity. The poor sample period is largely due to lack of its availability. Because the BBQ algorithm is especially designed to identify a recession as two quarters of negative growth using quarterly data is certainly a requirement. The real GDP growth is equally obtained for this study to identify the shape of the Nigeria's business cycle. Using the International Monetary Fund's World Economic Outlook annual real GDP growth from 1980—2020 is obtained via Quandl. We apply Hodrick-Prescott filter to extract the cyclical component of the real GDP growth series. Fig.1 below, plots the values of the cyclical component of the Nigeria's real GDP growth series obtained by the HP filter.

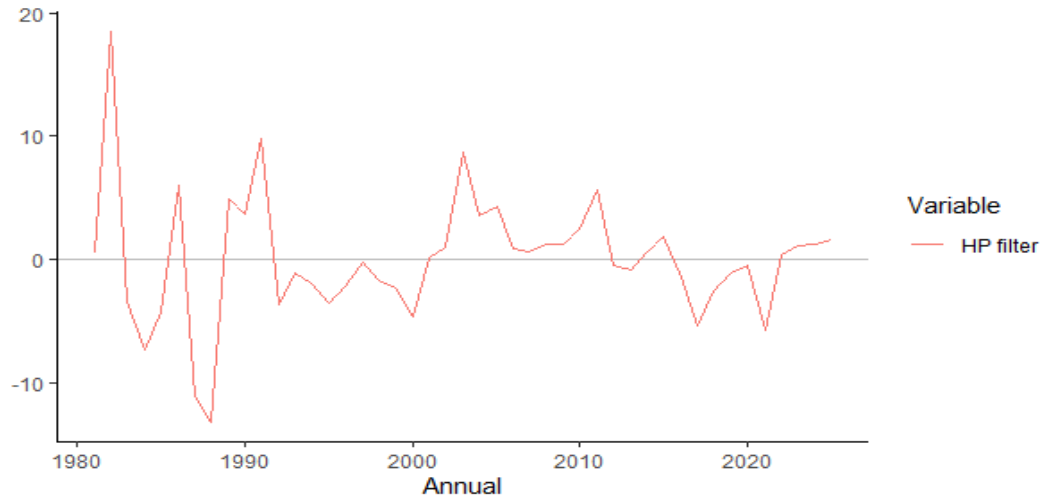


Figure 1: Nigeria's Business-cycle component of real GDP using Hodrick-Prescott (HP) filter

The Fig.1 shows business cycle fluctuations (peaks and troughs) throughout the sample period. Among these are the pronounced recessions around the 2011 arising from “insurgency”, 2016 “weaker global oil prices” and 2020 “COVID-19”. Recessions are periods of sustained zero or negative growth in real GDP. The largest business-cycle fluctuations occurred

between 1980 and 1990 with a peak and trough at higher scales. The largest volatility can be observed over these periods. Since the mid-1990s, however, the business-cycle fluctuations of GDP have been relatively small.

4. Nigeria's Business Cycle Reference dates from BBQ algorithm (2010Q1—2020Q2)

To fully characterize the Nigeria's business cycle, this study applies the Bry-Boschan Quarterly algorithm to identify the business cycle turning point dates. To implement the BBQ algorithm, the study employs the natural log of

the Nigeria's quarterly real GDP for the period from 2010Q1 until 2020Q4. Table 1 presents the turning point dates as established by the algorithm along with the NBS-determined recession dates.

Table 1: Nigeria's Business Cycle reference points (2010Q1–2020Q4)

Reference dates based on the BBQ algorithm	LGDP-point	Turning point	NBS announcement on beginning and end of recessions
2011Q1	1	Peak	-
2011Q3	-1	Trough	-
2015q4	1	Peak	-
2017q1	-1	Trough	2016q2 – 2017q2
2018q4	1	Peak	-
2020q2	-1	Trough	2020q2 – 2020q3
Average Duration	Expansions 16.0	Contraction 2.5	
Amplitude	Expansions 0.2	Contraction 0.0	

Source: Author's computation

The correspondence with the NBS dates is quite close, suggesting that the algorithm offers a promising alternative for recognizing business cycle turning points. Particularly the pronounced episodes, over the 2010Q1-2020Q4 quarterly sample, are the decline in 2011 due to insurgency, the 2016 recession as a result of "weaker global oil prices" and "covid-19" recession (2020). These results are depicted in Fig. 1. Information about the NBS-determined dates can be seen from Table 1. These dates marked the beginning and end of recessions as announced by the NBS.

The results in Table 1 provide the business cycle chronology for the peak(s) (the turning point when the expansion transitions into the contraction phase) and trough(s) (the turning point when the contraction transitions into the expansion phase), including the average duration (the number of quarters between peak and trough) and the amplitude (the height of differences between peak and trough) that characterizes the Nigeria's business cycle. The algorithm identifies 3 peaks and 3 troughs over

the 2010Q1-2020Q4 quarterly sample. The reference dates for the peaks includes 2011Q1, 2015Q4 and 2018Q4, where 2011Q3, 2017Q1 and 2020Q2 are established for the troughs. The average duration of expansion and contraction are approximately 16 and 3 quarters, respectively. This translates into longer expansions than contractions in the Nigeria's business cycle.

5. Conclusion and Recommendations

This study provides dates of the reference cycle turning points in Nigeria based on the Bry-Boschan Quarterly algorithm for identifying business cycle turning points. The empirical application identifies three complete cycles in the Nigeria's reference cycle from 2010 to 2020. The three pronounced recessions by the National Bureau of Statistics in the period from 2010 to 2020, namely the recessions of 2011, 2016 and 2020 are equally identified. Reference dates established for the peaks includes 2011Q1, 2015Q4 and 2019Q4, and for the troughs 2011Q3, 2017Q1 and 2020Q2. These are the

dates from the three reference cycle phases. The dates complement the pronouncements by the National Bureau of Statistics and can be used by both the academics and policy-makers for reference of the Nigeria's economic cycle.

References

- Bavaria, A. (2021). Indian Business Cycle Chronology—An Update. *Prajnan-Journal of Social and Management Sciences*, 51(1), 2022-23.
- Boshoff, W. H., & Becker, L. H. (2020). Business Cycle Recoveries: A Comparative View. In *Business cycles and structural change in South Africa* (pp. 73-96). Springer, Cham.
- Bracke, P. (2011). SBBQ: Stata module to implement the Harding and Pagan (2002) business cycle dating algorithm. Statistical Software Components S457288, Boston College Department of Economics.
- Burns, A., & Mitchell, W. (1946) Measuring business cycles. NBER Studies in Business Cycles, No. 2. National Bureau of Economic Research, New York
- Castro, V. (2015). The Portuguese business cycle: chronology and duration dependence. *Empirical Economics*, 49(1), 325-342.
- Chauvet, M., & Piger, J. (2002). Identifying business cycle turning points in real time.
- Chauvet, M., & Piger, J. (2008). A comparison of the real-time performance of business cycle dating methods. *Journal of Business & Economic Statistics*, 26(1), 42-49.
- Doz, C., & Petronevich, A. (2016). Dating business cycle turning points for the french economy: An MS-DFM approach. In *Dynamic Factor Models*. Emerald Group Publishing Limited.
- Fisher I (1925), Our unstable dollar and the so-called business cycle. *J Am Stat Assoc* 20:179–202
- Gehring, A., & Mayer, T. (2021). Measuring the business cycle chronology with a novel business cycle indicator for Germany. *Journal of Business Cycle Research*, 17, 71–89. <https://doi.org/10.1007/s41549-021-00054-6>.
- Giusto, A., & Piger, J. (2017). Identifying business cycle turning points in real time with vector quantization. *International Journal of Forecasting*, 33(1), 174-184.
- Holm, L. (2016). The Swedish business cycle, 1969-2013. *OECD Journal: Journal of Business Cycle Measurement and Analysis*, vol. 2015/2. <https://doi.org/10.1787/jbcm-a-2015-5j1z9hhpj4th>.
- Pacella, C. (2021). Dating the euro area business cycle: an evaluation. *Bank of Italy Temi di Discussione (Working Paper) No, 1332*.
- Pandey, R., Patnaik, I., & Shah, A. (2017). Dating business cycles in India. *Indian Growth and Development Review*, 10(1), 32-61.
- Rua, A. (2017). Dating the Portuguese business cycle. *Revista de Estudos Económicos do Banco de Portugal*, 60-61.
- Soybilgen, B. (2020). Identifying US business cycle regimes using dynamic factors and neural network models. *Journal of Forecasting*, 39(5), 827-840.