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OUTPUT GAP AND ITS DETERMINANTS: EVIDENCE FOR NAMIBIA[1]

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Abstract

The study analysed the potential output and output gap of the Namibian economy using annual data from 1980 to 2016. The study used the Hodrick-Prescott (HP) filter method and the production function approach to estimate potential output and output gap. The study also attempted to find the determinants of the output gap using the financial factors (domestic credit growth, money supply growth, and real interest rate). The results suggest a potential annual average growth rate of 3.6 percent using the HP filter method. However, it should be noted that the annual potential output growth has been shifting during the period under review. In fact, the results suggest an annual average growth at around 1.6 percent between 1980 and 1985 and increase to 2.5 percent in period 1986 to 1990. Potential output using the production function approach shows that potential output was smooth and stable throughout the study period. The potential output estimates under the two methods follow the same cyclical movements. The output gap estimates by the HP filter and the production function are very similar, and they tend to move in the same direction. The estimate of the impact of domestic credit growth, money supply growth, and real interest rate on Namibia's output gap suggest that the coefficients of the financial factors are generally statistically insignificant.

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1. INTRODUCTION

1. **The output gap measures the difference between actual output and the potential level consistent with full employment of resources in the economy.** Estimates of potential output provide a measure of the aggregate supply capacity of the economy. Output gap estimates thus identify the cyclical position of the economy, which can give an early indication of underlying inflationary pressures. All things being equal, if the output gap is positive through time, such that actual output is greater than potential output, then inflation will begin to increase in response to demand pressures in key markets. An economy will normally experience deflationary pressures if the output gap is negative (Claus, 2000). Faster growth in potential output would allow for a faster growth in actual output without generating undue price pressures. An ideal economy is thus one where the output gap is equal to zero. This signifies that an economy is operating efficiently.

2. **Central banks may be concerned about too much or too little demand pushing inflation appreciably above or below the set target.** According to Jovicic 2017, estimates of potential output and output gap are used by the central banks in their economic analysis primarily as an indicator of the business cycle position and the impact it has on inflation and the stability of the financial system. Therefore, when demand exceeds potential output, the central bank will typically raise interest rates to cool down demand and inflation pressures. While when demand falls short of potential output, the central bank will respond by lowering interest rates to boost demand. Thus, the potential output provides a key benchmark against which to assess sustainable non-inflationary growth. As a result, knowledge on the determinants of potential output can help in formulating structural policies that are focused on increasing the economy's growth rate in a sustainable manner by improving its potential growth.

3. **In Namibia, the economy has grown by 3.5 percent for the past three decades while the unemployment rate is much higher than the developing countries' standards.** The country's economy has grown by 3.5 percent for the last four decades, whilst the broad unemployment rate has in fact grown to 34.0 percent in 2016 based on the Namibia Labour Force Survey (2016). Despite macroeconomic stability and a single digit inflation rate, the unemployment rate keeps rising in the Namibian economy (Eita, 2010). According to Eita (2010) Namibia's unemployment responds positively if actual output is below potential output. However, this is contrary to expectations, where unemployment is expected to decrease when there is a positive output gap and increase when there is a negative output gap (Ciucci and Zoppe, 2017).

4. **A study by Kanyenze and Lapeyre (2012) showed that Namibia is facing a daunting structural unemployment and underemployment problem.** This was confirmed by the Government of Namibia (2013) in the labour market trends. Unemployment rates were reported to be high among persons with primary and secondary school education. This type of unemployment tends to persist and becomes present even if an economy is at full employment. Full employment is normally defined as a situation where there is no cyclical unemployment.

5. **The main objective of this study is to estimate potential output and output gap for Namibia and establish its macroeconomic determinants.** Using the conventional methods, the objective of the paper is to apply the Hodrick-Prescott (HP) filter and the production function approach to estimate potential output and the output gap in Namibia.

6. **The remainder of this paper is organised as follows.** Section II presents the conventional methods for measuring potential output and the output gap, through empirical review. Section III provides the Hodrick-Prescott (HP) filter and the production function approach methods and reviews the data used. Section IV presents the results and analyses the estimates while section V gives conclusion.

2. LITERATURE REVIEW

7. **There are numerous studies that have attempted to estimate potential output and output gaps in the literature.** There are numerous individual country studies (Alkhareif and Alsadoun, 2016; Almeida and Félix, 2006; Bokan and Ravnik, 2012; Fox and Zurlinden, 2006; Jemec, 2012; Stikuts, 2003).

8. **Using quarterly data from 1999 to 2015, Kasabov et al., (2017) use several methods to estimate the relationship between output and inflation.** The study used a macroeconomic model estimated with Bayesian methods and using Kalman filter to estimate a Phillips curve type relationship between output and inflation as well as produce estimates for output and unemployment gaps for Bulgaria. The results from the estimates show that the trade-off between economic activity and inflation is not as straightforward as theory suggests, which is mainly due to once-off and country-specific factors. A large negative output gap was observed between the period 1999–to 2003, which corresponds to the high unemployment in that period. High inflation was also observed during the same period, which the authors attribute to the transition to market economy the country went through in terms of opening up borders to trade and privatization on the one hand.

9. **Nepal Rastra Bank (2017) using annual data for the period from 1975 to 2017 estimated potential output and output gap for Nepal.** The study employed HP filter, Christiano-Fitzegerald filter, Beveridge-Nelson decomposition, unobserved component model and the production function. The study found potential output to be around 4.3 percent during the period under review. Whereas, the potential output remained above 4.5 percent during the 1980s and early 1990s, however, in the more recent years it was limited to 4 percent. The lower potential output growth rate is associated with the fall in total factor productivity. The study concluded that output gaps in Nepal are determined by the supply side shocks like weather conditions, natural disasters and supply disruptions.

10. **Alkhareif and Alsadoun (2016) estimated potential output and output gap for Saudi Arabia economy over the period 1980 to 2015 focusing on both total output and non-oil output.** They use Hodrick-Prescott (HP) filter, Kalman filter and production function approach to estimate output, comparing the three methods over the entire sample and the last five years. The results of the study show that the output gap is positive on average over the entire period; but the gap had turned negative. The results also showed that growth in both potential GDP and total factor productivity have accelerated in the period 2011-2015. The results suggest that average estimated potential growth was 5.1 percent

and 6.0 percent over the periods 1980-2015 and 2011– 2015. The study also found that overall economy productivity to be negative during the period of 1980-2015, but positive during the period 2011- 2015.

11. **Using quarterly data from the period 1960 to 2015, Fedderke and Mengisteab (2016) estimated South Africa's potential output using different univariate filters and production function approach.** They used Hodrick-Prescott filter, Christiano-Fitzgerald, Butterworth filters, Baxter-King filter, Kalman filter and production function approach to estimate output. They used four different measurements of output with four filters for 16 variations of the South African output gap. The results of the study show that the production function and Fitzgerald and Baxter-King produced similar results but with gaps of lower amplitudes. The estimated results from the Hodrick-Prescott, Christiano-Fitzgerald, and Kalman filter show that natural growth rate was in the range of 1.9 percent - 2.3 percent. The Hodrick-Prescott and Butterworth filters estimated a negative output gap whereas Christiano Fitzgerald and Baxter-King filters estimate positive output gap.

12. **Kloudova (2015) used quarterly data from 1995 to 2012 to estimate potential output and output gap for the Russian economy.** The study used three methods to estimate output gap and potential output, the Hodrick-Prescott filter, production function and Structural VAR model. All methods produced very similar output gap; though particular methods did not achieve the same values for the same time period. The output gap was used to forecast inflation. Kloudova argued that if there is a positive output gap in the economy; inflation should increase whereas if there is negative output gap inflation should decrease. The study used two models to confirm or reject that relationship. In the first model, Kloudova analyses the relationship between inflation and level of output gap, while in the second model he analyses the relationship between change in inflation and change in output gap. The result for both models indicate that output gap is a useful indicator of inflation in the Russian economy.

13. **On their part, Felipe et al., (2015) estimated potential output growth for the G-5 countries, as well as for 10 high- and middle-income Asian economies.** They also examined the impact of financial factors on output gap. To examine how essential financial factors are as a tool to measure the output gap and potential output the authors start with a univariate state space model of actual and potential output. In addition, it was transformed such that it captures the transition and measurement equations of a multivariate state space model of actual and potential output (Borio et al., 2013). They found that financial factors had a positive and statistically significant effect on the output

gap of the G-5 and high-income Asian economies, but not on that of the middle-income Asian economies.

14. **Jemec (2012) reviewed a number of different methods that can be used to estimate potential output gap for Slovenia and found positive output gaps in the periods of 1996-1997, 1999-2001 and especially 2006-2008, and negative otherwise.** Total factor productivity (TFP) was found to be the leading source of growth on average in the period 1996-2008. However, in the crisis its contribution fell most notably in absolute terms. Also the contribution of capital was found to be relatively high prior to the crisis and decreased a lot during the crisis. The labour contribution was found to be the lowest of all, and even turned negative during the crisis.

15. **Lungu, Jombo, and Chiumia (2012), using three methodologies, examined the relationship between the output gap and inflation in Malawi.** They make use of linear time trend, a Hodrick-Prescott filter and a structural vector autoregressive (SVAR) model. The results for the linear trend filter indicate that actual output is below its potential level for the period 2009, 2008 and 2010. The results for both methodologies indicated that the output gap in Malawi has a negative relationship with inflation, which implies that Malawi economy had been operating below its potential output level. Their finding suggests that other factors have been behind the price dynamics.

16. **Shahin (2011) estimated potential output and output gap for the Egyptian economy over the period 2003 to 2011.** The study used Hodrick-Prescott (HP) filter, the Running Median Smoothing filter (RMS), the Wavelets Filter and production function approach to estimate potential output. The production approach was employed whereby potential labor is obtained by deriving Egypt's nonaccelerating-inflation rate of unemployment (NAIRU)**.** The study found conflicting results produced by the production function and wavelets filter approach. The production function approach found a negative output gap during the global financial crises period, whereas the wavelets filter approach showed a positive output gap, following the global financial crisis. The results for both HP filter and RMS showed a negative output gap.

17. **Bhandari (2010) estimated potential output and the output gap in Nepal by different methodologies.** They used the Hodrick-Prescott filter and production function approach to estimate potential output and output gap in Nepal. The two methods produce similar results followed by analysis and observations. The results show that the output gaps were within relatively narrower band since 1990s. However, in 2008 the situation was different

and was aggravated further in 2009 as the economy exhibited signs of overheating which was reflected in the positive output gap of around one percent. The study's results from production function approach indicate that total factor productivity was declining continuously after the year 2000.

18. **Rodigueze (2009) estimated output gap, core inflation and NAIRU for Peru using quarterly data for the period of 1970 to 2007.** The study employed Hodrick-Prescott, Baxter-King (BK), Christiano-Fitzgerald (CF), Beveridge and Nelson (BN), Clark, simple linear trend and quadratic trend to estimate output gap. The study found output gap close to 5 percent significance level in Okun's Law and highly significant in the Phillips curve, however, investment equation was not significant. Rodigueze concluded that the inflation rate had useful information about the cyclical position of the economy. The results for the Phillips curve indicate that business cycles fluctuations have been associated with procylical behavior of inflation. The estimated result of the output gap from simple linear trend and quadratic perform better than filters such HP, BK, BN and CF perform better.

19. **Njuguna et al., (2005) estimated the output gap and potential output for Kenya using various methods.** They used the linear time trends, HP method, univariate and multivariate Beveridge Nelson, the structural VAR and the production function approach. Although the various methods produced varied results, they provided a broad consensus on the over-all trend and performance of the Kenyan economy. The study found that potential output growth had declined and the Kenyan economy has been contracting in the recent years.

20. **Orphanides and van Norden (2004) attempted to evaluate the usefulness of alternative univariate and multivariate estimates of the output gap for predicting inflation.** They found that forecasts using real-time estimates of the same measures do not perform nearly as well. The relative usefulness of real-time output gap estimates diminishes further when compared to simple bivariate forecasting models which use past inflation and output growth. Forecast performance also appears to be unstable over time, with models often performing differently over periods of high and low inflation. Their results call into question the practical usefulness of the output gap concept for forecasting inflation.

21. **Gradzewicz and Kalasa (2004) estimated potential output and output gap for the Polish economy over the period 1996-2002.** They calculate output gap based on two methods. The first method is based on a two-factor dynamic production function estimated

in the cointegrated vector error correction model (VECM), in which the potential GDP is calculated as the product resulting from the long term level of inputs of mean of production. The second method is the GDP Permanent Transitory Decomposition; they use long term restrictions within the VECM imposed in an endogenous way by cointegrating relationships. The study found that the results of output gap obtained using the production function show that the gap was positive until the third quarter of 1998 and then it fell below 1 percent. The three methods produce different results, however, if the different time-structures of the effect of the calculated gaps on the inflation are taken into account, the conclusion on the inflationary pressure in the economy drawn from those gaps are similar.

22. **Araujo et al., (2004) use quarterly data to estimate potential output and the output gap for the Brazil economy from 1995 to 2003**. They used deterministic trend, moving average, Hodrick-Prescott, Beveridge-Nelson, unobserved component models and production function model. The study also employed Phillips curve and rolling forecast experiment to compare output gap produced by different methods and test the forecast accuracy respectively. They classified output generated by different models into two groups: low and high variance trend. The study found that the forecasts produced by unobserved components models are more inaccurate than those produced by the simple univariate models. They found that deterministic trend, moving average, HP, Beveridge-Nelson and production function models had a strong short-term movement which moving upward and downward at the same time. The main finding of the study is that the Beveridge –Nelson method outperform all the model at all forecast horizons.

23. **De Brouwer (1998) using five methodologies, estimated the output gap for Australian economy over the period 1975 – 1997.** De Brouwer used linear time trends, multivariate HP filter trends, unobservable components models, Hodrick-Prescott (HP) filter trends, and a production function model. The results showed that there was a range of gap estimates, which in some instances gave contradictory indications about whether there was indeed excess capacity in the economy. The linear trend model for example, and some specifications of the univariate and multivariate HP filter models and the unobservable components model indicate that output was above potential at the end of 1997, while the production function approach and other specifications of the HP model indicate the opposite.

3. METHODOLOGY

24. **The study uses annual data for the period 1980 to 2016 to estimate Namibia's output gap and also establishes which factors have been driving the output gap over the sample period.** There are several methods used in the estimation of the output gap such as the linear time trends, multivariate HP filter trends, Hodrick-Prescott (HP) filter trends, unobservable components models and the production function model. This study uses the two conventional approaches, which is the Hodrick-Prescott (HP filter) and production function approach to estimate the potential output for Namibia. Potential output as unobservable variable cannot be estimated directly. It can, however, be estimated by several statistical and theoretical methods.

3.1 The Hodrick-Prescott Filter (HP) approach

25. **The Hodrick-Prescott filter (HP filter) is a very common approach to estimating potential output (Jemec, 2012).** The HP filter identifies trend output by minimizing a criterion combining the deviations from actual output and the fluctuations of the trend. The respective weights given to the two components of the criteria depend on an exogenous de-trending parameter (usually referred to as λ), which sets the degree of smoothness of the trend. To apply statistical methods, no other additional variables than actual output are needed. The HP filter minimizes the difference between actual and potential output as follow:

$$y_{t}^{*},_{HP} = \min_{\tau_t} \left[\sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} \{(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})\}^2 \right] \ldots\ldots\ldots\ldots\ldots (1)$$

26. **Where τ_t is trend component of output, y_t is actual output and λ parameter is constant and is called the smoothing parameter**. The first term minimises the distance between the actual and the potential (τ_t) value, while the second minimises the change in the trend value. Given that these two objectives contradict each other, the weight λ is used to control for the smoothness of the trend. It is typically set at 1000 for annual data. A low value of λ produce a trend output that follows actual output more closely. A high value, on the other hand, reduces the sensitivity of output trend to short-term fluctuations in actual output.

27. **The method gained popularity due to its flexibility in tracking the characteristics of the fluctuations in trend output.** The advantage of the HP filter is that it renders the output gap stationary over a wide range of smoothing values and it allows the trend to change overtime. Moreover, this method is preferred in most studies for developing countries because of considerably less data requirements (De Masi, 1997).

28. **Harvey and Jaeger 1993 have documented several weaknesses of HP filter approach.** The first weakness of the HP filter approach is the difficulty in identifying the appropriate de-trending parameter λ, which is generally overlooked by using arbitrary values popularized by the real business cycle literature. De Brouwer (1998) found that a lower smoothing factor produces a 'smaller' estimate of the gap. Mechanical de-trending based on the HP filter can lead to spurious cyclicality with integrated or nearly integrated time series and an excessive smoothing of structural breaks.

29. **Another important flaw of the HP filter arises from its high end-sample biases, which reflect the symmetric trending objective of the method across the whole sample and the different constraints that apply within the sample and at its edges.** Researchers use output projections to augment the observations to counter this problem. The reliability of measured potential output and output gap would then depend on the accuracy of the forecasts used to avoid the end-sample bias Njuguna et al., (2005).

3.2 The Production function approach

30. **The analysis of the production function is used as an alternative for measuring potential output.** The method describes the supply side and shows the relationship between output and its factor inputs. Potential output is represented by a combination of factors: the inputs, labor and capital, multiplied by total factor productivity. The most widely applied structural method is the estimation of the production function in the form of the Cobb-Douglas function (hereinafter, the CD function) (Jemec, 2012). The study follows Jemec (2012) and Alkhareif and Alsadoun (2016) and use a two factor Cobb-Douglas production function with Hicks-neutral technology which is subject to constant returns:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \qquad 0 < \alpha < 1 \qquad (2)$$

31. Where Y_t, is GDP, L_t, is the labor input, K_t, is capital input, A_t is the total factor productivity (TFP) level, $1 - \alpha$ is the elasticity of output with respect to labour and α is the elasticity of

output with respect to capital. TFP is unobservable, therefore following earlier studies such as Alkhareif and Alsadoun (2016) and Jemec (2012) it will be calculated The total factor productivity term is obtained as a Solow residual as follows:

$$A_t = \frac{Y_t}{L_t^{1-\alpha} * K_t^{\alpha}} \quad (3)$$

32. In order to estimate potential output potential values of total factor productivity, capital stock and labour input are needed. Potential output will be estimated as in equation (4) below.

$$Y_t^* = A_t^* L_t^{*1-\alpha} K_t^{\alpha} \quad (4)$$

33. Finally, the output gap for the Namibian economy will be determined as follows:

$$OG_t = \frac{y_t - y_t^*}{y_t^*} x100 \quad (5)$$

34. **Compared with other methods, the production function approach can provide useful information on the determinants of potential growth.** This approach relies, however, on an overly simplistic representation of the production technology, and sensitivity to the detrending techniques used for smoothing the components of the factor inputs. Problems of trend elimination for GDP is shifted to the trend estimates of the inputs Cerra and Saxena (2000). For example, the estimates from the production function approach share the end-sample biases that affect the underlying detrending techniques that are used for labor, capital, and productivity.

35. **The production function method has several other weaknesses aside from the difficultly in the estimation process (see Laxton and Tetlow 1992).** Laxton and Tetlow (1992) pointed out that there has been no useful model of estimating the productivity and hence, estimates are based on trend and therefore potential output is essentially exogenous time trends. Moreover, the problems of trend elimination for GDP are shifted to the trend estimates of the inputs. De-trending techniques such as the HP filter are used for smoothing the components of the factor inputs.

36. **According to Njuguna et al., (2005), these estimates may also be affected by measurement errors in factor inputs, particularly in the capital stock.** Moreover, the

production function approach may suffer from omitted variable bias due to improper use of value-added data and imperfectly competitive output markets. In addition, the so-called labor-hoarding hypothesis emphasizes transaction costs of adjustments in the labor force: firms may find it profitable to substitute labor utilization rates for measured labor input when the labor force cannot be modified without costs, and as a result effort levels may change over the business cycle instead of measured inputs.

3.3 Determinants of output gap

37. **After calculating the magnitude of the output gap over the study period the study will determine the possible factors which influence it**. Following studies by Borio et al., (2013) and Felipe et al., (2015) the study will include financial variables amongst the possible determinants of the output gap in Namibia. The study will use the two estimates of output gap separately. The financial variables to be included include private sector credit and money supply. These help to capture the interaction financing constraints and the demand conditions in an economy. Following Borio et al., (2013) and Felipe et al., (2015) the autoregressive component of the output gap is added to account for possible persistence. The model to be estimated is as follows:

$$OG_t = \beta_0 + \beta_1 OG_{t-1} + \beta_2 r_t + \beta_3 \Delta Cr_t + \beta_4 \Delta MS_t + \varepsilon_t \qquad (6)$$

$$r_t = i_t - \pi_t$$

38. Where OG_t is the output gap, r_t is the real interest rate; which is obtain from i_t, the nominal interest rate minus π_t the consumer price inflation rate. ΔCr_t is the real credit growth in per cent, ΔMS_t is the money supply growth rate in per cent, and the error term (ε_t).

3.4 Data

39. **This study used real gross domestic product (GDP) as its measure of output.** This measure has been used extensively in the literature (Stikuts, 2003; Jemec, 2012; Borio et al., 2013; Felipe et al., 2015; Alkhareif and Alsadoun, 2016).

40. **The labour input used in the production function is measured using various data sources.** Labour input is ideally measured as the number of hours worked. However, a time series data on working hours is not available in Namibia. The labour input is defined

as the number of employees in the economy based on the Namibian Labour Force Survey 2016.

41. **The capital input used in the production function approach is measured using fixed capital stock.** The data on fixed capital stock is obtained from Namibia Statistics Agency based on the guidelines of the 1993 United Nations System of National Accounts (SNA).

42. **Capital and Labour income shares (elasticities) are calculated using the GDP at factor cost**. The average labour income share for Namibia is about 49 percent. It therefore follows that the capital share of income is about 51 percent.

43. **Total Factor Productivity reflects the joint effects of many factors which are at play within an organization of production.** Historical data on Total factor productivity is calculated from Equation (3). TFP reflects output per unit of a set of combined inputs. With reference to Equation (2), a change in TFP reflects the change in output that cannot be accounted for by the change in combined inputs. The potential TFP is obtained from smoothing the historical series using the HP filter.

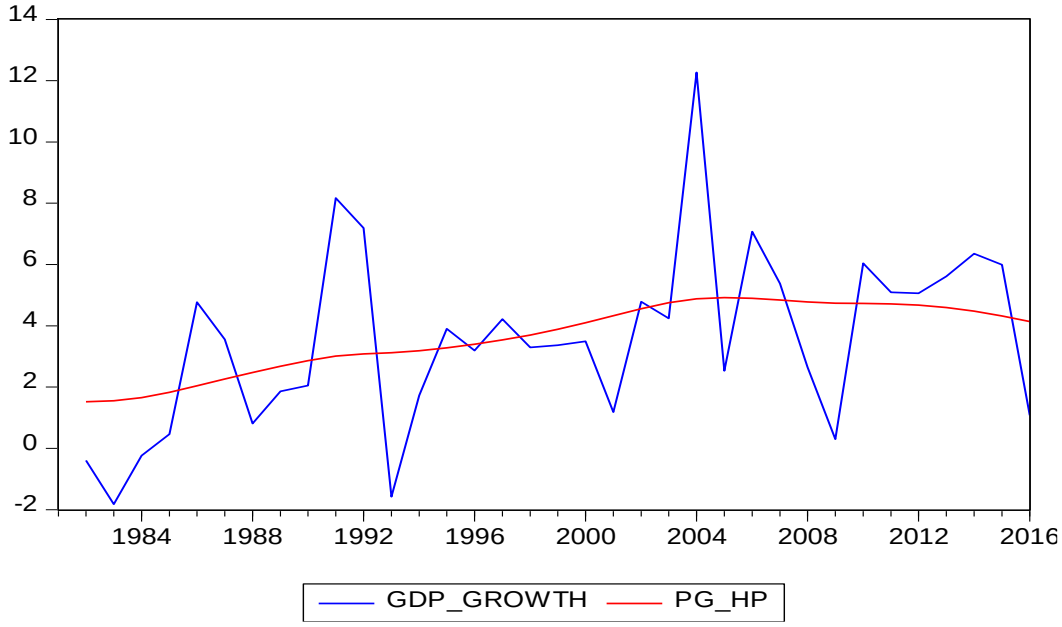
4. EMPIRICAL ESTIMATES OF POTENTIAL OUTPUT AND THE OUTPUT GAP

4.1 HP filter and Production function results

44. **In this sections we report the results using both HP filter and the production function to estimate potential output and the output gap in Namibia.** The results of potential output points to the maximum amount of goods and services an economy can produce when it is most efficient i.e. when the economy is operating under full capacity. Output gap will suggest that the economy is running at an inefficient rate- either overworking or underworking its resources. We make this assessment using annual data for the period 1980 to 2016.

45. **The HP filter starts with the estimation of the potential output.** We estimated potential output by applying the HP filter to the annual real GDP series for 1980 to 2016 and are plotted in figure 1. The restriction parameter λ is set at 100 for annual observations, in line with literature. The results suggest an annual average growth rate of 3.6 percent for the computed potential output. However, it should be noted that the annual potential output growth has been shifting during the period under review. In fact, the results suggest an annual average growth rate at around 1.6 percent between 1980 to 1985 and a growth rate of 2.5 percent during the period 1986 to 1990. The period after independence, the average potential output growth rate was 3.4 percent between 1991 and 1999. The average potential output growth rate was 4.6 percent between 2000 and 2016.

Figure 1: Actual GDP and Potential GDP annual growth rates



46. **The HP filter shows period of negative and positive swings in output gaps during the period under review.** The computed output gap is plotted in figure 2. The results from this method show a large positive swing in output during the 1990s when GDP growth accelerated strongly. There are two periods in which large negative output gap were seen: the period between the 1999 and 2003; and then again the period between 2009 and 2013. The results show that by the time of Namibian independence in 1990, output was significantly below its potential level. In the following years, real GDP surpassed potential output growth, determining a calculated output gap at around 3.8 per cent in 1995. The estimated output gap indicates economic excess capacity between 1991 and 1992; followed by the period between 2004 and 2008.

Figure 2: Potential output vs Actual output

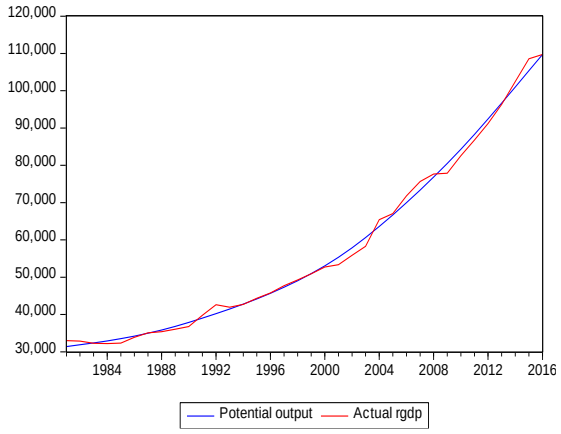
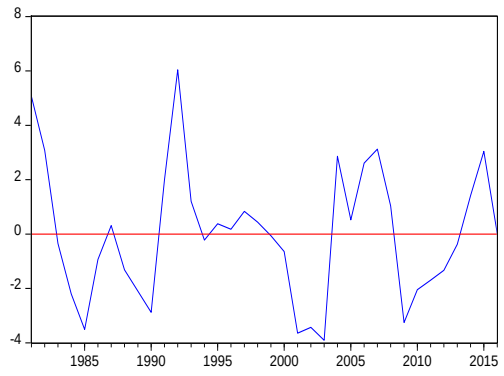


Figure 3: Output gap



47. **In the production function approach, the labour share is calculated as the share of labour income in the total value added based on the national accounts data.** The labour's share is estimated at 0.49 percent on average during 1980 to 2016, and thus capital share is estimated at 0.51 percent during the same period. The evolution of labour income share as a percentage of value added in the Namibian economy since 1980 to 2016. This information was used to calibrate the parameters α and $1 - \alpha$ in the production function equation.

48. **Potential TFP was calculated by using the labour and capital input data.** We first calculated the series of actual A, the Solow residual (TFP), by using equation (3) the actual employment and capital stock, real GDP as output, and 0.49 the labour share estimated as α. Second, we calculated the series of potential TFP by applying the HP filter with λ at 100 to the series of actual TFP. We can see that TFP growth varies a lot, which comes from the fact that it is calculated as a residual from the production function and as such reflects movements in physical capital stock, GDP and employment. The TFP growth was

also affected by the chosen capital series, according to which the contribution of capital grows due to the capital deepening process, and consequently of TFP as a residual fall.

49. **To assess factors contributing to potential output, we need to decompose the potential output into contributions from labour, capital and TFP.** The contribution capital accumulation to potential output growth during 1982 to 1999 was on average 1.35 percent and increased to 4.67 percent between 2000-2008 (Figure A3, Appendix). During 2009 to 2016 the contribution of capital to potential output growth on average was 7.68 percent mainly due to the undertaking of capital projects. The TFP growth shows an upward trend with slight drops in certain years. Since the onset of the global financial crisis of 2008-2009 the TFP growth shows a downward trajectory. In this regard, the low growth of TFP points to structural problems in the domestic economy that may hinder successful utilisation of the existing resources (Podpiera et al., 2017). The labour contribution to potential growth was moderate throughout the study period with a minimum of 2.24 percent and a maximum of 4.26 percent, on average.

50. **The estimated potential output with the two methods do not diverge significantly**. Figure 4 below illustrates the potential output estimated using the production function (PRGDP, blue line) and the estimated potential output using the HP method (Potential output, red line) as well as the real GDP. The potential output estimates under the two methods follow the same cyclical movements. The production function approach shows that potential output was smooth and stable throughout the study period. Both methods show negative output gap between 1999 and 2003, as well as 2009 and 2013.

51. **There are negligible differences between the output gap of the HP filter method and the production function method.** The output gap estimates by HP filter and production function are very similar, and they tend to move in the same direction. The production function approach gives an output gap structure that is closer to the HP filter (see figure 5). This holds specifically with respect to the positive and negative output gap during the period between 1980 and 2003.

52. **The analysis of the output gap from both methods will give an indication of whether the economy was underperforming or over performing during the period between 1980 to 2016**. During a boom output rises above its potential level, resulting in a positive gap which is often described as overheating. The results thereof point to upward pressure on inflation. However, during a recession actual output drops below its potential, creating a negative output gap. In the 1980s, the period leading to Namibia's independence,

negative output gaps can be observed in both methods. The period after 1990 is characterised by remarkable swift economic growth, depicting positive output gaps, which can be attributed to the structural changes with the new government. Thus the relatively strong period of growth in Namibia in 1992 reported as a year with a positive gap across all methods. The negative output gap observed between 1998 to 2004 could be attributed to the close of TCL mine during 1997 and 1998 as well as the Ramatex Textile Company between 2000 and 2008 which lead to much layoff labour, whereas negative output between 2009 and 2013 can be ascribed to the global financial crisis of 2008. The period of the global financial crisis is also uniformly reported as a period with a negative output gap.

Figure 4: Potential output vs Actual output

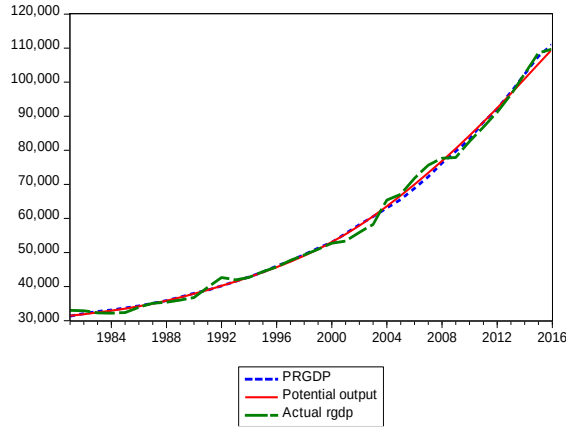
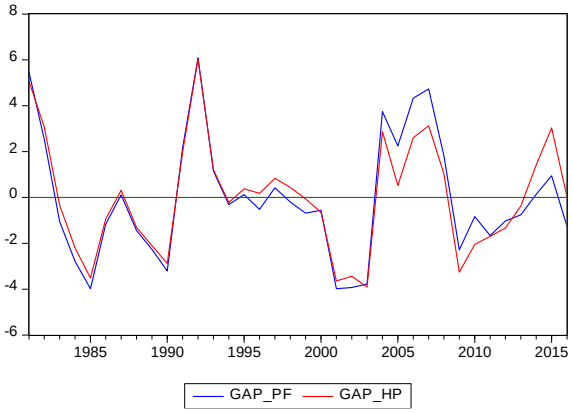


Figure 5: Output gap using HP filter vs Production function



53. Although also some differences are observable depending on the method used. Estimating potential output employing the production function approach may entail some problems as Shahin (2011) pointed out, problems in obtaining potential estimates of production function inputs are shifted to the estimated potential output. Shanin (2011) also argued that the merit of this approach focuses on the factors that drive growth in potential output rather than on historical behaviour of output. The production function produces larger positive output gaps than the HP filter method between the period 2004 and 2008. The observable differences could be due to the faster pace of growth in the country's potential output, hence the output gap is quite narrow and a statistical measure such as the HP filter method alone might underestimate the magnitude of the gap. Since the mid-2000s, on average, the annual potential output growth shifted to 4.6 percent, from 3.4 percent during the previous decade.

4.2 Determinants of Output gap results

54. **Following Felipe et al., (2015), the study applied their framework to estimate the impact of financial factors on the estimate of output gap for Namibia which was obtained using the production function approach.** Using annual data, equation (6) was used to estimate the impact of domestic credit growth, money supply growth, and real interest rate on Namibia's output gap. Table 1 below shows the estimated model. Each finance variable is included as a separate explanatory variable.

55. **Our results suggest that the coefficients of the financial factors are generally statistically insignificant.** We tried the Borio et al., (2013) framework but the coefficients of the financial factors remained statistically insignificant. These findings imply that the financial factors do not impact on the output gap. The coefficient of the lagged output gap term is highly significant which suggests a high degree of persistence of the Namibian output gap.

Table 1: Regression Results

Variable	Coefficient	Probability
GAP_PF(-1)	0.491	0.002
DCG	0.014	0.644
MSG	-0.007	0.823
RI	0.111	0.313
Constant	-0.251	0.774
Adjusted R2 : 0.21		

Source: Authors' computation

56. **Our results are in line with those found by Felipe et al., (2015) on a group of Asian middle-income economies.** They concluded that financial factors tend to play an important role in the output growth as economies develop. The notable insignificant financial variables suggest that swings revealed in the output gap cannot be explained by domestic credit growth, money supply and real interest rate (Table 1). Following Felipe et al., (2015)'s conclusions, our findings are consistent with the literature on the nonlinear effects of finance on growth. The lack of impact of financial factors on real output could be due to the fact that Namibia might not have reached the particular threshold of income at which they start having a prominent role.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

57. **In order to analyse the potential growth of Namibian economy, we estimate potential output and the output gap using two different approaches.** The HP filter and the production function was applied to the macro data covering period 1980 to 2016. We find the dynamics of the output gap is fairly similar among the employed methods. On average the output gap was positive in the periods of 1991-1992, 2004-2008, and 2012-2014, and negative otherwise.

58. **To improve potential output growth in Namibia might be challenging, therefore, well targeted structural reforms are needed.** To boost potential output, reforms should focus on reducing the mismatches in the labour market- improving access and quality of secondary and higher education, vocational and on-the-job training programs. In addition, the functioning of the labour market is essential through a more efficient dispute resolution processes.

59. **It is important that caution is always taken when implementing economic policy based on the estimates of the output gap.** Estimating output gap requires the estimation of potential output, which is unobservable and requires using different methods to estimate it. This makes it especially tricky when implementing policy using volatile and often biased output gap estimates. With the uncertainties that surround the output gap and the link from the output gap to inflation having the potential to give a misleading outlook for inflationary pressures, the Bank should avoid using the output gap mechanistically. It should rather look at a range of indictors of resource strain, such as capacity utilisation and labour shortages, rather than rely solely on our estimates of the output gap. Further research should look at different estimation techniques and compare the different results.

60. **The financial determinants of the output gap are found to be statistically insignificant, although the results are in line with the literature.** Focusing on the financial determinants of the output gap, this paper concludes that in Namibia, contrary to several developing countries, the financial variables (deposit rate, credit, money supply) are statistically insignificant. However, our findings are consistent with the literature on the nonlinear effects of finance on growth.

61. **Namibia, as a member of the Common Monetary Area, has a fixed exchange rate regime and thus is limited monetary policy independence.** Namibia has constraint monetary independence to boost or contract the economy, and thus monetary policy might

not be sufficient in boosting the economy during a recession. This is due to the requirement that the Namibian dollar should be at par with the South African Rand. Therefore, monetary policy should be used to support the fiscal policy in creating fiscal space and improving the fiscal automatic stabilizers to boost the economy, when the need arises. Examples of automatic fiscal stabilizers include target social transfers and progressive tax systems that increase spending and reduce revenues automatically when economic output slows.

62. **To reach a deeper understanding of the conclusion and results the study leaves a number of open questions that deserve some future research to test their validity as new information becomes available.** First, it seems important to consider the possibility of reconciling labour data in Namibia, since results obtained using the production function approach might change. Second, the utilisation of methods other than conventional methods will make it possible to test the robustness of the results and conclusions, given data availability on the required variables. Thirdly, linking output gap directly to inflation is beyond the scope of this study and would be beneficial, especially to the central bank, if further research can look into that relationship.

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Appendix

Figure A.1: HP: Potential output vs Actual output

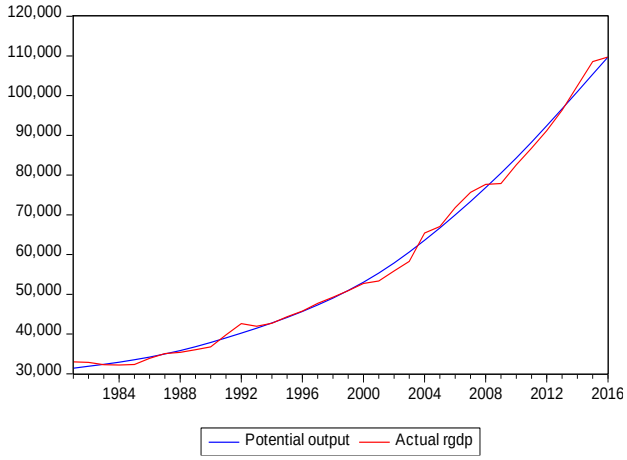

Figure A.2: Production Function: Potential output vs Actual output

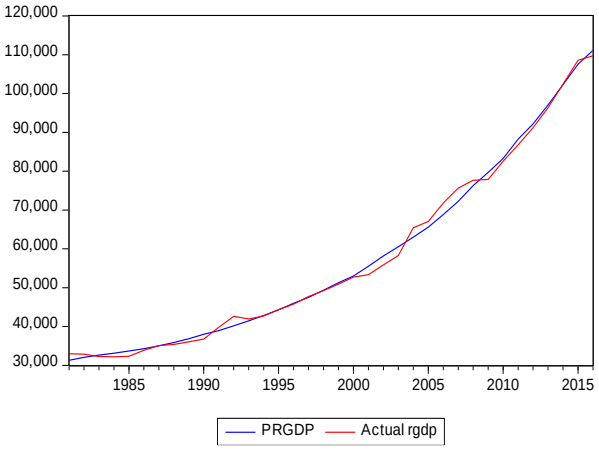

Figure A.3 TFP annual growth rates (1980-2016)

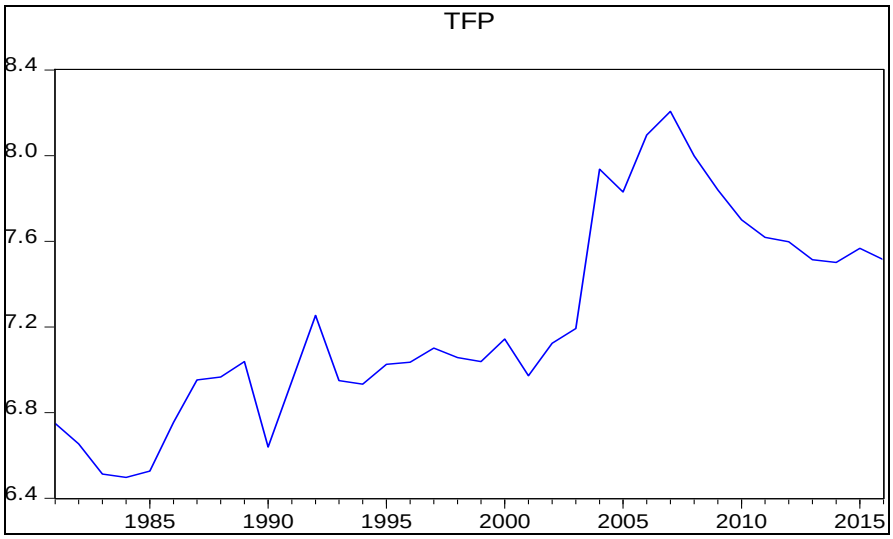

Figure A.4 Decomposition of the potential output growth rate