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Output Gap Estimation in NTB Province with Modified Hodrick Prescott Filter

Muhammad Yusuf¹, Nasrudin^{2*}

muhammad.y@bps.go.id¹; nasrudin@stis.ac.id²

Badan Pusat Statistik Kabupaten Bima, Indonesia¹;

Politeknik Statistika STIS, Indonesia²

Abstrak

- **Tujuan:** Penelitian ini bertujuan untuk mengestimasi *Output Gap* di Provinsi Nusa Tenggara Barat (NTB) menggunakan metode *Modified Hodrick Prescott (HP) Filter* berdasarkan sektor ekonomi: primer, sekunder, dan tersier.
- **Desain/metodologi/pendekatan:** Penelitian menggunakan data sekunder berupa Produk Domestik Regional Bruto (PDRB) triwulanan atas dasar harga konstan tahun dasar 2010 dari 2010Q1 hingga 2023Q3. Potensi PDRB dihitung dengan metode HP Filter yang telah dimodifikasi dengan pencarian nilai *lambda* optimal berdasarkan *Generalized Cross Validation (GCV)* minimum menggunakan fungsi algoritmik dalam perangkat lunak R-Statistics.
- **Temuan:** Nilai *lambda* optimal berbeda-beda untuk tiap sektor, yaitu 343 untuk total PDRB, 271 untuk sektor primer, 4438 untuk sektor sekunder, dan 989 untuk sektor tersier. *Overheating economy* teridentifikasi pada periode 2015Q1–2016Q1 akibat lonjakan sektor pertambangan. Resesi akibat pandemi COVID-19 terdeteksi pada periode 2020Q1–2022Q2. Sektor primer paling rentan terhadap *overheating*, sektor sekunder cenderung stabil, dan sektor tersier paling terdampak saat resesi.
- **Batasan penelitian/dampak:** Penggunaan metode univariat seperti *Modified HP Filter* belum mampu sepenuhnya menangkap pergeseran struktural ekonomi, terutama pada sektor primer yang responsnya kurang terhadap guncangan ekonomi. Penelitian lanjutan dengan pendekatan multivariat seperti SVAR, Kalman Filter, atau fungsi produksi sangat disarankan.
- **Implikasi praktis:** Estimasi output gap sektoral memungkinkan perumusan kebijakan fiskal dan moneter yang lebih tepat sasaran. Pemerintah daerah dapat merespons *overheating* dengan kebijakan kontraktif dan resesi dengan kebijakan ekspansif yang lebih efektif berdasarkan sektor yang terdampak.
- **Keaslian/nilai:** Penelitian ini memberikan kontribusi orisinal dalam memodifikasi metode HP Filter untuk konteks regional dan sektoral, yang belum banyak dikaji dalam literatur ekonomi Indonesia, serta memberikan alat analisis praktis bagi perencana kebijakan daerah.
- **Jenis makalah:** Makalah penelitian

Kata Kunci: *Output Gap*, NTB, PDRB Potensial, R-Statistik.



Abstract

- **Purpose:** This study aims to estimate the Output Gap in West Nusa Tenggara (NTB) Province using a Modified Hodrick Prescott (HP) Filter method by primary, secondary, and tertiary sectors.
- **Design/methodology/approach:** The study uses quarterly constant-price RGDP data from 2010Q1 to 2023Q3. The Potential RGDP is estimated using a modified HP Filter with an optimal lambda value derived by minimizing the Generalized Cross Validation (GCV). An algorithm developed in R-Statistics software was employed to automate lambda optimization and potential output computation.
- **Findings:** The optimal lambda values were found to be 343 for total RGDP, 271 for the primary sector, 4438 for the secondary sector, and 989 for the tertiary sector. Overheating was identified during 2015Q1–2016Q1 due to a surge in mining activity, while the COVID-19-induced recession was observed from 2020Q1 to 2022Q2. The primary sector was most vulnerable during overheating, the secondary sector remained stable, and the tertiary sector was most affected during the recession.
- **Research limitations/implications:** As a univariate method, the Modified HP Filter may not fully capture structural economic shifts, especially in the primary sector. Further research using multivariate approaches such as SVAR, Kalman Filters, or production functions is recommended.
- **Practical implications:** Sector-specific output gap estimation enables more targeted fiscal and monetary policy interventions. Policymakers can apply contractionary measures during overheating and expansionary actions during recession with greater precision based on sectoral sensitivity.
- **Originality/value:** This study provides a novel application of a modified HP Filter at a regional and sectoral level in Indonesia, offering a valuable analytical tool for regional economic monitoring and policy development.
- **Paper type:** Research paper

Keywords: Output Gap, NTB, Potential RGDP, R-Statistics.

Introduction

The output gap is difference between the actual output value (Regional Gross Domestic Product (RGDP)) and the potential output value (Potential RGDP). RGDP in this context is defined as the result of production of goods and services by all economic sectors in a certain area within a certain period of time. Okun (1962) explains that potential output is the level of output that can be achieved by a region with full employment conditions. Potential output also represents the maximum value that can be produced in an economy without causing inflation. Therefore, estimating the output gap helps the central bank in determining the right monetary policy to maintain a balance between economic growth and inflation.

Several studies-Nasution and Hendranata (2014), Gyurkovics and Takacs (2023), Chen and Gornicka (2020) and Selen (2018)- highlight that the output gap's is useful as a basis for making macroeconomic policies, both fiscal and monetary policies. If the output gap is positive, then the actual output is greater than the

potential output. This positive output gap is usually characterized by excess demand, which causes a tendency for prices to rise (inflation). In such cases, the government may apply contractionary fiscal policies (e.g., reducing government spending or increasing taxes). In addition, Bank Indonesia can implement contractionary monetary policies such as reducing the amount of money in circulation. This policy can cool the economic conditions so that overheating of the economy does not occur.

On the other hand, if the output gap is negative, the actual output is smaller than the potential output. Hildayana et al. (2023) explained that a negative output gap indicates that the resources being utilized are not being utilized optimally, which may result in increased unemployment and deflationary pressure. In such conditions, the government can implement expansionary fiscal policies such as increasing government consumption or cutting taxes. In addition, Bank Indonesia can also implement expansionary monetary policies such as increasing the amount of money in circulation. This policy is needed to avoid an economic recession such as the Indonesian economic crisis in 1998. This highlights the importance of estimating the output gap and potential RGDP as a summary indicator used for policy development analysis by the NTB government.

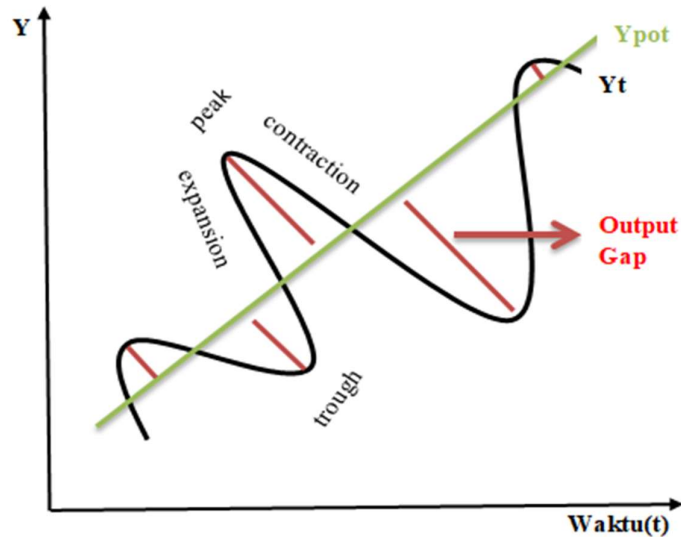
Because the output gap is an unobservable, it must be extracted from the trend and cycle values of RGDP so that it must be estimated using a time series method. One method that can estimate the output gap is the Hodrick Prescott Filter (HP Filter) introduced by Robert J. Hodrick and Edward C. Prescott in 1997. This method estimates with a fixed *lambda* value, namely 100 for annual data and 1600 for quarterly data. Therefore, this HP Filter method needs to be modified to obtain the accuracy of the *lambda* value with a minimum CGV value so as to reduce bias in the output gap estimate. This modification was also carried out by Choudary, et al. (2013) and Fajar (2017) for country-level data.

Literature review

Business Cycle Theory

The business cycle refers to fluctuation of macroeconomic variables that have a regular pattern that is excessive (positive) or lacking (negative). Jacob (1998) explains that the business cycle can be found in macroeconomic variable data such as: output, consumption, investment, employment and prices. The business cycle consists of four parts of change, namely: peak, trough, growth (expansion), and recession (contraction). These changes are repeated but not periodic, which means they can occur in varying durations and can possibly be more than one year to ten or twelve years. The business cycle can also be said to be the expansion and contraction of economic activity in aggregate, for example Gross Domestic Product (GDP) and Aggregate Real Expenditure.

Figure 1. Illustration of the Business Cycle and Output Gap Movement



Source: Jacob, 1988

The next theoretical development is the Real Business Cycle Theory developed by Kydland and Prescott (1982) who argue that the business cycle occurs due to shocks to real factors, such as technology or productivity. This real business cycle theory focuses on the supply side of the economy which assumes that economic fluctuations are caused by changes in technology and productivity, not monetary shocks. Estimation of potential output can be useful for understanding whether changes in actual output are cyclical or reflect structural shifts in the economy. In this theory, potential output changes dynamically according to changes in technology and productivity. Jacob (1998) explains that this business cycle can be measured in two methods, namely the National Bureau of Economic Research (NBER) method and classical statistical time series. One method for decomposing the output gap is the Hodrick Prescott (HP) Filter as explained by King and Rebelo (1999).

Monetary Theory and Okun's Law

Monetarists, led by Milton Friedman, argue that the output gap is closely related to inflation and unemployment. Okun's Law posits a negative correlation between the output gap and the unemployment rate, where any decrease in output below potential will increase unemployment. Okun (1962) also explained that this output gap has a positive effect on inflation, namely if the output gap has an excessive positive value above its potential output, it will increase excessive public consumption and cause inflation. Ball, et al. (2013) also stated that Okun's Law has a strong and stable effect between the output gap and unemployment in several countries and does not change its relationship during a recession. Estimating this output gap can help central banks in determining the right monetary policy to maintain a balance between economic growth and inflation.

Keynesian Theory and the Phillips Curve

Phillips (1958) explained that the New Keynesian Theory developed the concept that the output gap affects inflation through the Phillips Curve, which shows the relationship between unemployment and inflation. If the output gap is positive, inflationary pressures increase because labor demand is high. Conversely, if the output gap is negative, inflation tends to be low or deflation occurs. Mishkin (2022) explained that policymakers can reduce the output gap by using monetary policy to avoid inflation and unemployment problems as policymakers did when there was high inflation in the United States in the 1970s. Therefore, output gap estimates are used as a primary tool in modern monetary policy.

Output Gap Estimation with Modified Hodrick-Prescott (HP) Filter

The HP Filter method is one of the time series decomposition methods that aims to estimate the trend or potential conditions of the macroeconomic variable business cycle as explained by Hodrick and Prescott (1997). This method is classified as a univariate method because it only requires one series, namely the macroeconomic variable itself. These variables include Regional Gross Domestic Product (RGDP), Inflation, Open Unemployment Rate, Consumption, Investment and so on. This method was introduced by Robert J. Hodrick and Edward C. Prescott when investigating the post-war business cycle in the United States. Hodrick and Prescott in 1997 proposed the same parameter value for the business cycle of all country conditions, namely 100 for annual data or 1600 for quarterly data.

However, in reality, the business cycle of each country is different depending on the seasonal patterns and economic shocks in each country. Therefore, Choudary, et al. (2013) and Fajar (2017) modified the HP Filter by finding smooth parameter values from the minimum Generalized Cross Validation (GCV) criteria values for the business cycle of the economy in Indonesia. Fajar (2017) stated that the output gap estimate in Indonesia using the Modified HP Filter method obtained a *lambda* value of 856.69 which produced a smooth potential output and moved along its actual output. In addition to being used as a policy maker at the country level, this Output Gap estimate can be used to estimate economic conditions at the provincial level. Referring to previous studies, such as Jacob and Waibot (2022) estimated the output gap in North Maluku Province using the New Classical Synthesis approach method within the framework of Business Cycle Theory which is termed Economic Fluctuation, namely the Hodrick Prescott (HP) Filter Method. In addition, the study produced many negative output gap values or recession (bad news) in North Maluku Province.

Research method

This study uses secondary data sourced from the Central Statistics Agency (BPS) of NTB Province. The data used in this study is the Regional Gross Domestic Product (RGDP) at constant prices with a base year of 2010. The research period is quarterly, namely from 2010 Quarter I (2010Q1) to 2023 Quarter III (2023Q3). The RGDP data is then classified again into three sectors, namely the primary sector, secondary sector and tertiary sector. The primary sector includes category A

(Agriculture) and category B (Mining and Quarrying). The secondary sector includes category C (Processing Industry), category D (Electricity and Gas Supply), category E (Water Supply, Waste Management and Recycling), category F (Construction). The Tertiary Sector is a service sector that is not included in the primary and secondary sectors, which includes category G (Trade), category H (Transportation and Warehousing), category I (Provision of Accommodation and Food and Beverages) and category J (Information and Communication), Government Services, Education Services, Health Services and Other Services.

The RGDP data of NTB Province according to the sub-sectors is then calculated for the Potential RGDP of each sub-sector using the Hodrick Prescott (HP) Filter method. The researcher modified the *lambda* value used in the HP Filter calculation to produce a smoother and more accurate estimate of potential RGDP. The calculation of Potential RGDP and the search for minimum *lambda* are carried out using the R-Statistics program. The researcher created an algorithm for searching for *lambda* values and calculating Potential RGDP and made the algorithm an R-statistics function so that it facilitates the experiment of calculating potential RGDP using the modified HP Filter method.

Hodrick-Prescott (HP) Modified Filter

If the RGDP series is known in the observation period t ($RGDP_t$) then the business cycle of the series can be broken down into the *trent component* (g_t) and the cyclical component (c_t) of the RGDP as follows:

$$RGDP_t = OP_t + c_t ; t = 2010Q1, 2010Q2, \dots 2023Q3$$

Figure 2. RGDP series

Hodrick and Prescott (1997) explained that the *trent component* with the optimal condition of the RGDP is called Potential RGDP. This component is obtained by adding the gap between $RGDP_t$ and its Potential RGDP (OP_t), which is obtained with the following formula:

$$\left\{ \sum_{t=1}^T c_t^2 + \lambda \sum_{t=1}^T ((g_t - g_{t-1}) - (g_{t-1} - g_{t-2}))^2 \right\}; c_t = RGDP_t - OP_t$$

$$\widehat{g}_t = [I + \lambda A]^{-1} PDRB; \text{ where } A = K'K; K \text{ is } (T-2) \times T \text{ matrix}$$

$$K_{ij} = \{1, \text{ if } j = i \text{ or } j = i + 2 \quad -2, \text{ if } j = i + 1 \quad 0, \text{ others}\}$$

Figure 3. Potential RGDP

The λ value is the *smoothing parameter value* that will be modified and calculated to produce the optimal Potential RGDP from the minimum *Generalized Cross Validation (GCV) value*. If the quarterly observation period range is known to be T periods, the GCV value can be defined as follows:

$$GCV(\lambda) = T^{-1} \left(1 + \frac{2T}{\lambda} \right) \sum_{k=1}^T (RGDP_k - \widehat{OP_{t,k}}(\lambda))^2 \quad (5)$$

Figure 4. GCV value

The Modified HP Filter will iterate with λ values from 5 to 100000 by calculating the GCV for each λ . Furthermore, the Modified HP Filter function will select the λ value (λ_{min}) with the minimum GCV value. Then, the smoothing parameter value is used to estimate Potential RGDP (OP) by entering the minimum (λ_{min}) λ parameter value, into equation on Figure 3, which can be detailed as follows:

$$RGDP_t = OP_t + OG_t; t = 1, 2, 3 \dots 55 \quad (6)$$

$$\widehat{OP}_{55 \times 1} = [I_{55 \times 55} + \lambda_{min} * A_{55 \times 55}]^{-1} RGDP_{55 \times 1} \quad (7)$$

$$\begin{aligned}
(OP_1 OP_2 \dots OP_{55}) &= \begin{bmatrix} 1 & 0 & 0 & \dots & 0 & 0 & 1 & 0 & \dots & 0 & 0 & 0 & 1 & \dots & 0 & \vdots & \vdots \\ \vdots & 0 & 0 & 0 & \dots & 1 & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}_{55 \times 55} + \lambda_{min} \\
&\quad * \begin{bmatrix} 1 & -2 & 1 & \dots & 0 & 0 & 1 & -2 & \dots & 0 & 0 & 0 & 1 & \dots & 0 & \vdots & \vdots \\ \vdots & 0 & 0 & 0 & \dots & 1 & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}_{55 \times 53} \\
&\quad * \begin{bmatrix} 1 & 0 & 0 & \dots & 0 & -2 & 1 & 0 & \dots & 0 & 1 & -2 & 1 & \dots & 0 & \vdots & \vdots \\ \vdots & 0 & 0 & 0 & \dots & 1 & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}_{53 \times 55}^{-1} (RGDP_1 RGDP_2 \dots RGDP_{55})
\end{aligned} \tag{8}$$

$$OG_t = RGDP_t - OP_t; t = 1, 2, 3 \dots 55 \quad (9)$$

Figure 5. Modified HP Filter

Information:

OP_t : Potential Regional GDP of period t
 $RGDP_t$: Actual Regional Gross Domestic Product to -t
 OG_t : Output Gap in period t

The process is also applied to the primary, secondary and tertiary sector RGDP in NTB Province to obtain the potential RGDP for each sector. The results of the potential RGDP and *output gap* will then be analyzed by researchers in the next chapter.

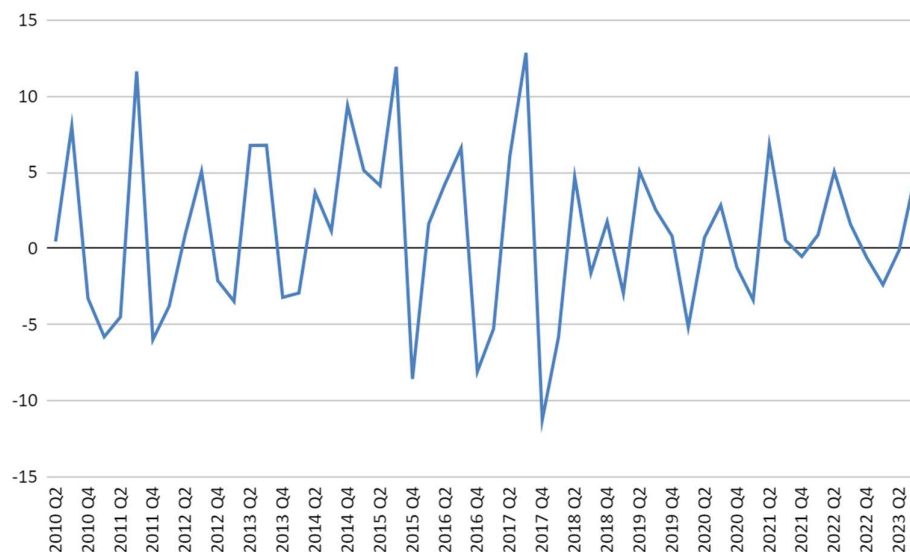
Result and Discussion

This study estimates the output gap according to the business sector, namely: primary, secondary and tertiary sectors using a modified HP Filter. This study also produces a *lambda* value to estimate potential output that takes into account the business cycle components of each business sector in NTB Province. This is because the economic shocks from each sector are different so that they can produce an estimated value that is closer to the actual output value.

In general, economic growth in NTB Province shows a fluctuating movement with a growth pattern in the second and third quarters and a decline in the first and fourth quarters. This seasonal pattern is typical across Indonesia (Qibtiyyah and Widodo (2024)). The level of fluctuation in economic growth over the past decade can be classified into two fluctuation periods. First, in 2010Q1 to 2018Q2, fluctuations in economic growth in NTB Province tended to be very volatile with a standard deviation of around 6.46. Second, in the period 2018Q3 to 2023Q3, fluctuations in economic growth in NTB Province tended not to be volatile and moved along the average with a standard deviation of 3.07. This phenomenon occurred due to the impact of COVID-19 and PPKM implemented in NTB Province.

Economic growth in NTB Province peaked in 2017Q3 at 12.86 percent. This value is twice that of the previous period, which was 6.06 percent in 2017Q2. Economic growth during this period grew from 21.91 billion Rupiah in the first quarter to 26.22 billion Rupiah in 2017Q3. The rapid increase in economic growth in a period of time is not necessarily a positive thing for the economy of a region. However, this phenomenon could cause the economic conditions of NTB Province to become an *overheating economy* which results in prolonged inflation as explained by Mankiw (2016) and Mishkin (2022).

Figure 6. Quarterly Economic Growth Rate of NTB Province 2010-2023

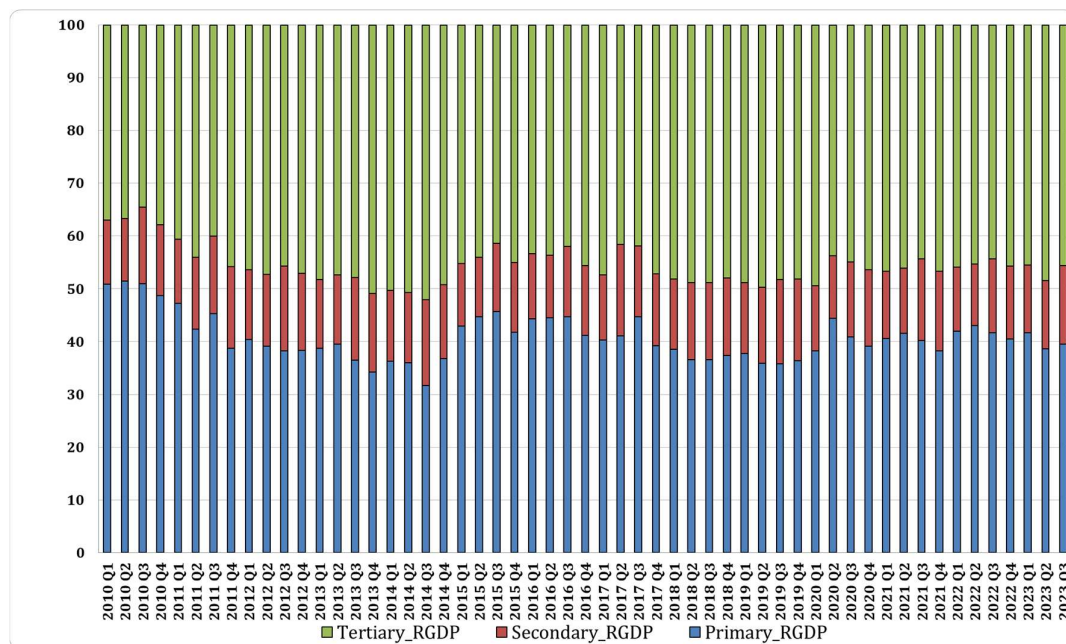


Source: NTB Province BPS (Excel Processing Results), 2024

The NTB government needs a cooling down effort to avoid overheating the economy at the end of the 2017 period. Nasution and Hendranata (2014) suggest that the government can implement contractionary fiscal and monetary policies, such as reducing government spending and reducing money supply during that period to avoid continued inflation and keep its growth at its potential point. Evidently, economic growth in NTB Province reached its lowest point in the next period, namely in 2017Q4 which reached -11.26 percent. NTB Province's RGDP fell from 26.22 billion Rupiah in 2017Q3 to 21.9 billion Rupiah in 2018Q1.

The distribution of business sectors in NTB Province is generally dominated by the primary and tertiary sectors over the past decade. The secondary sector in NTB Province has only reached an average of 13.69 percent over the past decade. The primary sector dominated maximally in 2010Q2 with 51.42 percent. The Central Statistics Agency (2024) explains that the mainstay primary business sectors in NTB Province are corn and shallot farming, which are widely exported outside NTB. Meanwhile, the secondary business sectors in NTB Province that contribute to economic growth are the production of copper, gold, silver and other metals by PT Newmont in West Sumbawa Regency and PT Sumbawa Timur Mining (STM) in Dompu Regency.

Figure 7. [2010 Series] Distribution of Quarterly Constant RGDP by Business Sector of NTB Province 2010-2023



Source: NTB Province BPS (Excel Processing Results), 2024

Based on Figure 7, the distribution of business sectors in NTB Province has experienced a sector shift over the past decade. In 2010, the distribution of business sectors in NTB Province was dominated by the primary sector, which was around 50.51 percent primary sector, 36.52 percent tertiary sector and 12.96 percent secondary sector. However, in 2023, the distribution of business sectors in NTB

Province shifted and was dominated by the tertiary sector, which was around 46.49 percent tertiary sector, 39.96 percent primary sector and 13.54 percent secondary sector. This shift was caused by the rapid development of the tourism sector in NTB, such as the construction of the Mandalika circuit and the opening of many tourist attractions that attract domestic and foreign tourists. This development responded to several tertiary sectors in NTB such as trade, hotels, restaurants, transportation services and other services.

The movement of the economic structure in NTB Province is in accordance with Chenery's Development Pattern Theory which explains that there is a movement of sectors from primary to secondary and tertiary in line with an increase in per capita income in a region. BPS noted that the RGDP per capita of NTB Province increased by 20.02 percent from 15.53 million rupiah in 2010 to 18.64 million rupiah in 2022. This is in accordance with the research findings of Suwarni (2006) and Alfarabi, et al. (2014).

Lambda Value Calculation

Lambda is a coefficient needed to calculate the Potential RGDP in NTB Province. *Lambda* values were calculated using a custom R-Statistics function, iterating from 5 to 100,000 to find the minimum GCV. Then the *lambda* search function will search for the *lambda* value with the minimum GCV for 999,995 possible types of *lambda*. The results of the *lambda* calculation for RGDP in NTB Province are as follows:

Table 1. Results of Calculation of *Lambda* Value and GCV of RGDP of NTB Province

No	Variables	Function Calculation Results		Standard Value	
		<i>Lambda</i>	GCV	<i>Lambda</i>	GCV
1	RGDP	343	1,185507	1600	1.449432
2	Primary RGDP	271	0.8882606	1600	1.27754
3	Secondary RGDP	4438	0.102308	1600	0.1038579
4	Tertiary RGDP	989	0.120328	1600	0.1214303

Source: Results of Processing R-Statistics Application Output, 2024

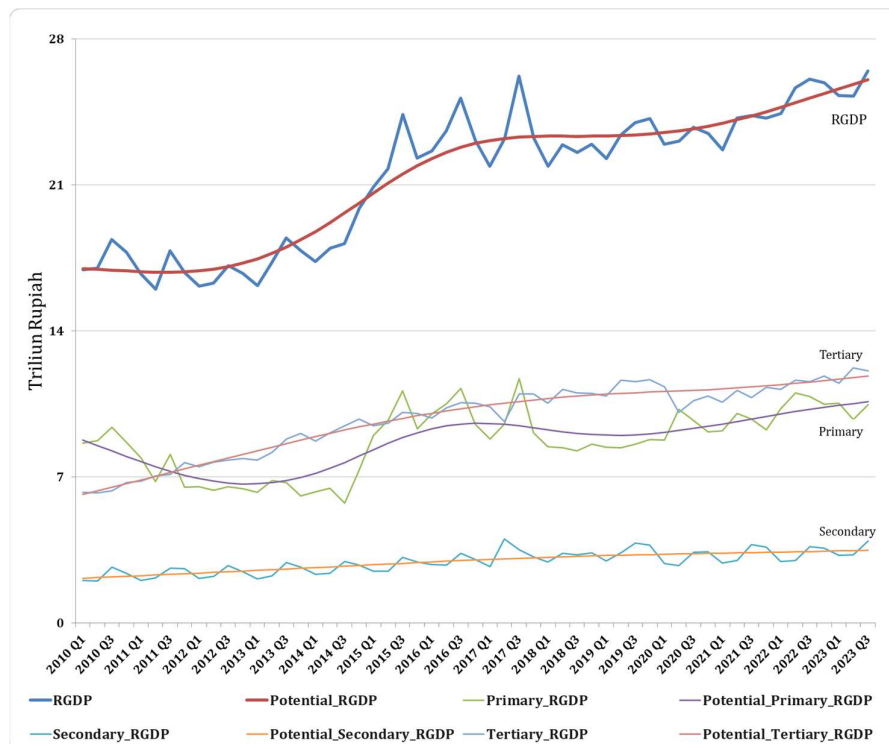
Based on Table 1, the results of the *lambda value calculation* with the search function from R-Statistics show the minimum GCV value compared to the standard value of quarterly data. The *lambda value* for the RGDP of NTB Province is 343 with a GCV of 1.185507. Then, the primary sector RGDP is 271 with a GCV of 0.8882606. After that, the secondary sector RGDP is 4438 with a GCV of 0.102308 and the *tertiary sector RGDP* is 989 with a GCV of 0.120328. The *lambda value* with the minimum GCV will be used to calculate the Potential RGDP in NTB Province. The results of the *lambda value* parameter calculation for the output gap estimation in NTB Province are in accordance with Fajar's research (2017) which states that the

CGV value is more minimal if using a modification of the lambda value search. Fajar (2017) said that the lambda value of 856.69 for the estimation of its Potential GDP produces a minimum CGV compared to the standard lambda value of 1600. Then, the calculation of Potential RGDP in NTB Province produces a smooth value following the fluctuation of its actual value according to the research results of Jacob and Waibot (2022) when estimating the Potential RGDP of North Maluku Province. On average, every year the economy in a region experiences recession and expansion twice each.

NTB Province Output Gap Estimation Results

The calculation results of the potential RGDP of NTB Province with lambda 343 produce a *smooth potential RGDP* and move along its actual value and have a positive *trend*. The same phenomenon is found in the estimation results of the potential RGDP of the secondary and tertiary sectors, the potential RGDP of the secondary and tertiary sectors move along their potential values. However, The RGDP of the secondary sector exhibited minimal fluctuation, as reflected in a standard deviation of just 0.35. The movement of RGDP in the primary and tertiary sectors tends to be more volatile than the secondary sector. This is different from the movement of Primary and Tertiary RGDP which have standard deviations of around 1.56 and 1.72, respectively.

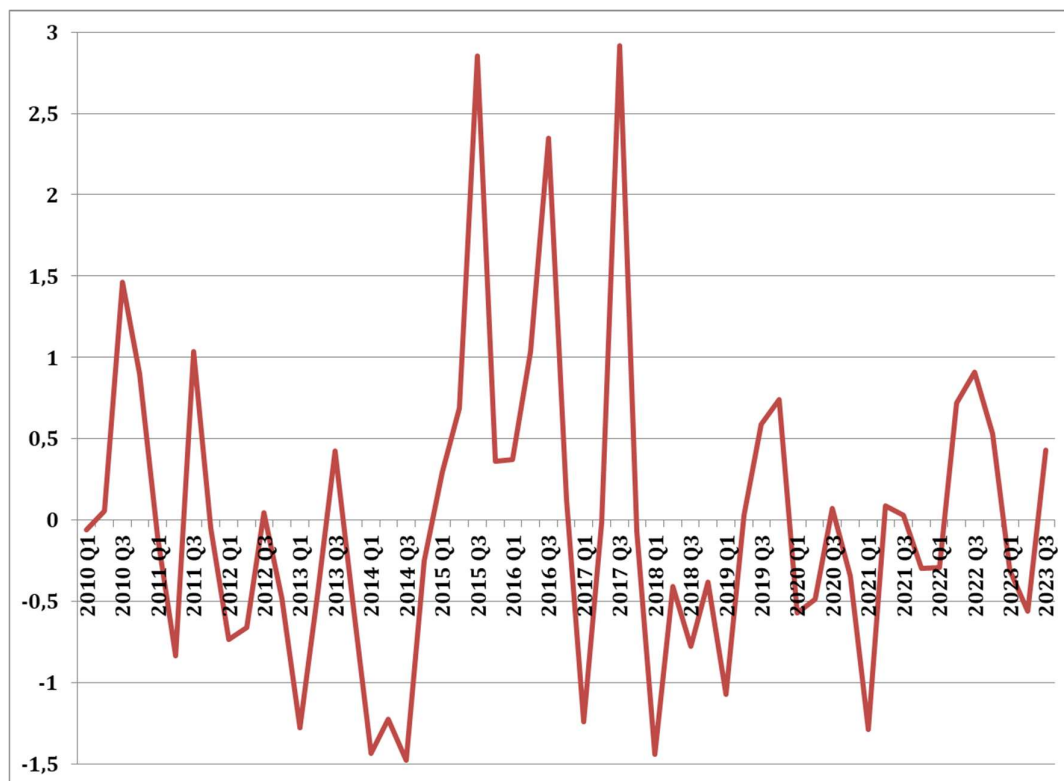
Figure 8. Results of Quarterly Potential RGDP Estimates for NTB Province 2010Q1-2023Q3 (Trillion Rupiah)



Source: R-Statistics Processing Results (2024)

Another phenomenon was found in the movement of potential RGDP of the primary sector in NTB Province which moved along its actual value but was less able to adjust for economic shocks. The RGDP of the primary sector increased by 93.23 percent from 5.75 trillion rupiah in 2014Q3 to 11.13 trillion rupiah in 2015Q3, but it was seen in the results of the estimation of potential RGDP with *the Hodrick Prescott Filter* that it could not adjust for the increase. The Central Statistics Agency (BPS) explained that the main cause of the high growth rate of the primary sector RGDP was the very significant growth in the mining and excavation category which reached 223.28 percent compared to 2014Q3. This high growth was driven by an increase in metal ore mining production from PT. Newmont Nusa Tenggara (PT. NNT). Initially, the movement of the primary sector RGDP decreased in 2014Q3 due to the enactment of the mineral and coal law which prohibited the export of mining materials in the form of concentrates until 2014Q2 which resulted in the temporary cessation of PT. NNT's concentrate production. However, in 2014Q3 the government again provided relaxation in the implementation of the mineral and coal law in the form of re-permitting the export of mining materials (concentrates) with special conditions, so that the growth of RGDP in the primary sector in NTB Province experienced a very high increase in 2014Q3.

Figure 9. Results of Quarterly RGDP Output Gap Estimation for NTB Province 2010Q1-2023Q3



Source: R-Statistics Processing Results, 2024

The movement of Indonesia's *output gap* generally has a growth pattern in the second and third quarters, and a *cooling down* in the first and fourth quarters. However, the movement pattern of the *output gap* in NTB Province is more fluctuating and irregular. Based on Figure 9, the results of the calculation of the NTB Province *output gap* for the period 2010Q1 to 2023Q3 show a fluctuating pattern with a standard deviation of 0.95. The NTB Province *output gap* has a positive value for eight periods, namely in the period 2015Q1 to 2016Q4. This phenomenon is very risky and can cause *overheating of the economy* in NTB Province. Therefore, in conditions like this, the government needs to implement a contractionary fiscal policy by reducing government spending and a contractionary monetary policy by reducing the amount of money in circulation.

Then, the impact of the COVID-19 pandemic that hit Indonesia in general was also seen to shake the economy in NTB Province. Based on Figure 9, the *output gap* in NTB Province reached a value of -570 billion rupiah in 2020Q1 and reached its *trough* in 2021Q1 of -1,283 billion rupiah. In conditions like this, the regional government must implement an expansionary fiscal policy by increasing government spending and an expansionary monetary policy by increasing the amount of money in circulation. The NTB Province economy returned to positive starting in 2022Q2 with an *output gap* value of 722 billion rupiah, 908 billion rupiah in 2022Q3 and 531 billion rupiah in 2022Q4.

Discussion and Analysis of Government Policy

Contractionary Policy Analysis

Based on Figure 9, the development of the *output gap* in 2015Q1 to 2016Q4 shows economic overheating. The *output gap* was worth 292 billion Rupiah in 2015Q1 and peaked in 2015Q3 at 2.85 trillion Rupiah and remained positive until 2016Q4 at 124 billion Rupiah. This phenomenon is in accordance with the NTB Province Inflation in 2015Q1 to 2016Q4 which always experienced inflation. The Central Statistics Agency (BPS) of NTB Province recorded an inflation value in 2015Q1 of 0.18 percent then peaked in 2015Q3 at 1.51 percent. The inflation value continued to be positive until 2016, namely in 2016Q1 at 1.08 percent and 2016Q4 at 1.06 percent. This ongoing inflation is in accordance with the statement of Nasution and Hendranata (2014) who said that *overheating of the economy* in a region is characterized by ongoing inflation.

During the overheating period (2015Q1–2016Q4), the primary sector exhibited the highest volatility, with an average output gap of 1.09 trillion Rupiah. Then, the secondary and tertiary sectors were more stable with fluctuating output gap values (sometimes positive and negative) during the period 2015Q1 to 2016Q4, namely with an average output gap of -34.11 and 69.32 billion Rupiah respectively. The Central Statistics Agency (2017) explained that several commodities that contributed the most to inflation in 2016 in NTB Province were rice, shallots, cayenne pepper and broiler chicken. In this condition, the central bank can implement a contractionary monetary policy by reducing the amount of money in circulation to reduce NTB community consumption during this *overheating economy*. Mankiw (2016) and Mishkin (2022) explain that a decrease in public consumption will reduce aggregate demand and create a new balance so that inflation can be controlled. The government can also implement a contractionary

fiscal policy by reducing NTB Provincial Government spending. This reduction in government spending will reduce the value of RGDP because government spending is a component that contributes to RGDP. Reduced government spending will reduce aggregate demand and create a new price balance (deflation).

Expansionary Policy Analysis

The impact of COVID-19 is also reflected in the negative *output gap* of NTB Province in the 2020Q1 period of 1.28 trillion Rupiah. Sayuti and Hidayati (2020) also said that COVID-19 in NTB Province also affected the decline in income of most people and limited employment opportunities. BPS (2021) noted that the Open Unemployment Rate (TPT) of NTB Province increased from 3.28 percent in August 2019 to 4.22 percent in August 2020. Unemployment in NTB Province is dominated by the Urban Population, namely the condition in February 2021 reaching 5.13 percent and February 2022 reaching 4.51 percent. Murapi, et al. (2021) explained something similar that unemployment in this period was caused by the COVID-19 pandemic.

During the COVID-19 recession period in NTB Province, the most volatile sector was the tertiary sector. This is evidenced by the tertiary sector output gap which was always negative for eight quarters, namely between 2020Q2 and 2022Q1 with an average of -414.26 billion Rupiah. The Central Statistics Agency (2021) explained that as many as 46.15 percent of Corporate Services, 34.02 percent of accommodation (hotels) and 22.22 percent of transportation businesses had stopped due to COVID-19 constraints. Then, the primary and secondary sectors were more stable with fluctuating output gap values (sometimes positive and negative) with an average of 45.79 and -162.79 billion Rupiah respectively.

In this condition, the central bank can implement an expansionary monetary policy by increasing the amount of money in circulation to increase consumption by the NTB community during a recession (weak economy). this. Increased public consumption will increase aggregate demand so that economic growth can increase. The government can also implement an expansionary fiscal policy by increasing NTB Provincial Government spending. The government can carry out government spending by providing direct assistance to the NTB community to spur NTB community consumption. The increase in government spending that directly targets the community will increase the RGDP value so that economic growth can increase (Juliannisa et al, 2025). Maryanti, et al. (2020) explained that the provision of this assistance had been carried out and became the focus of the NTB government when COVID-19 hit NTB Province. The NTB government has reallocated the less priority budget to accelerate economic recovery due to COVID-19.

Conclusions

The estimation of potential RGDP and output gap in NTB Province reveals several important findings. The modified HP Filter method produced a lambda of 343 for total RGDP with a CGV of 1.185507. Potential RGDP estimates for the total, secondary, and tertiary sectors displayed smooth movements that were well aligned with actual values. In contrast, the primary sector's potential RGDP appeared less responsive to economic shocks, indicating the need for more advanced approaches such as SVAR, Kalman Filter, or the Production Function method. Signs of an overheating economy were evident from 2015Q1 to 2016Q1, largely driven by the surge in mining exports from PT. Newmont Nusa Tenggara. Furthermore, the severe impact of the COVID-19 recession was observed between 2020Q1 and 2022Q2. During the overheating period, the primary sector was more vulnerable, highlighting the importance of price monitoring to mitigate inflationary pressures. Meanwhile, the tertiary sector was the most affected during the recession, suggesting that recovery strategies should focus on revitalizing this sector to strengthen potential growth.

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