**Macroeconomics Theory and Policy (ECO202)**

**2022 - 2023**

**Writing Assignment # 2**

**Name:**

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1. Introduction  
   The relationship between GDP growth and unemployment rate has been a topic of interest for economists and policymakers for decades. One of the most widely used frameworks for analyzing this relationship is Okun's Law, which suggests an inverse relationship between GDP growth and unemployment rate. However, the applicability of this law to different countries and economic contexts has been a subject of debate among economists. In this essay, I aim to explore the relationship between GDP growth and unemployment rate in Mali, utilizing Okun's Law as a framework for analysis.  
   Mali is a West African country with a rapidly growing population and economy, making it an interesting case study for this analysis. To conduct this study, I will utilize data from the World Bank on various economic and labor indicators such as GDP, inflation, and total unemployment as a percentage of the total labor force. Additionally, I will examine the concept of Phillips Curve, which suggests that there is an inverse relationship between inflation and unemployment rate.  
   Through an examination of these indicators and concepts, I aim to provide a nuanced understanding of how Okun's Law applies to Mali's unique economic context. Additionally, I will discuss the potential limitations of this model and the specific labor market challenges faced by Mali. By analyzing these factors, I aim to provide insights into how policymakers can promote sustainable growth, job creation, and overall economic stability in Mali.
2. Data
   1. I utilized the World Bank (<https://data.worldbank.org/>) as my data source: The World Bank provides my data on various economic and labor indicators, including GDP (constant LCU), inflation measured by the annual growth rate of the GDP implicit deflator, and total unemployment as a percentage of the total labor force. The GDP and inflation data are sourced from the World Bank national accounts data and OECD National Accounts data files and are reported on an annual basis. The unemployment data are sourced from the International Labour Organization's (ILO) Modelled Estimates and Projections database (ILOEST) and are reported on an annual basis as well. The license type for all three variables is CC BY-4.0. The GDP data are part of the Economic Policy & Debt topic, the inflation data are part of the Financial Sector: Exchange rates & prices topic, and the unemployment data are part of the Social Protection & Labor: Unemployment topic. The GDP and inflation data have a base period that varies by country, while the unemployment data are modeled estimates based on nationally representative labor force surveys with imputed data for countries with missing data. The ILO unemployment data also have a weighted average aggregation method and are based on the standard definition of unemployed persons. The limitations and exceptions of these variables vary depending on the specific data source and statistical concept and methodology used.
3. Data Presentation
   1. Appendix 8.1, a plot of Mali's GDP (1997-2021), reveals a positive growth trend with fluctuations due to factors like political instability, regional conflicts, and commodity price changes. Key events include the Global Financial Crisis (2007-2009), the 2012 coup d'état, and post-conflict recovery. Understanding these trends is crucial for estimating the Phillips curve and Okun's Law for Mali to inform macroeconomic policy recommendations promoting sustainable growth and stability.
   2. Appendix 8.2, a plot of Mali's inflation rate from 1997 to 2021, shows fluctuating but generally low and stable inflation rates. Key observations include periods of higher inflation in the late 1990s and early 2000s due to external and domestic factors, the impact of monetary policy from the BCEAO as part of WAEMU membership, and the relationship between economic growth and inflation. Political instability and conflict, such as in 2012, also influenced inflation rates. Understanding these patterns is crucial for estimating the Phillips curve and Okun's Law for Mali, providing insights for macroeconomic policies that promote sustainable growth, price stability, and overall economic stability.
   3. Appendix 8.3, a plot of Mali's unemployment rate from 1997-2021, reveals key trends and events influencing labor market dynamics, crucial for estimating the Phillips curve and Okun's Law in Mali. The plot shows fluctuating unemployment rates without a consistent trend. Unemployment doesn't always align with economic growth, possibly due to structural factors or sector-specific growth. Political instability in 2012 led to increased unemployment, while post-conflict recovery saw a decline. Structural unemployment and labor force challenges, such as a large informal sector, rural workforce, and low education levels, contribute to persistent unemployment.  
      In conclusion, the plot highlights the complex factors affecting Mali's labor market, essential for understanding the Phillips curve and Okun's Law relationships. These insights inform policies promoting sustainable growth, job creation, and economic stability.
   4. According to 3.4. Appendix 8.4, a plot of Mali's GDP growth rate from 1997 to 2021, reveals key trends and events impacting the country's economy, which are crucial for estimating the Phillips curve and Okun's Law:
      1. Fluctuating growth: Mali's GDP growth rate varied over time due to diverse influencing factors.
      2. High growth periods: Attributed to factors such as high commodity prices, favorable global conditions, and effective policies.
      3. Low/negative growth periods: Linked to declining commodity prices, global crises, or domestic challenges.
      4. Political instability impact: The 2012 decline in GDP growth reflects political instability and conflict.
      5. Post-conflict recovery: Mali's economy rebounded after conflict resolution and government stabilization.

These trends informs macroeconomic policies that promote sustainable growth, price stability, and overall economic stability for Mali.

* 1. In appendix 8.5, the scatter plot of Mali's Inflation Rate vs GDP Growth Rate (1997-2021) shows no clear relationship, impacting the estimation of the Phillips curve and Okun's Law for Mali.
     1. General observation: The plot displays yearly data points, but correlations or trends are not easily discernible.
     2. Phillips curve implications: The lack of a clear pattern suggests that the relationship between inflation and unemployment in Mali might be influenced by other factors.
     3. Okun's Law implications: The plot doesn't directly depict the relationship between GDP growth and unemployment; a separate plot is needed for a full assessment.
     4. Factors affecting the relationship: External shocks, structural factors, and political instability can all influence inflation and GDP growth, complicating the relationship between these variables.

In conclusion, to estimate the Phillips curve and Okun's Law relationships more accurately, it's essential to consider additional factors and analysis techniques. This can help inform macroeconomic policies for sustainable growth, price stability, and economic stability in Mali.

* 1. Different Philips Curve

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Interpretations:

* + 1. The modified version of the Phillips curve examines the relationship between inflation and output by analyzing the change in inflation rate and its relationship to GDP (Mankiw, 2014). In the equation:  
       π\_t - π\_(t-1) = a + b\*(Y\_t)  
       π\_t represents the inflation rate in the current period (t)  
       π\_(t-1) represents the inflation rate in the previous period (t-1)  
       Y\_t represents the GDP in the current period (t)  
       a and b are coefficients to be estimated
    2. The R-squared value of 0.001 suggests that the model does not fit the data well, as only 0.1% of the variation in the difference in inflation rates can be explained by GDP growth (Wooldridge, 2012).
    3. F-statistic: The F-statistic value of 0.02121 and its corresponding probability (Prob (F-statistic) = 0.886) show that there is no significant overall relationship between the difference in inflation rates and the GDP growth rate in the sample.
    4. The constant (a): The estimated constant of -0.7966 suggests that when the GDP (Y\_t) is equal to zero, the change in inflation (π\_t - π\_(t-1)) is expected to be -0.7966. However, this interpretation may not be practically meaningful, as it assumes a scenario with zero GDP, which is unlikely in a real-world context.
    5. The GDP coefficient (b): The estimated coefficient for GDP (b) is 1.819e-13, which is an extremely small positive value, close to zero. This result implies that there is little to no relationship between the change in inflation (π\_t - π\_(t-1)) and the GDP (Y\_t) in the given period. In other words, the GDP growth rate does not have a significant impact on the changes in inflation rate, based on this regression analysis.
    6. From a macroeconomic theory and policy perspective, this version of the Phillips curve indicates that other factors, such as structural elements of the economy, external shocks, or monetary policy, might play a more significant role in determining changes in inflation rate (Blanchard, 2017).
    7. It is essential to consider potential limitations of the analysis, such as omitted variables, measurement errors, or the quality of the data used. Additionally, further research using different econometric techniques or exploring other factors affecting inflation could provide more insights into the relationship between inflation and economic growth. Based on the OLS regression results, the modified Phillips curve does not show a strong or significant relationship between the difference in inflation rates and the GDP growth rate for Mali. The low R-squared value, lack of statistical significance of the coefficients, and potential issues with autocorrelation and multicollinearity suggest that this model may not be suitable for capturing the relationship between these variables in the context of Mali. Further analysis, data exploration, or alternative model specifications may be necessary to better understand the relationship between inflation and GDP growth in Mali.

1. Standard Philips Curve
   1. Based on the given results for the standard Phillips curve for Mali from 1997 to 2021, the estimated values are:  
      Alpha: 1.818871284882045e-13  
      Natural Level of Output: 4,379,744,201,283.4717 (approximately 4.38 trillion)
      1. Alpha: The estimated value of Œ± is 1.818871284882045e-13, which is an extremely small positive value, close to zero. In the context of the Phillips curve, Œ± represents the responsiveness of changes in inflation (œÄ\_t - œÄ(t-1)) to the deviation of GDP (Y\_t) from the natural level of output (»≤). The small positive value suggests that there is little to no relationship between changes in inflation and deviations from the natural level of output in Mali during the given period. This result may not align with expectations from the traditional Phillips curve theory, which predicts a more significant relationship between inflation and output gaps. (Friedman, 1968).
      2. Natural Level of Output: The estimated natural level of output for Mali is approximately 4.38 trillion. This value represents the potential GDP level when the economy is operating at full employment, with no cyclical unemployment or inflationary pressures. The actual value of this natural level of output depends on factors such as the size and structure of Mali's economy, the labor force, capital stock, and productivity. Without additional context or comparisons, it is difficult to assess whether this value is in line with expectations.
   2. From a macroeconomic theory and policy perspective, the results obtained from the standard Phillips curve analysis for Mali might not be in line with the expectations from traditional economic theories. The extremely small positive value of α indicates a weak relationship between changes in inflation and deviations from the natural level of output (Samuelson & Solow, 1960). This finding could suggest that other factors, such as structural elements of the economy, external shocks, or monetary and fiscal policies, play a more significant role in determining the changes in inflation rate in Mali.
   3. The estimated natural level of output at around 4.38 trillion provides a benchmark for evaluating the performance of Mali's economy. Policymakers can compare this value with the actual GDP levels to identify potential output gaps and design appropriate macroeconomic policies to promote sustainable growth, price stability, and full employment.
   4. It is essential to consider potential limitations of the analysis, such as omitted variables, measurement errors, or the quality of the data used. Additionally, further research using different econometric techniques or exploring other factors affecting inflation and output gaps could provide more insights into the relationship between inflation and economic growth in Mali. This deeper understanding can help inform macroeconomic policies that promote sustainable growth, price stability, and overall economic stability for the country.
2. Different Okun’s Law
   1. Table

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      This different version of Okun's Law being estimated is the first-difference form, as follows:  
      u\_t - u\_(t-1) = a + b \* g\_(yt)  
      Here, u\_t represents the unemployment rate at time t, u\_(t-1) is the unemployment rate at time t-1, and g\_(yt) is the GDP growth rate at time t. The coefficients a and b capture the constant term and the relationship between changes in the unemployment rate and GDP growth, respectively.  
      Based on the OLS Regression Results provided:
      1. Constant term (a): The estimated constant term is 0.2546, indicating that, on average, the unemployment rate would increase by 0.2546 percentage points if there were no changes in GDP growth.
      2. GDP growth coefficient (b): The estimated coefficient for GDP growth is -4.2473, suggesting that a 1% increase in GDP growth is associated with a decrease in the unemployment rate of approximately 4.25 percentage points. This result aligns with the general concept of Okun's Law, which posits that higher GDP growth leads to a reduction in unemployment.
      3. F-statistic: The F-statistic value is 2.669, which is used to test the overall significance of the regression model. A higher F-statistic value would indicate a stronger relationship between the variables. In this case, the F-statistic value of 2.669 is relatively low, suggesting that the relationship between changes in the unemployment rate and GDP growth might not be particularly strong or statistically significant.
      4. R-squared: The R-squared value is 0.108, which implies that approximately 10.8% of the variation in the change in the unemployment rate can be explained by GDP growth in this model. This relatively low R-squared value indicates that the model does not fit the data particularly well, and there may be other factors not included in the model that play a more significant role in determining changes in the unemployment rate.
   2. When interpreting the results in the context of macroeconomic theory and policy, it is essential to consider the following:
      1. Limitations of the model: The low R-squared value and F-statistic suggest that this version of Okun's Law may not adequately capture the relationship between changes in the unemployment rate and GDP growth for the given dataset. There may be other variables or factors that contribute to the unemployment rate dynamics that are not included in this simple model.
      2. Structural factors: As mentioned earlier, Mali's economy is characterized by a large informal sector, a predominantly rural and agricultural workforce, and low levels of education and skills development. These structural factors may contribute to persistent unemployment and underemployment, even during periods of economic growth, thus weakening the relationship between GDP growth and the unemployment rate.
      3. Additional considerations: To better understand the relationship between GDP growth and the unemployment rate, it may be helpful to explore other forms of Okun's Law or incorporate additional variables that could influence the unemployment rate, such as changes in labor force participation, demographic factors, or sectoral shifts in employment opportunities. Incorporating these additional factors into the analysis can provide a more comprehensive understanding of the relationship between GDP growth and the unemployment rate.
      4. Policy implications: Although the estimated relationship between GDP growth and the unemployment rate in this model is not particularly strong, the negative coefficient for GDP growth (-4.2473) still supports the general idea that higher economic growth is associated with lower unemployment. Policymakers should focus on promoting economic growth through measures such as fostering a business-friendly environment, investing in infrastructure, and supporting education and skills development. However, given the potential limitations of this model and the influence of structural factors, it is also essential for policymakers to address the specific labor market challenges faced by Mali, such as the large informal sector and the need for increased access to education and training opportunities.
   3. In conclusion, the estimated version of Okun's Law presented in this analysis suggests that higher GDP growth is associated with a reduction in the unemployment rate, but the relationship is not particularly strong or well-explained by the model. Further research and analysis, taking into account additional factors and alternative versions of Okun's Law, may provide a more accurate and nuanced understanding of the relationship between GDP growth and the unemployment rate. This understanding can help inform macroeconomic policies that promote sustainable growth, job creation, and overall economic stability for Mali.
3. Standard Okun’s Law
   1. The estimated Okun's Law function is given by:  
      u\_t - u\_(t-1) = -β\*(g\_(yt) - g)  
      where u\_t is the unemployment rate at time t, u\_(t-1) is the unemployment rate at time t-1, g\_(yt) is the GDP growth rate at time t, and g represents the average GDP growth rate over the analyzed period. The coefficient β captures the relationship between the change in the unemployment rate and the deviation of GDP growth from its average value.
   2. Based on the provided results:
      1. Beta (β): The estimated β value is 4.2473, which is positive. This suggests that an increase in GDP growth above its average rate leads to a decrease in the unemployment rate, and vice versa. The positive sign of β aligns with the general expectation from Okun's Law, indicating that higher GDP growth is associated with lower unemployment. The magnitude of β (4.2473) implies that a 1% increase in GDP growth above the average rate is associated with a decrease in the unemployment rate of approximately 4.25 percentage points. This relatively large effect suggests that economic growth can have a substantial impact on reducing unemployment in Mali.
      2. g: The estimated average GDP growth rate (g) is 0.0599, or approximately 5.99%. This value represents the long-term average GDP growth rate for Mali over the analyzed period (1997-2021). Given the historical context, including periods of high growth and contraction, this value seems plausible.
      3. The size and sign of β and g are in line with general macroeconomic theory and policy expectations:
      4. The positive β value supports the idea that economic growth is essential for reducing unemployment. Policymakers should focus on promoting economic growth through measures such as creating a business-friendly environment, investing in infrastructure, and supporting education and skills development.
      5. The estimated average GDP growth rate (g) provides a benchmark for evaluating the performance of the Malian economy. Policymakers can use this value to assess whether current and future GDP growth rates are above or below the long-term average, which can help inform macroeconomic policies and strategies aimed at fostering economic growth and reducing unemployment.
   3. In conclusion, the estimated Okun's Law function for Mali from 1997 to 2021 reveals a positive relationship between GDP growth and unemployment reduction, consistent with macroeconomic theory and policy expectations. This relationship highlights the importance of promoting economic growth to address unemployment challenges and improve overall economic stability in Mali.
4. Conclusion:

In conclusion, this essay has explored the relationship between GDP growth and unemployment rate in Mali, utilizing Okun's Law as a framework for analysis. Through an examination of various economic and labor indicators, including GDP, inflation, and total unemployment as a percentage of the total labor force, I have gained insight into how this law applies to Mali's unique economic context (Okun, 1962). My analysis has revealed that while there is a positive relationship between GDP growth and unemployment reduction in Mali, this relationship is not particularly strong or well-explained by the model. Additionally, I have discussed the potential limitations of this model and the specific labor market challenges faced by Mali.

Furthermore, I have examined the concept of Phillips Curve which suggests that there is an inverse relationship between inflation and unemployment rate. By analyzing these factors together, I have provided a nuanced understanding of how policymakers can promote sustainable growth, job creation, and overall economic stability in Mali.

Overall, my findings suggest that while Okun's Law provides a useful framework for understanding the relationship between GDP growth and unemployment rate in Mali, it is important to consider additional factors and analysis techniques to estimate these relationships more accurately. Policymakers must address specific labor market challenges faced by Mali to promote sustainable growth and job creation. This includes increasing access to education and training opportunities to improve human capital development and addressing structural factors that may limit job creation in the formal sector (Ball et al., 2013).

In conclusion, this essay has provided insights into how policymakers can promote sustainable growth, price stability, and economic stability in Mali by analyzing Okun's Law and Phillips Curve together with other relevant factors.

1. Appendix:
   1. Mali GDP (1997 – 2021)  
      Chart, line chart

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   2. Mali Inflation Rate (1997 – 2021)  
      Chart, line chart

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   3. Mali Unemployment Rate (1997 – 2021)  
      Chart, line chart

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   4. Mali GDP Growth Rate (1997 – 2021)  
      Chart, line chart

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   5. Mali Inflation Rate vs GDP Growth Rate (1997 – 2021)  
      Chart, scatter chart

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2. References:
   1. Blanchard, O. (2017). Macroeconomics (7th ed.). Pearson.
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   6. Samuelson, P. A., & Solow, R. M. (1960). Analytical aspects of anti-inflation policy. The American Economic Review, 50(2), 177-194.