Testing Phillips Curve in Sweden

Vanja Šimičević
Libertas International University, Croatia
Emil Lekavski
Libertas International University, Croatia

Abstract

The study aims to research the correlation between unemployment and inflation in Sweden between March 2020 - November 2021 to provide further insight into the validity of the Phillips curve. Previous research has found a contradictive relationship between unemployment and inflation. In addition, shifting market trends with lower globalization and higher inflation provide attention to evaluate the Philips curve. The focus is on Sweden because it is a small country with a high level of dependency on trade and technology. For that purpose, an econometric analysis has been applied to Swedish unemployment and inflation data between March 2020 - November 2021 to generate the correlation and examine the validity of the Phillips curve. The results indicate a weak linear relationship, suggesting that other variables than inflation have a more significant effect on unemployment than inflation. A possible explanation might be the inflation target that the Swedish Central Bank (Riksbanken) implemented in 1993, which contributed to a stable inflation level until 2021

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Introduction

The Phillips curve is an economic theory that claims that inflation and unemployment have an inverse relationship. Thus, if unemployment goes up, inflation tends to go down. If unemployment goes down, inflation tends to go up. According to the theory, people earn more money to spend as people are employed. At the same time, businesses employ more people, increase production, and boost wages to get more workers (Picardo, 2022). After COVID-19, new market dynamics have appeared globally with higher inflation rates. According to the Phillips curve, unemployment will decrease with higher inflation. In general, the theory is all about demand. However, during Covid-19, there has been a market disruption in the supply chain. The new circumstances of the economy provide an opportunity to evaluate the validity of the Phillips curve. However, the validity of the Phillips curve has been questioned. In the 1970s, stagflation disproved the theory of high inflation and high unemployment. Moreover, in the 1990s, there was an economic situation with low unemployment and inflation worldwide (Picardo, 2022). This indicates that other variables are more likely to affect unemployment than inflation.

Critics of the Phillips curve emphasize that we live in another economic dynamic than in the 1960s when the theory emerged. For example, the labour and product markets are more competitive today than in the 1960s due to globalization and technological development. These factors can decrease the production cost for companies and contribute to lower consumer prices, affecting the Philips curve's validity (Borio et al., 2018). Another factor that might affect the Phillips curve, at least in the short term, is the Central Bank's monetary policy. A study from the Swedish Central Bank indicates that a change in the monetary policy might break the connection between unemployment and inflation in the overall economy. At the same time, there is still a connection at the company level (Frohm, 2019). In general, studies confirm and deny the relationship between unemployment and inflation. The previous chairman of the Federal Reserve, Janet Yellen, has pointed out that more studies on the subject might contribute to the need for more inflation forecasts. Therefore, new data should supplement the Phillips curve to strengthen its credibility since the model is vital for monetary policy but should be questioned (Yellen, 2015). With this in mind, this study will focus on the validity of the Phillips curve in Sweden between March 2020 - July 2023. Such a study will be interesting from two aspects. The first aspect is that globalization peaked in 2008, and the trend has decreased even more after the Covid-19 pandemic. Nowadays, many multinational companies are engaged to have product lines more domestically (Diehn, 2022).

Furthermore, the inflation level was low until 2021, when the Central Bank started to change its monetary policy and raise interest rates. The second aspect is that Sweden is a small country with a high dependency on trade and a high technological level (Frohm, 2019). Therefore, by studying the Phillips curve from the angle of monetary policy and globalization, the model should still be intact in Sweden between March 2020 and July 2023. However, since Sweden is a country that trades a lot and has a high technological level, it should indicate the opposite. Because of this, this study will increase the clarity of unemployment and inflation and strengthen the Philips curve's credibility.

During the 1970s and 1980s, Sweden (like most countries worldwide) had problems with high inflation, and it was expected to exceed 10% annually. Due to the high inflation levels, it was hard to anticipate expectations for the economy in the future, and it could have been more convenient for companies and households to make sound economic decisions. This entailed uncalculated choices for prices and wages,

which only increased the high inflation (Riksbanken, 2018). 1992, the Swedish economy faced additional problems with an international low conjuncture and currency speculation. The German reunification and the interchange from Ostmark to D-mark to the course 1:1 caused an outflow of capital. While other European countries and the USA had low growth, Germany had high inflation, making them raise their interest rates. Then, a vast capital inflow started in Germany due to its high economic competitiveness (Riksbanken, 2018a).

Meanwhile, Sweden was unprepared for this development, and its competitiveness was not good, making the financial system fragile. The Central Bank in Sweden started raising interest rates dramatically but failed. Moreover, real estate companies in Sweden were highly indebted during that time, which caused a banking crisis. The Swedish crone was also an object for speculation. The Central Bank tried to stop the outflow of capital in Sweden and decided to raise the interest rate by 500% in 1992. However, this and other interest rate measures did not help; there was no trust for the Swedish crone internationally. The investors continued to choose other currencies before the Swedish crone, and millions of crones left the country. Finally, the Central Bank let the Swedish crone float to other currencies, which would take many years to recover.

However, those years were an essential lesson for the Central Bank in Sweden, and a new monetary policy was soon imposed. In 1993, the Central Bank announced an inflation target of 2% to create price stability and a foundation for long-term sustainable growth. The inflation target came into force in 1995. Eventually, it helped the economy recover and decreased price development insecurity. Companies and customers no longer had to worry about higher interest rates and borrowing costs, and the willingness to invest increased (Riksbanken, 2018). With the new monetary policy, Sweden was now among the first countries in the world with a floating currency and a clear inflation ambition. The new monetary policy was one of the main reasons Sweden averted the financial crisis in 2008 compared with other countries (Riksbanken, 2018b).

Literature Review

The Phillips curve is an economic theory from the study "The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861-1957" by the New Zeeland-born economist William Phillips. His analysis found a correlation between nominal wages and unemployment in the United Kingdom between 1861 and 1957. The economy tends to be at a high conjuncture when low unemployment increases inflation (Phillips, 1958). A few years later, the American economists Phelps (1967) and Friedman (1968) criticized the model by arguing that inflation expectations are the most crucial factor in which companies and people decide about wages and prices for goods and services. Furthermore, they argued that there is a short-term negative connection between unemployment and inflation but no long-term correlation. In other words, expecting a permanent connection between unemployment and inflation should not be possible. One of the first studies that verified the Phillips curve was written in 1960 by the American economists Samuelson and Samuelson (1960). Their study focused on data from the American economy between 1900 - 1960 and argued that a marginal increase in inflation could reduce the unemployment rate. It is essential to mention that their findings played a role in the Federal Reserve's monetary policy during the Great Inflation in the 1960s and the 1970s. Another researcher to verify the hypothesis was Gordon (1970), who used data from the US between 1951 and 1969. In his study, he applied a wage and

price equation to analyze if the cost of lowering the unemployment rate will result in higher inflation. He could find support for his hypothesis.

On the other hand, Friedman (1968) states a low correlation between unemployment and inflation rates, at least in the long term. According to his findings, companies tend to respond to an unexpected demand rise by accelerating production and adjusting prices. However, people will respond to the shift in demand slower than companies since they expect price stability. Thus, in the short term, higher inflation will lead to lower real wages and a higher employment rate since people react slower to inflation expectations. In the future, people will demand higher wages to match the increasing prices, making the workforce more expensive. Therefore, unemployment will be pushed back to its natural level in the long term.

Phelps (1967) argued that the Phillips curve is only valid if the companies underestimated the inflation expectations, which is unlikely. Phelps (1967) and Friedman (1968) state that unemployment and inflation could have a short-term negative correlation. However, in the long term, people will require higher wages, pushing unemployment back to its natural level. The research of the Phillips curve declined in the 1980s, even though it still was an important tool to direct monetary policy. However, in the 1990s, new studies analyzed the Phillips curve's short-term impact. For example, Laxton et al. (1994) analyzed whether the Phillips curve could be applied to the G7 countries and found support for the hypothesis.

In contrast, King et al. (1995) wrote a study about the correlation between unemployment and inflation during the 1970s. They could not confirm the hypothesis in the US and some other countries. Their study also analyzed the Phillips curve in different conjuncture cycles and found a significant negative correlation between 1954 and 1994. A few years afterwards, the researchers Debelle et al. (1997) could confirm that the Phillips curve is still valid in countries like the US, Canada, and the UK. During the early 2000s, Seyfried et al. (2001) analyzed the Phillips curve in the short term in the G7 countries and found contradictory results. There was a correlation between unemployment and inflation in countries like the US, Canada, France and Italy.

Meanwhile, they could not find support in countries such as the UK, Germany, and Japan. Moreover, Bhattarai (2016) analyzed whether the Phillips curve was valid in 28 OECD countries during 1990 - 2014 and showed a stronger connection between the variables in some countries than in others. Another study by Ho et al. (2018) analyzed the Phillips curve on a selection of EU countries and could confirm a correlation between the variables, at least in the short term. Frohm (2019) conducted a case study in Sweden using microdata for companies on behalf of the Swedish central bank. He focused on the company level because the monetary policy does not react to certain company events. Based on this, he concluded that the Phillips curve seems valid in Sweden.

The summary shows an unclear relationship between unemployment and inflation since the correlation grade often depends on countries and periods. Since the Phillips curve is a tool for Central Banks worldwide to formulate monetary policy, it is necessary to conduct studies focusing on the correlation in specific countries. Therefore, this study will fill a gap in the current research by focusing on Sweden and contribute to more insights on the subject.

Sweden's Economy

Sweden is a Scandinavian country with 10,45 million people (SCB, 2022). The country is a monarchy, and the capital is Stockholm, with approximately 1 million inhabitants. According to statistics from the OECD, the nine most wealthy countries worldwide

based on purchasing power adjusted GDP. In the 1970s, Sweden was in fourth place, but it decreased, especially after the crisis in the 1990s (Amelius, 2022). Since Sweden is one of the biggest European countries, it has access to many natural resources, such as iron ore, hydroelectric, and forests. The wide variety of natural resources explains why Sweden is one of the most industrialized countries in Europe and has a well-developed welfare system. Due to its highly developed industry, Sweden has historically been famous for exporting transport vehicles, telecom, and electronic equipment (Globalis, 2022).

Sweden is an open economy and highly depends on selling goods and services internationally. In 2021, the total export of goods and services was 230 billion Euros. Since the middle of the 1980s, Sweden has exported more goods and services than it has imported, meaning it has a surplus in the balance of payments. The surplus is a crucial explanation of why the Swedish GDP and the overall economy are growing (SCB1, 2022). However, the dependency on exports to other countries makes Sweden vulnerable to low conjunctures worldwide. For example, when other countries witness a decline in their economic activities, they will buy fewer products from Sweden. Therefore, the economic situation in the world is essential for the Swedish economy, and a global recession tends to affect it significantly (Globalis, 2022). Today, about 70% of the exports are goods, and the rest are services. The European market is the most important in that around 72% of all goods and services are exported. Norway and Germany are the most important trade partners, which export 11% of the total (SCB1, 2022). Recently, trade with the US and Asia has grown but is still a tiny part of the total export (Globalis, 2022). The financial crisis of 2008 caused a significant interruption in the Swedish economy, where the GDP dropped by 4%. Not since the 1950s has the Swedish economy faced such a decline (Amelius, 2022). However, the decline was not extended due to the government's expansive monetary policy.

With significant investments in infrastructure and healthcare, Sweden saw economic growth in 2010. The Euro crisis caused minor interruptions, but Sweden did well compared with other countries in the West (SCB1, 2022). Since 2016, the Swedish economy has been in a high conjuncture, but the coronavirus crisis in 2020 changed the circumstances. During the second quarter of 2020, the Swedish GDP dropped by 8.1% from the quarter before, which is the most significant quarterly drop measured. However, the Swedish economy has recovered to pre-pandemic levels, but the prospects for the upcoming quarters could be more favourable (Amelius, 2022). Due to high inflation levels, the central bank in Sweden has to promote a restrictive monetary policy with higher interest rates and quantitative tightening. Thus, the population's purchasing power and economic stimulation will decrease. Companies face higher borrowing costs, and necessary investments are postponed. High electricity costs pressure entrepreneurs with higher production costs, leading to higher consumer prices and inflation (Krantz, 2022). Another worth mentioning is that the average household debt level is the second largest in Europe. Every citizen between 16-65 has an average debt of approximately 56 920 Euros (Forsberg, 2021). Therefore, the manoeuvre space for the central bank might be restricted since they must find a balance between slowing down the economy and fighting inflation but not destroying it too much.

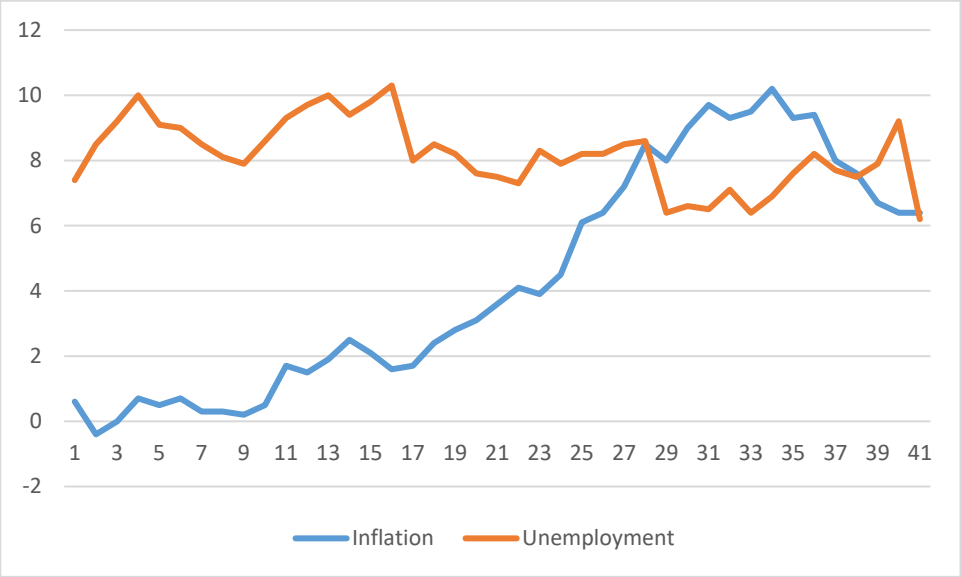
Problem Formulation

Even though the Philips curve has been questioned, the Central Bank in Sweden still uses it to formulate adequate policy (Frohm, 2019). Given the new economic circumstances with significantly higher inflation and interest rates and lower

globalization worldwide, there is an opportunity to evaluate the validity of the Philips curve from a Swedish context. According to the Philips curve, unemployment should decrease with higher inflation, suggesting an inverse relationship between the variables.

However, the validity of the Philips curve has been questioned. In the 1970s, stagflation disproved the theory of high inflation and high unemployment. Moreover, in the 1990s, there was an economic situation with low unemployment and inflation worldwide. This indicates that other variables are more likely to affect unemployment than inflation. With this in mind, the thesis will explain the correlation between the inflation rate and the unemployment rate in Sweden between March 2020 – July 2023. Given the new economic circumstances, this analysis will shed more light on whether the Philips curve is still relevant. There is inflation when the price levels increase, meaning the money's worth decreases. Therefore, the income must rise to correlate with the purchasing power. It is possible to measure inflation differently, but the most common is measuring prices and comparing over time in a price index. The most common way to measure inflation is to detect differences in the consumer price index (KPI) (SCB, 2022).

Figure 1
Inflation rate and Unemployment rate in Sweden March 2020 – July 2023.



Source: Author's illustration, according to SCB 2023.

The consumer price index (KPI) shows the price development of households' goods and services. For example, if inflation rises by 1.7% over the last month, consumer prices will also rise by the same percentage as last month. Another measurement of inflation is the KPIF, which is the same as the KPI, but the effects of interest rate changes on household housing loans are excluded. Since September 2017, the central bank in Sweden has used the KPIF to measure the inflation target. Therefore, this research will also use KPIF to measure the inflation rate in Sweden between March 2020 - March 2023.

The definition of *unemployment* is the proportion of the unemployed labour force. In other words, it is the difference between the number of employed and unemployed people. This research measures the total unemployment rate between 15 and 74

years. Thus, the measurement that will be used in the study is AKU. More specifically, in AKU, a person counts as unemployed if they are not employed but can start work within 14 days and has actively tried to find a job during the last four weeks or is waiting to start a job within more than three months of the measurement. Persons laid off or with reduced working hours are not counted as unemployed (Torstensson, 2022).

Methodology

This study aims to explain the correlation between the inflation rate and the unemployment rate in Sweden between March 2020 – July 2023. For that purpose, econometrics methods are applied. Econometrics uses data, statistical inference methods, and structural and descriptive modelling to address rigorous economic problems. Its development in finance is relatively recent and has been paralleled by a fast expansion of financial markets and an increasing variety and complexity of financial products. With the goal of up-to-date information—essential in today's rapidly evolving financial environment, the focus is on methods related to previous research and those modelling techniques that seem relevant to future advances. A balanced synthesis of financial theory and statistical methodology is presented. Recognizing that any model is necessarily a simplified image of reality and that econometric methods must be adapted and applied case-by-case by establishing a link between practical questions and the answers provided by financial and statistical theory (Gourieroux & Jasiak, 2022). *A positivistic approach* indicates collecting and analyzing data to reality (Bryman, 2011). A positivistic approach is suitable since this study will explain the correlation between the inflation rate and the unemployment rate in Sweden between March 2020 - July 2023. The empirical data are collected from two web pages: Statistic Sweden and Ekonomifakta. More specifically, the inflation rate data between March 2020 - July 2023 was collected from Statistics Sweden, and the corresponding employment rate data is from Ekonomifakta. These web pages are reliable since Statistic Sweden is responsible for official statistics in Sweden, and Ekonomifakta collects its data from institutions such as Statistic Sweden (SCB), OECD, and Eurostat. Deductive theory is a scientific method by which a hypothesis is derived from an existing theory.

When a hypothesis is derived from a current theory, it is tested on empirical material or data. If the hypothesis is correct with the empirical material or data, the hypothesis has been strengthened (Esaiasson et al., 2012). Thus, the hypothesis in this study has been derived from the Philips curve. If the Philips curve is still relevant, there should be an inverse relationship between the inflation rate and the unemployment rate in Sweden between March 2020 - July 2023. Furthermore, the hypothesis will be tested on empirical data showing Sweden's inflation and unemployment rates during that period. When the analysis is done, it will show whether the hypothesis is valid and provide insight into whether Sweden's Central Bank should use the Philips curve to formulate a policy.

Finding a significant correlation between two variables might be problematic. Even though there is a possible correlation between unemployment and inflation, it might not appear when using statistical methods. Most likely, unemployment has a closer connection with reforms in the labour market than inflation. The same applies to inflation, which is closer linked to food or oil prices. However, unemployment and inflation could have a closer impact on each other, even though the thesis shows differently. Thus, to show the validity of the Philips curve and whether it is a suitable tool for Central Banks worldwide, some method other than econometrics might be required.

The Phillips Curve

The Phillips curve is a concept in economics and econometrics developed to represent the link between unemployment and inflation. It shows an inverse link between the two variables, which means that while unemployment tends to reduce, inflation tends to increase, and vice versa. This suggests that there is an inverse relationship between the two variables.

Based on practical data, economist A.W. Phillips developed the Phillips curve for the first time in the 1950s and named it after himself. He discovered that the inflation rate in wages was inversely proportional to the level of unemployment in the United Kingdom. Nevertheless, the idea has progressed through the years and has been honed by additional research as time passes. Examining data from the past to see how inflation and unemployment are related to one another is a necessary step in the testing of the Phillips curve. Several different econometric methods can be utilized to accomplish this goal. Estimating a statistical model with data on unemployment and inflation is a typical strategy that can be taken. One type of statistical model that can be used is a regression model. The model may incorporate supplementary variables to account for other potential influences on the connection. There are several variations of the Phillips curve, the most well-known of which are the "short-run Phillips curve" and the "expectations-augmented Phillips curve." The original version of the Phillips curve was referred to as the "long-run Phillips curve." The latter reflects that individuals' expectations of future inflation play an important part in shaping current inflation levels. The Phillips curve could be adjusted to consider factors that measure inflationary anticipations in this scenario.

Evaluating the statistical significance of the predicted coefficients in the regression model and determining how well the model fits together are required steps in testing the Phillips curve. The stability of the Phillips curve connection over time may also be investigated by researchers interested in determining whether or not it is robust throughout various economic conditions or historical periods. It is important to remember that the Phillips curve has been criticized, and empirical objections have been presented. Due to the inverse relationship between inflation and unemployment, which has sometimes become weaker or wholly broken down, the idea has become less dependable in specific contexts. Additionally, the relationship between inflation and unemployment can be complicated by factors such as supply shocks, changes in productivity, and pay rigidities.

This section will describe the Philips curve derived from the hypothesis. Since the theory is essential to understanding the research objective, this will bring clarity to the reader. Furthermore, the data that has been collected will be defined and clarify what is meant by the inflation rate and unemployment rate. Different definitions of the concepts can occur; therefore, it is essential to clarify what is analyzed. The study's validity will be strengthened by defining the inflation and unemployment rates. The Philips curve is an economic theory that suggests a correlation between inflation and unemployment rates. When the inflation rate rises, the unemployment rate should decrease, making the relationship between the variables inverse. A. W. Philips developed the theory in 1958 and claimed that economic growth stimulates inflation, increasing job opportunities and lowering unemployment. Businesses will increase their investments and hire more people when the economy grows. Therefore, there will be more demand for labour, increasing wages. As more people get employed, they have more money to spend, stimulating higher inflation (Hoover, 2008).

However, the Philips curve has been disproven several times during history. For example, during the stagflation years in the 1970s, inflation and unemployment rates

increased. At the beginning of the 1990s, it was a reversed situation with low inflation and unemployment. Since the theory has been disproven, researchers believe that the Philips curve is broken, and there are more likely other factors that cause a change in the inflation rate and unemployment rate. However, Central Banks worldwide still use the Philips curve to formulate a monetary policy (Picardo, 2022).

The chapter begins with the assumption that the null hypothesis is true: There is no correlation between the inflation rate and the unemployment rate in Sweden between March 2020 - July 2023.

Correlation and Regression Analysis

A correlation between two variables is the strength of the linear connection, which can be positive or negative (Bryman, 2011). There are several methods available to calculate the correlation between two variables. However, the choice fell on the Pearson linear regression in this research paper. The choice of method was made because it is suitable for bivariate analysis.

In this research, the variables are defined: the dependent variable on the financial performance of the Y-variable is the unemployment rate, and the independent X-variable is the inflation rate in Sweden between March 2020 - July 2023. Pearson r is a coefficient that determines the strength of the connection between two variables and values between 0 and 1. A coefficient close to 1 indicates a strong relationship between the variables, while a close to 0 indicates a weaker connection. Again, mentioning that the coefficient can be positive and negative is crucial, showing the relationship's direction. Furthermore, a correlation of more than 0,7 indicates a strong relationship, while 0,5 or more suggests some relationship (Körner & Wahlgren, 2015).

The equation gives the estimated linear regression model.

$$\hat{y}_i = b_0 + b_1 x_1 + e_i \quad (1)$$

where b_0 and b_1 are the estimated values of the coefficients and *ei* is the difference between the predicted value *Y* on the regressionon line, defined as

$$\hat{y}_i = b_0 + b_1 x_1 \quad (2)$$

and the observed value *yi*. The difference between $y\hat{}_i$ and *yi* for each value of *X* is defined

as the residual

$$e_i = y_i - \hat{y}_i \quad (3)$$

Thus, for each observed value of *X,* there is a predicted value of *Y* from the estimated model and an observed value. The difference between the observed and predicted values of *Y* is defined as the *residual* e_i . The *residual*, e_i , is not the model error but is the combined measure of the model error and errors that result because b_0 and b_1 are sample results and, thus, subject to random variation or error; in turn, this leads to variation or error in estimating the predicted value. The estimated regression model is determined by obtaining estimates b_0 and b_1 of the population coefficients using the least squares analysis process (LSM). These coefficients are, in turn, used to obtain

predicted values of *Y* for every value of *X*. Regression analysis produces several random variables such as b_0, b_1, and $y\hat{}$, which are linear functions of *e*, the error-term random variables in linear regression. (Newbold et al., 2020). Regression analysis is a suitable method when describing if a change in one variable could be described with a change in another. The Pearson ***r*** between the two variables will be produced through regression analysis. The ordinary least squares method estimates the cross-section linear regression model (Kennedy, 2008).

A difficulty with the quantitative approach is determining to which extent a result can be generalized to the population. There is always a risk of sampling or selection errors. If there is a sampling error, the sample will not represent the whole population, and the finding will not be sufficiently valid (Bryman, 2011). Therefore, a regression analysis will provide the value *p*, which shows the statistical significance of the research. The statistical significance indicates how reliable or trustworthy the results are and can be generalized to the population from the sample. Social scientists believe that the acceptable statistical significance is $p < 0.05$. This means that the results are not likely to be due to chance or coincidence.

Furthermore, a regression analysis will show an *R Square value* (Coefficient of determination), indicating how much variation in one variable depends on the variation in the other. The *R Square* will be presented in the study but will not be analyzed further since the purpose of the study is not to explain why the connection has occurred. Moreover, it will provide insights into the reliability of the study.

Reliability, Validity and Replicability

When conducting quantitative research, an important term to mention is reliability, which indicates whether the measurements in this study capture what it intends to (Bryman, 2011). Since this study intends to measure the correlation between unemployment and inflation in Sweden between March 2020 – July 2023, it is essential to collect the data from trustworthy sources. The data of this study are compiled from two prominent institutions, Swedish Statistics (SCB) and Ekonomifakta. In addition, all results in the study will be tested for statistical significance. Based on this, the stability of the measurements should be high. Another advantage to using secondary data is that it is available for everyone, making it cheaper and saving research time.

Moreover, the study will also fulfil the requirement of replicability due to the transparency of the method. Thus, another researcher could easily use the same process and collect the same data to produce the same results. The term validity explains whether the measurements in the study are relevant according to its purpose. Thus, high validity minimizes the risk of systematic measurement errors in the analysis. The study focuses on analyzing whether the Phillips curve is still relevant in Sweden between March 2020 – July 2023. Hence, unemployment and inflation should be appropriate for the thesis because the literature review has confirmed that those are the main variables for the Phillips curve. Generally, using the same variables as already established studies will strengthen the validity.

Generally, there are at least two types of validity relevant to the research: internal and external. Internal validity explains the degree of confidence that other factors or variables do not influence the variables tested. Hence, this criteria will be hard to fulfil since it has already been mentioned that other variables, such as market structure, affect unemployment more than inflation. On the other hand, oil prices will affect inflation more than unemployment. Since this concern has already been raised and the study results will be discussed from this context, the internal validity will at least be fulfilled in the best way possible. External validity describes to which extent the study

results can be generalized to other populations. In quantitative studies, the sample size tends to affect the results and their generalization.

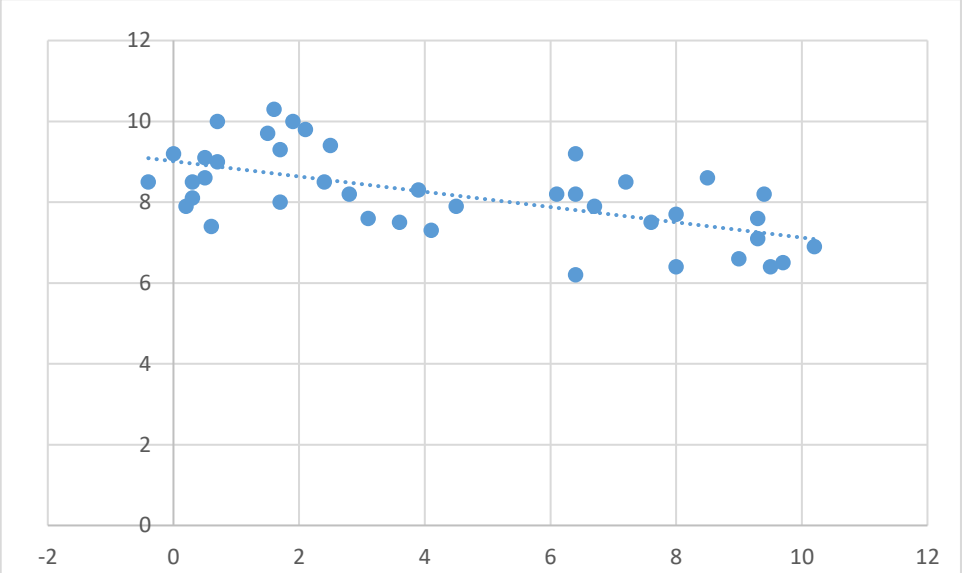
Therefore, the correlation between unemployment and inflation in Sweden might generate another result depending on the year analyzed. The scope of the study does not give room for more detailed research, and with this in mind, it would not be appropriate to generalize the results to other populations. Moreover, since this is a case study, there would be better options than generalizing the results to other countries.

Results

This chapter analyzes the correlation between the inflation rate and the unemployment rate in Sweden between March 2020 – July 2023. A regression analysis generated the following values: Pearson *r*, the value p showing statistical significance, and the *R Square* value.

The first step of the analysis is to create a scatter plot that shows the linear relationship between inflation and unemployment in Sweden between March 2020 – July 2023. Such a model will provide a visual picture of whether the inflation and unemployment rates are linearly related.

Figure 2
A scatter plot of Inflation rate and Unemployment rates in Sweden between March 2020 – July 2023.



Source: Author's illustration, according to SCB 2023.

The scatter plot indicates a strong inverse linear relationship between the variables. It is possible to identify that most points are away from the trend line due to the relationship.

Furthermore, the scatter plot shows that the *R Square* value is 0,3833. This means that approximately 38.33% of the variation in unemployment is dependent on inflation. The next step will show more concrete analysis numbers and interpret the correlation between the inflation rate and the unemployment rate in Sweden between March 2020 - July 2023. It is possible to confirm the strong inverse linear relationship between

inflation and unemployment (*r* = -0,62). The *r-value* being over 0.5 indicates that there is a negative correlation between the inflation rate and the unemployment rate in Sweden between March 2020 - July 2023. However, since the r-value is not over 0,7, it is not a strong relationship but indicates some negative relationship between the two variables. So far, it is possible to see a strong inverse linear relationship between the inflation rate and unemployment rate in Sweden between March 2020 - July 2023. Despite that, it is possible to see an inverse relationship between inflation and unemployment; the variation in the unemployment rate in Sweden is most likely dependent on variables other than the inflation rate. In other words, the analysis shows that the unemployment rate is connected to at least another variable other than the inflation rate. At the same time, the results still give some insights that the Phillips curve is still relevant in Sweden to some extent based on the empirical data used in the research since it confirms the inverse relationship between the inflation rate and the unemployment rate. Hence, it is possible to formulate a null hypothesis that inflation and unemployment rates are not related in Sweden between March 2020 and July 2023. However, it does not show to which extent the null hypothesis can be applied to the population. Therefore, the next step will be to determine to which extent the results are reliable and trustworthy, showing statistical significance. The rest of the regression analysis represents some interesting values. The values in the square of *Significance F* show the statistical significance. Since the number is approximately 1,59-05, it is far below the acceptable $p < 0,05$. Therefore, the sample has evidence to reject the null hypothesis, which indicates no correlation between the inflation rate and unemployment rate in Sweden between March 2020 - July 2023, confirming the inverse relationship in which the Phillips curve is adequate. The results have statistical significance and could also be connected to other populations. In other words, the negative correlation between the inflation rate and unemployment rate in Sweden confirms the Phillips curve moderately, and the results could also be generalized.

However, it is important to mention that the sample size is higher than the acceptable level. The inflation rate in Sweden has been relatively low until the last 4 - 5 months of 2021, which could explain why the correlation between inflation and unemployment is negative. Therefore, it is essential not to draw too much conclusions from this analysis. If the inflation rate rises for more months, it might give another *R-value*. In any case, this study indicates that there are most likely other variables that affect unemployment more than the inflation rate in Sweden based on the collected data. Suppose the inflation levels continue to exceed the target of 2% over the upcoming years. In that case, it will certainly be interesting to conduct a similar study in the future, especially if we see higher fluctuations in the unemployment rate. The 38% suggests that it is more likely that other variables affected the unemployment rate more than inflation in Sweden between March 2020 - July 2023 than the inflation rate.

The negative sign of the correlation coefficient confirms the validity of the Philips curve theory because it represents the inverse measure of the inflation rate and unemployment rate. This result indicates that the unemployment rate decreases by approximately 0,19% per month from March 2020 - July 2023. Furthermore, they argued that there is a short-term negative connection between unemployment and inflation but not a long-term correlation (Friedman, 1968).

Researching the history of the correlation between the unemployment rate and inflation rate in Sweden, oscillations of that indicator are observed in Table 1.

Table 1
Range of Values for the Correlation Coefficient in Sweden from 1830 -2021.

Year	Correlation Coefficient
1830 - 2021	0,04221
1951 - 1991	0,32533
1992 - 2021	-0,13866
2000 - 2021	-0,0929

Source: Research and processing by the author

Towards a historical review of the correlation between the inflation rate and unemployment rate in Sweden from 1830 - 2021, the conclusion is that the observation period is a significant factor contributing to this indicator's value and interpretation.

Discussion

Discussing the results from the literature review provides some interesting insights. Firstly, the results align to a greater extent with Phelps (1967) and Friedman (1968), who noticed a short-term negative relationship between the inflation rate and the unemployment rate. However, there is no correlation in the long term, according to the authors. In this context, it is interesting to mention the findings of King et al. (1995), who found a significant negative correlation between inflation and unemployment between 1954 and 1994, a time frame that should be considered long-term. Since this study focused on the time frame of March 2020 - July 2023 and found a moderate negative relationship, it confirms the thoughts of Phelps and Friedman to a greater extent, but at the same time, it is not possible to dismiss the results of King et al. (1995).

The contradiction within the space might result from different research methods, samples, and periods researched. In general, evaluating the Phillips curve is challenging since it might require methods other than a statistic. As the study has shown, other variables than inflation affect unemployment, and some of those could be market dynamics, taxes, and economic cycles. Despite this realization, the results derived from this study are statistically significant, and it is possible to generalize them to other populations, strengthening the study's internal validity.

Interestingly, the Phillips curve is also significant from a macroeconomic perspective. Previous studies from Frohm (2019) could confirm that the Phillips curve is valid in Sweden from research on the company level. The results from this study confirm that the Phillips curve is relevant to some extent in a macroeconomic environment and an environment with a new monetary policy with higher interest rates due to higher inflation levels. Frohm (2019) emphasized that a sudden change in monetary policy could break the connection between inflation and the unemployment rate in the overall economy, but this seems different here. The results from this study are also attractive because they are statistically significant and can be generalized to other populations. A concern was raised that the generalization would not be preferable due to the limited scope of this study. It is now vital to examine whether the inverse relationship between the inflation rate and the unemployment rate is on only a short-term basis or if it is in the long-term as well. The anticipated fluctuations in the inflation rate might shape an interesting landscape in future research within the field of the Philips curve.

Conclusion

This study aimed to explain the correlation between the inflation rate and the unemployment rate in Sweden between March 2020 - July 2023. A hypothesis was derived from the Philips curve theory, which suggests that higher inflation decreases unemployment. Therefore, this study hypothesized that there should be a correlation between the inflation rate in Sweden between March 2020 and July 2023. Moreover, Sweden was chosen for two reasons. The first is that the Central in Sweden still uses the Philips curve to some extent to formulate adequate policy. The other is that Covid-19 has provided a new market environment with higher inflation rates and disruption in the supply chain, which is interesting since the Philip curve is all about demand. A regression analysis indicated a negative linear relationship between the inflation rate and the unemployment rate.

Moreover, the correlation was statistically significant, making it possible to generalize the result to other populations. The results make the Phillips curve valid, at least in the short term, which has already been noticed by Phelps (1967) and Friedman (1968), albeit moderately on a macroeconomic level. However, it is worth mentioning that there is a high probability that other variables than the inflation rate affect the unemployment rate to a greater extent. Despite this realization, dismissing the Phillips curve entirely is impossible due to the moderate negative correlation between the variables and the statistical significance.

The Central Bank's (Riksbankens) inflation target in 1993 could be a defining aspect. Since 1993, the inflation level has been around 2%. Thus, with minor fluctuations in the annual inflation rate, it might be problematic to find out how inflation affects unemployment. However, in 2021, the inflation levels started to increase worldwide due to a monetary policy based on low-interest rates and quantitive easing after the financial crisis of 2008. Therefore, this subject might be interesting to investigate a few years from now, depending on how the Central Bank in Sweden manages inflation. More data on fluctuating inflation levels might provide insights into how it affects unemployment and whether other methods beyond statistics are still necessary to validate the Phillips curve in Sweden.

Nevertheless, it will provide insights into whether the Phillips curve is also valid in the long term if Phelps (1967) and Friedman (1968) were right about the assumptions of the short-term negative correlation or whether King et al.(1995) are right about his long-term correlation. Such a study will also be interesting since the previous research claims that a change in monetary policy might break the connection in the overall economy, at least in the short term. According to the findings of this study, there is no reason to assume that the higher interest rates in Sweden have broken the validity of the Phillips curve. However, the new economic landscape with increasing inflation, interest rates, and potential recession data will deepen knowledge of the validity of the Phillips curve. Those insights will contribute to the overall research and re-evaluate the Phillips curve as a monetary tool to direct monetary policy.

Suggestions for further research are to conduct a comparative study before and after 1993 to see to what extent the inflation target has affected the Phillips curve in Sweden. Another suggestion would be to choose a different country and investigate if the results are similar to Sweden's. In this context, a country with a technological level other than Sweden could be fascinating since previous research claims that it negatively impacts the correlation. Moreover, to study a more extended period to see how the sample affects the results and the generalization to other populations. It would also be interesting to conduct a study with methods other than econometrics and use other levels than the state to expand the views on the Phillips curve.

References

1. Amelius, H. (2022). BNP - Sverige. Ekonomifakta. Available online: https://www.ekonomifakta.se/fakta/ekonomi/tillvaxt/bnp---sverige/ (2022-10-29)
2. Arbetslöshet, Available online: globalis.se (2022-10-24)
3. Bhattari, K. (2016). Unemployment-inflation trade-offs in OECD countries. Economic modeling 58, 93–103. ScienceDirect.
4. Borio, C., Piti, D., Mikael, J. & Phurichai, R. (2018). Monetary policy in the grip of a pincer movement. BIS Working Papers 706, Bank for International Settlements.
5. Bryman, A. (2011). Samhällsvetenskapliga metoder. Malmö: Liber.
6. Debelle, G. & Laxton, D. (1997). Is the Phillips curve a curve: some evidence for Canada, New Zealand, and the United States. IMF staff papers 44, 249–282.
7. Diehn, S.A. (2022). Has globalization passed its peak? Deutsche Welle. Available online: https://www.dw.com/en/has-globalization-passed-its-peak/a-61325661 (2022-10-23)
8. Ekonomifakta (2023). Available online: https://www.ekonomifakta.se/fakta/arbetsmarknad/arbetsloshet/arbetsloshet/?graph=/25554/1,2,3/all/ (2023-9-2)
9. Esaiasson, P. Giljam, M. Oscarsson, H. & Wängnerud, L. (2012). Metodpraktikan: konsten att studera samhälle, individ och marknad. Stockholm: Norstedts juridik.
10. Forsberg, O. (2021). Så mycket lån har en svensk i genomsnitt. Tillväxt Sverige. Available online: https://www.xn--tillvxtsverige-9hb.se/sa-mycket-lan-har-en-svensk-igenomsnitt/ (2022-10-29)
11. Frohm, E. (2019). Sambandet mellan resursutnyttjande och inflation: ett mikrodataperspektiv. Sveriges Riksbank. Available online: https://www.riksbank.se/globalassets/media/rapporter/ekonomiska-kommentarer/svenska/2019/sambandet-mellan-resursutnyttjande-och-inflation-ettmikrodataperspektiv.pdf (2022-10-23)
12. Friedman, M. (1968). The role of monetary policy. American economic review 58, 1–17.
13. Globalis (2022). Sverige. Svenska FN-förbundet. Available online: https://www.globalis.se/Laender/sverige (2022-10-29)
14. Gordon, R. (1970). The recent acceleration of inflation and its lessons for the future. Brookings papers on economic activity 1, 8–47.
15. Gourieroux, C. & Jasiak,J. (2022). Financial Econometrics: Problems, Models and Methods, Princeton University Press, New Jersey, USA.
16. Ho, S-Y. & Njindan Iyke, B. N. (2018). Unemployment and inflation: evidence of a nonlinear Phillips curve in the eurozone. The Journal of developing, area 53.
17. Hoover, D. K. (2008). Philips Curve. Econlib. Available online: https://www.econlib.org/library/Enc/PhillipsCurve.html (2022-02-04)
18. Kennedy, P. (2008). A guide to Econometrics. New Jersey, Wiley Blackwell.
19. King, R.G., Stock J.H. & Watson M.W. (1995). Temporal instability of the unemploymentinflation relationship. Economic perspectives 19, pp. 2–11.
20. Körner, Svante & Wahlgren, Lars. (2015). Statistiska metoder. Lund.
21. Krantz, M. (2022). Elpriset: en tsunamivåg på väg mot företagarna. Företagarna Available online: https://www.foretagarna.se/nyheter/riks/2022/september/elpriset-en-tsunamivag-pa-vag-motforetagen (2022-10-25)
22. Laxton, D., Meredith, G. & Rose. D. (1995). Asymmetric effects of economic activity: evidence and policy implication. IMF staff papers 42, 344–374.
23. Newbold, P., Carlson, W. L. & Thorne, B. (2020). Statistics for business and economics, UK, Pearson Education Limited.
24. Phelps, E. S. (1967). Phillips curves, expectations of inflation, and optimal unemployment over time. Economica 34, 254-281.
25. Phillips, A.W. (1958). The relationship between the unemployment rate and the rate of change of money wage rates in the United Kingdom, 1861-1957. Economica 25, 258-299.
26. Picardo, E. (2022). How Inflation and Unemployment are related. Investopedia. Available online:

https://www.investopedia.com/articles/markets/081515/howinflationandunemployment-are-related.asp (2022-10-20)
27. Riksbanken (2018). Inflationsmålet. Sveriges Riksbank. Available online: https://www.riksbank.se/sv/penningpolitik/inflationsmalet/ (2022-10-20)
28. Riksbanken (2018a). 1992 – Räntan 500 % - Kronan flyter. Sveriges Riksbank. Available online: https://www.riksbank.se/sv/om-riksbanken/historia/historisktidslinje/19001999/rantan-500----kronan-flyter/ (2022-10-20)
29. Riksbanken (2018b). Historisk inflationsmålet. Sveriges Riksbank. Available online: https://www.riksbank.se/sv/penningpolitik/inflationsmalet/historik-inflationsmalet/ (2022-1020)
30. Samuelson, P.A. & Solow, R.M. (1960). Analytical aspect of anti-inflation policy. American economic review 50, 177–194.
31. SCB (2022). Sveriges befolkning. Statistikmyndigheten (SCB). Available online: https://www.scb.se/hitta-statistik/sverige-i-siffror/manniskorna-i-sverige/sveriges-befolkning/ (2022-10-29)
32. SCB (2023). Statistikmyndigheten (SCB). Available online: https://www.scb.se/hitta-statistik/statistik-efter-amne/priser-ockonsumtion/konsumentprisindex/konsumentprisindex-kpi/pong/tabell-och-diagram/konsumentprisindex-med-fast-ranta-kpif-och-kpif-xe/kpif-12-manadersforandring/ (2023-9-2)
33. Seyfried, W. L. & Ewing, B. T. (2001). Inflation uncertainty and unemployment: some international evidence. The American economist 45, 33-39.
34. Statistikmyndigheten. (2022). Inflationen i Sverige. SCB. Available online: https://www.scb.se/hitta-statistik/sverige-i-siffror/samhallets-ekonomi/inflation/ (2022-01-29)
35. Torstensson, S. (2022). Arbetslöshet. Ekonomifakta. Available online: https://www.ekonomifakta.se/fakta/arbetsmarknad/arbetsloshet/arbetsloshet/ (2022-01-29)
36. Yellen, J. (2015). Inflation dynamics and monetary policy. Federal Reserve. Available online: https://www.federalreserve.gov/newsevents/speech/yellen20150924a.htm (2022-10-24)

About the authors

Vanja Šimičević is a Full Professor at the Libertas International University, Zagreb, Croatia. She received a PhD in quantitative economics from the University of Zagreb, Faculty of Economics and Business. Her primary area of research is focused on applications of quantitative methods, particularly statistical modelling techniques and analysis, in business, economics and other social sciences, using a wide range of statistical methods and techniques. She has published some papers on those topics in international and national journals. Her scientific work significantly contributes to applying modern statistical methods in social sciences using various statistical methods and techniques. The author can be contacted at **vsimicevic@libertas.hr**

Emil Lekavski received a BS in International Business in 2023 at Libertas International University, Zagreb, Croatia, on the thesis "Testing Phillips curve in Sweden." He has previous experience from an internship at the European Parliament, from work at the Swedish Tax Office, and the iGaming industry in Malta. Moreover, he has studied Political Science and the Law of Social Welfare at Halmstad University in Sweden. Currently, he is working as a freelancer, primarily in marketing. The author can be contacted at **elekavski@libertas.hr**