STAGFALTION ANALYSIS

5 December 2022

Research Division

Kasior B., Mateuss M. and Paggen L.

Website | **Newsletter** | **Instagram** | LinkedIn

STAGFALTION ANALYSIS

5 December 2022

Mareks Mateuss,

Leo Paggen,

Benedikt Kasior

Abstract

This paper aims at finding the link between monetary policy and inflation in the European Union for the last two decades. Ultimately, it attempts to reconstruct how the eurozone ended up in a stagflation in the early 2020s. Firstly, the theoretical explanation for the inflation and recession is being elaborated. Secondly, using regressions and scatterplots, these theoretical links are reviewed in context of the actual data. It was found that the current inflation is largely due to monetary policy decisions whereas the recession can be explained with exogenous shocks.

Contents

1. Introduction

The inflation at the beginning of this decade has been rising significantly across Europe. Academics, businesses, and governments have different visions over the source of this phenomenon specifically for this period. Standard economic theory has several suggestions to explain inflation, but most of them root in the supply of money, be it regulated by fiscal or monetary policy or affected by the private sector (e.g., through the money multiplier and commercial bank money). Others consider massive government support in times of the COVID-19 pandemic as a primary source of accelerated inflation. Latter blame the Russian invasion of Ukraine and gas prices. The core question this paper asks is to what extent a monetary policy in recent times can be considered a primary reason for upsurging inflation. We seek to find out whether the monetary policy in past decades was strong and confident enough to combat inflationary pressure. Other than that, the present paper aims to find out what are the individual and overall effects of international relations and recent developments in international trade on the change of the price level in the European Union (EU). The paper is structured as follows. Section 2 gives a brief overview of the economic theory that explains inflation formation. In this section, we describe the effect that relevant monetary and non-monetary variables supposedly have on the development of inflation. Section 3 uses this framework to assess the effectiveness of monetary policy in shaping inflation behaviour. Section 4 presents the output of formal statistical modelling in predicting the extent to which relevant variables affect inflation. Section 5 discusses the potential limitations of the model and proposes possible ways of their elimination in future studies. Finally, it suggests recommendations for future monetary policy based on lessons learned from the present analysis.

2. Theoretical Framework

The studies of the relationship between inflation and output are by no means modern phenomena. It is well known currently that the foundation of the field was laid down by Milton Freidman and Anna J. Schwartz and their *A Monetary History of the United States, 1867–1960* (Hetzel, 2007). However, since then economics science witnessed numerous transformations in an attempt to characterise the price dynamics as precisely as possible. In this chapter, we overview the currently broadly accepted theoretical principles of inflation and output behaviour. Along that, we attempt to find the reflection of these theoretical concepts in actually unfolding economic developments.

2.1Causes of Stagflation

Stagflation, so the combination of slow economic growth and high inflation is most commonly believed to be the result of several, conflating factors. A recession, either as a natural part of the business cycle or as the exhaustion of a new technology occurred in the early 1970s and 2022. Whereas in the 1970s the postwar economic boom came to an end, rendering American manufacturers less competitive on the global market and the American economy more dependent on foreign suppliers, the recession in 2022 has different reasons. The COVID-19 pandemic hit the global economy in 2019, resulting in severe problems for almost all enterprises. The governments of most major economies initiated lockdowns, sending millions of workers to home-office, if possible. Next to the consequences of the pandemic, the world, and especially Europe, is suffering from the ongoing invasion of Ukraine. Apart from the refugee crisis and grain shortages caused by the war, the European countries that relied heavily on Russian gas and oil are now facing a severe energy crisis. This situation bears certain parallels to the USA in the 1970s which was struck by the oil embargo of the OPEC cartel (United States Department of State, n.d.). The heavy use of fiscal and monetary policy to absorb the effects of the various external shocks pumped a disproportionate amount of money into the economy. Governments set up huge debt-financed stimulus programs for businesses and consumers. Central banks (CB) continued keeping the interest rate extremely low and buying government bonds to ensure a low-risk premium. This large amount of new liquidity can lead to an overheating economy with relatively high inflation (Nelson & Nikolov, 2003). However, these policies are unable to sustain long-term economic growth. A serious recession as in the 1970s cannot be compensated for entirely with various institutional stimuli. To summarize, the inflation was caused by external supply chain shocks (Blinder & Rudd, 2013), as well as the institutional endeavours to offset these shocks with monetary and fiscal policy, that baked higher prices into the economy. If this coincides with a natural recession that exhausts the option of policymakers, stagflation occurs.

An alternative approach to the explanation of this phenomenon is purely based on monetary policy. The key concept of this idea is the assumption that prices, at least the final consumer prices, are fixed in the short run (Barsky & Kilian, 2001). Thus, an expansionary monetary policy by the CB can induce an artificial boom. There is more money in the economy and interest rates are low, fuelling the aggregate demand. Since the prices remain the same, this increases output, initiating economic growth. However, over time, a growing percentage of economic agents becomes aware of monetary expansion. Hence, they start adjusting their prices in expectation of inflation. So, there is a time lag between the implementation of the expansionary policy and the resulting inflation. The output reaches its artificial peak most likely before the inflation becomes noticeable (Barsky & Kilian, 2001). Nonetheless, since this output is above the natural level of production, it will decrease simultaneously with the rise in inflation. The increase in prices reduces purchasing power and diminishes demand. In addition, the CB will be forced to raise interest rates to tackle inflation. This will reduce output even further and will likely lead to a recession. In this scenario, a recession in combination with high inflation is exactly what commonly is referred to as stagflation. The high commodity prices, e.g. oil, are in this interpretation not the cause but the result of stagflation. The artificially increased demand cannot be matched by the supply and drives the prices up by an unforeseen degree.

2.2Fighting Stagflation

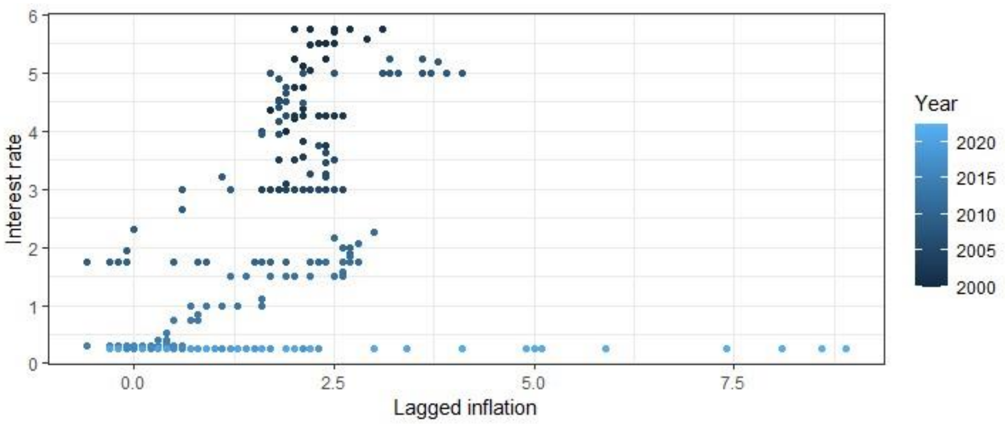
When fighting stagflation, policymakers face several problems. The main difficulty is the inverse relationship between a reduction in output and inflation. The predominant economic theory suggests that inflation occurs when the economy has a positive output gap. In this overheating economy, unemployment is unnatural low, driving up prices and wages. In stagflation, however, there is a reduction in output, eventually even a negative output gap and inflation. Thus, policymakers have the option of letting inflation increase further and further and eventually de-anchoring expectations by maintaining a low interest rate and high government spending. The benefit of this policy is questionable because one accepts the harm by inflation in order to gain economic growth. However, this growth is uncertain and unsustainable since it is not grounded in an actual increase in productivity. The other option is increasing the interest rate to contain inflation but risking exacerbating the already existing inflation. In the long run, the latter option has certainly more merit but leads to a more severe economic decline in the short run. In practice, a conflict of interest of policymakers may arise. Politicians might refuse to implement necessary but unpopular policies to not jeopardise their reelection. In theory, a natural recession with a cleansing effect on the economy seems almost inevitable.

3. Monetary Policy and Inflation

Recent worldwide fall in output growth can be explained by unexpected exogenous shocks. Inflation, however, certainly can be controlled by the monetary and fiscal authorities in each and separate country or monetary union. Apart from the fact that monetary and fiscal policies can be unsynchronized and that they are performed by different institutions, the former faces an extremely complex system. On one hand, inflation can be relatively easily beaten via increasing policy rates. On the other hand, however, there is a substantial risk of a deflationary spiral which occurs if the contractionary policy is too tight. The exit from this spiral requires strong commitment and cooperation between central bankers and the government. Therefore, it is crucial to assess whether the monetary policy in recent times was appropriate for the corresponding inflation rate that the European economy faced. In other words, whether the risk of inflation dynamics was perceived seriously and was timely minimized. If the policy was too weak, inflation may persist for a longer time if not increase in light of new shocks that may lead to an even deeper recession. In this case, stagflation is unavoidable and the way out of it may be long and thorny. If the policy was too tight, the probability that the recession is more severe than would be under the neutral interest rate is higher.

To evaluate whether inflation data have a significant effect on monetary policy decisions, we create the scatterplot of lagged inflation as an independent variable and the interest rate as a dependent variable (Figure 1). Such a backward-looking rule implies that monetary authorities should seriously consider past inflation dynamics to determine the optimal policy rate (Carlstrom & Fuerst, 2000). The data is sampled at a monthly frequency from April 2001 until June 2022. There is a certain upward-sloping relationship between inflation in the previous period and interest rate in the current period. This means policy decision-makers indeed take into account the inflation rate in the previous period and adjust the interest rate accordingly.

Figure 1: Lagged inflation versus interest rate



However, there are several observations that fall outside an overall increasing trend. The most suspicious outliers are observed on the right-hand side of the plot. We identify 11 extreme outliers for this plot that correspond to the lagged inflation of higher than 3 per cent and the interest rate of lower than 0.5 per cent. All of these observations belong to the period from August 2021 to June 2022. Visual inspection of the graph suggests that recent monetary policy actions do not go in line with the overall trend of the past two decades. Moreover, it seriously underperforms in terms of its use of conventional tools (i.e., policy rate calibration according to macroeconomic data) for capturing increasing inflation.

To formally evaluate the effect that a change in the inflation rate has on the interest rate, we perform two simple regression analyses. The output can be seen in Table 1. For the first, we create a subset of data points from April 2001 to January 2011 and for the second, another subset with data from February 2011 to June 2022. For both regressions, our independent variable is inflation in the previous period and the dependent variable is the interest rate in the current period. We find that the effect of inflation on the interest rate in the first subset is statistically more significant than in the second regression. One of the possible reasons why the data do not show a closer relationship between inflation and interest rate in the past decade is the combination of low inflation and low-interest rate. Namely, as the policy rate is already at an effective zero level, non-conventional monetary policy was the main instrument for the ECB to encourage spending and inflation. Since movements in inflation (and, consequently, in interest rate) were less dynamic relative to the first subset, the slope of the coefficient is lower. Based on the visual inspection of the scatterplot and regression analysis we can draw several preliminary conclusions: (i) it seems that monetary authorities did not get used to so high inflation rates after years of low inflation, therefore the timing of the most recent policy rate raises was wrong, (ii) inflation became a weak predictor of movements in policy rate because of its standstill on low levels, and (iii) prolonged unconventional monetary policy have a weaker effect on inflation than conventional tools (Gambacorta et al., 2014).

Table 1—Estimate of the effect of change in lagged inflation to the interest rate

	Independent variable	
	$inflation_{2001}-2010$	$inflation_{2011}-2022$
Intercept	1.822 (0.241)	0.512 (0.072)
Slope	0.925*** (0.109)	0.071* (0.030)
Adjusted R-squared	0.351	0.032
Observations	132	139

The number in parentheses indicates standard error of the coefficient.

*** significant at 1% level

** significant at 5% level

* significant at 10% level

3.1Regression Analysis

Analyzing relevant literature on stagflation reveals two main points of view for the appearance of the phenomenon. One point of view blames shocks in oil prices as being largely responsible for inflation, while the other point of view argues that inadequate monetary policy can lead to stagflation. To account for both points of view, we have constructed one model for each of the two points of views. This leads us to our two regressions, a monetary regression, and a non-monetary regression.

The monetary regression aims to estimate changes in inflation with the help of five explanatory variables, namely the interest rate, the monetary aggregate M1, the ratio of assets to liabilities, the euro-dollar exchange rate and a final lagged inflation variable. All our data is relevant for the European Union, and spans from January 2010 to July 2022, giving us around 150 observations per chosen variable. Our data is time series data and therefore requires us to run a series of tests and transformations for us to be able to correctly interpret our estimated regression coefficients. Firstly, we apply logarithms to all our variables, as this will give our model a more practical interpretation, as will be shown later. The next step in analysing our data is to test every one of our variables for the presence of a unit root, which will help us determine what kind of transformation on our variables is required for a correct interpretation to be given. The appropriate Augmented Dickey-Fuller (ADF) test with constant and trend for each variable is reported in Table B1. The tests provide weak evidence against the presence of a unit root in our variables, except for our aggregate money supply variable M1, which series does not have a unit root, according to the ADF test. To eliminate the stochastic trend in our series, we apply first-order difference transformations to each of the variables for which we cannot reject the unit root null hypothesis. Despite the fact that the M1 series has a deterministic trend which can be removed by adding a time variable to the model (otherwise known as detrending), we will still apply a first order difference transformation to the logarithm of M1 in order for our model to be consistent. Testing for unit roots in our newly transformed variables gives us Table B2, which shows our data is now stationary and ready to use without the risk of running a so called "spurious regression". The results of our monetary regression are reported in Table 2. Our results display statistical insignificance for all variables except for the growth rate of the aggregate money supply variable M1 and the first lag of the growth rate of inflation. This makes us unable to interpret our model to any useful extent. Our R-squared value is safe to look at, because we previously made sure all our variables were stationary before running our regression. Nonetheless, the R-squared of our monetary policy regression is extremely small; not much of the variation in the growth rate of inflation can be explained by the variation in the growth rate of the variables we selected to include in our model.

Table 2—Monetary Regression

	$\Delta ln(inflation)$
Intercept	−0.004 (0.030)
Δln(exchange rate)	0.882 (1.577)
Δln(interest rate)	−0.096 (0.498)
Δln(assets)	1.625** (1.211)
Δln(M1)	−0.572** (0.266)
Δln(inflation$_{t-1}$)	−0.188 (0.085)
Adjusted R-squared	0.039
Observations	129

The number in parentheses indicates standard error of the coefficient.

** significant at 5% level

We also aim to reason why some of our variables turned out to be insignificant in our monetary model. To begin with, we take a look at the growth rate of assets. Theoretically, if the asset side of the CB's balance sheet increases, (i.e. the CB purchases government bonds and other financial assets), additional liquidity is provided to the market. Consequently, as the market gets access to broader and relatively cheaper financial resources, it allocates them into new financial assets, thus causing inflation to rise. One possible explanation of why this particular variable turned out to be insignificant is that some other factors constrained the inflation upraise in recent times, despite the fact that the asset side of the balance sheet expanded significantly since the Great Recession. Hence, due to restraining effects of these other factors, the correlation between inflation and our asset growth rate variable may be weak. We then take a look at why the growth rate of the exchange rate is not significant. Our third insignificant value is the growth rate of the ECB policy rate. Economic theory predicts that we should observe a significant, negative coefficient for this variable (in theory higher rates are supposed to slow down inflation) but we do not observe this in our model. Our reasoning is based on the idea that inflation itself is not always driven by investment (think of the loans people take out to buy houses), but can be driven by the price of commodities, similar to the situation we are currently observing in Europe. If we assume inflation pressure is to be driven by commodity price shocks rather than investments, it makes sense for our model to report the growth rate of the EU policy rate to be insignificant. The coefficient of the growth rate of our monetary aggregate variable, Δln(M1), turns out to be statistically significant at the 5% level. It means that Milton Friedman's finding about close relationship between amount of money circulating in the economy and the inflation still holds regardless of how long the CB is constrained by the zero lower bound. The lagged growth rate of inflation is also highly significant, this follows from the fact that inflation itself is a variable which shows a lot of serial correlation (up to 12 months according to our data).

Our second regression deals with the non-monetary aspect of stagflation, accounting for the idea that it could be due to changes in crude oil prices. Our independent variables are average crude oil prices (nominal US dollars), the Global Supply Chain Pressure Index (GSCPI), a COVID-19 dummy variable, and a final lagged inflation growth rate variable, to account for previous inflation values in our model. Average crude oil price is included because we want to see if oil price shocks have an inflationary effect. GSCPI is included because we suspect troubled global supply chains contributed to the rise in inflation. We use the same approach as we did for monetary regression. Firstly, we transform variables to log-form for more practical interpretation. We then run unit root tests on our variables, which are reported in Table B3. We apply a first order difference transformation to following variables: *ln*(oil), *ln*(inflation), and *ln*(GSCPI). This transformation makes them stationary and suitable for our regression (Table B4). The regression results are presented in Table

B5. The corona variable is highly insignificant, and so is the growth rate of the GSCPI (Δln(GSCPI)). The growth rate of the GSCPI might not have an immediate effect on the growth rate of inflation, but even accounting for lags in this variable does not give it any statistical significance in our model. This might be due to the idea that there are other factors than purely supply and demand factors affecting inflation, namely monetary policy itself. The growth rate of the oil price (Δln(oil)) is also not highly significant. The only variable that is highly significant is the $\Delta ln(\text{oil}_{t-1})$, suggesting the growth rate of oil prices does not have a direct impact on that of inflation, but rather has a slightly delayed impact on the latter.

We will turn towards the Auto-Regressive Distributed Lag (ARDL) model in an attempt to obtain better results. ARDL models are powerful models to use when dealing with a single explanatory variable, in our case being the growth rate of the prices of crude oil (Δln(oil)). The output of our new model is reported in Table 3. We find that all variables except Δln(oil) are highly significant, indicating that past crude oil price growth rates are correlated to current inflation growth rates. Past inflation growth rates ($\Delta ln(\text{inflation}_{t-1})$) are also very much correlated with future inflation growth rates (Δln(inflation)). Our findings are however to be interpreted with great care, because the prevalence of the literature opposing the oil price shocks as an explanation for stagflation is significant, and full of very convincing arguments. Take for example a paper by Barsky and Kilian (2001) which comes to the conclusion that "oil price increases by themselves are unlikely to reignite stagflation, as long as the Federal Reserve refrains from excessively expansionary monetary policies".

4. Conclusion

The paper aims to find possible reasons for the most recent high-stance inflation in the EU and potential stagflation afterwards. Rapid decrease in output may be explained by exogenous sequential shocks, i.e., the coronavirus pandemic and the Russian invasion of Ukraine. The key component of

Table 3—Non-Monetary Regression

	$\Delta ln(inflation)$
Intercept	0.012 (0.023)
Δln(oil)	0.353 (0.248)
$\Delta ln(\text{oil}_{t-1})$	1.567*** (0.263)
$\Delta ln(\text{inflation}_{t-1})$	−0.300*** (0.075)
Adjusted R-squared	0.284
Observations	129

The number in parentheses indicates standard error of the coefficient. *** significant at 1% level

potential stagflation, however, is unprecedented inflation. We find that the loose monetary policy (i.e., low-interest rate and liquidity provision in the course of the recession during the coronavirus pandemic) that failed to keep inflation at the target level is one of the main factors of increasing prices. It should be noted, although, that very low inflation in the last decade made it impossible for the ECB to raise rates and gain an interest rate buffer necessary for timely monetary easing in times of coronavirus crisis. This potentially could give more flexibility in performing monetary policy and abstaining from the overuse of non-conventional policy.

According to our model, high inflation may also be regarded to the recent upsurge of oil prices, primarily caused by international sanctions. Other factors like the number of coronavirus cases, fluctuations in exchange rates, and the Global Supply Chain Pressure Index as opposed to our expectations do not have a significant effect on price changes for a given period.

Future research may be devoted to studying the effect of non-monetary factors that persist for a more prolonged period (e.g., unlike coronavirus cases) and which effect is easier to track over a longer time period. On the monetary regression side, variables of non-conventional policy tools like forward guidance, frequency and magnitude of changes of balance sheet composition and more precise variables of quantitative easing may be included.

6. References

Barsky, R. B., & Kilian, L. (2001). Do we really know that oil caused the great stagflation? A monetary alternative. *NBER Macroeconomics annual*, *16*, 137–183.

Blinder, A. S., & Rudd, J. B. (2013). The supply-shock explanation of the great stagflation revisited. *The Great Inflation: The rebirth of modern central banking*, 119–175.

Carlstrom, C. T., & Fuerst, T. S. (2000). *Forward-looking versus backward-looking taylor rules* (Report).

Gambacorta, L., Hofmann, B., & Peersman, G. (2014). The effectiveness of unconventional monetary policy at the zero lower bound: A cross-country analysis. *Journal of Money, Credit and Banking*, *46*(4), 615–642.

Hetzel, R. L. (2007). The contributions of Milton Friedman to economics. *FRB Richmond Economic Quarterly*, *93*(1), 1–30.

Nelson, E., & Nikolov, K. (2003). Uk inflation in the 1970s and 1980s: The role of output gap mismeasurement. *Journal of Economics and Business*, *55*(4), 353–370.

United States Department of State. (n.d.). Oil embargo, 1973–1974. https://history.state.
gov/milestones/1969-1976/oil-embargo

Appendix A: Data Sources

Data for the ECB policy rate was retrieved from the European Central Bank Statistical Data Warehouse. Retrieved from http://bitly.ws/wSPt

Data for the ratio of total assets to total liabilities in the EU was retrieved from the European Central Bank Statistical Data Warehouse. Retrieved from http://bitly.ws/wSPC

Data for the average price per barrel of crude oil was retrieved from the World Bank's "Pink Sheet".

Retrieved from http://bitly.ws/wSPD

Data for the Euro – U.S. Dollar exchange rate was retrieved from the European Central Bank's website. Retrieved from http://bitly.ws/wSPF

Data for the Global Supply Chain Pressure Index was retrieved from the New York Fed's website. Retrieved from http://bitly.ws/wSPH

Data for inflation (HCPI) in the EU was retrieved from the European Central Bank Statistical Data Warehouse. Retrieved from http://bitly.ws/wSPM

Appendix B: Unit Root Test and Regression Outputs

Table B1—Augmented Dickey-Fuller Tests for Log-Transformed Variables of Monetary Regression

	P-value	Observations
ln(inflation) L1	0.251	125
ln(exchange rate) L1	0.015**	149
ln(interest rate) L1	0.374	147
ln(assets) L1	0.008***	147
ln(M1) L1	0.003***	148

*** significant at 1% level
** significant at 5% level

Table B2—Augmented Dickey-Fuller Tests for First Difference Log-Transformed Variables of Monetary Regression

	P-value	Observations
Δ*ln*(inflation) L1	0.000***	117
Δ*ln*(exchange rate) L1	0.000***	149
Δ*ln*(interest rate) L1	0.000***	146
Δ*ln*(assets) L1	0.000***	146
Δ*ln*(M1) L1	0.000***	148

*** significant at 1% level

Table B3—Augmented Dickey-Fuller Tests for Log-Transformed Variables of Non-Monetary Regression

	P-value	Observations
ln(inflation) L1	0.251	125
ln(oil) L1	0.105	148
ln(GSCPI) L1	0.002***	73

*** significant at 1% level

Table B4—Augmented Dickey-Fuller Tests for First Difference Log-Transformed Variables of Non-Monetary Regression

	P-value	Observations
Δ*ln*(inflation) L1	0.000***	117
Δ*ln*(oil) L1	0.000***	148
Δ*ln*(GSCPI) L1	0.000***	73

*** significant at 1% level

Table B5—Non-Monetary Regression (Reduced)

	$\Delta ln(inflation)$
Intercept	−0.001 (0.029)
corona	0.014 (0.048)
Δln(oil)	0.374* (0.202)
$\Delta ln(\text{oil}_{t-1})$	1.562*** (0.202)
Δln(GSCPI)	−0.001 (0.025)
Adjusted R-squared	0.536
Observations	67

The number in parentheses indicates standard error of the coefficient.

*** significant at 1% level

* significant at 10% level