Forecasting, Monetary Policy, Nominal Gross Domestic Product Stability, and Macroeconomic Outcomes in a suboptimal currency area.

An examination of the Eurozone

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Abstract
The purpose of this paper is the examination of whether a strategy of using forecasts to stabilise the Nominal Gross Domestic Product (NGDP) growth rate as a nominal anchor, through a rules-based approach to monetary policy is viable in the Eurozone. The paper uses a modified Taylor rule, that uses NGDP forecasts as a variable to generate a prescribed interest rate from which the interest rate set by the European Central Bank (ECB) is subtracted to create a variable we call the Rate Gap. The Rate Gap is a measure of deviation that actual monetary policy had from a country’s optimal rate at a given moment in time according to the Taylor rule. Under the hypothesis that a strategy of using forecasts to stabilise the NGDP growth rate as a nominal anchor is viable, we should expect to see countries with larger positive (negative) rate gaps have macroeconomic outcomes associated with monetary contraction (expansion). The empirical results in this paper contradict the former hypothesis as different countries have dissimilar rate gaps at the same time period which is affirmation of the Eurozone being a suboptimal currency area. However, they are supportive of the latter hypothesis, as countries with larger positive (negative) rate gaps tended to have macroeconomic outcomes associated with monetary contraction (expansion). This paper also discusses the impact of different monetary transmission mechanisms and their relationship to fiscal policy. It also contributes to the field of macroeconomics through its examination of the problem of finding viable policy strategies for a suboptimal currency area.
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1. Introduction

Central Banks are widely recognised today as one of the most important institutions in modern economies and one of the biggest players in financial markets. Its importance lies in its function as the government authority in charge of monetary policy. Its actions affect interest rates, money supply, and availability of credit, all of which have direct impacts not only on financial markets but also by extension macroeconomic performance.

The most important role of a central bank is to engage in monetary policy for the promotion of price stability and by extension macroeconomic stability. Price instability is a source of macroeconomic instability due to the uncertainty that price confusion and money illusion create, and as a result, undermine economic efficiency.

Central banks seek to achieve their goals by means of the use of a nominal anchor, defined as a nominal variable that when kept within a narrow range stabilises inflation expectations and aids in the promotion of price stability in the economy (Mishkin, 2022).

Different nominal anchors such as the inflation rate and money supply growth rate have been proposed for use by central banks. Targeting the inflation rate is arguably the most popular framework with many prominent central banks around the world having an explicit inflation target (ranging from 1%-2%). The macroeconomic performance of many countries has shown significant improvements after the adoption of targeting inflation as its nominal anchor but the financial crisis of 2008 led many to question its efficacy and whether central banks need a new monetary policy framework. A growing number of observers believe so, leading to discussions of whether a new nominal anchor is needed (Beckworth, 2019 and Sumner 2012).

One that has (relatively) recently gained popularity is the use of Nominal Gross Domestic Product (NGDP). During the 2008 Global Financial Crisis, a group of economists known as “the market monetarists” expressed support for such proposals in their blogs. Many of their prescriptions have since received endorsement from prominent mainstream economists and there are increasing amounts of discussions about whether central banks should adopt it as a new nominal anchor, especially as a solution to many of the perceived problems of inflation targeting. Hopefully, nominal GDP targeting would achieve price stability goals and better macroeconomic outcomes.

This paper seeks to explore the impact of using NDGP as a nominal anchor to set the central bank policy rate on macroeconomic outcomes in the Eurozone. While the Eurozone does not officially use NGDP as a nominal anchor, it serves as a good candidate for this case study as it is highly doubtful that it is an optimum currency area, which means that different nations in the Eurozone have different macroeconomic conditions that require different optimal monetary policy prescriptions but are all affected by the same policy rate set by the European Central Bank (ECB).
We seek to calculate optimal monetary prescriptions for different members of the Eurozone by using a modified Taylor rule that uses NGDP forecasts. The modified Taylor rule produces the optimal interest rate given an NGDP forecast targeting regime that would have stabilised the growth path of NGDP for each member of the Eurozone. We then proceed to measure the deviation of the actual interest rate set by the ECB from the optimal rate prescribed by the modified Taylor rule for each country.

A relationship between the Rate Gap (the difference between the actual ECB rate and optimal rate prescribed by the modified Taylor rule) and macroeconomic outcomes will be tested to see whether countries that had larger positive or negative rate gaps tended to have macroeconomic outcomes associated with those deviations.

In section 2, we discuss the background behind the increased popularity of prescribing NGDP as a new nominal anchor for central banks to target. A deeper discussion of the role of monetary policy will be presented along with more context behind the problems the ECB and members of the Eurozone face when trying to set monetary policy. Section 3 starts with a literature review that will be used to supplement a more in-depth discussion of the theoretical framework behind nominal targeting as a new monetary policy regime, which will be section 4 of the paper. Section 5 will attempt to answer the research question empirically through the generation of optimal policy rates using the modified Taylor rule and testing to see if there was any statistically significant relationship between the deviation of the ECB’s interest rate from one’s optimal policy rate for each country and macroeconomic outcomes. Variables in question include inflation rates, employment, and output statistics. Section 6 will present and discuss the results of our empirical analysis. The discussion of the results weaknesses and limitations will be presented in section 7 before concluding the essay in section 8.
2. Background

2.1 Role of Monetary Policy

Central banks engage in monetary policy for the promotion of price stability and by extension macroeconomic stability but what is the role of monetary policy in all this. To cite Nobel Laureate Milton Friedman, the role of monetary policy can be summarised as (1) It is unable to peg interest rates for more than very limited periods (due to the Fisher effect); (2) It is unable to peg the rate of unemployment for more than very limited periods (due to the natural rate hypothesis of unemployment and long-run neutrality of money); (3) It can prevent money itself from being a major source of economic disturbance; (4) It can “provide a stable background for the economy-keep the machine well oiled”. This is an endorsement of using monetary policy to promote price and macroeconomic stability. Friedman follows up point 4 by saying “Our economic system will work best when producers and consumers, employers and employees, can proceed with full confidence that the average level of prices will behave in a known way in the future-preferably that it will be highly stable.” which is a recognition of the importance of stabilising inflation expectations in promotion of price and macroeconomic stability. (Friedman, 1968)

Once well understood, we can recognise a clear message that monetary policy, in the long run, affects only nominal economic variables such as prices but in the short run influences real variables like consumption, real output, and employment. The implication of this is that while good monetary policy does not guarantee great macroeconomic performance as it does not affect real variables in the long run, poor monetary conditions certainly guarantee poor macroeconomic performance and can be destabilising to an economy in several ways. It is a necessary but not sufficient condition for macroeconomic stability and that is why Friedman argued in point (3) that monetary policy should prevent itself from being a major source of economic disturbance instead of being a source of economic prosperity for example.

2.2 Rise of NGDP TARGETING: The culmination of a search for a nominal anchor

For monetary policy to successfully do its role in points (3) and (4) it is necessary that central banks can target and stabilise a nominal anchor. As mentioned earlier, stabilising a nominal anchor stabilises and anchors inflation expectations which helps promote price stability. The most popular nominal anchoring in use today is the use of inflation targeting as a monetary policy strategy usually at a rate of 2%. The elements of this regime include public
The announcement of the target, institutional commitment towards achieving that target with price stability as its ultimate goal, consideration of many variables when making monetary policy decisions with increased transparency through better communication with the general public, and increased accountability of the central bank for achieving its stated objectives (Mishkin, 2022).

Its adoption could be argued to be largely a success, as many countries that formally adopted targeting inflation saw their macroeconomic performance improve as a result (Bernanke et al., 2001). However, since the 2008 Financial crisis, criticisms of inflation targeting (explored more in section 3 of this paper), despite its success, have begun to rise with many beginning to suggest a new monetary policy framework is needed. This led to the genesis of a search for alternative nominal anchors that the central bank could target (Beckworth, 2014) which culminated in the increased popularity of NDGP-level targeting.

NGDP is defined as the total value of final goods and services in current prices and, if targeted, would have central banks target a stable growth path for the total amount of spending in the economy (stable average growth of NGDP). This is not a new idea, but it gained renewed interest in 2008, starting from the blogosphere with a group of economists known as the “market monetarists” who endorsed this idea. Interest eventually spread to news media and influential academics (Christensen, 2011). For example, the former Chairman of the Council of Economic Advisers in the Obama administration encouraged the Federal Reserve chairman Ben Bernanke to target NGDP in a widely read New York Times article (Romer, 2011). Endorsements from prominent economists like Michael Woodford (Woodford, 2012), Brad DeLong, and Paul Krugman followed. Goldman Sachs has become interested in this new framework.

2.3 Eurozone, optimum currency areas, and the dilemma of setting monetary policy.

Economic and monetary union (EMU) (known as the Eurozone), is a fixed exchange area in the European Union where the national currencies of its members would be replaced by a single EU currency managed by a sole central bank (the ECB) operating on behalf of all EU members. Consisting of 19 member countries, its main goals are to promote greater political and economic cooperation and integration among its members.

The idea important to understand the economics of the Eurozone is the theory of optimum currency areas. The theory of optimum currency areas clarifies the costs and benefits a country gains from joining a monetary union and its dependency on the degree of economic integration between the country in question and the members of the monetary union it seeks to join. (Krugman et al., 2023)
Benefits for a country that joined a monetary union are derived from minimizing transaction costs, particularly ones incurred from exchange rate fluctuations, currency conversions, and uncertainty. However, the costs are largely derived from giving up monetary policy autonomy to in this case the ECB, leaving countries unable to use that tool to deal with its internal macroeconomic shocks. The central prediction of the theory of optimum currency areas is the more closely economically integrated a country is with the members of the monetary union through international trade and factor movements, the greater the benefits of joining it and the less costly it becomes. (Mundell, 1961)

There is good reason to believe that the Eurozone is not an optimum currency area at the moment. A dissimilarity of economic structure among members (Glick et al., 2015), lack of fiscal union and federalism, language, and cultural barriers, labour market rigidities (Eichengreen, 1991), and the lack of unification of policy toward bank and financial market stability, characteristics that another monetary union namely the United States lack increases the degree of economic integration that is needed for the Eurozone to have to become an optimum currency area. Even for the United States, it took a minimum of 150 years for it to become an optimum currency area (Rockoff, 2000) while having fewer barriers to economic integration than the Eurozone currently has.

The implication of the Eurozone not being an optimum currency area is that asymmetric economic developments within different countries of the Eurozone might require different monetary policy conditions to achieve price and macroeconomic stability within the different countries which, while under the Eurozone, will be difficult under a single central bank.

The central monetary policy dilemma that the Eurozone faces, how to set monetary policy for countries with different macroeconomic conditions, stems from the fact that the Eurozone is not an optimal currency area. And its impact on Eurozone’s macroeconomic outcomes is what the paper seeks to explore given that the optimal monetary policy condition for each country is determined by a rule that seeks to stabilise NGDP as the nominal anchor.
3. Literature Review

3.1 Rules and Discretion

Hayek (1945) famously argued that the central economic problem is the coordination of economic activity under conditions of diffuse and decentralised private knowledge, in what is known as the “knowledge problem”. Implications of that insight is that knowledge needed for optimal economic planning by a central planner given its nature is inaccessible thereby making it a suboptimal solution to the coordination problem as opposed to its decentralised alternative in the price system.

This insight applies to central banking as Friedman (1948) argued. The “knowledge problem” makes discretionary activist countercyclical policy suboptimal as central bankers lack access to information that would be needed to make informed monetary policy decisions, hence why Friedman proposes the implementation of a rule to minimise the discretionary power of central bankers.

Prescott and Kydland (1977) argue that even if the “knowledge problem” can be overcome and there are agreed-upon social objectives for central planners, the discretionary policy would still lead to suboptimal long-term outcomes due to what is now known as the “time inconsistency problem”. Defined as a situation where the perception of optimal policy changes with time which causes changes in the policy applied. Prescott and Kydland argued that the tendency for inflationary bias among central banks acting with full discretion could be explained by the problem of time inconsistency and therefore limiting discretion through the implementation of credible rules could improve economic performance. Barro and Gordon (1983) came to a similar conclusion.

Taylor (1993) concluded that good policy rules prescribe changes in central bank interest rates in response to changes in inflation and/or real output (presented as an equation now famously known as the Taylor rule). It also assesses ways to apply a policy rule in an environment where its mechanical application as shown in the equation is practically impossible to follow by policymakers with recommendations to use the rule as one of the inputs to central bank decision-making and application of the general principles that underlie the policy rule by policymakers without the constraints of the algebraic formula.

Beckworth and Hendrickson (2019) argue that the “Taylor rule” faces a “knowledge problem” due to the difficulty of estimating the output gap in real time and the need to have information on multiple variables like response coefficient, inflation rate, and the natural rate of interest. They argue in favour of NGDP targeting as opposed to a Taylor rule on grounds that it requires less knowledge for policymakers as they would need to estimate fewer variables than the Taylor rule in real-time and the variables in question are easier to estimate.
for NGDP targeting as opposed to the Taylor rule, particularly the lack of reliance on estimations of the output gap for NGDP Targeting. Their work attempts to show that under conditions of imperfect information, the nominal GDP targeting rule would produce lower volatility in both inflation and the output gap in comparison with the Taylor rule.

3.2 Inflation Targeting

Bernanke and Mishkin (1997) discuss a strategy for a monetary policy known as "inflation targeting", defined as a framework for doing monetary policy that involves an official announcement of an institutional commitment towards achieving a target range of inflation at a certain time horizon with an approach known as “constrained discretion”. Constrained discretion is an approach that provides monetary policymakers with the flexibility to respond to unforeseen economic developments while constraining their discretion through means of a strong commitment to achieving their target range of inflation in the long run. This approach is argued to provide a middle ground where both the inflexibility of rules and the instability of discretion are avoided. The advantages of this strategy as argued by the authors include increased transparency on central bank operations, increased accountability, and the reduction of time-inconsistency problems due to greater attention to long-run considerations of monetary policy. In a follow-up book written by the authors of the paper and other contributors, they document empirical evidence displaying that inflation targeting has improved the macroeconomic performance of nations that adopted it. (Bernanke et al., 2001)

Beckworth (2014) argues that inflation targeting as a monetary policy regime is inadequate due to its inability to deal with large supply and demand shocks in the economy and its contributions to financial instability and therefore, should be replaced by a monetary policy regime that ignores supply shocks, but responds to demand shocks. While recognising that it provided a much-needed nominal anchor that had been missing since the collapse of the Bretton Woods system, he recommends an NGDP level target as a new regime citing its ability to respond to demand shocks and ignore supply shocks citing much of the success of inflation targeting down to luck. Arguments for its superior ability to promote financial stability through risk sharing have also been proposed (Beckworth, 2019 and Koenig, 2013).

3.3 Further Considerations

3.3.1 Makeup Policy

Nobel Laureate Paul Krugman (1998) in his analysis of Japan’s liquidity trap concluded that the liquidity trap was not a problem of monetary policy losing its effectiveness at the zero lower bound but rather a credibility problem for policy makers. If central banks lack credibility due to perceived unwillingness to do what Krugman calls “credibly promise to be irresponsible” (permanent expansion of the monetary base), public expectations for the
future path of monetary policy will become difficult to manage, and the ability for monetary policy to stimulate the economy through the expectations channel will be hampered. In other words, if central banks could credibly commit to being “irresponsible” in an attempt to increase the future price level, monetary policy would be effective through the expectations monetary transmission channel. (Due to the Fisher effect, raising inflation expectations at 0 nominal interest rates will decrease the real interest rate). Interest rates are not the problem, they are only the problem if paired with additional assumptions about public expectations of the credibility of central bank policy and the future path of policy.

Building on Krugman’s work, featuring a more sophisticated and realistic price-setting process and richer dynamics, Woodford and Eggertson (2003) argue that at all times, the key to successful monetary policy is the management of expectations and that monetary policy tools such as open market purchases, large scale asset purchases, helicopter drop or even sovereign debt monetization are effective monetary tools precisely because they are a transmission mechanism for monetary policy through the expectations and signalling channel rather than their impact due to their ability to act as a signal of future policy intentions by the central bank. Through this perspective, the zero lower bound is an issue due to the central bank’s inability to further cut interest rates but rather due to the central bank’s inability to signal policy future policy intentions as a result of not being able to further cut interest rates, hence unconventional means of monetary policy might be needed as a substitute to communicate future policy intentions to financial markets.

An important implication of Eggertson and Woodford's insight is that policy should not be purely forward-looking but should also be what they call "history-dependent". Past macroeconomic outcomes should also play a role in current policy decisions in conjunction with present and forecasted macroeconomic conditions which leads to a prescription of the level target as opposed to a simple inflation target where central banks would be obligated to make up for past monetary policy errors. Level Targeting creates an automatic stabiliser, for example, if central banks undershoot their target (assuming price level for argument’s sake) and policy credibility is assumed, the belief that the central bank will make up for past mistakes will raise inflation expectations effectively creating much needed expansionary monetary policy that is stabilising for the economy. Beckworth (2017) provides support for Krugman, Eggertson, and Woodford’s work.

3.3.2 Targeting the Forecast

Lars Svensson has written several papers (Svensson, 1997, 2003 & 2022) advocating for central banks to engage in inflation forecast targeting. Forecast targeting involves the implementation of monetary policy that produces forecasts that are the same rate as a target. For example, if the nominal anchor of choice was the inflation rate and the target was 2%, the central bank should engage in monetary policy that produces a forecast of 2% inflation. If forecasts are below target, policy should be more expansionary and if forecasts are above target then policy should be more contractionary.
Forecast targeting is argued to be a solution to many problems that monetary policy faces including policy implementation problems due to imperfect control of inflation by central banks and public monitoring problems due to changes in rates of inflation, infamously, reacting to monetary policy instrument adjustments with what Milton Friedman called “long and variable lags”. Svensson proposes that the central bank forecast becomes an explicit intermediate target.
4. Theoretical Framework

This section of the essay will discuss the theoretical framework that underpins the relationship between monetary policy and key macroeconomic variables like the inflation and unemployment rate. The key idea is that the equation of exchange when supplemented with assumptions regarding the nature of price flexibility can give us great insight into the short and long-run effects of monetary changes on the overall macroeconomy. The similarities and differences between targeting inflation or Nominal GDP as nominal anchors will be explored with respect to how they both fare when dealing with demand and supply shocks.

4.1 Equation of Exchange and Quantity Theory of Money

The equation of exchange is an identity to relates the quantity of money supply \((M)\) and velocity of money, defined as the average number of times per year that a dollar is spent in buying the total amount of goods and services produced in the economy \((V)\) to the price level \((P)\) and real output \((Y)\). The equation if formally stated below:

\[
M \cdot V = P \cdot Y
\]

\(P \cdot Y\) is the aggregate nominal income in the economy or NGDP. Given the identity relation, we can take \(\text{NGDP} = M \cdot V = P \cdot Y\). Now let’s assume Velocity is stable which many have, a change in the quantity of money supplied will change the level of nominal GDP. This theory is known as the Quantity Theory of Money (Friedman, 1969). Let’s further assume Real Output is stable and in full employment and completely flexible prices. Under those assumptions, a shift in the quantity of money will only affect the price level by the same proportional level. This is a concept known as money neutrality.

Given what we know about the equation of exchange, we can rewrite it to give us a theory of inflation.

\[
\frac{\%\Delta \text{NGDP}}{\%\Delta Y} = \frac{\%\Delta M}{\%\Delta Y} + \frac{\%\Delta V}{\%\Delta Y}
\]

The Greek letter \(\pi\) (\(\pi\)) will be used to denote inflation (percentage change in the price level):

\[
\pi = \%\Delta P = (\%\Delta M + \%\Delta V) - \%\Delta Y
\]

\(\pi = \%\Delta P = \%\Delta \text{NGDP} - \%\Delta Y\) (since \(\%\Delta \text{NGDP} = (\%\Delta M + \%\Delta V)\))

Or

\[
\text{NGDP} = P \cdot Y
\]

\[
\%\Delta \text{NGDP} = \%\Delta P + \%\Delta Y
\]

\[
\pi = \%\Delta P = \%\Delta \text{NGDP} - \%\Delta Y
\]
Given the equation above, changes in the rate of inflation is approximately equal to changes in NGDP minus changes in real output.

The assumption of price flexibility at least in the short run is unrealistic, there is plenty of literature that documents examples of supply-side price “stickiness” (Mankiw, 1985, Akerlof et al., 1985, and Blanchard et al., 1987). It has great implications for monetary theory. If Money supply for example increases with the assumption of stable velocity, NGDP has to increase by the same proportional level given their identity relation, however if price increases do not fully reflect the changes in NGDP, then by definition, real output must increase by the proportional level not reflected by the increase in price. With the assumption of price stickiness, Money is not neutral and money supply changes affect both prices and real economic variables like output (and as we will see later, unemployment). (Friedman, 1968, 1969, and 1977)

4.2 Slight modification of the AD-AS curve

Aggregate Demand-Aggregate Supply model is one of the most popular models taught in many macroeconomic textbooks (Mishkin, 2022). In this paper, we will use a slightly modified version of it for pedagogical purposes to illustrate the impact of and challenges faced by central bankers when engaging in monetary policy. The downward-sloping Aggregate Demand curve will be replaced by what Beckworth (2019) calls the Monetary Policy (MP) curve. Short-run and long-run aggregate supply curves will remain the same. Equations for the model as stated below

MP: $\pi_t + \%\Delta Y = \%\Delta NGDP$

where the $\pi_t$ denotes the inflation rate at time t with approximate percentage change in NGDP being the sum of percentage change between inflation rate and real output growth rate (Beckworth, 2019). Meanwhile for the Short Run Aggregate Supply Curve below:

SRAS: $\pi_t = \pi_e + g(Y - Y_P) + s$

In this model, the inflation rate at time t is the sum of inflation expectations for that time ($\pi_e$), output gap $g(Y - Y_P)$ with g referring to how sensitive prices are to changes in output and supply shocks (s). (Mishkin, 2022)

Below is a diagram of a graphical representation of the model assuming an NGDP growth rate of 4% (inflation rate of 2% and real output growth rate of 2%).

Figure 1: MP-SRAS curve
4.2.1 Equation of exchange, monetary policy, shocks, and MP-AS model.

As discussed above, the equation of exchange when supplemented by an array of assumptions regarding the stability of velocity and flexibility of prices generates a theoretical framework regarding the nature of the relationship between changes in the money supply and changes in nominal GDP. For purposes of this discussion, we will relax the assumption of stable velocity and assume short-run price stickiness (thus making money none-neutral in the short run) as perfectly flexible prices would mean that the SRAS curve and LRAS curve are identical.

Let’s look at the equation below:

\[ MP: \pi_t + \%\Delta Y = \%\Delta NGDP \]
\[ \%\Delta NGDP = \%\Delta M + \%\Delta V \]
\[ \%\Delta NGDP = \pi_t + \%\Delta Y = \%\Delta M + \%\Delta V \]

As discussed previously and given the identity relation, changes in nominal GDP reflected by changes in both prices and real output must occur either as a result of changes in money supply or changes in velocity. A percentage increase in the size of NGDP will lead to an upward shift of the MP curve and a percentage decrease will lead to a downward shift of the MP curve. Since Central Banks have a monopoly on money supply, changes in monetary policy lead to shifts in the MP curve as changes in the quantity of money supplied all things being equal will lead to changes in the level of nominal GDP. All none-money supply-related reasons for changes in the level of nominal GDP will be captured by changes in velocity, where, all things being equal will have the same effect on the level of nominal GDP as changes in the quantity of money supplied. Demand shocks in the economy will be captured in changes of velocity. Negative demand shocks all things being equal would lead to lower velocity of money and positive demand shocks would lead to higher velocity of money (Beckworth & Hendrickson, 2012). Supply shocks whether short or long run, will lead to movements along the curve but do not change the level of nominal GDP, it will only change the proportion of nominal GDP made of prices and real GDP. Positive supply shocks will
increase the level of real GDP which is equally offset by a decline in prices and vice versa for negative supply shocks leaving the level of nominal GDP unchanged.

4.2.2 Quantity Theory of Money, interest rates, and MP Curve

Interest rates are the main instrument of choice for most central banks today (including the ECB) for engaging in monetary policy. Central banks signal their stance on policy by targeting overnight interbank interest rates (the interest rate on loans of reserves from one bank to another). Money supply and interest rates in the short run tend to have an inverse relationship (all other things being equal). To understand the relationship, see the equations below:

\[ M = mm \cdot MB \]
\[ MB = C + R \]
\[ MB = NBR + BR \]

where mm stands for money multiplier, MB for monetary base, C for currency in circulation, R for total reserves in the banking system, NBR for none borrowed reserves and BR for borrowed reserves. We see that the quantity of money supplied is the product of the money multiplier and monetary base. In other words, the quantity of money supplied has a positive relationship with factors that increase the money multiplier or the size of the monetary base. The monetary base is the sum of both currency in circulation and total reserves in the banking system and the sum of borrowed and none-borrowed reserves from the central bank. Increasing the number of total reserves (most importantly none-borrowed ones) will increase the size of the monetary base and thus increase the quantity of money supplied.

The overnight interbank rate is determined by the market for reserves which central banks exert influence over by determining the supply of none-borrowed reserves through open market operations. Below is a simple diagram showing the market for reserves.

**Figure 2: Market for reserves**

![Diagram of Market for Reserves](image-url)
For purposes of this discussion, we will solely focus on how open market operations are used by central banks to engage in expansionary or contractionary monetary policy. Central banks engage in expansionary (contractionary) monetary policy by increasing the supply of none-borrowed reserves when they engage in an open market purchase (sale) which will shift the supply curve (Rs) to the right (left) and lower (raise) the overnight interbank rate. As explained earlier, increasing (decreasing) the supply of reserves through open market operations increases (decreases) the size of the monetary base which in turn increases (decreases) the quantity of money supplied in the economy. Changes in the quantity of money supplied in turn shift the MP curve due to its impact on the level of nominal GDP and thus have macroeconomic influence (Mishkin, 2022).

4.2.3 Short comment on transmission mechanisms of monetary policy.

Simply defined as ways in which monetary policy affects the economy, the transmission mechanisms of monetary policy can be broadly categorised into four categories. The credit channels (Bernanke & Gertler, 1995), the asset price channels (Kaldor, 1966, Brainard and Tobin, 1968 and Taylor, 1995), the traditional interest rate channels (Taylor, 1995), and the signalling and/or expectations channel (Krugman, 1998 and Woodford & Eggertson, 2003). While there has been much debate over the effectiveness of each channel, none of them is inconsistent with the view that expansionary or contractionary monetary policy is effective through an increase or decrease in the quantity of money supplied.

4.2.4 Okun’s law.

Okun’s law (named after Arthur Okun) describes the negative relationship between the unemployment gap and the output gap. See the equation below for its exposition:

\[ U - U_n = - 0.5 \cdot (Y - Y_p) \]

The law states that for each percentage point change in the output gap, the unemployment rate has an inverse half percentage point difference from its natural rate (Okun, 1972). To understand the natural rate of unemployment, a discussion of Philip’s curve is required.

4.2.5 Expectations Augmented Phillips Curve Equation and Aggregate Supply Curve

The Phillips curve explores the short-run inverse relationship between the inflation rate and the unemployment rate. Short-run relationship occurs as a result of price stickiness which causes money to be none neutral in the short run. However, in the long run, the unemployment rate eventually reverts to what is referred to as its natural rate (Friedman,
1977) or NAIRU, level of unemployment that would occur if all wages and prices were flexible. In the long run, inflation and unemployment are independent consistent with the money neutrality assumption in the quantity theory of money. See the equation below.

$$\pi_t = \pi_e - g(U - U_n) + s$$

In this model, the inflation rate at time t is the sum of inflation expectations for that time ($\pi_e$), unemployment gap $g(U - U_n)$ with g referring to how sensitive prices are to changes in unemployment) and supply shocks (s) (Mishkin, 2022).

Using Okun’s law, we can substitute $g(U - U_n)$ with $0.5 \cdot (Y - Y_P)$. Assuming g is 1, we get a short-run aggregate supply curve which implies a relationship between the SRAS and Philip’s curve (Mishkin, 2022). See the equation below:

$$\pi_t = \pi_e + 0.5 \cdot (Y - Y_P) + s$$

**Figure 3: Long Run Philips curve**

![Diagram of the Long Run Philips curve](image)

### 4.2.6 Monetary Policy and Unemployment

Okun’s law describes the negative relationship between the unemployment gap and the output gap which in turn, with the combination of Philip’s curve, is used to build a useful theoretical framework for understanding how unemployment in the macro economy is affected by changes in the level of nominal GDP under the assumption of short-run money none neutrality. Imagine a scenario where a none independent central bank engages in expansionary monetary policy to help a politician win an election increasing the level of nominal GDP from 4% to 8%. Given short-run money none neutrality as a result of sticky prices, any increase in NGDP not captured by an increase in price will be reflected by an increase in real output (For this example we will assume the inflation rate and rate of Real GDP growth increased to 4% each). Due to Okun’s law, the 2% increase in real GDP must also lead to a 1% decrease in the unemployment rate with the rate of inflation increasing as predicted by the quantity theory of money, MP-SRAS model, and short-run Philip’s curve theory.
The key insights drawn from this discussion are that an increase (decrease) in the level of nominal GDP either as a result of monetary expansion (contraction) or none-monetary reasons captured by an increase (decrease) in velocity will, in the short run, lead to an increase (decrease) in the rate of inflation and real GDP growth rate and a decrease (increase) in the rate of unemployment below (above) its natural rate. Macroeconomic stabilisation through the maintenance of a stable rate of nominal GDP growth would in theory also stabilise the rate of inflation, real GDP growth rate, and unemployment rates at their natural level barring supply shocks. This conclusion can be derived even if we drop the assumption that for each percentage point change in the output gap, the unemployment rate has an inverse half percentage point difference from its natural rate. The only commitment that has to be made is the inverse relationship between real GDP growth rates and unemployment rates under conditions of rising or falling levels of nominal GDP growth rates.

4.2.7 Supply Shock Problem and Response to Demand Shocks

An application of the MP-AS model will be used here to graphically display the supply shock problem of inflation and how NGDP targeting is argued to be a solution for it.

**Figure 4: MP-AS model of demand shock response by central banks**

Both inflation and NGDP targeting respond to demand shocks the same way, a negative demand shock would be offset by expansionary monetary policy, and a positive demand shock would be offset by contractionary monetary policy. The notion that there is no trade-off between achieving price and economic activity stability when responding to demand shocks with monetary policy is referred to as “divine coincidence” (Blanchard et al., 2007).

4.2.8 Inflation Targeting Response to Short-Run Supply Shocks.

**Figure 5: MP-AS model of inflation targeting central bank responding to supply shocks.**
However, when responding to supply shocks, NGDP targeting has significant advantages over inflation targeting as it allows central banks to ignore supply shocks as it does not affect the NGDP growth rate, only results in changes in components of NGDP while supply shocks affect the rate of inflation and forces central banks to respond to restore it to its target rate, in this case, assumed to be 2%. As the graphs show above, responding to supply shocks leads to a larger output gap than what the initial supply shock caused. There is a tradeoff between stabilising inflation and having a smaller output gap.

Proponents of inflation targeting could argue that the supply shock problem could be resolved through the adoption of greater flexibility under a constrained discretion approach where deviations of the inflation rate from its target could be tolerated during a temporary supply shock (Mishkin and Bernanke, 1997).

However, proponents of NGDP argue that policymakers would still need to apply judgement on whether a change in inflation is due to demand or supply shocks which is difficult to do in real-time and leaves the possibility for human error to be a factor while under NGDP targeting, this judgement would not be needed as supply shock problem would simply be ignored as NGDP growth rate would not change from its target if a supply shock occurs while NGDP would deviate from its target if a demand shock occurred calling for policymakers to respond to stabilise macroeconomic conditions (Selgin, 1997).

Another response critics of inflation targeting would present is that during periods of positive supply shocks, policymakers would take advantage of the supply-side deflation to have more expansionary monetary policy than would have otherwise happened had macroeconomic conditions been normal due to its ability to further fuel an economic boom while having a contractionary monetary policy due to fears of rising inflation if a negative supply shock occurred. Examples of these episodes of alleged monetary policy mismanagement as a result of supply shock responses include the early 2000s subprime boom where productivity growth led the Federal Reserve to keep rates lower than they otherwise would have been (had they followed a Taylor rule-like approach) despite the economy “booming” (Selgin et al., 2015 and Ahrend et al., 2008) and the ECB’s decision to raise interest rates in 2011 due to fears of inflation caused by negative supply shocks (Beckworth, 2014 and 2017).
The diagram below illustrates how the supply shock problem is avoided under an NGDP Targeting regime.

4.2.9 NGDP Targeting Response to Short-Run Supply Shocks

**Figure 6: MP-AS model of NGDP targeting central bank responding to supply shocks.**

A central bank targeting NGDP would not need to respond to supply shocks as an increase in real output would be offset by the same proportional decrease in the level of prices. Conversely, a decrease in real output would be offset by the same proportional increase in the level of prices as predicted by the Quantity Theory of Money if NGDP (=M·V=P·Q) is stable.

4.3 Discussion and Implications

The equation of exchange which is an identity relation when given assumptions gives us the quantity theory of money and a theory of inflation. Under realistic assumptions of sticky prices, we concluded that any changes in NGDP will in the short run affect both prices and real output. When augmented into a standard AD-AS model, and examining its relationship to the Long Run Philip’s curve. We can observe that changes in NGDP in the short run will impact real economic variables like real output and unemployment.

Since central banks have a monopoly on money supply and thus are in charge of monetary policy, the theories of the quantity theory of money, the MP-AS curve, and Philip’s curve give us a framework to understand how their monetary policy decisions impact economic activity in both the short and long run. Our understanding of the role of monetary policy that we discussed in the background and the importance of central banks stabilising a nominal anchor largely comes from our theoretical understanding of how changes in monetary policy and their impact on NDGP affect the real economy in both the short and long run.
5. Data and empirical estimation

5.1 Method

In this section of the paper we will describe how we seek to test whether the claims of NGDP Targeting Proponents hold up well. In other words, we will test the hypothesis of whether a rules-based NGDP Forecast Targeting would improve the macroeconomic outcomes of a nation. We will do our investigation by exploring how the monetary policy conditions of the Eurozone which we argued in our background is likely not an optimum currency area meaning that due to asymmetric economic developments among member states in the Eurozone, the monetary policy that the ECB set will affect them differently as they all have different macroeconomic needs. In this paper, we will attempt to examine whether the monetary policy of the ECB managed to produce conditions in certain member countries in the Eurozone that best mimicked what an NGDP Targeting regime would like.

To examine this, we would need to first determine how monetary policy would be set had an NGDP Targeting regime been in place. We have decided that a couple of modified Taylor rules that take into account NGDP variables as opposed to (inflation and output gap) to produce, given those variables, what the prescribed target rate for each country would be, at a given period had they maintained monetary policy autonomy to pursue a NGDP Targeting Regime.

Once the prescribed target rate has been produced, we will find the difference between the ECB rate and the prescribed target rates to create a variable that we call the “Rate Gap”. Implications are that countries with a Rate Gap closer to 0 have an optimal prescribed target rate closer to the rate that the ECB had set for all nations. A positive Rate Gap (ECB rate > Optimal Rate) implies tighter monetary conditions than ideal. A negative Rate Gap (ECB rate < Optimal Rate) implies looser monetary conditions than ideal.

We will then examine through multiple fixed effects regressions whether there is a relationship between the Rate Gap and macroeconomic performance indicators for each member of the Eurozone.

The hypothesis that will be tested is whether countries that had larger positive (negative) rate gaps tended to have macroeconomic outcomes associated with monetary contraction (expansion)

5.1.1 Explaining the modified Taylor Rules
An exposition of the modified Taylor rules used to estimate prescribed policy rate will be presented. There are 3 equations that we will use in this paper to try and produce the prescribed target rates.

Before the presentation of the modifications, it is important to note that the rules, while having theoretical macroeconomic foundations, and seeking to solve the knowledge problem present in the standard Taylor rule, are not an exact relationship between the variables. The rules described in this paper are strictly for operational purposes. Examine the equations below:

\[ i = \pi_e + r \]
\[ \%\Delta NGDP_e = \pi_e + \%\Delta Y_e \]

Nominal interest rates (i) according to the Fisher equation is the sum made of real interest rates (r) and inflation expectations (\( \pi_e \)). Expected nominal GDP is according to the equation of exchange the sum of inflation expectations and expected real GDP growth rates (\( \%\Delta Y_e \)).

All things being equal, nominal interests and expected NGDP have a positive relationship with one another as inflation expectations component of both equations are identical and real interest rates have a positive relationship with expected real GDP growth rates (King, 1993, European Central Bank, 2019, Aghion & Howitt, 2010, and Beckworth & Sumner, 2013).

In an ideal world where Svensson’s, Woodford’s, and Eggertson’s approaches to monetary policy are incorporated to stabilise NGDP as the nominal anchor, we should expect

\[ NGDP_{it} = NGDP Target_{it} = NGDP Forecast_{it+1} = NGDP_{e_{it}} \]

Where the present day nominal GDP, the central bank’s target, expectations and its forecast of future NGDP are identical with no need for makeup policy. If we assume that other determinants of real interest are held stable, then the rate of real interest and expected real GDP growth rates would approximate each other, for purposes of producing a rate gap, we will just assume an identity relation in which we get interest rates and NGDP being identical as seen below:

\[ i_{it} = NGDP_{it} = NGDP Target_{it} = NGDP Forecast_{it} = NGDP_{e_{it}} \]

The Taylor rule in use.

The equation will be solely focused on whether Central banks used the “Targeting the forecast” approach to NGDP Targeting. See equation below:

\[ i_{it} = NGDP Forecast_{it+1} + 0.5 Forecast Gap_{it+1} \]
Where \( i_{it} \) stands for central bank target rate prescribed by the equation, \( NGDP\ Forecast_{it+1} \) being year ahead forecast of NGDP and \( Forecast\ Gap_{it+1} \) being the difference between forecasted level of NGDP growth rate and target level. The conclusion one can derive from this equation is that if the forecast gap is 0 (where forecast = target level) then the nominal interest rate that the central bank should target in full employment should be equal to both their forecasted and targeted level of NGDP. The equation has an inbuilt Taylor Principle where any changes in NGDP forecast will lead to greater proportionate change of nominal interest rates in the same direction (Taylor, 1993).

The forecast variable will be done using OECD forecast data with more realistic assumptions that policymakers will be without perfect information and will have to rely on imperfect forecasts to make policy decisions.

5.1.2 Sample selection

Data on the dependent and independent variables were selected from 12 Eurozone member countries namely Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. Other member countries of the Eurozone were omitted from the study because they were not members of the monetary union at the latest, the year 2001, and therefore were not subject to ECB monetary policy until their later membership (European Central Bank, 2022). The main independent variable of interest, the Rate Gap uses the ECB deposit facility rate which is considered to be the most important one of the three interest rates that the ECB uses as its tools for monetary policy (Mishkin, 2022) from a period of 2001-2015. It also correlates positively with the other two key interest rates (namely the marginal lending facility rate and the refinancing rate) so whatever impact on monetary policy that those other two rates have will be proxied by changes in the deposit facility rate. The dependent variables from each country are collected from a period of 2002-2016. This means that rates from one year will be compared to macroeconomic results of the year after the rate was set because it takes time for monetary policy to impact the economy due to what Milton Friedman described as “long and variable lags” (Friedman, 1961). Since the policy is being set based on a year ahead forecast, the results of the policy should be during the time on which the forecast to do the policy was based.

5.1.3 Regression selection and variables

The nature of the data collected is a panel which is defined as cross-sectional data over time. To regress panel data, three different methods were considered. Pooled OLS method, Fixed Effects Model (FEM) and Random Effects Model (REM). Pooled OLS assumes that explanatory variables are both time-invariant and lack subject-specific heterogeneity. We believe this assumption to be false for macroeconomic outcomes as different countries (the subjects in the model) have differing geographical, cultural, and institutional differences that
impact the interactions individuals have among one another when engaging in exchange which in turn influences macroeconomic outcomes. Using Pooled OLS leaves will likely leave us with biased results. This leaves us with 2 options, either FEM or REM. FEM assumes explanatory variables for the outcome have subject-specific heterogeneity but are time-invariant and controls for all those time-invariant differences. A good indicator of heterogeneity is the presence of a correlation between error term and explanatory variables in the model. If the correlation however is 0, then the REM model is preferable. A Hausman test can be done to test which model is preferable (Gujarati & Porter, 2009).

Independent Variable

Rate Gap
Once the interest rates have been produced, we will find the rate gap which is the difference between the ECB Interest Rate and the prescribed Target rate by the Taylor rule.

\[ Rate \ Gap_{it} = ECB \ Interest_t - i_t \]

If \( Rate \ Gap_{it} > 0 \) then the policy is too contractionary
If \( Rate \ Gap_{it} = 0 \) then the policy is appropriate
If \( Rate \ Gap_{it} < 0 \) then the policy is too expansionary

Dependent Variables.
The paper will have multiple dependent variables as there are many indicators of macroeconomic stability. Below are different empirical models that will be used to measure the relationship between the Rate Gap as an independent variable and other macroeconomic outcomes as dependent ones.

A Hausman test will be conducted to see whether REM or FEM is preferable for each dependent variable, under the null hypothesis FEM and REM are all consistent but FEM is inefficient while REM is efficient and therefore preferred. Under the alternative hypothesis, FEM is consistent but REM is inconsistent making FEM the preferred model. We reject (do not reject) the null hypothesis and use FEM (REM) if prob<chi2 (prob>chi2) (Gujarati & Porter, 2009).

**Inflation**

A Hausman test for inflation was done where the null hypothesis was not rejected and therefore, the REM was preferred for testing the relationship between inflation and independent variables.

The model in use for regressing inflation will be shown below.

\[ \pi_{it} = \beta_0 + \beta_1 rate \ gap_{it-1} - 1 + \beta_2 real \ gdp_{it} + \beta_3 risk premium_{it} + \beta_4 deficit_{it-1} - 1 + \epsilon_{it} \]
Unemployment

The Hausman test for unemployment produced results where the null hypothesis was rejected, therefore FEM was the preferred method of choice. The model in use will be shown below.

\[ U_{it} = \beta_0 + \beta_1 \text{rate gap}_{it-1} + \beta_2 \text{inflation}_{it} + B_3 \text{risk premium}_{it} + B_4 \text{deficit}_{it-1} + \epsilon_{it} \]

Ideally, we would like to use the unemployment gap as an independent variable instead of unemployment rate to align our empirical investigation closer to our theoretical framework. We however decided against it largely due to the difficulty of getting accurate estimates of what the natural rate of unemployment is for each country which is needed for calculating the unemployment gap. Unemployment rate data was more easily accessible and would still experience responses to changes in macroeconomic conditions so it was the best option given our constraints but our study will have the limitation of not taking into account different natural rates of unemployment that different countries will have at a given moment in time.

Real GDP

The results from the Hausman test for the two real gdp regressions concluded that we reject the null hypothesis and therefore FEM was the preferred model of choice.

\[ \%\Delta Y_{it} = \beta_0 + \beta_1 \text{rate gap}_{it-1} + B_3 \text{risk premium}_{it} + B_4 \text{deficit}_{it-1} + \epsilon_{it} \]

Just like the unemployment gap, we would have ideally preferred to use the output gap as our dependent variable for similar aforementioned reasons, however, difficulty in acquiring data estimates of the full employment rate of output is difficult and real GDP growth rate as the next best options. It will suffer from similar limitations as the unemployment regression model.

Data for the rates of real GDP growth rates, inflation, and unemployment per given year in each country was collected from the International Monetary Fund’s World Economic Outlook reports.

Control Variables

The control variables of choice are deficit spending as a % of GDP, the equity risk premium, the inflation rate, and the real GDP growth rate. In contemporary macroeconomic theory, fiscal policy is considered, alongside monetary policy, to be an important tool for macroeconomic stabilisation with an effect on aggregate demand which in turn has implications on unemployment, real GDP, and rate of inflation (Baxter & King, 1993 and Mankiw et al., 2023). Our measure of choice for proxying fiscal policy is deficit spending as
a % of GDP. The deficit variable from one year will be compared to the macroeconomic results of the year after the deficit was spent because, like monetary policy, it takes time for fiscal policy to impact the economy due to lags (Alesina et al., 2020).

We also included the equity risk premium as a control variable which serves two purposes. The first purpose is as a proxy of investor sentiment in markets, whenever investors become more (less) risk averse, usually due to pessimistic (optimistic) macroeconomic expectations, they demand (lower) higher compensation for taking on equity which shows up as an increase (decrease) in the equity risk premium (Damodaran, 2023). The second reason is related to our discussion of monetary transmission mechanisms, where the asset price channel was briefly discussed. Since changes in the equity risk premium do affect asset pricing, that would have macroeconomic implications if the asset price channel of monetary transmission is effective, as lower (higher) asset prices, either as a result of or proxied by an increasing (decreasing) equity risk premium should contribute to macroeconomic contraction (expansion) (Kaldor, 1966, Brainard and Tobin, 1968, Taylor, 1995, Sumner, 2021 and Mishkin, 2022). Data on the equity risk premium is collected from Professor Aswath Damodaran’s website (Damodaran, n.d).

Real GDP growth rate is added as a control variable as well as a proxy for supply shocks. As argued earlier in the theoretical framework, all things being equal, real GDP growth rates have an inverse relationship with the rate of inflation (Friedman, 1969).

The Philip’s curve relationship at least in the short run compels us to add inflation as a control variable in the model that attempts to provide an explanation for differing rates of unemployment among the subjects of study. It also plays the role of a proxy for short-run supply shocks where the rate of unemployment tends to decrease (increase) due to a positive (negative) short-run supply shock (Friedman, 1977).

5.2 Relationship Examination

Once the Rate Gap has been calculated, we seek to examine the relationship between the Rate Gap and Macroeconomic outcomes among Eurozone members. The rate Gap will be the main independent variable tested while the inflation rate, unemployment rate, and real GDP will be the dependent variables as multiple regressions will be done for each dependent variable. As the theory predicts, If the rate gap is positive, we should expect to see macroeconomic outcomes associated with monetary tightening such as lower rates of inflation, higher rates of unemployment, and lower rates of real GDP growth. If the rate gap is negative, we should expect to see macroeconomic variables associated with monetary expansion such as higher rates of inflation, real GDP growth, and lower rates of unemployment. If expected results occur, evidence in favour of the hypothesis that NGDP stability would contribute to macroeconomic stability would be present as below-target levels of NGDP growth would be
an indicator of macroeconomic contraction (expansion) evidenced by lower (higher) rates of inflation, real GDP growth and higher (lower) rates of unemployment.
6. Results and analysis

6.1 Descriptive statistics

Table 1: Descriptive statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>observations</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>inflation</td>
<td>180</td>
<td>0.018</td>
<td>0.013</td>
<td>-0.017</td>
<td>0.047</td>
</tr>
<tr>
<td>real gdp</td>
<td>180</td>
<td>0.013</td>
<td>0.033</td>
<td>-0.101</td>
<td>0.244</td>
</tr>
<tr>
<td>rate gap$_{t-1}$</td>
<td>180</td>
<td>-0.016</td>
<td>0.065</td>
<td>-0.512</td>
<td>0.188</td>
</tr>
<tr>
<td>premium</td>
<td>180</td>
<td>0.062</td>
<td>0.026</td>
<td>0.045</td>
<td>0.219</td>
</tr>
<tr>
<td>unemploymer</td>
<td>180</td>
<td>0.092</td>
<td>0.048</td>
<td>0.025</td>
<td>0.275</td>
</tr>
<tr>
<td>deficit$_{t-1}$</td>
<td>180</td>
<td>0.025</td>
<td>0.081</td>
<td>-0.327</td>
<td>0.518</td>
</tr>
</tbody>
</table>

Table 1 shows the descriptive statistics for variables being explored in this paper. The first observation made is that despite having a lower mean than the rate of inflation, the real GDP growth rate also has a larger standard deviation and a larger range. Perhaps this is an indicator of either relatively strong levels of short-run price stickiness or the presence of varying supply shocks among different countries. It is important to note however that while both hypotheses are plausible, Ireland had an outlier year where the real GDP growth rate was 24.4% which is far above the average and range of real GDP growth both Ireland and other Eurozone countries face even with the presence of shocks in the economy. Ireland’s unusual result might bias the data contributing to the large range and standard deviation that the real GDP growth rate has.

Another interesting observation is that the average nominal GDP growth rate of countries in question within the sample period is below the 4% target our paper is using but the average rate gap is -0.0159 which is an indicator of on average, the ECB set policy that is by our operational definition, too expansionary for most of the studied countries in the Eurozone.

Deficit variables show the largest range and largest standard deviation of all variables in the model. This reflects the differing fiscal policies and varying levels of fiscal responsibility that different member countries have. It is important to remember that the Eurozone debt crisis happened within the sample period of study and countries like Greece which were at the centre of it also happened to have the largest recorded deficits and equity risk premiums. A question to be asked; Do large equity risk premiums lead to higher deficits as a % of GDP due to depressed asset prices contributing to economic contraction through the asset price
transmission mechanism or do higher deficits and higher levels of government debt that occur result in an increase in the equity risk premium (Damodaran, 2023). Maybe it is a case of both in a “doom loop” (Mishkin, 2022 & Krugman et al., 2023) like situation but the question of causation regarding this matter is beyond the scope of this paper.

6.2 Correlation analysis

Table 2: Correlation matrix

<table>
<thead>
<tr>
<th>Variables</th>
<th>inflation</th>
<th>unemploy</th>
<th>Real GDP</th>
<th>Rate Gap</th>
<th>premium</th>
<th>deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>inflation</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>unemploymen</td>
<td>-0.369</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>real gdp</td>
<td>0.069</td>
<td>-0.281</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rate gap</td>
<td>-0.186</td>
<td>0.323</td>
<td>-0.948</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>premium</td>
<td>-0.401</td>
<td>0.721</td>
<td>-0.182</td>
<td>0.193</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>deficit</td>
<td>-0.302</td>
<td>0.390</td>
<td>-0.220</td>
<td>0.253</td>
<td>0.292</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 2 shows the correlations between different variables explored in the paper. The first noteful observation is that while the rate gap does not have a strong correlation with other variables, it has a very strong negative correlation with the real GDP growth rate. There are two implications of this. The first has to do with its consistency with the hypothesis that prices are sticky in the short run which could explain why monetary policy is more strongly negatively correlated with the real GDP growth rate than the inflation rate, the relationship between the rate gap and unemployment is also positive as predicted by the theoretical framework behind this paper. The second implication is that it could be a source of multicollinearity, defined as several variables in the model being correlated with one another. While OLS estimators are still the best linear unbiased estimators in the presence of multicollinearity, they will have large standard errors which contributes to less precise estimates with wide confidence intervals and a higher risk of committing a type 2 error (not rejecting a false null hypothesis). Indicators of multicollinearity include the presence of an overall significant model with a high R2 but insignificant estimates and a Variance Inflation Factor (VIF) that exceeds 10. In all the models, the only variable that had a VIF that exceeded 10 was the rate gap in the model that had inflation as an independent variable. As we believe one of the reasons for the correlation is due to the fact that the variables in
question naturally correlate with each other and should be given economic theoretical reasons, we decided in this paper to leave the multicollinearity as it is and accept the risks associated with it. We also believe that the relatively small sample size of 180 observations contributes to the problem, increasing the sample size in a future study with the availability of more data would help reduce the size of standard errors. Dropping a variable with high VIF is a possible remedy but the possibility of underfitting, a kind of specification bias, deters us from pursuing such a solution (Gujarati & Porter, 2009).

The second observation is seeing the negative relationship the equity risk premium has with the inflation rate and real GDP growth rate and a strong positive relationship with the unemployment rate. This is consistent with the idea that asset prices are a reliable transmission mechanism of monetary policy and investor sentiment affecting aggregate demand.

The most surprising observation is the negative relationship deficit spending has with the inflation rate and real GDP growth rate and the positive relationship with the unemployment rate, contrary to many beliefs about the use of countercyclical fiscal policy as a tool for macroeconomic stabilisation (Baxter & King, 1993). If the countercyclical fiscal policy were a reliable tool for macroeconomic stabilisation, fiscal policy as proxied by deficits should have a positive relationship with the inflation rate and real GDP growth rate and a negative relationship with the rate of unemployment. A plausible hypothesis is that deficits harm macroeconomic activity through a combination of Ricardian equivalence (Barro, 1989), crowding out, and asset price transmission mechanisms. Typically, deficits are financed either through issuing bonds or expanding the monetary base to engage in debt monetisation. Debt monetisation is out of the question for the sake of argument (and it is inflationary see Rogoff & Reinhart, 2010 and Mishkin 2022) so that leaves issuing bonds as the alternative. Increasing the supply of bonds to fund deficits has downward pressure on bond prices and upward pressure on yields and interest rates. Lower bond prices especially if they are a large part of many households’ and financial institutions’ portfolios, would not only have downward pressure on demand which is a leading driver of economic contraction through the asset price transmission mechanism but it could also be a source of increasing financial frictions and uncertainty, which heavily contribute to monetary and economic contraction through the credit channel (Bernanke & Gertler, 1995 and Bloom, 2009). Crowding out occurs as well as funds allocated to the government to finance a deficit are funds not allocated to the private sector which is arguably more efficient at using and allocating those funds to its most highly valued uses in the macroeconomy. Financing government spending by raising taxes has downward pressure on bond prices and upward pressure on yield and interest rates as well as decreasing the demand for bonds and supply of loanable funds (Mishkin, 2022). Tax hikes also have downward pressure on both demand through the reduction of disposable income and supply through disincentives to engage in labour and productive long-term investments by lowering expected future income and increasing costs (Daveri & Tabellini, 2000, Alesina & Ardagna, 2010, and Alesina et al., 2020). It is important to recall that correlations do not provide sufficient evidence to draw conclusions but it is important to keep these alternative hypotheses in mind.
6.3 Regression analysis

This section of the paper looks at and discusses the results of the regressions. Pooled OLS regressions were done for all the models as a point of comparison to the REM model when discussing explanatory variables for inflation and FEM models when discussing explanatory variables for unemployment and real GDP growth rate.

Before we get into discussing the results of the regression, we need to test the models for heteroscedasticity (non-constant variance). An assumption of many regression models is the presence of homoscedasticity (constant variance), to make sure that this assumption holds, we performed a Breusch-Pagan test for all 3 OLS models where the null hypothesis is the presence of homoscedasticity and the alternative hypothesis is the presence of heteroscedasticity. If the p-value is less than the 5% significance level, we reject the null hypothesis and affirm the presence of heteroscedasticity (Gujarati & Porter, 2009).

In the OLS model where inflation and real GDP were the dependent variables, the p-value was higher than 0.05 concluding that we do not reject the null hypothesis and affirm the presence of homoscedasticity. However, for the models where unemployment was the dependent variable, the p-value was less than 0.05 concluding that we reject the null hypothesis and affirm the presence of heteroscedasticity.

A modified Wald test for heteroscedasticity was done for the FEM models. For both models that had unemployment and real GDP as dependent variables, the p-value was less than the significance level, therefore we reject the null hypothesis and affirm the presence of heteroscedasticity. The model that had inflation as a dependent variable had a p-value more than the significance level indicating homoscedasticity.

Heteroscedasticity in this paper is dealt with through the use of robust standard errors across all different models.

Table 3: Pooled OLS, REM and FEM regressions with inflation as Dependent variable

<table>
<thead>
<tr>
<th>Variables</th>
<th>Inflation (OLS)</th>
<th>Inflation (REM)</th>
<th>Inflation (FEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>rate gap(_t-1)</td>
<td>-0.217*** (0.047)</td>
<td>-0.217*** (0.033)</td>
<td>-0.356*** (0.100)</td>
</tr>
<tr>
<td>real gdp(_t)</td>
<td>-0.421*** (0.077)</td>
<td>-0.421*** (0.079)</td>
<td>-0.188*** (0.041)</td>
</tr>
<tr>
<td>premium(_t)</td>
<td>-0.173*** (0.036)</td>
<td>-0.173*** (0.040)</td>
<td>-0.291*** (0.044)</td>
</tr>
</tbody>
</table>
Table 3 displays the results of Pooled OLS, FEM, and REM regressions for inflation as an independent variable. There are three key observations.

The first observation is that the values of the intercept and slopes of the both REM and OLS models when rounded off are nearly identical. The only difference in insight the REM model gives us is that the OLS method does not distinguish between the R-Square (within) and R-Square (between). REM and FEM model results suggest that our models do a worse job explaining the differences in the inflation rate between the countries of study than within the countries.

The second observation is that all the intercepts and slopes in both models are statistically significant at a 1% significance level barring the deficit variable, which is significant at a 5% significance level in both OLS and REM models and 10% in the FEM model.

The third observation is that the models affirm an inverse relationship between the rate gap and rate of inflation which serves as evidence in favour of our hypothesis of interest that a positive (negative) rate gap if it is an indicator of monetary policy that is too contractionary (expansionary), should predict the rate of inflation decreasing (increasing). Real GDP growth rate and equity risk premium also have an inverse relationship with the inflation rate both serving as evidence in favour of supply shocks, investor sentiment, and asset price monetary transmission mechanism also influencing the rate of inflation. The most surprising result is the inverse relationship deficit spending has with the rate of inflation. This is inconsistent with a popular view that expansionary fiscal policy through deficit spending is a source of demand that can be used to help stabilise the macroeconomy during periods of negative
demand shocks. The results however are more consistent with the view that deficits harm macroeconomic activity through a combination of crowding out, uncertainty, and asset price transmission mechanism as discussed in our analysis of the results from Table 2.

Table 4: Pooled OLS and FEM regressions with unemployment as dependent variable

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unemployment (OLS)</th>
<th>Unemployment (FEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>rate gap&lt;sub&gt;r−1&lt;/sub&gt;</td>
<td>0.116**(0.050)</td>
<td>0.100*(0.052)</td>
</tr>
<tr>
<td>inflation&lt;sub&gt;t&lt;/sub&gt;</td>
<td>-0.148 (0.205)</td>
<td>-0.458**(0.159)</td>
</tr>
<tr>
<td>premium&lt;sub&gt;t&lt;/sub&gt;</td>
<td>1.170*** (0.116)</td>
<td>0.919***(0.041)</td>
</tr>
<tr>
<td>deficit&lt;sub&gt;r−1&lt;/sub&gt;</td>
<td>0.092*** (0.035)</td>
<td>0.087*(0.041)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.022** (0.009)</td>
<td>0.043***(0.005)</td>
</tr>
<tr>
<td>Observations</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>No. of countries</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>R-Square (within):</td>
<td></td>
<td>0.695</td>
</tr>
<tr>
<td>R-Square (between):</td>
<td></td>
<td>0.499</td>
</tr>
<tr>
<td>R-Square (overall):</td>
<td></td>
<td>0.579</td>
</tr>
<tr>
<td>F-test</td>
<td>41.41</td>
<td>375.27</td>
</tr>
</tbody>
</table>

Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1 with the robust standard errors being in the parenthesis.

Table 4 displays the results of Pooled OLS and FEM regressions for unemployment as an independent variable.

The first observation we make is that in the OLS model, all variables barring inflation are statistically significant, with equity risk premium and deficit at a 1% significance level and rate gap and intercept at a 5% significance level. Meanwhile, the FEM model affirms all variables being significant, with equity risk premium and deficit at the 1% level, inflation at the 5% level, and deficit and rate gap at the 10% level. This highlights the flaws of the OLS method that the FEM attempts to remedy, namely, its assumption of the lack subject specific heterogeneity. Different countries have different cultural and institutionally contingent factors
that affect their respective labour markets and failure to control them, which OLS fails to do, leads to biased results. By using FEM, the model’s explanatory power of unemployment rates within countries improved as shown by a higher within R-Squared. The FEM model does have a slightly lower overall R-squared than the OLS model but the results are less biased. Just like the previous models attempting to explain the rate of inflation, the models do a better job at explaining factors that influence the rate of unemployment within a country than cross-country differentials in the rate of unemployment.

The second observation is the positive relationship that the rate gap has with the unemployment rate, which serves as evidence in favour of our hypothesis of interest that a positive (negative) rate gap should predict the rate of unemployment increasing (decreasing). The equity risk premium and deficit spending also have a positive relationship with the rate of unemployment which lends support to the effectiveness of asset price monetary transmission mechanism and the macroeconomic impact of both investor sentiment and crowding out effects of government spending. The rate of inflation has an inverse relationship with the rate of unemployment which provides evidence for both the short-run Philip’s curve theory and the none-neutrality of money. However, this relationship is only statistically significant in the FEM.

Table 5: Pooled OLS and FEM regressions with Real GDP as dependent variable

<table>
<thead>
<tr>
<th>Variables</th>
<th>RealGDP (OLS)</th>
<th>RealGDP (FEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( rate\ gap_{t-1} )</td>
<td>-0.479** *(0.016)</td>
<td>-0.475*** (0.030)</td>
</tr>
<tr>
<td>( premium_t )</td>
<td>0.007 (0.035)</td>
<td>0.029 (0.048)</td>
</tr>
<tr>
<td>( deficit_{t-1} )</td>
<td>0.009 (0.012)</td>
<td>0.007 (0.012)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.006*** (0.002)</td>
<td>0.004 (0.004)</td>
</tr>
<tr>
<td>Observations</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>No. of countries</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>R-Square (within):</td>
<td>0.898</td>
<td>0.898</td>
</tr>
<tr>
<td>R-Square (between):</td>
<td>0.909</td>
<td>0.909</td>
</tr>
<tr>
<td>R-Square (overall):</td>
<td>0.899</td>
<td>0.899</td>
</tr>
<tr>
<td>F-Test</td>
<td>298.96</td>
<td>242.20</td>
</tr>
</tbody>
</table>
Significance levels are indicated as *** $p<0.01$, ** $p<0.05$, * $p<0.1$ with the robust standard errors being in the parenthesis.

Table 5 displays the results of Pooled OLS and FEM regressions with real GDP growth rate as an independent variable.

In both models, the only slope that is statistically significant at any level is the rate gap, which passes the 1% threshold, and affirms an inverse relationship between the two variables as our hypothesis of interest would predict. The models also have the highest R-squared value of all the models while having the fewest statistically significant slopes. These are usually indicators of multicollinearity which as explained in our discussion of Table 2 results, we decided to accept for fear of specification bias. It could be the case that the other variables are genuinely not statistically significant and the rate gap alone has great explanatory power under a hypothesis where the real GDP growth rate is stable but fluctuations are due to short-run demand shocks in an economy with high levels of price stickiness. However, due to signs of multicollinearity, it could be the case that the other estimates are not statistically significant due to type 2 errors where failure to reject false null hypotheses occurred (Gujarati & Porter, 2009). It is not unreasonable to suggest so to be the case given the inconsistency the results of these 2 regressions would have with the results of other models in this paper and existing academic literature discussed in this paper.
7. Discussion

7.1 Weaknesses and limitations

The paper has attempted to establish a criterion for what is considered excessively easy or tight monetary policy by looking at the behaviour of interest rates at a given time period and comparing the prescribed interest rate to the rate set by the ECB. However, this method suffers from the limitations discussed in this section. A summary of the criticism is that many of the limitations to the approach adopted in the article are closely tied to the problems faced by using nominal interest rates as the primary instrument of monetary policy.

The first limitation is that it overly emphasizes open market operations as the primary tool for monetary policy, without taking into account other tools especially, those that are now referred to as “unconventional tools of monetary policy” such as large-scale asset purchase programs, term auction facilities, and forward guidance. Zero lower bound as discussed in the literature review is only a problem because the means of communication of what the stance of monetary policy is from the central bank to market participants become impotent if interest rates hit 0 and can not be lowered any further which is an issue that unconventional tools solve (Woodford & Eggertson, 2003). Changes in both the required and excess reserve ratios can increase or decrease the money multiplier which is an important component of the money supply (Mishkin, 2022).

The second limitation which is related to the first has to do with monetary transmission mechanisms. The paper supports a view where interest rates at the very least, are one of the many effective channels through which monetary policy affects the economy (Taylor, 1995) but this conclusion is heavily disputed (Mishkin, 2022 and Sumner, 2023). Alternative views have been proposed and while the paper attempts to capture the asset price channel through means of equity risk premium, the credit channel has regrettably been neglected despite some academic support for it (Bernanke & Gettier, 1995). The expectations channel is not well covered in the paper as well, the main reason is due to the difficulty of acquiring data that captures market expectations. One can, however, argue that due to the signalling role that interest rates play (Woodford & Eggertson, 2003), it can be used as a proxy for the stance of policy through which the expectations channel is effective (Sumner, 2023). The equity risk premium could also be argued to be a proxy for market expectations at a given period of time (Damodaran, 2023) but these are imperfect solutions to the main issue at hand.

The third limitation is related to the unreliability of nominal interest rates as an indicator of the stance of policy. While increasing the supply of money through open market operations does lower interest rates (through what is referred to as the liquidity effect). Interest rates themselves are increasingly considered to be unreliable indicators of what the stance of monetary policy is due to antecedents other than the liquidity effect that open market operations control. When inflation expectations decrease (increase) due to pessimistic
(optimistic) macroeconomic expectations, lower (higher) interests could be an indicator of contractionary (expansionary) as opposed to expansionary monetary policy (Friedman, 1968 & 1998). To quote Fredric Mishkin, “It is dangerous to consistently associate an easing or tightening of monetary policy with a fall or rise in short-term nominal interest rates……..we have been careful to associate monetary easing or tightening with changes in real and not nominal interest rates.” (Mishkin, 2022). Real interest rates themselves while they fare better than nominal interest rates, also can be misleading as lower real interest rates could be an indicator of pessimistic real GDP expectations (King, 1993, Beckworth & Sumner, 2013) as opposed to expansionary monetary policy in form of, all things being equal, lowering nominal interest rates or raising inflation expectations. This policy rule in the paper has an inbuilt Taylor principle to attempt to deal with the problem but this is an imperfect solution. One could however argue that a lower (higher) prescribed rate the policy rule in the paper prescribes could be a call for expansionary (contractionary) monetary policy that lowers (raises) nominal interest rates through the liquidity effect or could be an indicator of contractionary (expansionary) monetary policy through the fisher effect.

The final limitation in question is the mechanical nature of the Taylor rule approach this paper takes. Monetary policy in the real world is not like the equations discussed in the paper as its mechanical application is practically impossible to follow. However, a potential solution is simply appealing to approaches where one would use the rule as one of the inputs to central bank decision-making and apply the general principles that underlie the policy rule by policymakers without the constraints of the algebraic formula (Taylor, 1993).

7.2 Other problems to ponder

As discussed earlier in the paper, there were signs of multicollinearity that we decided not to deal with due to concerns of specification bias and theoretical justification for the correlation results observed. The sample size of 180 observations is partly to blame, a larger sample would have reduced the size of standard errors and given us more accurate results helping to alleviate the multicollinearity problem (Gujarati & Porter, 2009). The main reason for the small sample is largely due to the European Central Bank being a relatively young central bank. It has not existed for as long as other more well-recognised and studied institutions like the Federal Reserve and Bank of England. A suggestion for further research would be the continued study of the asymmetric impacts of ECB monetary policy on different countries in the future where data would be more available as a result of more time simply passing allowing us to collect more panel data observations. It's not likely, given the findings of Rogoff (2000), that the Eurozone would be an optimum currency area within the next 100 years, so one of the topics of research that this paper attempts to deal with is likely still going to be relevant.

The theoretical framework in this paper went to great lengths to make a comparison between targeting two nominal anchors, inflation or NGDP. However, we did not make an empirical
comparison using a standard rule. Why so? It was assumed that the actual policy that the ECB took and observed results in terms of macroeconomic outcomes were done under an inflation-targeting regime. However, claims of engaging in inflation targeting by a central bank are not necessarily indicative that they do it in practice. A similar approach that this paper did to try and test the legitimacy of NGDP as a suitable nominal anchor could in principle have been done for the rate of inflation using a Taylor rule. The paper here did not try to engage in that citing the knowledge problem. One of the virtues of NGDP Targeting over a Taylor rule approach is a better solution to the knowledge problem that policymakers face due to its need for less knowledge in decision-making processes than the Taylor rule (Beckworth & Hendrickson, 2019).

One of the topics we discussed in our literature review is Eggertson and Woodford’s (2003) insights on the importance of monetary policy not being purely forward-looking but also “history-dependent” through what is known as level targeting, where if policy credibility is assumed, an automatic stabiliser is through the expectations channel will be present. Our paper took a purely forward-looking approach to evaluating ECB policy. Ideally, we should have a framework that incorporates both the virtues of a forward-looking approach to forecast targeting (Svensson, 1997, 2003 & 2022) and the history dependency of level targeting (Beckworth, 2019 & Sumner, 2021 & 2023). This insight has many real-world implications as the Federal Reserve has abandoned its “flexible inflation targeting” monetary policy strategy to a strategy of “flexible average inflation targeting” which is a form of level targeting that uses inflation as a nominal anchor (Powell, 2020 and Martinez-García et al., 2021).

A serious challenge to using forecasts as a means to guide our policy decisions, if central banks are consistently inaccurately forecasting future macroeconomic outcomes, would not they be making errors in policy decision-making? We believe so to be the case, however, the forecasts used in this paper, while far from perfect (Jansen & Kishan, 1996), are still good enough to be of good use when engaging in monetary policy decision-making. One suggestion is that instead of central banks or other big government institutions forecasting themselves, they could instead use market forecasts as suggested by Scott Sumner. A radical proposal where one sets up an NGDP futures market and ties open market operations to changes in market expectations of future economic activity. If market expectations become pessimistic (optimistic) and sell (buy) NGDP futures, the central bank would automatically purchase (sell) it through an open market purchase (sell) effectively engaging in much-needed expansionary (contractionary) monetary policy. This would reduce the amount of discretion needed by central banks thereby reducing the time-inconsistency problem while providing monetary incentives for engaging in accurate economic forecasting for market participants which central banks will use to engage in monetary policy (Sumner, 2013). While there is literature and debate regarding whether central banks can use market forecasts (Bernanke & Woodford, 1997, Garrison & White, 1997 and Sumner 2013 & 2023), this area is still understudied, and more research is needed to further our understanding of the intersection between financial markets and monetary policy. Questions like the relationship and the implications of market efficiency, defined as how well asset prices reflect all
available information and monetary policy outcomes, especially if the asset price transmission mechanism is effective have great implications for macroeconomics. Another question of interest that is still debated is whether central banks should pop “asset price bubbles” or clean up the financial crisis that ensues if the popping of the bubble has the potential to seriously damage macroeconomic activity through contagion. (Mishkin, 2022). The main takeaway is that minimizing forecast errors and studying the importance of financial markets is key to improving our understanding of monetary policy and its relationship to the macroeconomy.

The results of this paper find that fiscal policy as measured by deficit as a % of GDP has an inverse relationship with inflation and a positive relationship with unemployment. This is contrary to the standard macroeconomic views (Baxter & King, 1993 and Mankiw et al., 2023). However, there are some problems to consider when interpreting the results of this paper. One is the presence of what is known as the “endogeneity problem”. Do higher deficits contribute to macroeconomic contraction or does macroeconomic contraction contribute to deficits as a % of GDP to rise? There are some reasons for doubt, The paper compared the deficit of one year with the macroeconomic results of the year that succeeded it due to recognition of fiscal policy, just like monetary policy affecting the economy with lag (Alesina et al., 2020). There are two additional and complementary plausible explanations for the results observed to supplement the earlier discussion of fiscal policy in our interpretation of correlations observed in Table 2. One is Ricardian equivalence theory and another is deficits acting as a form of implicit monetary policy through the expectations channel.

Ricardian equivalence posits that the macroeconomic impact of funding government spending through taxes or deficits is equivalent, as spending decisions of economic participants are influenced by the present value of taxes, which only changes when the present value of government spending changes. At a given level of spending, a tax cut in the present would not be stimulative as it will be matched by a corresponding increase in the present value of future taxes (Barro, 1989). A spending cut would be stimulative if it's believed to be credible and permanent as it would decrease the present value of taxes, thus encouraging an increase in both consumption and investment (Alesina & Ardagna, 2010 and Alesina et al., 2020). There is some evidence of partial Ricardian equivalence being present in the Eurozone as savings rates increase in correspondence with deficit spending (Checherita-Westphal & Stechert, 2021).

Deficits act as a form of implicit contractionary monetary policy through the expectations channel. This can occur when central banks make what markets perceive to be a credible commitment to base their monetary policy on fiscal policy, thus making fiscal policy and political developments related to it as part of its monetary policy reaction function. In a game theoretic sense, the central bank makes the fiscal authority the Stackelberg leader (Rowe & Power, 1998) and uses it as a form of forward guidance. If the central bank has a credible commitment to its nominal anchor, it always can override any fiscal developments (Blinder, 1982 and Nordhaus et al., 1994). If fiscal policy is too expansionary (contractionary), central banks can engage in contractionary (expansionary) monetary policy to offset the
expansionary (contractionary) effect of fiscal policy. The fiscal multiplier for this reason would be 0. With this knowledge in mind, forward-looking markets will adjust their inflation expectations based on political developments related to fiscal policy, which will be a form of monetary policy through the expectations channel. If political developments in a country make markets believe that fiscal policy is going to be expansionary (contractionary) in the form of increased deficit spending (decreased government spending), then their inflation expectations will decrease (increase) causing real interest rates to increase (decrease), thus making expansionary (contractionary) fiscal policy a form of contractionary (expansionary) monetary policy. However, due to the unpredictable nature of politics, tying monetary policy to political developments indirectly through fiscal policy could lead to increased financial market volatility as markets will respond quickly to ever-changing political news. The uncertainty generated is itself a source of macroeconomic contraction (Bloom, 2009). An example of this is during the Great Depression, asset prices and news stories related to gold and/or political developments had an especially close relationship (Sumner, 2015). The Eurozone crisis produced a similar effect, the ECB had a credible commitment to their decision of engaging in monetary expansion being dependent on whether countries affected by the crisis engaged in contractionary fiscal policy (European Central Bank, 2012) which would explain why we observe an inverse relationship between deficits and inflation and a positive relationship between deficits and unemployment rates. Political news also began appearing in the financial section of newspapers which lends further evidence in favour of this hypothesis. Financial volatility in the Eurozone only began to decrease when ECB President at the time, Mario Draghi publicly committed to do “whatever it takes” to help alleviate the Eurozone crisis (Krugman et al., 2023).
8. Conclusion and final thoughts.

There are four main themes discussed in this paper, nominal GDP as a nominal anchor, the Eurozone not as an optimum currency area, the use of forecast targeting, and rules-based monetary policy. Predicated on the assumption that the Eurozone was not an optimum currency area, we attempted an empirical investigation on whether forecast targeting with NGDP as a nominal anchor would help improve macroeconomic outcomes through examination of whether countries with a prescribed policy rate generated by a modified policy rule that deviated largely from the ECB interest rate in real time had more macroeconomic instability than those with smaller deviations in a variable we called the “rate gap”. A positive (negative) rate gap which indicates contractionary (expansionary) monetary policy was a predictor of macroeconomic outcomes associated with monetary contraction (expansion) like higher (lower) rates of unemployment and lower (higher) rates of inflation and real GDP growth. The idea behind this is that if the evidence supports our hypothesis, then it would simultaneously support the views that forecast targeting is effective, monetary policy affects different Eurozone countries differently and nominal GDP is a viable nominal anchor that can serve as a good indicator on what the stance of monetary policy is and help promote macroeconomic stability. The results for all models at a 10% significant level were in support of our hypothesis, while the 5% and 1% significance levels were in support of our hypothesis for models that had inflation and real GDP as dependent variables. However, the model that had the unemployment rate as the dependent variable had equity risk premium be a statistically significant explanatory variable at a 1% significance level indicating potential monetary effects from a different monetary transmission mechanism. Despite some limitations, this paper contributes to an ever-growing progressive research program in macroeconomic theory seeking to answer important macroeconomic questions like this paper attempts because the stakes are high. Suboptimal monetary policy is a source of economic instability that directly affects the lives of people in a nation. It is important to recall that the hypothesis was not disproven, instead of proven, the presence of evidence makes it more probable that the hypothesis being investigated is true but it is not conclusive proof. However, evidence of absence would conclusively disprove the hypothesis (absence of evidence does not disprove a hypothesis, saying so would be an appeal to ignorance fallacy).
9. References


FISHER, I. (2018). *Purchasing power of money: Its determination and relation to credit, interest and crises ... (Classic reprint)*. FORGOTTEN BOOKS.


YouTube. (2012, July 26). *ECB’s Draghi to the euro’s rescue?* YouTube. https://www.youtube.com/watch?v=Pq1V0aPEO3c

10. Appendix

**Appendix 1: Wu Hausman for Inflation**

<table>
<thead>
<tr>
<th>(b)</th>
<th>(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fixed</td>
<td>Random</td>
</tr>
</tbody>
</table>
rategap  & -.1884323 & -.2172086 \\
realgdp & -.3550467 & -.4206245 \\
premium & -.2910436 & -.1733399 \\
deficit & -.2910436 & -.1733399 \\
Prob  & >  & 37.37 \\
chi2 &  & 0.0000 \\
chi2(4) &  & 0.74

Appendix 2: Wu-Hausman Test for unemployment

<table>
<thead>
<tr>
<th></th>
<th>(b)</th>
<th>(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fixed</td>
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<tr>
<td>rategap</td>
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<td>inf</td>
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<td>-.4438807</td>
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<tr>
<td>premium</td>
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<tr>
<td>deficit</td>
<td>.0871461</td>
<td>.08725</td>
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<tr>
<td>Prob</td>
<td>&gt;</td>
<td>0.74</td>
</tr>
<tr>
<td>chi2</td>
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</tr>
<tr>
<td>chi2(4)</td>
<td></td>
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</tbody>
</table>

Appendix 3: Wu-Hausman Test for realgdp

—Coefficients—

<table>
<thead>
<tr>
<th></th>
<th>(b)</th>
<th>(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fixed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

49

**Inflation**

Assumption: Normal error terms
Variable: Fitted values of inf

H0: Constant variance

\[ \text{chi2}(1) = 0.10 \]
\[ \text{Prob} > \text{chi2} = 0.7461 \]

---

**Unemployment**

Assumption: Normal error terms
Variable: Fitted values of unemp

H0: Constant variance

\[ \text{chi2}(1) = 13.88 \]
\[ \text{Prob} > \text{chi2} = 0.0002 \]

---

**Realgdp**

---
Assumption: Normal error terms  
Variable: Fitted values of realgdp  

H0: Constant variance  

\[ \chi^2(1) = 9.40 \]  
\[ \text{Prob} > \chi^2 = 0.01213 \]

---

**Appendix 5:** *Modified Wald test for groupwise heteroskedasticity in fixed effect regression model*

**Inflation**

\[ H_0: \sigma(i)^2 = \sigma^2 \text{ for all } i \]

\[ \chi^2 (12) = 21.00 \]  
\[ \text{Prob} > \chi^2 = 0.0503 \]

---

**Unemployment**

\[ H_0: \sigma(i)^2 = \sigma^2 \text{ for all } i \]

\[ \chi^2 (12) = 1159.60 \]  
\[ \text{Prob} > \chi^2 = 0.0000 \]

---

**Realgdp**

\[ H_0: \sigma(i)^2 = \sigma^2 \text{ for all } i \]
\[ \text{chi2 (12)} = 3258.60 \]
\[ \text{Prob>chi2} = 0.0000 \]

### Appendix 6: RealGDP Pooled OLS, RealGDP Fixed effects

<table>
<thead>
<tr>
<th>Variables</th>
<th>RealGDP (OLS)</th>
<th>RealGDP (FEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate Gap</td>
<td>-0.479**</td>
<td>-0.4748399</td>
</tr>
<tr>
<td></td>
<td>*(0.016)</td>
<td>***(0.030)</td>
</tr>
<tr>
<td>Premium</td>
<td>0.007</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>Deficit</td>
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<td>0.007</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.006***</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>*(0.002)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Observations</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>No. of countries</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>R-Square (within):</td>
<td>0.898</td>
<td>0.909</td>
</tr>
<tr>
<td>R-Square (between):</td>
<td>0.899</td>
<td>0.898</td>
</tr>
<tr>
<td>F-Test</td>
<td>298.96</td>
<td>242.20</td>
</tr>
</tbody>
</table>