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About the risks of fiscal inflation, a comparison between the euro area and the US

The recommendations of the Taylor rule

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Abstract

The surge in inflation in 2021-22 and the slow response of central banks, both in the US and in the euro area, is raising questions about the willingness of authorities to fight effectively to maintain price stability. While the theory of monetary and fiscal policy interaction suggests combined action to achieve the inflation target, the sustainability of public debt could be a brake, especially in Europe. However, the Fed and the ECB have a different view of the situation. A significant increase in interest rates would only weaken the economic recovery, and given the origins of inflation, such an increase is not necessary. They claim that the rise in prices is only temporary and will slow down as soon as the disruptions in supply chains and the fiscal stimulus measures fade away. This paper found that their scenario is indeed plausible and has been successful so far in convincing markets and consumers. On the other hand, it implies a historically weak monetary policy response that contravenes the recommendations of the Taylor Rule. Moreover, the signs of improvement are not yet evident and the uncertainties surrounding the future remain high.

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Contents

Introduction	3
1 Monetary and Fiscal Policy Interaction: Theory	4
1.1 The Quantity Theory of Money	4
1.2 The Founding Papers	5
1.2.1 Unpleasant arithmetic	5
1.2.2 Active and Passive Monetary and Fiscal Policy	6
1.3 The Fiscal Theory of the Price Level	8
1.3.1 Less Inflation now means more future Inflation	9
1.3.2 The Disinflation	9
1.4 The Central Bank	10
1.4.1 The Independence	10
1.4.2 The Notion of Price Stability and Inflation Targets	11
1.5 The Monetary Policy Reaction Function: The Taylor Principle	12
2 Central banks and Inflation, Some Figures	18
2.1 The Roots of Inflation in the Eurozone and the US	18
2.2 The EU and Successive Crises	19
2.2.1 Energy and External Factors	21
2.2.2 Supply bottlenecks	22
2.3 The US Government and the Pandemic Response	22
2.3.1 An extraordinary Fiscal Stimulus	22
2.3.2 Supply bottlenecks	24
2.3.3 A Tight Labour Market	25
3 A Start on Inflation	27
3.1 The Federal Reserve	27
3.1.1 Forward Guidance	28
3.1.2 The End of Inflation	29
3.2 The European Central Bank	31
3.2.1 Inflation is Temporary	31
3.2.2 Objective: The Pre-Pandemic Level	32
3.2.3 ECB's New Monetary Policy Strategy	33

3.3	Inflation Expectations	34
3.3.1	The Surveys	35
3.3.2	The Market Measures	37
4	The ECB's Dilemma	40
4.1	The European Central Bank	40
4.2	A New Euro Crisis?	41
4.2.1	Poor Fundamentals	41
4.2.2	Two Possible Scenarii	43
4.3	One Eurozone, 19 Countries	44
4.3.1	The Debt Sustainability	44
4.3.2	A Fiscal Inflation	48
5	The Taylor Rule: Empirical Analysis	50
5.1	Data and Methodology	50
5.1.1	European Data	51
5.1.2	U.S. Data	52
5.2	The European Central Bank's Reaction Function	53
5.2.1	The original Taylor Rule recommendations	53
5.2.2	The Dynamic Model	53
5.2.3	Taylor Rule recommendations and MROs rate	56
5.3	The Federal Reserve's Reaction Function	57
5.3.1	The Great Inflation	57
5.3.2	The original recommendations of the Taylor Rule	57
5.3.3	The Dynamic model and projections of the Federal Funds rate	58
5.3.4	Residuals	60
	Conclusion	64
	References	67
A	Additional figures	68

Introduction

The US and Europe have barely emerged from a global pandemic as they have to deal again with a new crisis against which they seem equally helpless. Some might have thought that the COVID crisis was history, or so they hope, but its consequences are more present than ever and will leave their mark on our economy. It is of course the inflationary episode that we are talking about and this is a subject of lively discussion among economists. Where does it come from, what causes it, what scale will it reach, how to fight it?

In June 2022, inflation hit 8.6% in the euro area and 9.1% in the United States, in 12-month percentage change. These are the highest rates achieved since the 1980s and this trend is not yet abating. However, the treasury has not the fiscal space to finance a rates hike of the same magnitude as the fiscal situation is totally different from that of the 1980s. This raises the question of the risks of fiscal inflation, without ambitious tax reform, would the central bank let inflation run away to avoid putting the treasury in a difficult position? With most of the debt denominated in nominal rates, inflation has the effect of reducing the real value of the debt, from this point of view it is a windfall effect for indebted states. However, this implies suffering the negative welfare effects of inflation and possibly undermining the credibility of the central bank.

To understand the ins and outs, it is necessary to put this episode in context. In response to the pandemic crisis, the US and the EU have taken countercyclical measures to avoid the negative impact of the shock. Treasuries have granted benefits to households and businesses to contain the social and economic crisis, which resulted in a large public deficit. In order to support the government's efforts, central banks pursued an expansionary monetary policy by significantly increasing the size of their balance sheet. The consequence, at the end of the crisis, is a record public debt ratio. The government debt as a percentage of the GDP peaked at 136% in the second quarter of 2020 in the US and at 100% in the first quarter of 2021 in the euro area.

Then, the post-COVID economic recovery has brought highly volatile inflation, while the response of central banks has been slow and very modest. Economists

disagree on the main cause of it, with some blaming the supply chain disruptions or the energy price shock while others accusing the fiscal shock which has fuelled abnormally high demand. For the latter, the question is where this extra demand comes from. The standard response to high inflation is to raise key interest rates by more than the rate of inflation, as suggested by the Taylor rule. However, states have gone heavily into debt to finance aid and may find it difficult to roll over their debt at higher rates. Ricardian equivalence would suggest that agents save this aid income in anticipation of future taxes. Unless they don't anticipate any tax increase and these additional expenses will never be paid back, this money can therefore be spent on extra consumption. That kind of expectations may arise when the government's fiscal burden is not credible. We would then have fiscal inflation.

This paper discusses the origins of inflation, what the US and European data say about the determinants of inflation and the state of the economy. The situation in the two regions is different with a larger fiscal stimulus in the US and a stronger impact of energy prices in the euro area, this would be imported inflation. Some would say that the central bank is powerless to curb inflation that it did not cause. Yet it can still manage the aggregate demand, but is it worth the risk of causing a recession?

Both the Federal Reserve and the European Central Bank see the current inflation as temporary, with projections of a return to the target level in the medium term. On the basis of these forecasts, they are therefore acting in accordance with their mandate. The objective of the Fed is to smooth its rates rise to reach what they call a soft landing, i.e. bring the GDP back to its potential level smoothly, without causing a recession. For its part, the ECB is intending to support its companies in coping with the energy shock. Although the reasoning behind these scenarios are defensible, an essential element of monetary policy is its credibility and it seems that so far people trust the official line, with inflation expectations remaining anchored.

A tool often used to evaluate the behaviour of a central bank is the Taylor rule. It focuses on the policy rate, which is a key gauge of the stance of monetary policy. The joint analysis of the Taylor Rule recommendations and the actual key rate gives an insightful look on the past and present monetary policy direction. It allows to track the characteristics of past policies through coefficients and then compare their degree of adequacy with the current monetary policy. It appears that the current episode does not match past data.

The remainder of this analysis is organised as follows. The first chapter outlines the theory about monetary and fiscal policy interactions. It explains how the objective of price stability is a commitment of the government as a whole, both the monetary and the fiscal authority. Chapter two attempts to answer the question of the origins of the current inflation in the euro area and the US. Chapter three is

about official statements on inflation and how central banks view the future. It discusses the credibility that economic agents attach to their scenarios. The previous two chapters consider the euro area as a whole, which is why chapter 4 focuses on intra-European divergences from a fiscal point of view. Chapter 5 details the Taylor rule model considered, the estimation results and the recommendations based on the Taylor principle. Finally the conclusion summarises the key points of the different chapters and offers some policy implications.

Chapter 1

Monetary and Fiscal Policy Interaction: Theory

Policy makers and central bankers are well aware of the importance of maintaining sound public finances to control inflation and have been for many years. Lessons learned by [Sargent et al., 1982] from the great episodes of hyperinflation in Europe at the beginning of the 20th century and by [Bianchi and Ilut, 2017] from the Great Inflation in the US, are there to remind us. These crises could be resolved by a coordinated change in monetary and fiscal policies. It was only when these political reforms were deemed credible that inflation dropped, emphasising the importance of agents' expectations in the resolution of that kind of crisis. Nevertheless, as [Bianchi and Ilut, 2017] pointed out, *when economists have studied the evolution of inflation and output over the past sixty years, the role of fiscal policy has often been neglected.*

It is in these circumstances that a literature analysing the monetary/fiscal interactions has developed since the 1980s. This literature is sometimes summarised under the title of fiscal theory of the price level (FTPL) and one of its founding papers is certainly "unpleasant monetarist arithmetic", [Sargent et al., 1981].

1.1 The Quantity Theory of Money

In a purely monetarist economy, the link between money, inflation and output is called the quantity theory of money. Popularised by Milton Friedman, it states that monetary policy cannot affect on the long run some macroeconomic variables like the level of real output, unemployment or real rates of return on securities. However the quantity of money in circulation has a direct impact on the level of price. The quantity theory of money is based on the equation of exchange

$$P_t y = M_t \bar{V} \tag{1.1}$$

where P_t the level of price at time t , y the real output, M_t the money supply at time t and $\bar{V}$ the velocity of money measured as the number of times per year that

a unit of money is spent.

According to Fischer the velocity can be approximate as constant on the short term. It implies that the nominal income on the left hand side is determined solely by movement in the quantity of money M . If we consider the other way around the demand for money is only function of the nominal GDP and interest rates have no effect. If currently central banks attempt to influence interest rates, it is with the view to affect the level of output to maintain inflation under control and let M adjust to the level of nominal income. Monetary theory insists on what they call the neutrality of money.

1.2 The Founding Papers

1.2.1 Unpleasant arithmetic

It is based on the quantity theory of money that [Sargent et al., 1981] made their main contribution with their paper *Some unpleasant arithmetic*. In this paper the authors pioneered the study of the fiscal/monetary links. They found that under certain conditions, the monetary authority may fail to control inflation thus contradicting M. Friedman's assertions.

They consider a monetarist model in which money demand = money supply as in the equation 1.1. Thus satisfying the monetarist assumption: the monetary base is closely connected to the price level.

They introduce the government debt valuation equation

$$b_{t-1} = \sum_{j=0}^{\infty} E_t \left[\beta^j \left(s_{t+j} + \frac{M_{t+j} - M_{t+j-1}}{P_{t+j}} \right) \right]$$

where b is the real stock of public debt and s the surplus. This equation reflects the fact that the public debt has value because it is backed by taxes and the monetary authority can raise revenue from money creation (seigniorage). They gave a major role to deficits/surpluses in the price level determination process and laid the foundations for the fiscal theory.

Their conclusion is that the monetary policy ability to control inflation is bounded. On one hand, the public's demand for government bonds imposes two constraints, first, the demand affects the interest rate the government must pay and second, the demand is limited by the real income of an economy. Indeed the real stock of government bonds cannot go on forever and depends on the output the economy produces.

On the other hand the way the fiscal and monetary policies are coordinated can also limit the power of the monetary authority.

This paper introduces the monetary-fiscal coordination in the form of two different schemes. Under the first one, the monetary policy dominates the fiscal policy. It means that the monetary authority determines the revenue raised through seigniorage while the fiscal authority faces the constraints set by the demand for bonds. The latter must determine its deficits so it can be financed by seigniorage, independently fixed by the monetary authority, and by bond sales. The monetary authority remains completely independent in the creation of money base and can permanently control inflation.

Under the second scheme, fiscal policy dominates monetary policy. The treasury decides current and future deficits/surpluses and forces the monetary authority to face the constraints imposed by the demand for bonds. Therefore two situations can arise whether the deficits can be financed only by selling bonds or if the monetary authority has to create money to fund the difference and thus produce additional inflation.

The author focuses on the second scheme which puts in ahead the links between deficits and inflation. To understand it better, let us return to the constraints faced by the monetary authority. If the interest rate the government must pay on its debt is higher than the growth rate of the economy and if the fiscal authority decides to run a deficit then the monetary authority is unable to permanently control inflation. It can limit the growth of money base now to fight current inflation and so finance the deficit by letting the stock of government bonds grow. But because of the upper limit in the bond demand imposed by the output of the economy, sooner or later in the absence of additional surplus, the monetary authority will be forced to raise the seigniorage revenue to finance deficits. In other words the present value of seigniorage revenue remains constant. In summary, less inflation now means more in the future. In addition to this first purely monetarist model, the authors developed a second one, more realistic, which takes into account the agents' expectations. The conclusion is slightly different since a tighter monetary policy can directly increase the current inflation since agents anticipate the future seigniorage revenue.

In short, if the fiscal authority moves first and decides on a sequence of too large deficits, the monetary authority can conduct a tighter monetary policy now only by conducting a looser policy later.

1.2.2 Active and Passive Monetary and Fiscal Policy

[Leeper, 1991] points out in Lucas (1976) : *a coherent characterisation of the policy process is required for consumers' decision to be well defined*. Indeed, because of

the forward looking nature of intertemporal households problem, the central bank's response and the government's budget are supposed to follow systematic rules to be predictable. To this end, Leeper, in his paper "Equilibria under 'active' and 'passive' monetary and fiscal policies", categorised the authorities' behaviour as 'active' or 'passive' depending on the constraints they face. An active authority sets its control variable without paying attention to the sustainability of the government debt while a passive authority must respond to fiscal shock and its action is constrained by active authority's policy and by consumer and firm optimisation.

The paper considers two authorities, monetary and fiscal, the first decides the nominal interest rate as a function of the current inflation rate. Its tool is different from the Sargent and Wallace's paper as instead of controlling the quantity of money, it sets the nominal interest rate. Therefore seigniorage revenues come in the form of an inflation taxes. The second authority picks a level of direct lump sum taxes as a function of the real government debt held by the public.

Depending on whether they are active or passive, the interactions between the fiscal and monetary authority vary. The author identified three regimes to categorise these interactions, two polar cases, Active Monetary/Passive Fiscal (AM/PF) and Passive Monetary/Active Fiscal (PM/AF). The third regime describes a conflict between the two authorities, Active Monetary/Active Fiscal (AM/AF). The first two regimes are similar to what [Sargent et al., 1981] developed in their paper.

The first regime, Active Monetary/Passive Fiscal, is denominated monetary dominance. It gives priority to a foreseeable inflation and a sustainable debt level which is a prerequisite for the achievement of other suitable objectives. Fiscal policies act passively to support these objectives. In other words, the central bank controls the inflation while the fiscal authority maintain the debt stable. In most of the literature this is the standard view of how fiscal and monetary policy operates.

The second is a regime of fiscal dominance, in this situation the treasury follows its own fiscal policy without regard to the sustainability of the debt or the inflation path. It forces the monetary authority to support the treasury to remains solvent by eventually providing seigniorage revenues and subsequently loses control over inflation. In practice, the central bank keep the nominal interest rate at such a level that the debt service does not increase too fast.

How these two regimes actually work depends on agents' expectations. Suppose a transfer made by the government and financed by bonds selling. Two situations can arise, if agents believe that the obligations are fully backed by taxes they anticipate future tax spending and then are going to save some of the transfers. In the extreme if they fully integrate future taxes they will save all of it, that would deliver Ricardian equivalence. This first situation describes monetary dominance. The second supposes that agents consider these transfers as emergency spending,

a one shot with no concern about how it is going to be paid off. The amount of money received acts as a wealth increase, some is spent and some is saved. It results an increase in aggregate demand and higher prices, that would be considered fiscal dominance. Notice agent's expectations play a major role in the monetary/fiscal policy mix. Indeed, in a market economy, the agents set the prices and choose their level of savings hence the importance of designing credible and binding policies but this will be developed supra.

The author also noticed that whatever the primary source of revenue for the government, seigniorage or taxes, it is irrelevant to assess if a debt shock will be monetised or repaid by future surpluses. Therefore this paper switch from the study of the average toward marginal source of revenues. It focus on the the financing of shocks, how are debt innovations handled? This makes it a much more useful tool for understanding reality.

1.3 The Fiscal Theory of the Price Level

The founding papers laid the ground for a new theory linking the monetary and fiscal policy, the fiscal theory of the price level. It puts forward a new theory on the value of money, money is valued because the government accepts it as a means of paying taxes. The cycle of money is also rethought, "The government prints money to redeem debt and soaks money up with surpluses and more debt".

To resume what the FTPL is we can think of it as an asset pricing equation for government liabilities. By definition, the value of an asset is determined by the present value of the expected future cash flows it is going to generate. Transposed to the government liabilities, the public debt is equal to the sum of all the expected future primary surpluses discounted to the present. Surpluses represent the contribution of the private sector to the public budget. Thus the government debt is valuable thanks to its fiscal backing, in other words, according to the expected real resources the fiscal authority will be able to extract from the private sector. Therefore, an increase in the present value of surpluses will result in higher bonds prices and a lower price level since money, which is in a way the mirror image of public liabilities, is worth more, and vice versa.

The intuition behind this phenomenon is the following, if individuals expect an increase in the surpluses they also anticipate higher future tax spending. Beside that, the households utility function says that they want to smooth their consumption over time, to that end they will directly save more to maintain an equivalent consumption level in the future. The result is a drop in the aggregate demand today and a rise in the demand for government bonds because a part of their savings will be held in that form. All this leading to lower prices and higher bond prices.

On the contrary, if the total amount of public debt increases without an equivalent rise in the present value of the surpluses, The real value of debt will fall. Bond prices will decrease since agents will no longer want to hold their savings in that form. The additional cash will be spent and it results a higher aggregate demand and higher prices. The conclusion of general equilibrium models is the following, central banks can control inflation only if the fiscal authority stabilises debt.

1.3.1 Less Inflation now means more future Inflation

Nevertheless, with unchanged fiscal policy, the central bank still has some room for manoeuvre. Even in the case of fiscal dominance, the central bank keep its prerogative to determine the interest rate. Through its monetary policy it can change the relative price of consumption, a higher interest rate makes current consumption more expensive relative to future consumption. It therefore has the power to influence household behaviour by increasing or decreasing aggregate demand. It can choose to let inflation rise now or in the future, the time horizon depends on the state of public finances. This choice amounts to shifting the debt burden from short-term to long-term bondholders. However, it will also increase financing costs for the government and the higher interest costs on the debt must be paid for by higher surpluses at some point if inflation is not to be caused.

However, the choice to postpone inflation, or to spread it out over time, is not irrational. The advantage of such a move is that it gives policymakers some leeway to reverse the fiscal trend. It can also help with social temperance. The disadvantage is that the future inflation rise will be larger than the current inflation reduction [Cochrane, 2022].

1.3.2 The Disinflation

In a fiscal dominance scheme, the monetary authority is constraint by budget considerations, but these constraints materialise in different ways. Say otherwise, a monetary disinflation affects the treasury budget by three channels. First, the decline in seigniorage income. Second, higher interest rates increase the costs of refinancing debt. Third, while inflation puts the burden of the debt on the bondholders, disinflation acts as a windfall for them that must be paid. While government revenues are reduced by disinflation, its debt burden does not change. Fortunately, it only concerns debt that has been financed at a higher rate. Eventually, the government can no longer rely on inflation to smooth its finances.

Historically, the end of the great inflation in the US or the fight against inflation

in the UK remain in memory as painful episodes. Though, a disinflation is not necessarily painful. The introduction of an inflation target was smooth in Sweden, Canada, New Zealand. The reason is that the commitment made by their government has been judged credible and inflation expectations changed quickly to the new target. The challenge is therefore to carry out reforms that will make the long-run fiscal situation sustainable [Bianchi and Ilut, 2017]. It will result a drop in inflation, interest rates will fall, the money supply may even rise as well as the deficits but only temporary.

1.4 The Central Bank

1.4.1 The Independence

As you will have understood, a monetary dominance scheme is essential to give the central bank full flexibility to control inflation. Nevertheless such a regime is a necessary but not sufficient condition, the economic agents still need to be convinced that the rules will be maintained at all costs. In a market economy, the agents' expectations play a major role and must be treated with great care. In the modern models, the expectations are described as rational. The monetary authority can fool people once, maybe more but then they will learn from that failure and will change their expectations. Afterwards, recreate confidence could prove to be an arduous task and for this reason, most central banks do not risk it.

With the aim of persuading the market of their willingness to maintain sound public finances and not monetise the debt, governments have devised an interesting structure. The first part is an independent central bank, independent of the treasury, with the mandate to set the interest rate to stabilise inflation. The treasury has to ensure a sustainable level of public debt by managing the present and future taxes and spending. Both are part of a broader institutional structure that helps the government to commit against inflationary finance. The monetary and fiscal authority are involved in a fiscal commitment forcing the treasury to raise surpluses in order to finance deficits, redeem issued bonds without relying on seigniorage revenues, at least not to finance fiscal shocks.

The advantages are double for the government, historical evidence shows that it is a prerequisite to keep inflation under control, but by gaining the market's confidence government can also be funded at a lower cost thanks to reduced inflation risk premiums.

The independence of central bank materialises through its control on monetary policy. In modern central bank practices or at least in developed countries, central bankers have the monopoly on the issuance of hard currency and reserves and ben-

efit some latitude in the tools they can deploy to achieve their goals as well as a certain autonomy to face any short term political agenda. Nevertheless they cannot pursue any objectives unrelated to inflation or not included in their goals. In order to achieve this independence while reaching their institutional mission, central banks are given limited mandates and political autonomy. Their mandates is defined by institutional regulations which for instance prevent the central bank from intervening in fiscal policy. Consequently central banks cannot give out money and helicopter money is illegal, they must lend or buy a limited range of assets and they are prohibited from favour an industry or manipulate the market. The mandate of the two largest banks resumes "price stability", "maximum employment" and "financial stability" for the Federal Reserve while the ECB focuses primarily on price stability but financial stability and indirectly economic health are also of part of its concerns.

1.4.2 The Notion of Price Stability and Inflation Targets

Historically, government struggled to convince about their commitment to fight inflationary finance while since the 2010s the combat against deflation became also important. Simon (1936) already recommended a game with defined rules for monetary policy in order to be easily understood and predicted. The notion of price stability is in line with this idea and is now well integrated by the monetary authorities.

In terms of objective, an inflation target is preferred to a price level target as it reduces the risk of deflation. From the perspective of FTPL, both are a commitment that involved all the government, it is an agreement between the monetary and fiscal authority. The inflation target has the advantage of being easier to achieve and more credible. It takes into account changes in long-term factors such as productivity or wage developments.

Nowadays, there seems to be a consensus around a moderate 2% target rate. However, for economic and monetary unions of the size of the US or the Eurozone, with such macroeconomic divergences and few budget transfers (euro area), this indicator may be inappropriate. Moreover, remember that this is an average measure. Voices are being raised to re-discuss this objective. In the euro area, the ECB was modelled on the Bundesbank, i.e. to be the guardian of a strong currency. Which fitted well with the functioning of the German economy. At the time, the other countries agreed, only too happy to borrow at rates close to the German rate. However, in the long term, the lack of regulation and supervision of financial markets has led to growing macroeconomic imbalances. The benefits of low rates are gone and the ECB must intervene in the markets to limit the spread. This may be an opportunity to discuss the model again.

In an interview, E. Leeper expresses himself on this very issue of monetary policy, here is what he says: *fiscal policy has first order distributional consequences and those should be in the hands of elected officials. I agree with that. But you know what? Monetary policy has distributional consequences too. But somehow we've decided that's okay. We're not going to put that in the hands of elected officials* [Beckworth, 2022].

1.5 The Monetary Policy Reaction Function: The Taylor Principle

Central bankers' job is a complex task. They collect and analyse a wide range of data through different models each subject to many interpretations. They reconcile a variety of views and judgements of advisers with the view to adjust the model predictions. The resulting monetary policy rule is therefore an elaborate function of several variables describing the state of the economy.

In their attempt to model the monetary policy making process, macroeconomists designed simplified reaction functions. A simple rule has some advantages both in an econometrics perspective but it also allows a more general use. In practice, central bankers use a short term nominal interest rate policy as their primary instrument. Based on this, John B. [Taylor, 1993] proposed one of the most famous rule. He assessed that the U.S. monetary policy can be described by a rule linking the interest rate to the inflation and the output gap. His first equation takes the form

$$i_t = \bar{i} + \pi_t + \alpha(\pi_t - \pi^*) + \gamma(y_t - \bar{y}_t) \quad (1.2)$$

with i_t the policy rate target, $\bar{i}$ the long run policy rate, π_t the inflation rate and $y_t - \bar{y}_t$ the output gap. The coefficients α and γ was both set at 0.5 and 0.5 to fit the federal funds rate especially since 1960. The long run rate or equilibrium real rate as well as the inflation target rate were assumed equal to 2%.

This rule is probably the most successful attempt to represent the behaviour of the Fed. While many models failed to model a stable function reaction over time. Although the first equation has been subject to modifications, nowadays it is not more than a positive rule. Many economists and policymakers consider its normative prescriptions as a desirable policy. For that matter, the Taylor principle is now the standard way of thinking about inflation. It requires, for a central bank to be able to fight inflation effectively, that the nominal interest rate be raised by more than one for one with the increase in inflation in the long run. Many articles in the literature show how well this simple rule approximates the policy of several major central banks. While empirically it is a success, this rule represents also a good policy in a variety of macroeconomic models because it stabilises both inflation and

the output. For instance, this principle is a sufficient condition for local determinacy of equilibrium in the new Keynesian model explained in the following section.

A simple new-Keynesian Model

A simple new Keynesian (NK) model as described in [Woodford, 2003] gives the insight to understand the theoretical foundations of the Taylor principle. The author first developed what he called the Neo-Wicksellian framework, in honour of the economist Knut Wicksel. The key element of this theory is the link between price level and the interest rates. Contrary to what the traditional monetarist theory claims, here the equilibrium price level is not determined by any monetary aggregates. The fundamentals that define inflation are, on the one hand, the determinants of the equilibrium real interest rate and, on the other hand, the central bank's policy rule that determines the policy rate in response to changes in price level.

In the Taylor rule case, the model is slightly different since the central bank do not aim a certain price level but rather an inflation rate target. What matters, therefore, is how the price level evolves.

This model does not seem too unrealistic given the current monetary policy of most modern central banks, which consists of determining an operational target rate while being attentive to the level of inflation and the state of the economy but paying no attention to monetary aggregates. This model also suppose a cashless economy, thus an economy without monetary frictions. In a world of fiat money where electronic payments are becoming generalised, it is not absurd to say that currency frictions are becoming increasingly negligible.

In the following, the monetary policy reaction function is assumed to follow a Taylor rule of the form

$$i_t = \phi(\Pi_t/\Pi_t^*; \nu_t) \quad (1.3)$$

where $\Pi_t \equiv \frac{P_t}{P_{t-1}}$ is the inflation rate, Π_t^* the inflation target rate and ν_t represents any exogenous random disturbances to the policy rule with $\phi(., \nu) \geq 0$ and $\phi'_\nu \geq 0 \forall \nu$.

For this NK model to have a uniquely determined equilibrium path of interest rates and inflation, we look for a local determinacy, means locally unique. The search for a local determinacy is the question "whether there is a unique equilibrium within a sufficiently small neighborhood of certain paths for the endogenous variables" [Woodford, 2003]. In other words, consider an environment in which the exogenous variables remain close to their steady state value while the response of the exogenous variables lies in a small interval which includes their steady state

value. One of the advantage to study the behavior of endogenous variables affected by small variations in the exogenous variables is that it can be addressed using linear methods as log linear approximation and the response to the system is the bounded log linear solutions. This linear model is also called Fisherian.

The resulting log linear approximation of equation 1.3 is

$$\begin{aligned}\hat{i}_t &= \phi_\pi(\hat{\pi}_t - \hat{\pi}_t^*) + \nu_t \\ \hat{i}_t &= \phi_\pi \hat{\pi}_t + u_t\end{aligned}\tag{1.4}$$

where $\hat{i}$ is the interest rate deviation from the steady state level $\bar{i}$, ϕ_π is the elasticity of ϕ with respect to the inflation level and $u_t \equiv \nu_t - \phi_\pi \pi_t^*$ measures the exogenous variations in the interest rate rule due to a change in the inflation target, a disruption in the implementation mechanism or the transmission mechanism etc.

Solving the household optimisation problem and taking the log-linear approximation of the resulting equilibrium conditions, we obtain the Fischer equation given by

$$\hat{i}_t = \hat{r}_t + E_t \hat{\pi}_{t+1}\tag{1.5}$$

The New Keynesian Phillips curve is determined by the following relation

$$\hat{\pi}_t = \kappa \hat{Y}_t + \beta E_t \hat{\pi}_{t+1}\tag{1.6}$$

with $\kappa > 0$

And the government budget constraint takes the form

$$b_t P_t = \frac{b_{t-1}}{1 + \pi_t} + s_t\tag{1.7}$$

where b_t is the real value of the public debt and $B_t \equiv b_t P_t$ the nominal value with the price level $P_t \equiv E_t \frac{\beta(1+\pi_{t+1})}{1+r_t}$. s_t is the surplus, i.e. the total amount of government revenue minus the total amount of public spending.

The log linear approximation of the budget constraint (1.7) is given by

$$\bar{P} \bar{b}(\hat{b}_t + \hat{P}_t) = \frac{\bar{b}}{\bar{\pi}}(\hat{b}_{t-1} - \hat{\pi}_t) - \bar{s} \hat{s}_t\tag{1.8}$$

Suppose that (1.8) is satisfied independently of $\hat{\pi}_t$. This requires that $\hat{s}_t$ adjusts to finance the debt.

Substituting (1.5) into (1.4) we obtain an expectational difference equation for the inflation rate

$$\phi_\pi \hat{\pi}_t + u_t = \hat{r}_t + E_t \hat{\pi}_{t+1}. \quad (1.9)$$

Set also $u_t = 0$ and thus assume no exogenous variation of $\hat{i}$.

Depending on the value $\|\phi_\pi\|$ will take, the difference equation is stable or unstable. let us analyse the two scenarios.

1st Case: $\|\phi_\pi\| < 1$

According to [Taylor, 1999], [Clarida et al., 2000], etc. the period of high inflation volatility in the U.S. during the late 1960s and 1970s is due to bad monetary policy choices. The Fed did not rise its policy rate accordingly with the Taylor principle so that $\|\phi_\pi\| \in [0, 1]$.

The consequences of such policies are the following, with $\|\phi_\pi\| < 1$, (1.9) becomes a stable difference equation that can be solved backward.

Actual inflation is related to expectations in the previous period but also to shocks in such way that

$$\pi_{t+1} = E_t \pi_{t+1} + \eta_{t+1} \quad (1.10)$$

where η measures the shocks not related to fundamentals such that $\eta \sim i.i.d.$ and $E_t \eta_{t+1} = 0$.

Substituting (1.10) into 1.9 gives

$$\phi_\pi \hat{\pi}_t + u_t = \hat{r}_t + \hat{\pi}_{t+1} - \eta_{t+1}$$

Then solve backward

$$\begin{aligned} \hat{\pi}_{t+1} &= -\hat{r}_t + \eta_{t+1} + \phi_\pi \hat{\pi}_t \\ &= -\hat{r}_t + \eta_{t+1} + \phi_\pi (-\hat{r}_{t-1} + \eta_t) + \phi_\pi^2 \hat{\pi}_{t-1} \\ &= -\hat{r}_t + \eta_{t+1} + \phi_\pi (-\hat{r}_{t-1} + \eta_t) + \phi_\pi^2 (-\hat{r}_{t-2} + \eta_{t-1}) + \dots + \phi_\pi^{t+1} \hat{\pi}_0 \end{aligned}$$

Since η is a sunspot, i.e. a noise unrelated to fundamentals, $\|\phi_\pi\| < 1$ allows inflation to move in response to non fundamental shocks, leading to pure expectations-driven fluctuations.

This means that even if the government budget constraint is satisfied by taxes, thus with a passive fiscal policy, inflation can be volatile if the monetary authority cannot convince of its ability and willingness to raise rates sufficiently to drive expectations.

2nd Case: $\|\phi_n\| > 1$

Similarly, these authors have argued that in order to curb high inflation in the United States in the early 1980s, the new Fed Chairman, Paul Volcker, radically changed monetary policy by raising key interest rates, thus satisfying the Taylor principle.

The model justifies this principle since with $\|\phi_\pi\| > 1$ the difference equation 1.9 is unstable and can be solved forward as follows

$$\begin{aligned}\hat{\pi}_t &= \frac{\hat{r}_t}{\phi_\pi} + \frac{E_t \hat{\pi}_{t+1}}{\phi_\pi} \\ &= \frac{\hat{r}_t}{\phi_\pi} + \frac{1}{\phi_\pi} \frac{E_t \hat{r}_{t+1}}{\phi_\pi} + \frac{E_t \hat{\pi}_{t+2}}{\phi_\pi^2} \\ &= \frac{\hat{r}_t}{\phi_\pi} + \frac{E_t \hat{r}_{t+1}}{\phi_\pi^2} + \frac{E_t \hat{r}_{t+2}}{\phi_\pi^3} + \dots + \lim_{j \rightarrow \infty} \frac{E_t \hat{\pi}_{t+j}}{\phi_\pi^j}\end{aligned}$$

Since $\|\phi_\pi\| > 1$, $\lim_{j \rightarrow \infty} \frac{E_t \hat{\pi}_{t+j}}{\phi_\pi^j} = 0$, giving us this unique bounded log linear solutions

$$\hat{\pi}_t = \sum_{j=0}^{\infty} \frac{E_t \hat{r}_{t+j}}{\phi_\pi^{j+1}}. \quad (1.11)$$

The result of such a monetary policy feature is as follows.

Proposition 1. *[Woodford, 2003] If monetary policy is characterised by an interest rate feedback rule of the form 1.3, with $\|\phi_\pi\| > 1$, then the rational-expectations equilibrium paths of inflation and the nominal interest rate are (locally) determinate; $\exists$ open sets $\mathcal{P}$ and $\mathcal{I}$ such that in the case of any tight enough bounds on the fluctuations in the exogenous processes $\{\hat{r}_t, \pi_t^*, \nu_t\}$, there exists a unique rational-expectations equilibrium in which $\pi_t \in \mathcal{P}$ and $i_t \in \mathcal{I} \forall t$. Furthermore, equation 1.11 gives a log-linear (first order Taylor series) approximation to the evolution of inflation in that equilibrium. If instead $0 \leq \|\phi_\pi\| < 1$, rational-expectations equilibrium is indeterminate, as for the 1st case.*

3rd Case: $\hat{b} >> 0$, $\hat{\pi}$ needs to increase

So far, we have assumed that the budget constraint is satisfied. We considered fiscal policy as exogenous and passive. But there is a situation where the debt reaches such a level that the treasury cannot fulfil its commitment.

The transversality condition imposes that the value of debt becomes zero such that

$$b_t P_t \xrightarrow{t \rightarrow +\infty} 0$$

This means that the right-hand side of the budget constraint equation 1.8 is equal to zero when $t \longrightarrow \infty$,

$$\sum_{j=0}^{\infty} \beta^j \bar{s} \hat{s}_{t+j} = \frac{\bar{b}}{\bar{\pi}} (\hat{b}_{t-1} - \hat{\pi}_t) \quad (1.12)$$

where the discount factor $\beta < 1$. The left hand side describes the present value of surpluses while the right hand side is the total amount of government liabilities. If the Treasury do not generate sufficient surpluses, i.e. if it cannot rise present or future taxes or reduce present or future spending, inflation has to adjust to satisfy the government budget constraint.

In this case it turns out that $\|\phi_{\pi}\|$ needs to be < 1 . Indeed if $\|\phi_{\pi}\| > 1$, then $\hat{\pi}_t$ cannot increase to meet (1.12). The counterpart is a higher and way more volatile inflation rate.

Chapter 2

Central banks and Inflation, Some Figures

2021 will have been the year of post-COVID recovery but also of the return of inflation in the US and Europe. For June 2022, inflation reached 8.6% in the euro area, measured by the Harmonised Index of Consumer Price (HICP), and 9.1% in the US, measured by the Consumer Price Index (CPI), breaking historical records not seen since the early 1980s. At the moment and in view of the extent of the phenomenon, all major central banks have announced measures to tighten their monetary policy, the European Central Bank (ECB) being the last to take the plunge.

The "normalisation of monetary policy" follows an extraordinary monetary and fiscal stimulus to cushion the effects of the COVID crisis. Both the US central bank (Federal Reserve) and the European Central Bank (ECB) put in place measures to provide the necessary liquidity to avoid a dislocation of the financial markets and to enable the financing of public policies. Central banks reduced their key interest rates but also used unconventional policy tools like impressive asset purchase programmes (app). At the same time, governments distributed large sums of money to businesses and households to mitigate the loss of income and wages induced by health measures. While most observers recognise the usefulness and appropriateness of these measures, some feel that they have lasted long enough and that they are partly responsible for the actual inflationary period.

2.1 The Roots of Inflation in the Eurozone and the US

The COVID-19 was a multidimensional shock, both the demand and the supply side was affected by the containment measures, many businesses were closed while demand has been limited to the essentials. All of this, not only in Europe but worldwide, with the result that supply chains were severely disrupted. It is obvious

that such disturbances cannot be solved with a snap of the fingers. First, the recovery is not uniform, some countries have deconfined faster than others. With Asia particularly hard hit, supply chains are taking time to recover. Second, households have been forced to save for months, in addition, the monetary and fiscal stimuli have boosted households and businesses savings. They now want to take advantage of this money and consume. Third, rising consumption and production, inevitably leads to an increase in energy demand. The result is a period of historically high inflation volatility.

The inflation in Europe and the US has the same roots, yet they differs in magnitude. This section discusses the drivers of inflation developments from the first stirrings of the pandemic to the war in Ukraine and the ensuing energy crisis. In what direction are they evolving, what are the similarities and differences between the European and American inflation? There is currently a debate between economists who blame lax monetary policy on governments and those who blame a supply shock against which the central bank can do nothing. What do the facts say?

Figures 2.1 and 2.2 illustrates the contribution of the main components of the consumer price index to headline inflation in the euro area and the US. There is an upward trend in both regions but inflation started much more sharply in the US and the causes are definitely different. While energy and unprocessed food are pushing up the indices in Europe, industrial goods and services remain at a relatively low level. In the US, although energy prices play a significant role, especially in recent months, it is the prices of goods and services that account for over half of the increase. The US is a net exporter of energy, so there is less pressure on its energy market than in Europe, which is more dependent on Russian gas.

2.2 The EU and Successive Crises

Figure 2.1 shows the recent evolution of the headline inflation in the euro area. While inflation was already low, with an average rate of 1.2% for 2019, the pandemic shock hit the price level even harder. It fell to 0.3% in 2020, driven by lower energy prices mainly oil prices and even moved into negative territory for the second half of 2020, when, in addition to energy, the core inflation suffered from disinflationary tendencies. This can be attributed to the containment measures which decreased the demand for services and goods. However, from January 2021, the recovery has reversed the situation and we are now at the record level we know and it is very likely to increase more. While all the components experience a surge, international markets play a major role.

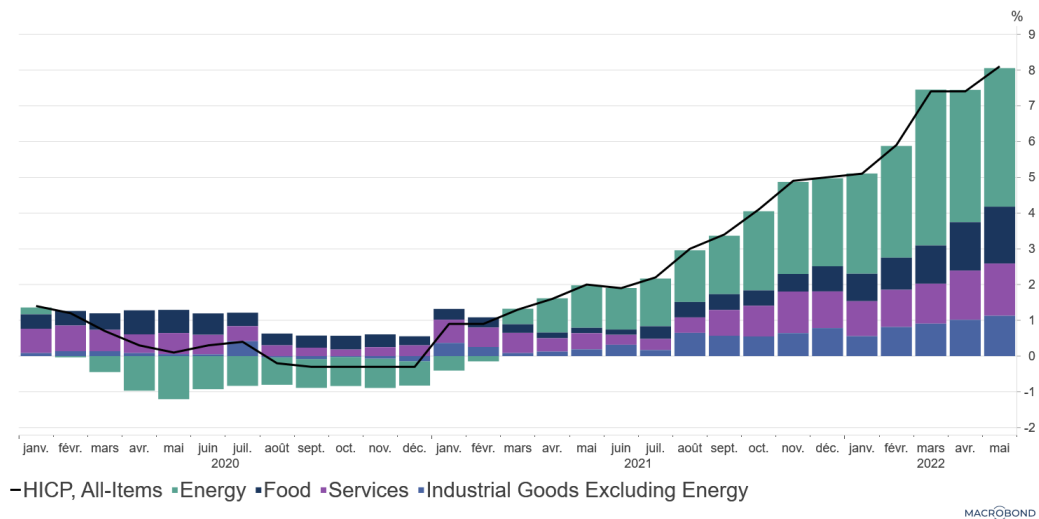


Figure 2.1: Headline inflation in the Eurozone and its main components, change Y/Y.

Source: ECB.

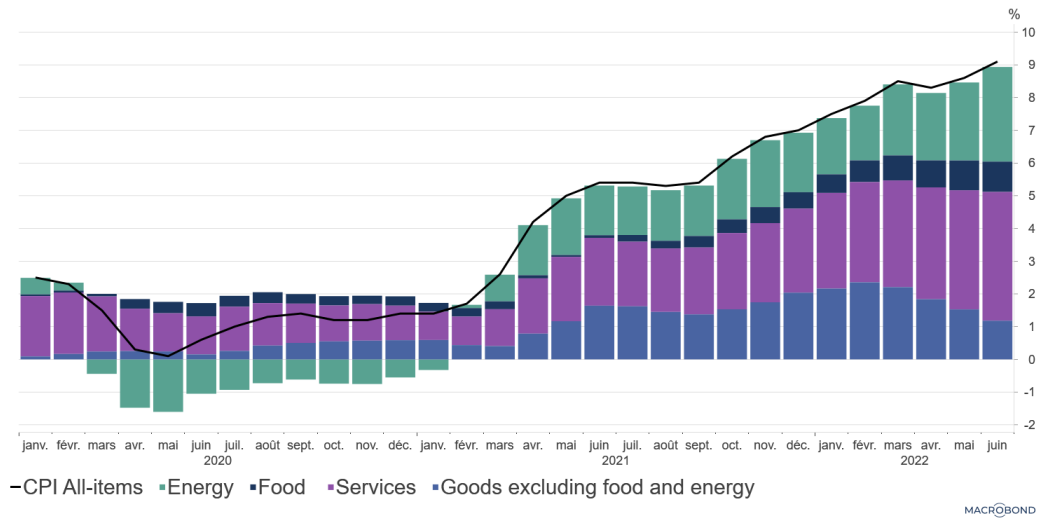


Figure 2.2: Headline inflation in the US and its main components, change Y/Y.

Source: OECD.

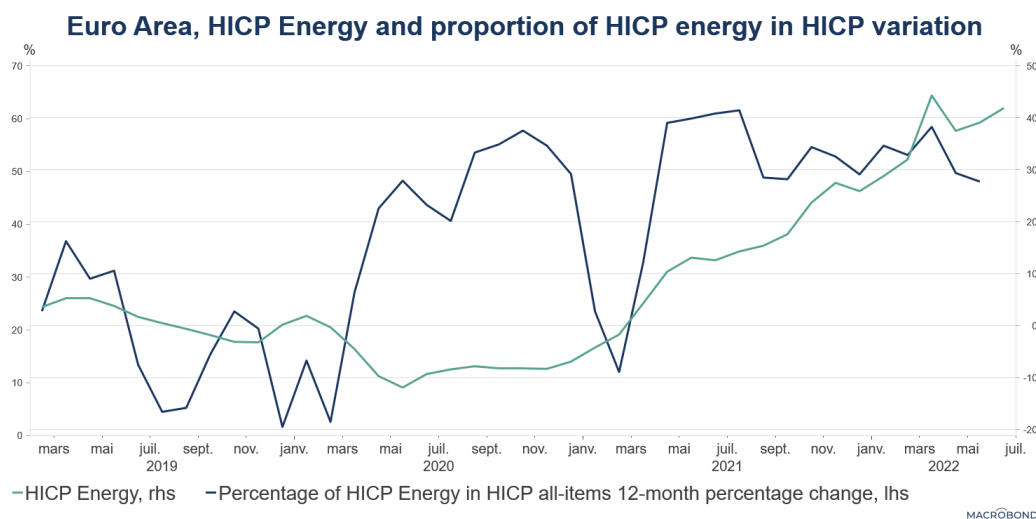


Figure 2.3: Energy inflation (change Y/Y) and the proportion of energy inflation to the headline 12-month inflation rate.
Source: Eurostat.

2.2.1 Energy and External Factors

The previous figures already gave an indication of the extent of the energy crisis. Figure 2.3 confirms that fact by illustrating the developments in the energy markets through the evolution of prices and through the contribution to headline inflation. This is clearly the main driver, since mid 2021, the energy inflation has counted for more than 50% of the HICP. This is more than twice as much as before the COVID. During the two phases of the pandemic, very cartoonishly, the recession in 2020 and the recovery in 2021, the price determinants were changes in global energy demand. But since February 2022, supply has also been affected as the Russian war in Ukraine destabilises the markets. This element comes on top of the previous crisis and makes the situation even more uncertain. Not to mention that energy prices are also reflected in the price of food, non energy industrial goods (NEIG) and services.

In addition to energy, another external factor involved is the prices of imports. They play an increasing role in the current price level. [Koester et al., 2022] analyse the contributions of goods and services with high import content and those with low (see figure A.1 in appendix). While the contribution of low import content items remains stable, importations put upward pressure on prices. It is an additional argument that discredits domestic price pressures.

2.2.2 Supply bottlenecks

Without going into too much detail, [Koester et al., 2022] gives the reasons for the supply bottlenecks we are currently experiencing. As stated above, the pandemic-related restrictions have postponed some of the demand. In addition with state allowances keeping many workers' wages up, households built up substantial savings. Then, with the reopening of the economy, aggregate demand has risen sharply, which could not be met by additional supply and leading to an increase in the overall price level. Second, the recovery has been gradual, in line with vaccination and the easing of containment measures, it has been asymmetric. The demand has been constrained, with the high contact service sector being the last to fully reopen. These constraints have led to a shift toward the consumption of goods. Third, at the same time, some factories remained shutdown, especially in China. Four, the labour market has undergone profound changes and is tight in Europe and the US. And finally transportation capacities has been insufficient to ensure the smooth logistics of the additional demand around the world. A higher demand and a disrupted supply has led to bottlenecks and inflation in goods.

We will discuss later what the central bank is doing to combat rising prices but this already gives an intuition as to where the problem is coming from, partly from abroad. Abnormally high demand is at play but the impact of fiscal and monetary policies is much more moderate than in the US.

2.3 The US Government and the Pandemic Response

2.3.1 An extraordinary Fiscal Stimulus

The post COVID recovery was strong in the US, the figure 2.2 illustrates the surge in inflation from March 2021. Driven initially by energy prices, it is goods and services that account for the bulk of the price increase. Some economists such as John Cochrane identify the origins of inflation in the government's response to the pandemic. According to him, the theory of a supply shock does not hold. It is a confusion between individual and aggregate supply curve, if prices rise due to an individual supply shortage, people will shift their demand to another good. For the federal funds rate, nothing unusual either. What has changed is the extraordinary provision of liquidity bring by the Federal Reserve from March 2020 onwards, which has provided short term collateralised credit through diverse programmes, as well as long term refinancing programmes. Via these programmes, the fed bought a large quantity of treasury bonds. Inflation would therefore be due to the sharp increase in the amount of public debt in addition to a large deficit, in his words: *Our government printed up about \$3 trillion in extra money, and sent it out as checks. It*

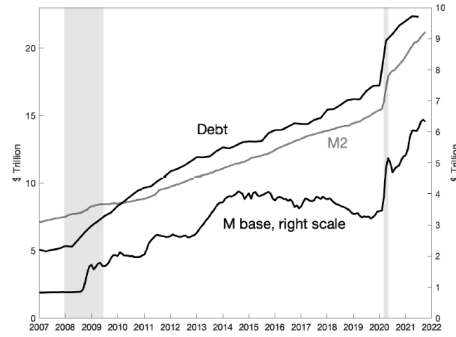


Figure 2.4: Monetary aggregate and debt for the US.
Source: [Cochrane, 2022].

borrowed another \$2 trillion and sent more checks [Cochrane, 2022]. The reasons why these policies may have stimulated the inflation is because they acted like a helicopter drop.

The word helicopter money was first used by Milton Friedman in his metaphor to describe a situation where a government would transfer large sums of money to the public in order to stimulate the economy. A helicopter drop is a fiscal/monetary policy operation which is materialised as follows: the Treasury issues bonds, hands out the money to the economic agents through transfer payments and the central bank then buy the Treasury bond by creating new money. In the figure 2.4, showing the evolution of government liabilities for the last 15 years, the monetary and fiscal intervention during the COVID crisis is clearly noticeable. The Fed has heavily increased its reserve and at the same time the Treasury has emitted a large amount of debt. The particularity of the helicopter money is the signal sent to households. As reminded in the first chapter, consumers see it as an emergency spending that won't be repaid, therefore acting like a wealth increase. These kind of transfers directly impact the price level and what can be useful in times of low inflation, can also be a thorn in the side when trying to curb inflation.

Again according to the author, the public intervention was poorly sized because the Fed and the Treasury misdiagnosed the reason of the recession. It was not a demand shortfall, of course the demand fell but due to containment measures, once the pandemic subsided, the demand has rebounded. It was rather the result of a supply shock due to the pandemic effects. Supply chains was disrupted and, instead of giving them time to recover, the abnormal increase in aggregate demand has compounded the problem. From this point of view, the Fed would be responsible for not having normalised its interest rates more quickly, for not having paid attention to the output gap or the level of unemployment and knowing this, for not having reacted according to the prescription of the Taylor principle for example.

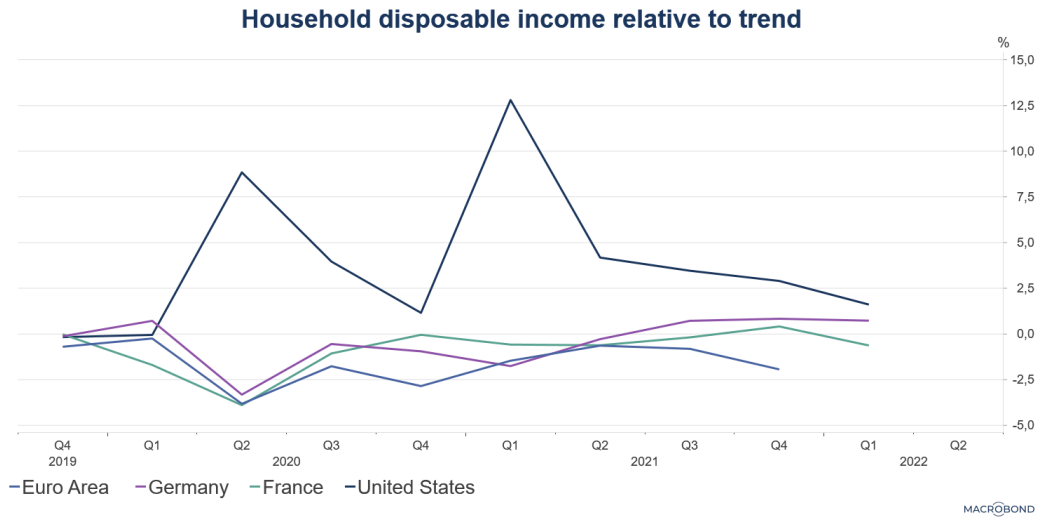


Figure 2.5: Development of household disposable income as a percentage of their pre-pandemic trend.

Source: Eurostat; US Bureau of Economic Analysis; INSEE; Statistisches Bundesamt; author calculations.

The responsibility of the Fed and the US government is probably more important than that of the European states in the current context. The US fiscal support was oversized relative to the economic situation of US households before COVID, while European states have managed to maintain a more constant income for their population. This can be measured by comparing the development of household disposable income through the pandemic (see figure 2.5). The disposable incomes are measured as a percentage of deviation from their trend. France and Germany, the two largest European economies and the euro area as a whole managed to limit the decline as economic activity contracted, quickly returning to a pre-covid level. On the other hand, the United States has seen a considerable increase in the disposable personal income.

2.3.2 Supply bottlenecks

For all that, the debate on the supply cause of inflation is not over. In an attempt to answer this question, [Shapiro et al., 2022] tries to determine the extent to which supply or demand-driven components are responsible for inflation. For this purpose, the US items on the PCE basket of goods and services are divided in 2 groups. Demand-driven items are those for which an unexpected change in prices varies in the same direction as the change in quantity, while an unexpected change in prices for supply-driven items moves in the opposite direction to the change in quantity. Are considered unexpected prices changes, because they are more likely to come from a change in demand or supply, whereas expected changes are more

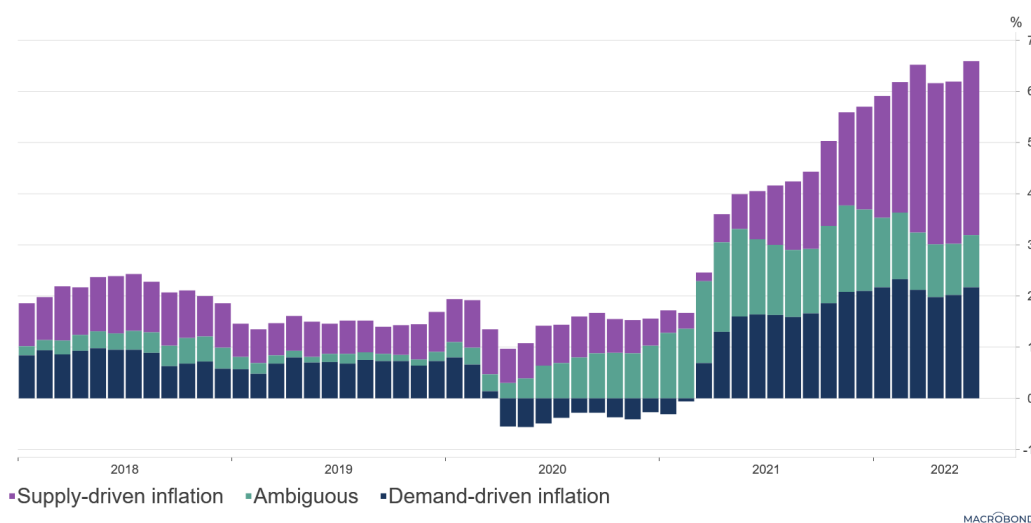


Figure 2.6: Supply and demand driven contributions to PCE inflation, change Y/Y. Source: [Shapiro et al., 2022].

likely to come from long-term factors. Finally, the demand or supply-driven feature is recalculated from month to month.

Figure 2.6¹ presents the contributions of the supply and demand-driven inflation to the overall inflation. Ambiguous elements are those that cannot be classified in a single category. While the demand-driven inflation rose sharply at the beginning of the inflation boom, the PCE index is now pulled by supply-driven inflation, adding a further argument for the non-domestic cause of inflation.

2.3.3 A Tight Labour Market

The pandemic had a negative impact on the US labour market, more so than in Europe. The reason is their less extensive social protection system than in Europe which has not protected jobs as much. Workers who lost their jobs during the pandemic were subsequently reluctant to return to their previous job or to a job at all. This phenomenon is known as the "great resignation", it has decreased the labour force participation and may have participated to inflation by reducing supply. This effect probably lasted as long as the state allocated unemployment insurance and should have reduced beyond September 2021.

Figure 2.7 presents 2 key indicators of the US labour market, the unemployment

¹Note: the index used to measure inflation is the Personal Consumption Expenditure, it is the one preferred by the Fed. Figure A.2 in appendix, illustrates its evolution along with the CPI, they differ slightly except for the last month where it has experienced a lower growth.

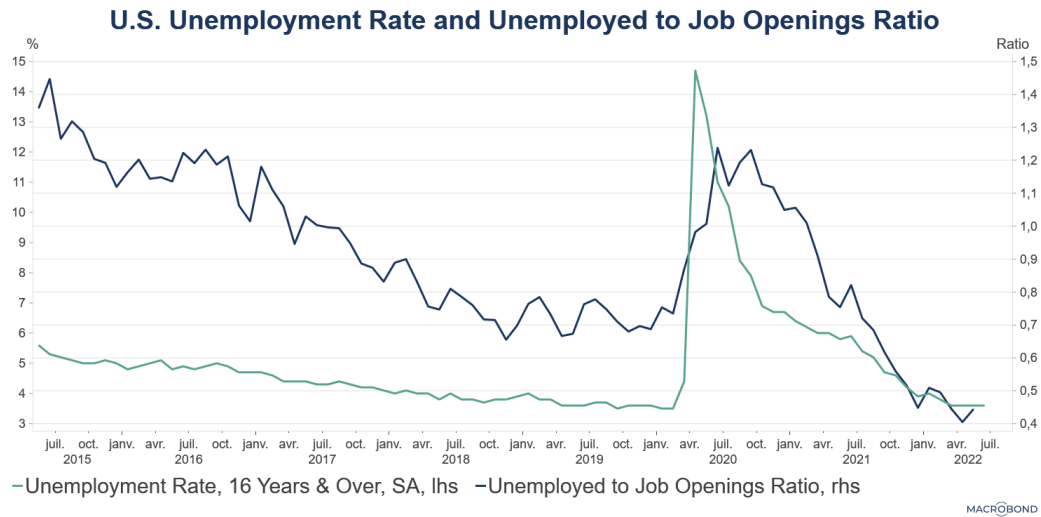


Figure 2.7: Unemployment rate and ratio of unemployed workers to job openings for the US.

Source: US Bureau of Labor Statistics.

rate and the unemployed workers to job openings ratio. The current US labour market is tight, it displays a low level of unemployment, which has returned to its pre-pandemic level. This feature of the labour market may produce additional inflation by putting pressure on wages. This may have played a larger role than expected as the Phillips curve may be steeper when unemployment is low [Furman, 2022]. Additionally, job openings and quits soared in 2021, as indicates the ratio. In fact it has reached its lower level since many years, which could have a strong impact on wages.

Chapter 3

A Start on Inflation

The previous chapter is an attempt to identify the causes of inflation. It seems that some of it would be imported, especially in Europe, but fiscal intervention is certainly part of the problem. In any case, in an institutional framework where the central bank is the guardian of price stability, it is normal to turn to it for accountability. What is their stance, what do they plan to do?

While central banks acted against deflation and to maintain financial stability during the pandemic. The crucial question they face as the crisis recedes is when and how scale back the provision of liquidity, pull up the policy rate and eventually reduce their balance sheet. To assess the timing and the rhythm to return to normal monetary conditions the evolution of economic conditions is crucial. The risk of normalising too quickly is to harm the recovery while being too slow could lead to inflationary pressure.

3.1 The Federal Reserve

The Federal Reserve has started reducing the pace of its asset purchase programme (app) before the European Central bank, but it is still slow. Figure 3.1 is a good illustration of the slowness of the Fed's response to the surge in inflation. The governing council decided to raise the federal funds rate for the first time in March 2022 when inflation had already been above target for almost a year. In addition, unemployment was already at a low level so the labour market is not an explanation. Even historically speaking it is a timid and very moderate intervention. What is the official stance of the Fed? Is it too slow? Does it act as an additional stimulus and thus fuel inflation?

Although the Fed reacted first, the way it reacts puts it under fire. A lack of foresight for some, they misdiagnosed the supply origins of the crisis, they did not see the lack of transportation coming etc. For other they have underestimated inflation

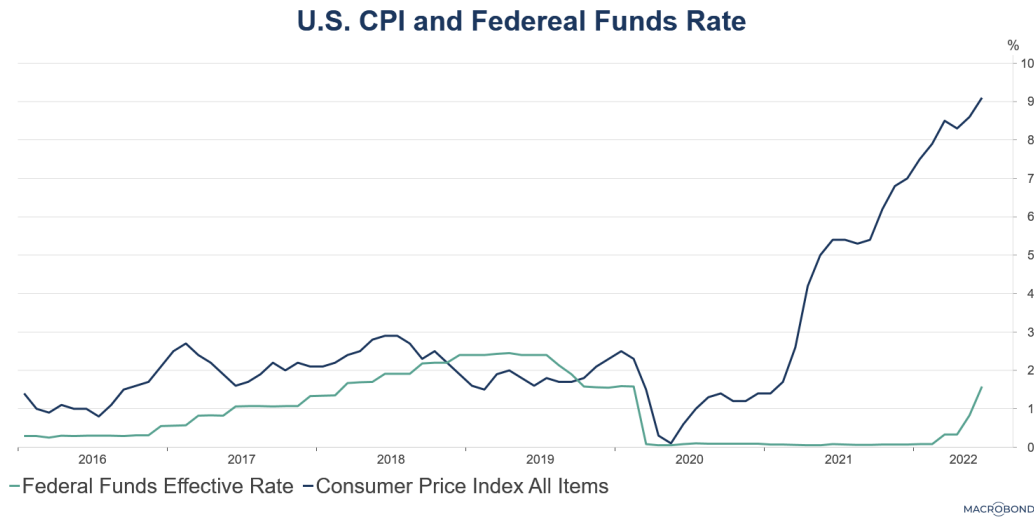


Figure 3.1: Inflation in the US and Federal Funds Rate, change Y/Y.
Source: US Bureau of Labor Statistics; Federal Reserve Bank of New York.

and therefore the response. The Fed admitted it was surprised by the magnitude of inflation which turned out to be higher and lasting longer than expected but its scenario has not changed much.

3.1.1 Forward Guidance

An element can explain the timing of the response, the use by the Fed of its forward guidance tool. It is true that historically, it appears that the Fed reacts rather slowly, even compared to the 1960's and 1970's. But the policy is different from then because they said they would do this. Fed officials heavily use forward guidance, they regularly and precisely communicate the stance of their policy. The rationale behind this approach is explained in the section 3.3. The Fed really worry about its reputation, the result is that it is stuck in its trajectory for fear of creating disruption in the financial markets. Its view is that by announcing a more aggressive policy against inflation, it could surprise the markets, cause a sharp correction in asset prices, greatly alter the financing conditions and ultimately harm financial stability.

The Fed's behaviour to lock itself in a policy position is notably criticised by [Cochrane, 2022] and [Eichengreen, 2022]. They see the Fed's fixation on the markets reaction as a brake that makes it less flexible and prevent it to react in case of more alarming inflation numbers. This is less the case for the ECB, perhaps because the financial system in the euro area relies more on its banks and less on financial markets. In any case, it is better able to react quickly.

The Fed remains very attached to its scenario, but what is that scenario? For

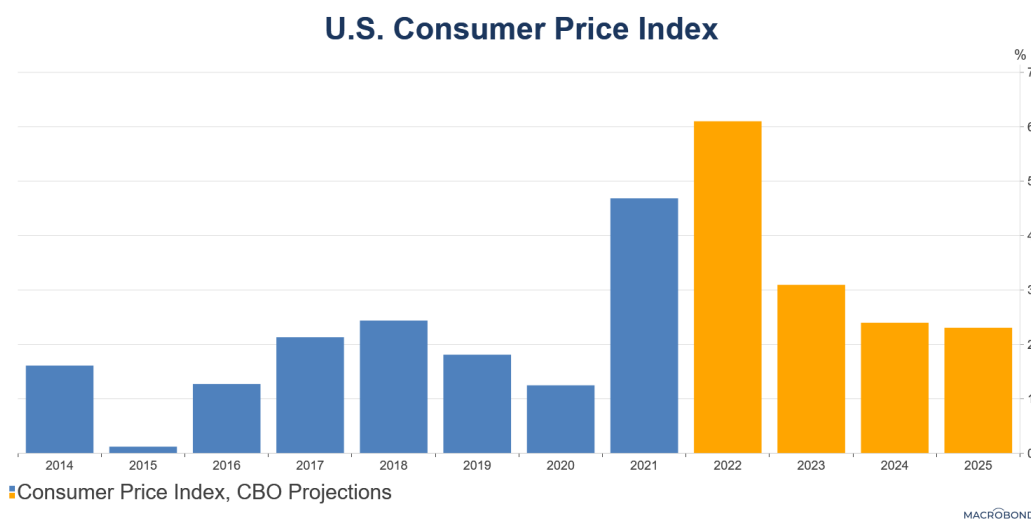


Figure 3.2: Inflation projections for the United States, change Y/Y.
Source: US Congressional Budget Office.

the Fed, the causes of inflation are the fiscal stimulus and the disruptions on the supply chains. It therefore expects inflation to slow, with consumer spending falling as the government stimulus wears off and with the global supply chain recovering.

3.1.2 The End of Inflation

Figure 3.2 presents the projections for the Consumer price index in the US. The US government still perceived inflation as a transitory supply shock. After peaking in 2022, inflation should fall back in 2023 to a reasonable level thereafter but still above the pre-COVID level. The Fed expects inflation to scale back by 2024, but is it a plausible scenario?

The latest figures for June 2022 try to show a slight downward trend in inflation on goods and services, but this is mainly due to goods excluding energy and food, prices for services continue to rise, see figure 2.2. The figures on the consumption side are therefore not yet encouraging. The reason is that the fed expects the effects of the stimulus to fade, however, the figure 2.5 shows that incomes are still above the growth trend. This means that households probably still have excess savings to spend, although these are decreasing. The Fed's second expectations is that global supply chains recover, again this scenario is uncertain. COVID in Asia and particularly in China continues to prevent a return to normal life and no one can predict how it will evolve. Then, the war in Ukraine has caused another supply shock in the energy market that also brings uncertainty.

There are many uncertainties surrounding the fed's scenario. Suppose it comes true,

how long will it last before inflation falls? The first element is quite trivial, inflation does not fall once the stimulus is removed. The dynamic of the sticky prices give it some momentum. Whether it is a fiscal shock or a supply shock in the Phillips curve, the persistence of the shock depends on how steep is the Philips curve and how prices are sticky.

Second, the monetary and fiscal interactions theory poses some conditions for inflation to end after a fiscal shock. The Fed may want to raise the interest rates substantially to fight inflation, but it may not be able to rely on a passive tax authority. Figure 3.3 shows the CBO deficit and debt projections, as it stands, the Treasury does not seem capable to implement the right surpluses to match the monetary policy. According to the fiscal theory, we may face an unpleasant arithmetic. [Cochrane, 2022] estimated a new Keynesian model that matched the Fed's predictions, leading to the conclusion that the Fed is new Keynesian. Although this model justifies the behaviour of the Fed, this paper also demonstrated that with unchanged fiscal policy, the US central bank can only smooth inflation over time but it cannot eliminate fiscal inflation. If this situation remains unchanged, the question is therefore how much of the deficit do people expect will be repaid by future surpluses?

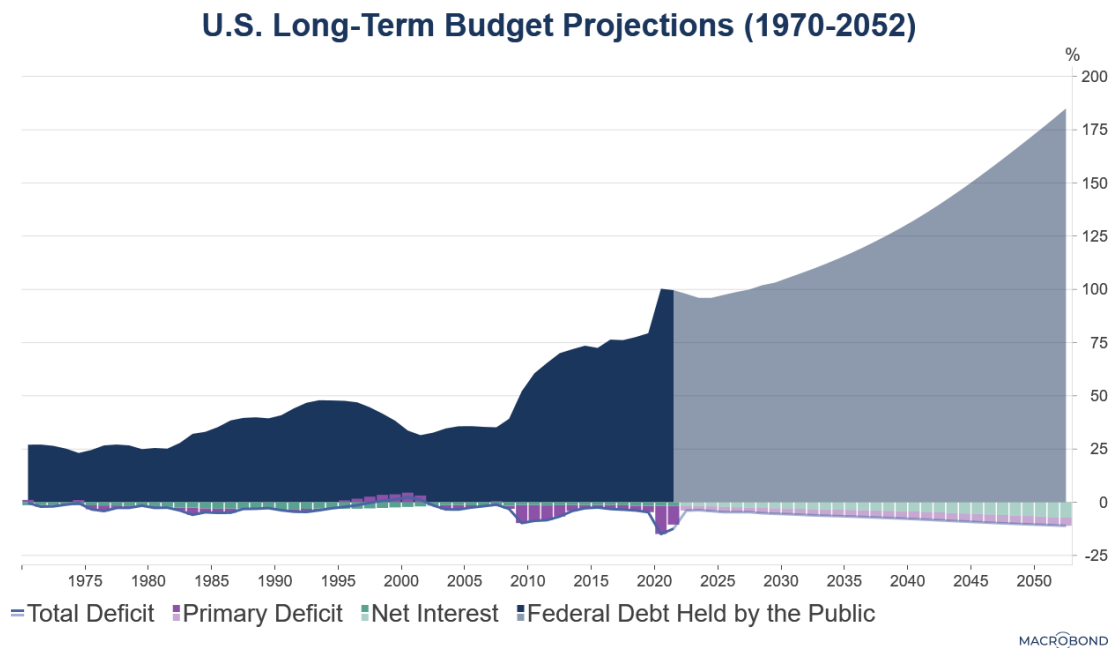


Figure 3.3: CBO projections for US Government debt-to-GDP and deficits.
Source: US Congressional Budget Office.

3.2 The European Central Bank

The ECB was the last to make a statement about reversing its policy stance. Until month, the guideline was to keep the same interest rate policy and pursue the QE program as planned. Why did the ECB maintain its low interest rate policy so long?

3.2.1 Inflation is Temporary

During a speech in November 2021, Christine Lagarde, ECB president, reminded the objective of the institution to see euro area GDP back at its pre-pandemic level before the end of this year. While annual inflation reached 5%, she recalled that the conditions before rates will start to rise are not likely to be met soon as the medium term inflation outlook remains subdued and the purchase of bond will pursue. The wish by keeping cheap money is also to support purchasing power in the face of rising energy costs. In a way, the ECB has learned the lessons of the previous crisis and does not want to repeat the same mistakes by slowing down the recovery with a too restrictive monetary policy.

Therefore a first element of response is the medium term orientation that the ECB has adopted. The bank is giving itself time to reach its main objective of 2%. This medium term is not precisely determined and may vary depending on the size, persistence and type of shock. This perspective allows the Governing Council to take into account uncertainties in the monetary policy transmission mechanism and ensuring that economic activity is not unnecessarily impaired thus pursuing its other objectives of financial stability and employment.

The central bank is also sticking to its medium-term objective because since the first burst of inflation, the high rate of inflation is seen as temporary by the bank. The figure 3.5 presents the last ECB surveys made to professional forecasters, despite the current situation they envisage a sharp decline by 2023 and a return to normal by 2024. Governing council's arguments are the following. The economic output has been growing strongly since the spring of 2021, driven by abnormally high demand after more than a year of contraction in consumption, which is fuelling prices. Only this should not last and is just a consequence of the recovery. Second, some exogenous political developments have increased energy prices. And third, the supply-chains faces bottlenecks partly due to lockdowns still in place in some countries and to transportation.

About the first argument, the economic output, the figure 3.4 shows indeed a strong economic recovery for 2021, which continues very slightly in 2022. It should quickly fade as projections for 2023 and 2024 are comparable to what we saw before the pandemic. It is worth noting the differences with last year's forecast, with expected growth for 2022 falling sharply from almost 5% to less than 3%. Although the

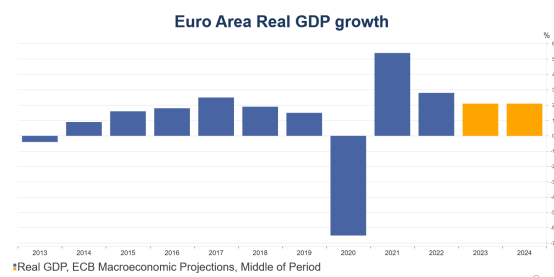


Figure 3.4: Real GDP growth for the euro area, change Y/Y.
Source: ECB survey of professional forecasters.

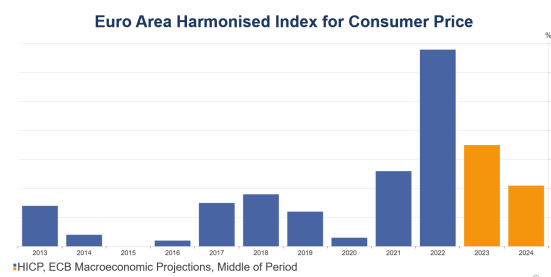


Figure 3.5: Inflation projections for the euro area, change Y/Y.
Source: ECB survey of professional forecasters.

growth outlook is down, inflationary pressure is not falling. This is undoubtedly due to a worsening energy crisis that exceeds in magnitude all other determinants.

The second argument concerning soaring energy prices is undeniable. While the first peak is attributable to the global economic rebound, the consequences of the war in Europe are enormous. The energy prices play a crucial role in the current high price level in Europe as illustrated by figure 2.3 and described infra. Whether this increase is temporary or persistent is another matter.

The last argument has already been detailed in the section 2.2. It is very likely that these disruptions fade as the COVID-19 is overcome. Supply bottlenecks should disappear when demand returns to normal and containment measures are lifted, so it is temporary.

The ECB expressed its view last year, does this policy stance still hold in the light of recent events? More recent ECB staff projections recognise that inflation has been more persistent than previously forecasted. But they still consider this to be temporary, with disturbances expected to return to normal over the coming years. The baseline scenario is an inflation of 5.1% for 2022 and a return to target from 2023. They also consider a more adverse scenario in which inflation is higher for 2022 and 2023 but moderate in 2024¹.

3.2.2 Objective: The Pre-Pandemic Level

As the ECB president recalled in her speech, the objective was to put the Euro area economic activity back on track and reached the pre-pandemic level as soon as possible. Covid has led to a fall in activity well below the potential level. The figure 3.6 displays this increase in the gap between actual and the estimated potential

¹see <https://www.ecb.europa.eu/home/html/index.en.html>

GDP. While 2021 has seen a sharp reduction in the gap, there is still a space that should be closed in 2023. On the other hand, the prospect for improvement on the labour market are poor. As figure 3.7 illustrates, the labour market has already fully recovered. The unemployment rate is at its lowest level since the introduction of the euro. This raises doubts about the ability of the euro area economy to recover further or about the impact on the prices. A tight labour market fuels inflationary pressures.

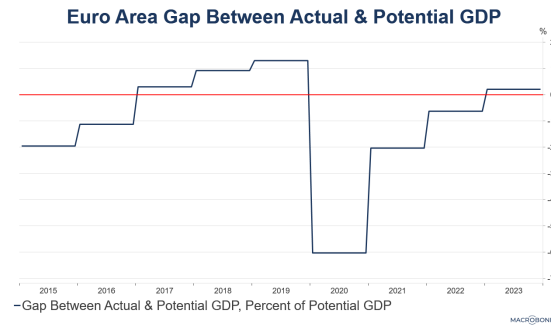


Figure 3.6: Gap between the actual and potential GDP.
Source: AMECO.

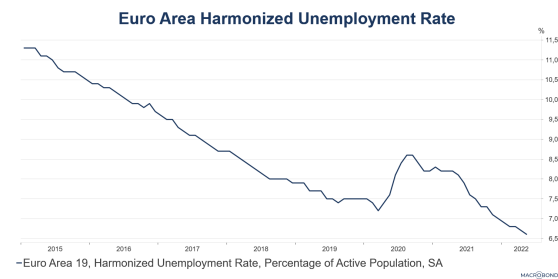


Figure 3.7: Unemployment rate for the Eurozone.
Source: Eurostat.

3.2.3 ECB's New Monetary Policy Strategy

Then, it can be noted that in June 2021, the ECB has published its new monetary policy strategy. What does this involve? Among the changes, the inflation target has been redefined from *"an inflation aim of below, but close to, two per cent over the medium term"* to *"aiming for a two per cent inflation target over the medium term"*². The purpose is multiple, first the former goal was controversial due to the lack of information about which downward deviation from the target is bearable and which one is not. The new objective aims a 'specific quantitative target'. Second, the ECB is committed to a symmetrical monetary policy in response to positive and negative long-term deviation from the 2%, as they are considered equally undesirable. A goal around 2 per cent provide a larger safety margin to guard against deflation by providing more policy space in terms of nominal interest rates, while protecting the economy from the harmful welfare effects of higher inflation.

The policy shift takes place after an extended period of low real interest rates, close to the effective lower bound and making the monetary policy less efficient.

²See the ECB's website (https://www.ecb.europa.eu/home/search/review/html/ecb.strategyreview_monpol_strategy_overview.en.html)

In addition to a low inflation rate over an extended period of time. Since the financial crisis it is well below the 2% target, making the interest rate channel less effective as the central bank cannot reduce its key rate in a zero lower bound environment. The first surges in inflation were therefore perceived as positive by some.

One criticism of the Fed is that it has focused too much on deflation and forgotten the risks of inflation. We note that the ECB, through its new monetary policy strategy, is clearly also focusing its attention on deflation or at least ensures that the transmission mechanism is made more functional. So can the same criticism be applied to the ECB? It is unlikely, at least not in its new policy statement, the ECB recalls the stabilising role of fiscal policies in the macroeconomic context. While countercyclical policy can help the economy recover from large recessions, it also stresses the importance of 'rebuilding buffers' once the economy is back on track. When the Frankfurt institution states that *"by stabilising the economy in large recessions, while ensuring debt sustainability, fiscal policy also makes its best contribution to price stability"*, it is really emphasising the importance of having a passive fiscal policy to reinforce the effectiveness of monetary policy. The purpose of the ECB with this new policy strategy is to anchor the long term inflation expectations more firmly. The bank made their target more predictable which allows for clearer communication of the ECB's strategy, it reaffirms and reinforces its forward guidance tool.

3.3 Inflation Expectations

Since a market economy is the sum of the behaviour of individuals, if the central bank wants to move the economy in one direction or another, it must succeed in influencing behaviours. About behaviour, nowadays, most macroeconomic models assume the agents are rational, which means they use all available information to make their decision and learn from their mistakes. They may be deceived once, but the likelihood of being deceived further decreases as their distrust increases, with the inconvenience of losing a trusted interlocutor as a bonus. Hence the importance for the central bank to maintain its creditworthiness. Moreover, in the decision process, game theory tells us that agents move taking into account the movements of other agents. As the central bank is a major player, its move is essential and closely monitored to assess the best move to do. Aware of this, central bankers have designed a powerful tool for this purpose, forward guidance. They communicate transparently on their future policy, their objectives are clearly defined, they avoid surprises as much as possible, all of this with the aim to shape the expectations. Expectations that are a key driver for influencing behaviour. The advantages of this tool is that it steers the economy in a specific direction without initiating any actions or spending any money. As [McGough et al., 2005] states: "Monetary policy is in large part a process of shaping private-sector expectations about the future path of short-term

interest rates, which affect long-term interest rates and other asset prices, in order to achieve various macroeconomic objectives”.

Therefore, a closely watched indicator is the evolution of inflation expectations, which is why it has its own section. This indicator measures the effectiveness of the forward guidance tool and alerts in case of loss of confidence in the central bank scenario. Inflation expectations are crucial since the principal objective is price stability, they influence the whole monetary policy. Both the Fed and the ECB pursue the 2% inflation rate target, thus as long as the inflation expectations remains close to 2% on the medium term, the objective is completed. We say that the expectations are well anchored. On the contrary if economic agents believe the surge in price is lasting, expectations are de-anchored and there is a risk of wage-price spirals both upwards and downwards. The risk of de-anchoring may arise if inflation fails to meet the target for a prolonged period, agents may internalise the change in the game and the new average inflation may become embedded in the expectations [Draghi, 2014]. Though, well-anchored inflation allows shocks to be weathered without the long-term adverse effect of inflation.

3.3.1 The Surveys

There exists different measures of inflation expectations. Some are based on the market view and some on consumers and businesses view. About the latter, the ECB releases an index based on surveys of professional forecasters, four times a year. This is the index considered for the euro zone. For the United States, the University of Michigan publishes a survey of American consumers each month. In addition, the Fed undertook to construct the Index of Common Inflation Expectations (CIE). It aggregates information from various databases to use the growing amount of data on the economy and inflation. The survey of long term inflation expectations forecasts is the most closely followed, these expectations are less sensitive to potential shocks and correspond to the medium-term horizon of the central banks.

The Euro Area

The European Central Bank collects and process a number of survey made by professional forecasters over different time frame. It calculates an average number and its distribution to assess the risks. Figure 3.8 shows these survey-based expectations for 1, 2 and 4-5 years ahead. The evolution of long-term inflation expectations over the past 10 years reached and stayed at a historically low level between 2013 and 2019, declining to an average of 1.84% (varies according to the statistic used), plus, with a downward trend [Corsello et al., 2021]. Then, the pandemic led to a further decrease in 2020 as it reached a range of 1.64-1.67% [Koester et al., 2022]. This lasting drop in expectations led some to argue that long-term expectations was de-anchored in

Euro Area, HICP inflations expectations, Survey of Professional Forecasters

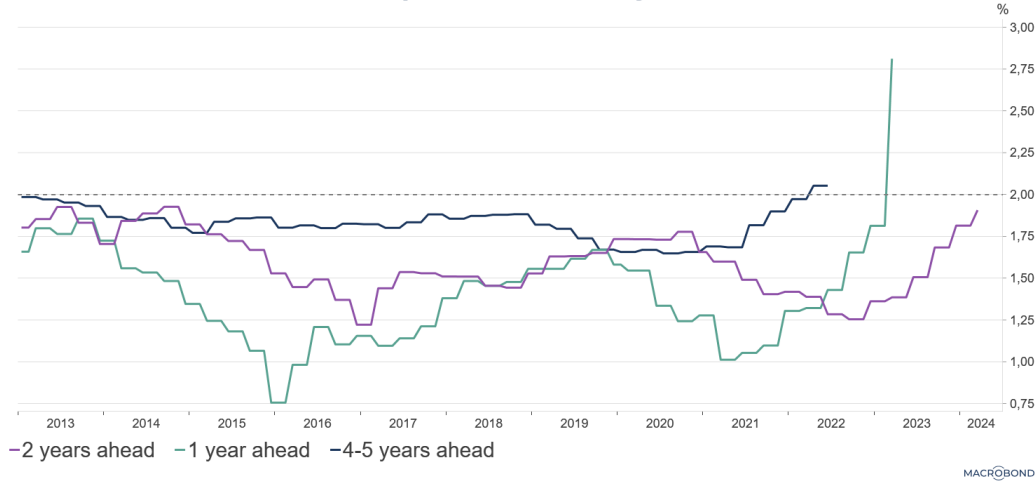


Figure 3.8: Inflation expectations, last survey conducted between the 1 and 4 April 2022, change Y/Y.

Source: ECB survey of professional forecasters.

the euro area. This conclusion was also an argument used by the ECB to justify its new monetary policy strategy. Still, since January 2021 the expectations have been moving up, towards the ECB's inflation target. This has been welcomed by analysts who believe that it will allow inflation to reach and remain at 2% for longer.

The short term expectations are also in line with the ECB's prediction, inflation continues until 2023 but much more moderate and returns to its level in 2024. In fact the 2 years ahead expectations are even below the 2% target. Yet, it should be noted that expectations have been rising steadily since 2021. Recent developments need to be monitored closely as they could have a further impact on expectations and possibly miss the target if it continues to rise.

The American Consumers

The University of Michigan survey aims to determine the direction of consumers' spending and saving decision by estimating the Index of Consumer Expectations. Because it is a consumer survey, it is biased upwards. The literature focuses on the inflation behaviour of consumers, who are likely to have higher perceptions and expectations of inflation [Meyler et al., 2021]. In order to get a clearer picture of consumer perceptions, the time series have been modified to take this bias into account. The raw series is subtracted from its 10-year moving average and added to the 10-year moving average of the CPI.

Figure 3.9 presents the resulting graphs, consumers expect inflation to remain high

U.S. CPI inflation expectations, Consumer Surveys and Common inflation expectations

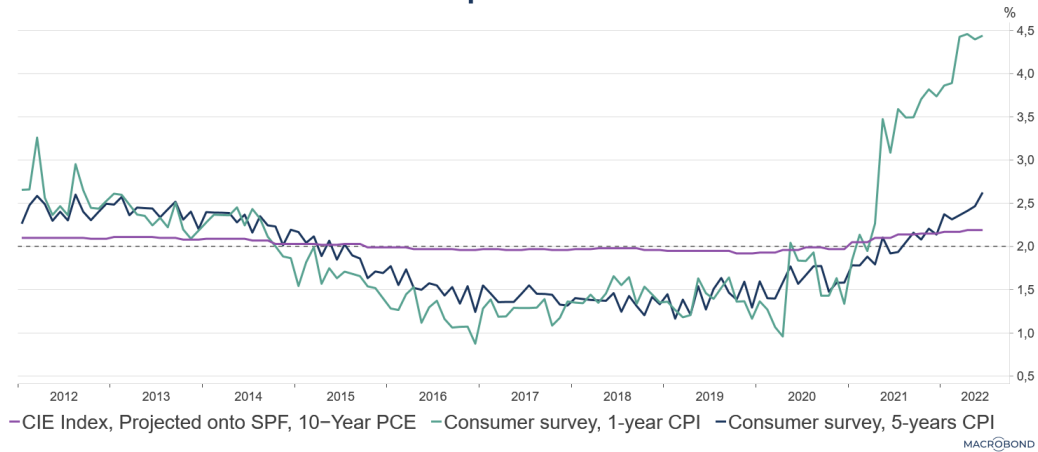


Figure 3.9: Inflation expectations, last survey conducted in June 2022, change Y/Y. Note: to address the survey bias, graphs = Consumer survey - consumer survey moving average(10y) + CPI moving average(10y). Source: University of Michigan surveys; Federal Reserve.

next year but to return to a lower level within 5 years. This is consistent with the Fed's projections, note that the level of expectations may be overestimated when inflation is abnormally high as households tend to overreact to high inflation. In view of the current rampant inflation, concerned observers cannot help but draw parallels with the 1970s. Nevertheless the last numbers remind us that the situation is different and that expectations stay anchored. Consumers expect inflation to return to the Fed's target within 5 years. About the common inflation expectations, variations are much smaller since the time horizon is longer and it is based on survey of professional forecasters. However, the dynamics is similar, an upward but moderate trend since 2021 which reach 2.2% in June 2022.

3.3.2 The Market Measures

We can also base on market expectations by considering inflation linked swaps contracts (ILS) or bonds and calculate the break-even inflation rate (BEIR). The BEIR is a market indicator that measures expected inflation as the difference in yield between a nominal Treasury security and an inflation-indexed Treasury security of the same maturity. It therefore reflects investors' expectations in terms of inflation. This measure is not perfect as it includes also inflation risk and liquidity premia inherent in this type of market.

The European Market

The financial markets tend to indicate the same downward tendency the surveys display but even more pronounced. Figure 3.10 illustrates this BEIR downward trend which began in the aftermath of the financial crisis. More recently they reached a low point in March 2021, correspondent to the day the markets internalised the COVID shock but then remained low throughout 2021. It is only since the beginning of 2022 that rates have risen to between 1 and 2%, so below the target.

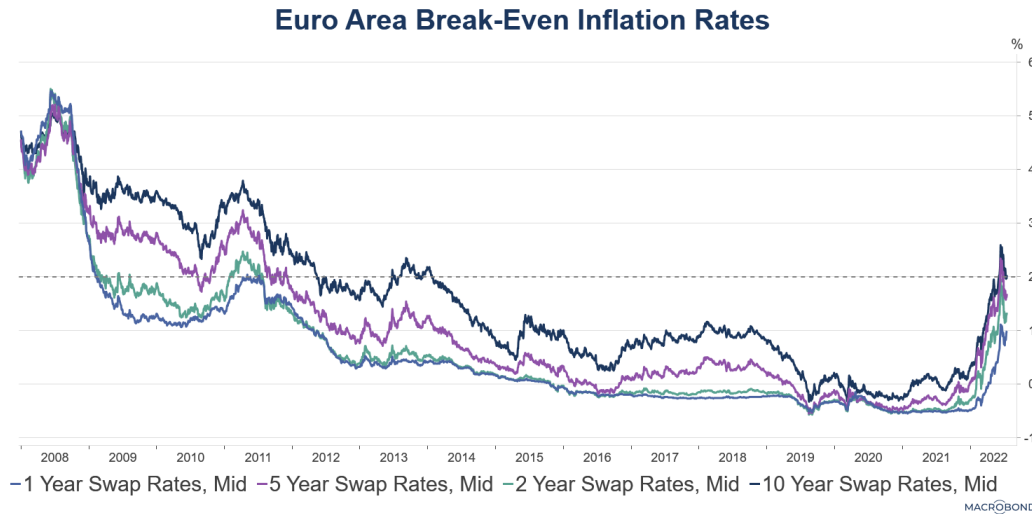


Figure 3.10: Euro area break-even inflation rates, change Y/Y (last data July 2022). Source: Macrobond.

The American Investors

The situation in the US markets is comparable to what we have seen in Europe but less steeply downwards and with a few years' delay. From 2018 to the beginning of the COVID crisis, inflation expectations were decreasing (figure 3.11). In March 2020 as a result of the COVID shock, the 1, 5 and 10 year BEIR fell beneath 1%, so well below the Fed's target. However, the government's intervention in response to the emergency succeeded in comforting the markets, since when expectations have been rising. They reached a peak in March 2022 but are already declining. The last upgrade indicates that markets seem to be in adequacy with the Fed's projections, while the one year ahead BEIR expected inflation to run at 5.5% in March, it is decreasing to almost 4% in June 2022. The 5 and 10 year rates indicate an average expectation returning to 2 and 2.5%, meaning investors expect inflation to be lower in the coming years given expected inflation of 4.3% for 2022-23.

In summary, inflation expectations were too low before the pandemic, reached a level just above the target for 2021-22 but are returning to 2%. In a way, one can

say that the pandemic help expectations to re-anchor. The market view remind us that we are not facing the 1970's problem. At that time, inflation expectations were high because the collapse of the Bretton Woods system did not coincide with the adoption of a new link between inflation and monetary policy. Current Federal Reserve Officials are well aware of this and have a completely different objective. Price stability is their main concern, and they understand that not surprising the markets is the key to keep their credibility. The Federal Open Market Committee (FOMC) communicates regularly its intention concerning the future of the monetary policy, by doing so relying heavily on forward guidance. This is the analysis of [Eichengreen, 2022] to explain the slow reaction of the Fed. Which does not prevent him from criticising a very accommodating policy.

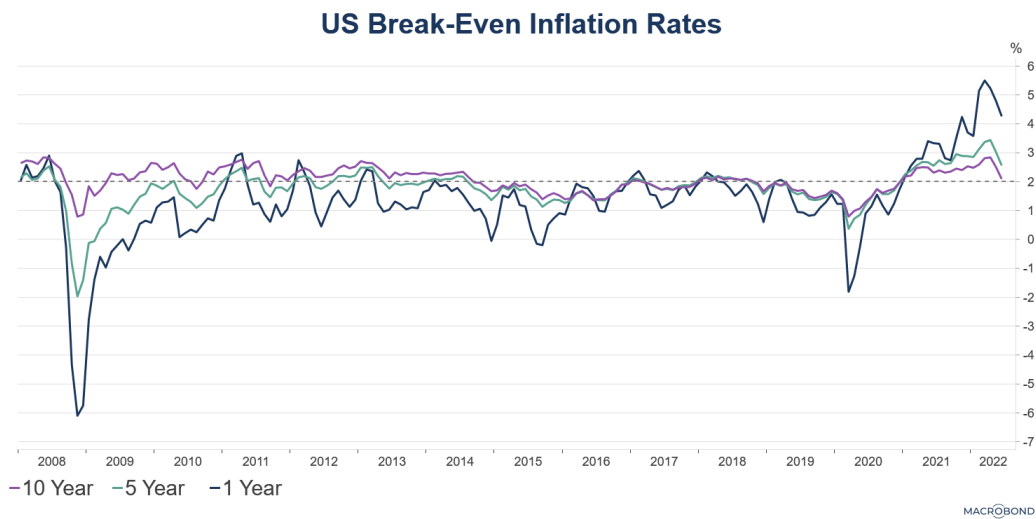


Figure 3.11: US break-even inflation rates, change Y/Y (last data June 2022).
Source: US Department of Treasury.

Chapter 4

The ECB's Dilemma

So far, we have analysed and compared inflation and the resulting central bank response in the US and the euro area. But with regard to the latter, some would argue that a global approach is not relevant given the heterogeneity within the Euro area. After the previous rates hike in 2011, [Nechio et al., 2011] already identified the challenge faced by the ECB in designing a target rate path that best suits the different countries, given the wide economic disparities. Therefore in this chapter we will focus on the differences between the main economies that make up the monetary union, how they could impact on ECB decisions and for what consequences.

At the end of last year, [Rangvid, 2021] is surprised by the reaction of the European Central Bank or rather the lack of reaction. The inflation in Europe reached historical level and contrary to the Fed or the Bank of England which had already announced some tightening in their policy, the ECB only talked about keeping rates low. Official statements still regarded inflation as temporary and saw no point in jeopardising the post-covid recovery. The reasons behind the Frankfurt institution decision are obviously highly complex and as reminded infra, a central bank policy making process is all but a trivial task. Nevertheless, it is questionable to what extent the sustainability of public debt and the risk of a new euro crisis could influence decision-making. Indeed, as developed in the first chapter, fiscal theory emphasises the importance of sound public finances if the central bank is to be empowered to keep inflation under control. This may give the insight to understand why the particularities of the euro area may well make the decision to raise rates less obvious, especially if this solution is highly debated. The wrong response to inflation may have terrible consequences.

4.1 The European Central Bank

The European Central Bank, at the present level of European construction, is a supranational institution to which member states have delegated their monetary pol-

icy. The ECB is therefore completely independent from fiscal policy, which remains a national competence, and pursue an objective of price stability. The architecture of the euro zone was designed in this way to send a signal to financial markets. The will of the policymakers was to convince their intention to not inflate the debt. This is also the reason why all Member States must comply with the Stability and Growth Pact (SGP), it is a fiscal commitment that every country commits to when it wishes to join the euro zone. Lessons learned from the past crisis have helped to supplement the existing rules with additional regulations, the purpose is to monitor compliance and prevent deviations with these commitments. In the vocabulary of the FTPL, in this institutional set-up the monetary policy is designated as active and the fiscal policy as passive.

4.2 A New Euro Crisis?

Why is the ECB so slow to respond to rising inflation? If, as some argue, the best way to fight inflation is to significantly raise interest rates, the answer should already have come in the last quarter of 2021. In addition to the fact that this opinion is very controversial, increase the rates may not be without consequences given the disparities within the euro area member.

According to the theory, with active monetary policy and passive fiscal policy, a monetary authority has full space to keep inflation under control. The institutions governing the Eurozone were designed to maintain this balance of power, that is why some critics would argue that the fiscal theory of the price level is irrelevant in the euro area. In practice that is probably more complex and not entirely true.

4.2.1 Poor Fundamentals

Since the global financial crisis and state interventions to refinance the banking sector, it is well known that the SGP is no longer fulfilled for some countries, especially in Southern Europe. During the sovereign debt crisis the high level of the debt-to-GDP ratio reached after the previous crisis and poor growth prospects in these countries already threatened the European financial and monetary system which fail to reassure the markets. This led to severe disruptions in the government bond market until the ECB used its unconventional monetary policy to ease the pressure on the public yield spread. Today, the public finance in some of these countries is far from improved. To illustrate that, figure 4.1 shows the position of the debt-to-GDP ratio of different eurozone countries since the financial crisis. The GIIPS countries, (Greece, Ireland, Italy, Portugal, Spain) are those who have been hit hard by the 2008 financial crisis and the sovereign debt crisis. As the graph shows, between 2013, the height of the debt crisis and 2019, just before the pandemic, Ireland, Por-

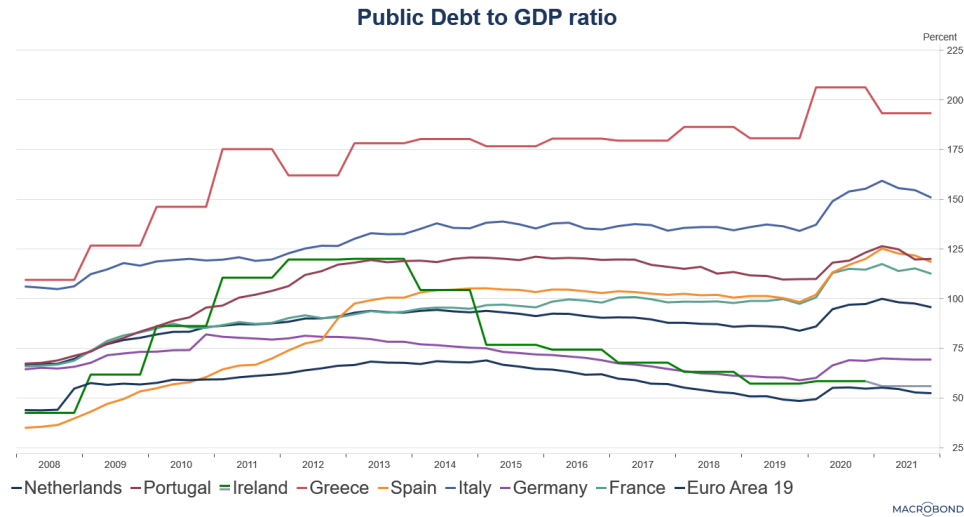


Figure 4.1: Debt to GDP ratio in the GIIPS, France, Germany, Netherlands and the Euro area. Source: Macrobond.

tugal and Spain succeeded to improve their fundamentals. The situation remains worrying in Italy, Greece and France which have failed to restore the buffer during this period of growth. As a comparison between the north and the south of the Eurozone, Germany and Netherlands fell back below the 70% of the SGP. As we shall see below it is clear that higher interest rates could be detrimental if the governments of highly indebted countries do not propose convincing fiscal reform, as tax reform at EU level is highly unlikely in the near future.

In summary, given the current macroeconomic situation in the Eurozone and based on growth and deficit forecasts, see figure 4.2, the situation is worse than before the pandemic. An increase in the interest rates may raise debt service costs in two ways. On one hand the risk free rate will increase as the central bank tightens its financing conditions. On the other hand, there is a risk that some Member States will face a higher risk premium as their bad situation worsens. Indeed the possibility exists that the resurgence of such macroeconomic imbalances could trigger a fly-to-safety phenomenon with a possible panic movement that would put additional pressure on the public spread. They could therefore face unsustainable debt if they fail to reduce their current and future deficits convincingly enough to finance themselves on the market and roll over their debt. Moreover the new macroprudential policy put in place since the successive crises and supposed to solve that kind of problem, may not be enough to convince the financial market, see [De Grauwe, 2011] about the EFSF (European Financial Stability Facility) and the ESM (European Stability Mechanism). All these events taken together have the potential to threaten the financial stability of the euro area and although the ECB's mandate gives priority to "price stability", the institution recognises that financial stability is a precondition

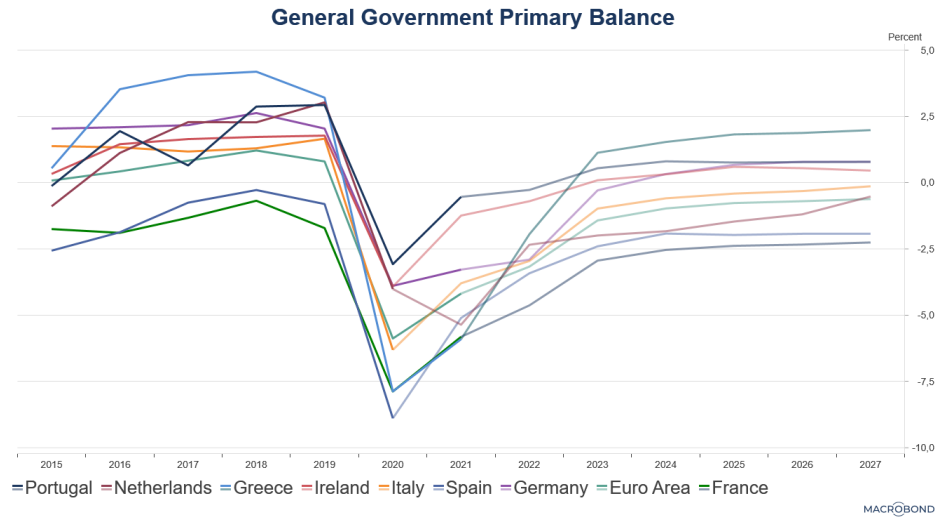


Figure 4.2: Realised and forecasted primary government budget balance in the GI-IPS, France, Germany, Netherlands and the Euro area, % GDP. Source: IMF.

for this objective. It would therefore be consistent with its mandate for the central banker to intervene.

4.2.2 Two Possible Scenarii

For any Member State part of the EMU, the control of the monetary policy remains a prerogative of the central bank. However depending on the situation that may arise, the latter can be constrained in its decision by the fiscal position of a member. In a crisis situation, when a fiscal shock occurs, we distinguish 2 scenarii depending on the size of the economy. If a fiscal shock hits a small economy, the threat to the euro area system is not systemic. The ECB will most probably maintain its policy and will not be involved in the resolution of the crisis or at least not in a way that would change its whole monetary policy. The Greek crisis is a good example of how the Eurozone solves that kind of problem. The parties involved were content to ensure that the fiscal policy becomes stable again, means passive. However, in view of the more than questionable result, the possibility exists that the European institutions may not wish to renew this procedure.

Nevertheless if the shock hits a bigger economy the risk to spill over major European economies become higher, means a higher probability of global default. The ECB's balance sheet could be threaten [Del Negro and Sims, 2015] and so the financial stability of the entire euro area. Other members may be forced to recapitalize the ECB to avoid insolvency, preserve the credibility of the euro and ultimately keep inflation under control. Actually the mere possibility of this happening should push the ECB to act upstream to prevent such an event.

During a debt crisis, the link between monetary and fiscal policy become clearer, the central bank being backed by the Member States treasury. The independence of the central bank is guaranteed as long as the government fiscal position is sustainable. Eventually the credibility of the ECB and the euro lies in the strength of the economies that guarantee them.

We can think of the latter situation as what happened during the Eurozone crisis. At the time the Italian spread, among others, known a sharp rising threatening the sustainability of Italian debt. Mario Draghi, then President of the ECB, uttered his now famous phrase: “within our mandate, the ECB is ready to do whatever it takes to preserve the euro and believe me, it will be enough”. It means the ECB has the ability to buy as much debt as it wants and it will not give up its main members. One can also think about the legitimacy of such actions. The central bank argued that it was in line with their mandate, the prevailing view being that the central bank acted on the transmission mechanism of its monetary policy to ensure the effectiveness of its rate policy across EMU. By doing this they were not manipulating the markets. But during that kind of period one can imagine that, having learned from its mistakes, the ECB will no longer let the situation get out of hand and acts upstream to preserve the financial stability. The line between changing or not changing the market view is blurred.

4.3 One Eurozone, 19 Countries

There are many divergences in the Euro area, we have already mentioned the fiscal situation, and now that inflation is soaring, the divergences are confirmed. Figure 4.3 shows the HICP for the main Eurozone economies. Inflation in the Euro area was 8.6% in annual percentage changes in June, this is well above the two percent target. Moreover, there are substantial differences between country: lower inflation is observed in France, at 5.8%, but it is higher in Germany, 8.2% and reaches 10.5% in Belgium. These inflationary pressures, which are exerted differently on the populations, will exert proportional pressure on the governments. There is no doubt that the urgency to address the problem will diverge in the same way. Especially for countries that have no interest in it.

4.3.1 The Debt Sustainability

As the fundamentals are a major concern in assessing the likelihood of a new debt crisis, especially if the ECB is about to raise the rates. Let us see the differences within the euro area. Not all countries are in a critical situation, the focus will be

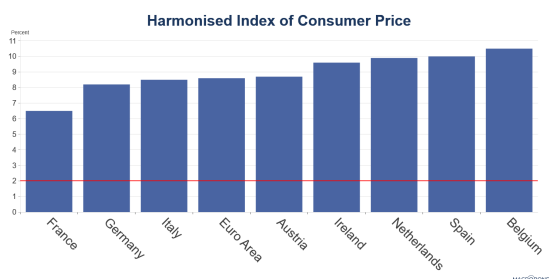


Figure 4.3: Inflation in the main Eurozone economies, change Y/Y, June 2022. Source: Eurostat.

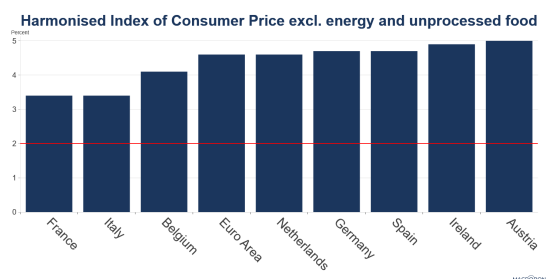


Figure 4.4: Core inflation in the main Eurozone economies, change Y/Y, June 2022. Source: Eurostat.

on peripheral countries compared to the "orthodox" economies, Germany being the most important of them. On the contrary Italy is the third largest economy in the area but its debt level is still very high and its prospects are poor, she is the most fragile member and will be given special attention.

Figure 4.1 illustrates the evolution of the debt to GDP ratio for some Eurozone economies. Although the upward pressure seems to have eased between 2013 and 2019, the gaps are widening. The paces of recovery are different and the COVID crisis has accentuated them. However, considering the debt servicing costs, it gets improve. Figure 4.5 illustrates the decrease in net interest payments governments pay as a percentage of GDP. Thus, despite a significant increase in the debt-to-GDP ratio, the cost of debt is falling. This is undoubtedly an effect of the ECB's action, with low policy rates partly, but not exclusively, responsible.

The second reason for the fall in debt servicing costs is that, in addition to low key rates, the ECB has purchased a record amount of public debt through various asset purchasing programmes. The Public Sector Purchase Programme (PSPP) was launched in the aftermath of the Eurozone debt crisis and the Pandemic Emergency Purchase Programme was designed to enable the funding of the anti-COVID plans. These programmes have had the effect of considerably increasing the amount of public debt on the ECB's balance sheet. Consider the Italian government securities, figure 4.6 shows the evolution of the government bonds held on the ECB's balance sheet since March 2015 and the launch of the securities buy-back programmes. Under the PSPP, the ECB acquired nearly €450bn in debt and €280bn under the PEPP, which corresponds to 26% of the general government Italian debt.

The impact of these two types of measures separately is difficult to quantify precisely but it is certain that they have played an important role in reducing debt cost. Therefore what would happen if the ECB was forced to raise the rates and stop its purchase programmes?

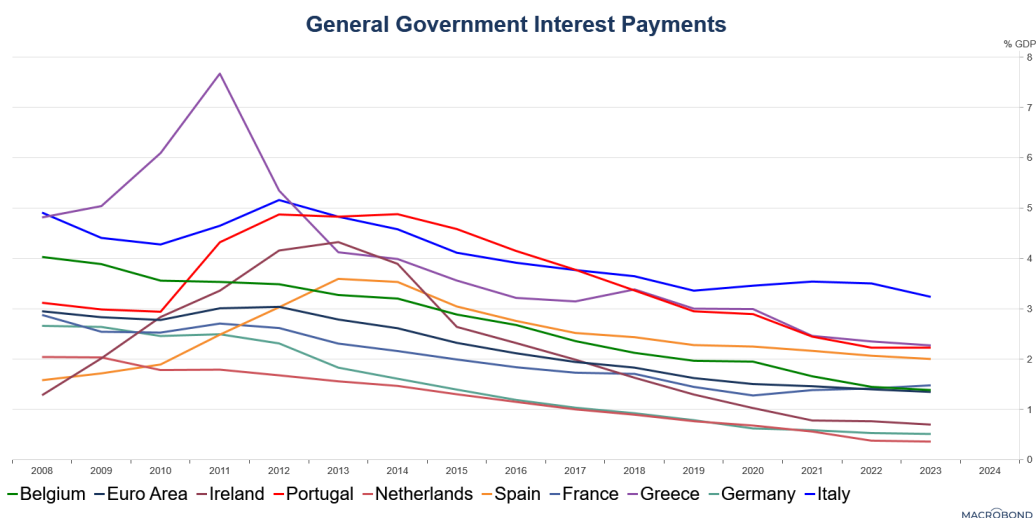


Figure 4.5: Net government interest payments for the GIIPS, France, Germany, Netherlands and the Euro area, % GDP. Source: AMECO.

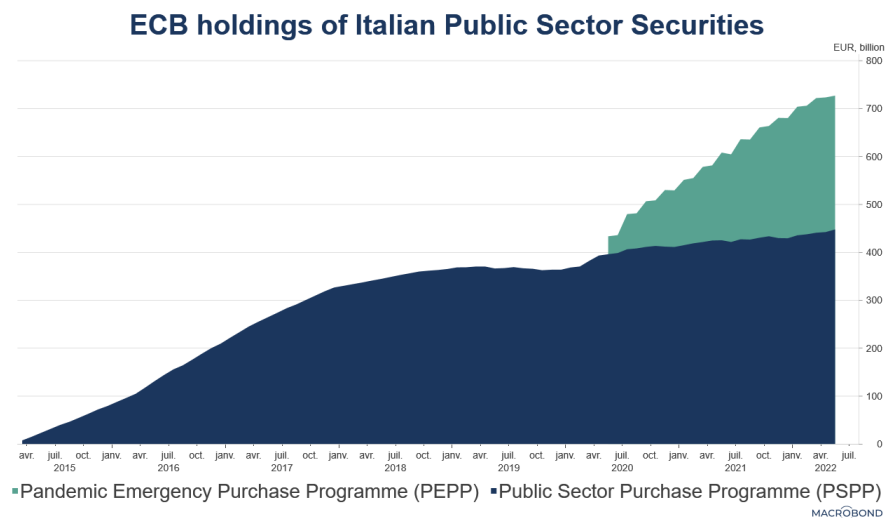


Figure 4.6: Amount of Italian public sector securities in the ECB balance sheet, May 2022. Source: ECB.

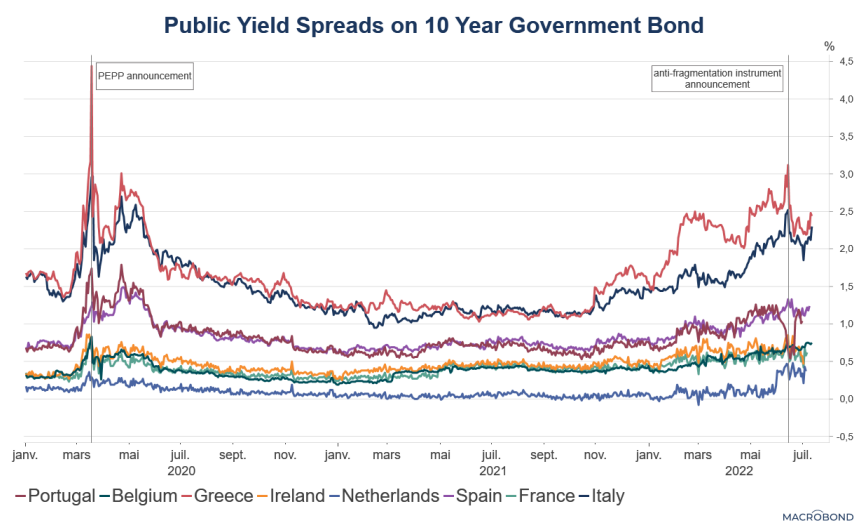


Figure 4.7: Public yield spreads on 10 years Eurozone government bonds.
Source: Eurostat.

There is no doubt that financing costs will increase which will have a direct impact on the state deficits. The section 4.2.1 described the two channels by which the debt service costs are affected. A likely immediate consequence is the widening of public yield spreads. In fact, this has already happened after the ECB announced in June the normalisation of its policy, see figure 4.7, the Italian spread rose for a few days before the European Central Bank communicated on the creation a new anti-fragmentation instrument. In fact, the situation in the government bonds financial markets has been unstable since the financial crisis. In 2012, Mario Draghi's intervention succeeded in stabilising the markets after several years of great volatility. Since, the ECB has ensured that sovereign yield spreads are kept within an acceptable range, but any shocks create an immediate widening in the public yields as the recent COVID crisis reminds us. The central bank is compelled to intervene in multiple markets by manipulating a single money, so far the variety of instrument at its disposal are sufficient to cope with the successive crises, but for how long?

In order to figure out the size of an interest rate shock, consider some simple counterfactual figures. The impact of higher funding costs on an economy is function of its debt and deficits. The treasury must finance both the new deficits and roll over the existent debt. Table 4.1 displays statistics about our four major economies. One consider the debt, the actual debt servicing costs and the extra deficit, it designates the additional deficits the country would face if interest rates increase. Suppose the ECB raises rates to 5% (very unlikely but not exaggerated given the current inflation), the impact would be huge in terms of GDP ratio. For comparison, the second column indicates the current interest payments.

	Debt-to-GDP (%)	Net Gov. int. payments (% GDP)	Extra deficit (% GDP)
France	112.9	1.38	5.6
Germany	69.3	0.59	3.5
Italy	150.8	3.54	7.5
Spain	118.4	2.16	5.9

Table 4.1: Extra deficit implied by an interest rate of 5%, data of December 2021. Source: AMECO.

Of course these figures are very simplistic and not realistic since financing costs do not change immediately after an increase in the rates. The costs depend on the proportion of the debt pegged to inflation, the maturity of the government debt and the primary budget balance and of course the level of debt. An economy with a large deficit and more short term debts will be more impacted, the weighted average maturity of debt (WAM) is commonly used to measure a country's exposure to the risk of rising interest rates. Only it does not include the date on which the matured debt need to be refinanced. It would be interesting to investigate this further for the Eurozone. Recently The Economist published an article¹ on this topic, it appears that, based on a measure developed by the Office for Budget Responsibility in Britain, Italy will have to refund half of its debt in a little bit more than two years. It is not the point to discuss about that estimation here but it does shed some light on Italy's plight if rates rise. Additionally, the rate rise would probably be uneven between the Euro area economies and finally the debt ratios will evolve but probably in both directions.

4.3.2 A Fiscal Inflation

Until now, we assumed that the ECB will, or at least should, raise rates and for what consequences. On the contrary, suppose now that the interest rate remains affordable so the macroeconomic situation of the different members remains sustainable. If inflation stays at a high level, whatever the causes behind the surge in inflation, how public debts would evolve?

The majority of debts is denominated in nominal value so mechanically the ratio debt to GDP will decrease, all other things being equal. From this perspective it is interesting for treasuries that see their liabilities decrease in value compared to their revenues that increase, at least in nominal value. To understand the national interests in seeing inflation persist, the estimation of the time needed for our four benchmark countries to reach a debt ratio of 100% or 70% as prescribed by the SGP,

¹<https://www.economist.com/finance-and-economics/2022/07/12/how-higher-interest-rates-will-squeeze-government-budgets>

seems a good indicator. The question is, based on the debt to GDP ratio at the end of 2021, how long does the inflation need to stay at the level of May 2022?

	Debt-to-GDP (%)	Inflation rate (%)	Time to 100% (year)	Time to 70% (year)
France	112.9	5.8	2.15	8.48
Germany	69.3	8.7	0	0
Italy	150.8	7.3	5.83	10.89
Spain	118.4	8.5	2.07	6.44

Table 4.2: Estimated time to inflate the public debt to reach 100% and 70% level. Source: Eurostat.

Table 4.2 displays these figures, with the exception of Germany, the other countries have an interest in doing so. In terms of fiscal inflation France is penalised by its low inflation rate. Italy would benefit the most given its very high level of debt, but it is probably unrealistic to maintain this level of inflation for so long.

To calculate this duration, it is assumed that the debt ratio remains constant over time, but the longer the duration, the more this assumption may not be correct. Indeed, governments are supposed to reimburse the debt during periods of growth while a recession increase the debt level. Moreover the assumptions we made for these forecasts ignore the negative effects that inflation can have on public finances. For example, the government could be asked to smooth out the increase in energy or food price, the wages of civil servants would be subject to increase demands. An advanced analysis should take this into account.

Chapter 5

The Taylor Rule: Empirical Analysis

The COVID crisis is fading and the ensuing recovery coupled with geopolitical problems and supply chains disruptions result in a historically high rise in inflation. The Taylor principle, described in the first chapter, requires the central bank to raise its policy rate by more than one for one with the inflation rate in order to stabilise the inflation path.

The European Central Bank raised its target rates in July 2022 for the first time since 2011, by 50 basis points. The Fed preceded it in March. From the perspective of a simple interest rate rule, are these hikes consistent with the current economic and inflationary situation? This chapter presents the results of an empirical analysis of central bank behaviour. Our starting point is the calculations of the original Taylor rule. Second, an estimated dynamic version of the Taylor rule is used to further describe the Fed policy. How it behaves in relation to inflation and unemployment gap in different periods of the past and how it fits with the Taylor principle. Third, a Taylor rule estimated on the basis of the estimated coefficients with past data provides a guideline to compare with the actual path of the FED and ECB target rate.

5.1 Data and Methodology

The first analysis consists in comparing the recommendations of the original Taylor rule as specified by the equation 1.2, with the actual policy rates. The dependant variables are the GDP deflator as it better measures how debtors are affected by a price decline. It is a broader indicator that does not take into account taxes and input prices development, but focuses on the income growth [Alcidi et al., 2016], and the output gap.

Then, the estimated dynamic model is a modified version of Taylor's rule as in

[Yellen, 2004] and [Rudebusch et al., 2010]. The dependent variables are slightly different from the original rule. It is a least square regression of the target rate on core inflation and the unemployment gap of the form,

$$i_t = c + \phi_\pi \pi_t + \phi_u (u_t - \bar{u}_t) \quad (5.1)$$

where i_t denotes the target rate, π_t the four quarter change in the core inflation, u_t the unemployment rate and $\bar{u}_t$ an estimation of the non-accelerating inflation rate of unemployment (NAIRU) or non-accelerating wage rate of unemployment (NAWRU) for the EU. The constant $c = \bar{i} - (\phi_\pi - 1)\pi^*$ with $\bar{i}$ the long-term rate and π^* the inflation target (see equation 1.2).

In this model, the policy rate is a function of the inflation rate as prescribed by the Taylor rule but also of the unemployment gap. Consider the unemployment gap instead of the output gap is not a fundamental change to the original model since, as Okun's law shows, unemployment and output are directly proportional. However, the unemployment rate has a more direct impact on inflation. Indeed, employment influences inflation through wages as shown by the Phillips curve and also has the advantage of being less subject to revision.

It is a simple equation that only roughly describe the central bank's behaviour. Some most advanced models add lag variables to allow the possibility for the central bank to adjust gradually its key rate, [Rudebusch, 2005]. The aim here is not to find the best model to follow the variations of the key interest rate, but rather to find out whether monetary policy complies with the Taylor principle and whether the central bank is constant in its behaviour with regard to inflation.

All measurements used for the estimation are taken from the Macrobond database. Most of the original times series were too short or not at the right frequency for the purpose of this study, they were therefore merged or transformed ensuring that their behaviour remains unchanged.

5.1.1 European Data

Concerning the target rate, the Governing Council of the ECB sets three key interest rates for the Euro area, the rate on the main refinancing operations (MROs), the one which provide the bulk of liquidity to the banking system, is used for the regression. Eurostat, the European Statistical Office, publishes the Harmonised Index of Consumer Prices (HICP) and its components every month. The benchmark indicator used by the ECB to measure inflation is the headline HICP. However, it seems that core inflation predicts medium-term inflation better and is widely used in the literature, as suggested by the articles on which our model is based. The measure of core inflation considered is the HICP overall index excluding energy and

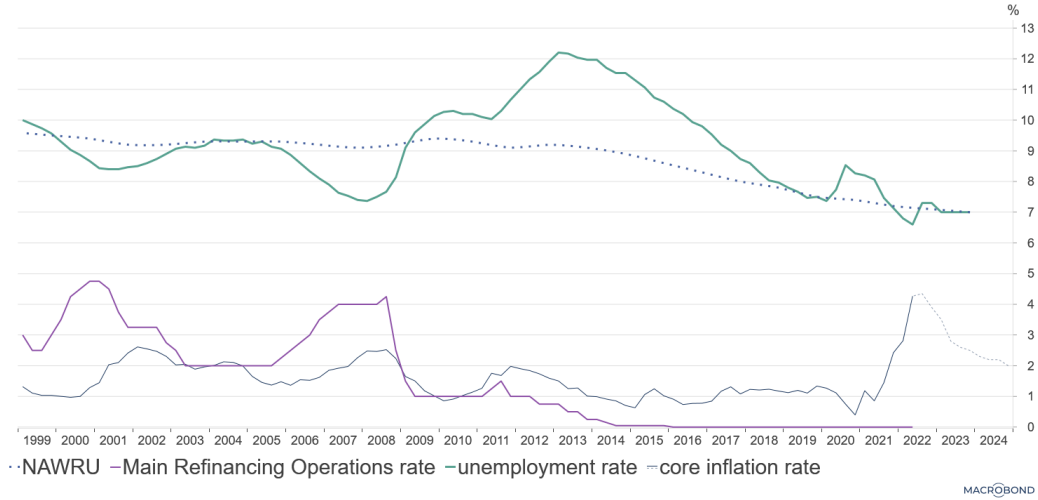


Figure 5.1: MROs, core inflation, unemployment rates and NAWRU for the euro area.

Source: Eurostat; DG ECFIN; ECB.

unprocessed food, its projections are estimated by the DG ECFIN (European Commission). The harmonised unemployment rate is also issued by eurostat and the NAWRU is estimated by the DG ECFIN.

By way of comparison, the same exercise is performed with an alternative measure of inflation, the HICP (model 2) and with the output gap (model 3) instead of the unemployment gap. The potential GDP used to calculate the gap is that considered by the European Commission. This gives us 3 different models to estimate. Figure 5.1 reports the data used to estimate the main model.

5.1.2 U.S. Data

Unlike the ECB, the Federal Reserve sets a single target rate, called the federal funds rate (FFR). As data on the target federal funds rate are not available before 1971:1, the series is completed with the effective rate. The US inflation is measured by two indices, the Consumer Price Index (CPI), published by the US Bureau of Labor Statistics, but the Fed prefers the Personal Consumption Expenditure (PCE), computed by the US Bureau of Economic Affairs. The regression is thus performed with the core measure of both indices. The unemployment rate is published by the US Bureau of Labor Statistics. And the Congressional Budget Office provides the projections and estimates for all the time series. Figure 5.2 presents the US data.

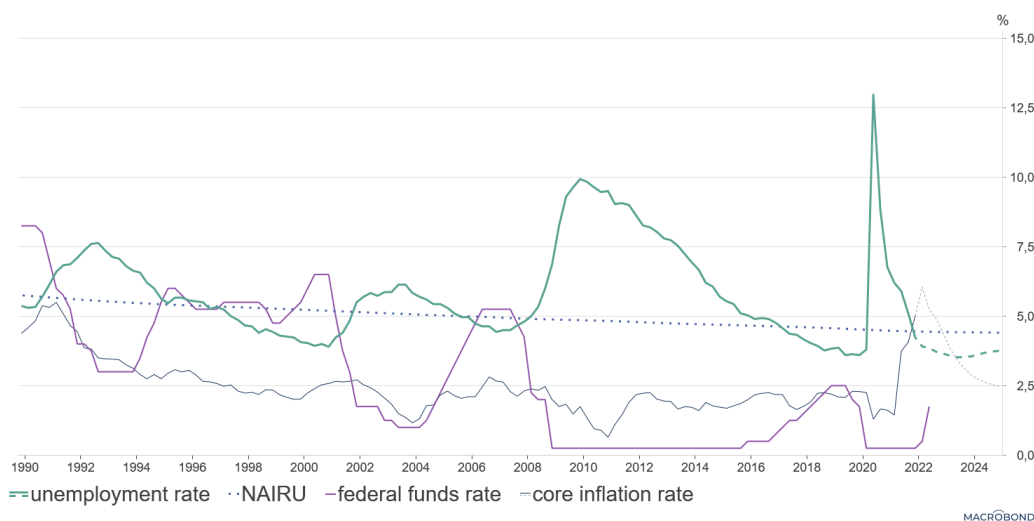


Figure 5.2: Federal funds, core inflation (CPI), unemployment rates and NAIRU for the US.

Source: Fed; US Bureau of Labor Statistics; US CBO.

5.2 The European Central Bank's Reaction Function

5.2.1 The original Taylor Rule recommendations

The figure 5.3 presents the two Taylor rule recommendations along with the ECB's policy rate. It appears that the original Taylor rule is not suitable for modelling European monetary policy, as it only loosely follows the contours of the interest rate. The dynamic model fits better. The explanation lies partly in different explanatory variables, see figure A.3. The GDP deflator and the GDP gap are more volatile than the data used to estimate the dynamic model. A good example is the recent decline in GDP in 2020, which was not felt as strongly in the labour market due to social protection measures. But also in the original assumptions made by [Taylor, 1993] about the inflation target and the real interest rate that are unrealistic for the euro area. First, the inflation target was below 2%, especially after the financial crisis, by the way the ECB struggled to raise inflation. Second, the real interest rate felt below 2% for most of the euro members. It results in too high and too volatile interest rate recommendations but by correcting for these flaws, the predictions are not so far from those of our dynamic model.

5.2.2 The Dynamic Model

The estimate sample for the ECB's reaction function ranges from 2001:1 to 2021:2, date when inflation has exceeded the 2% target rate. Stop at this point allows to

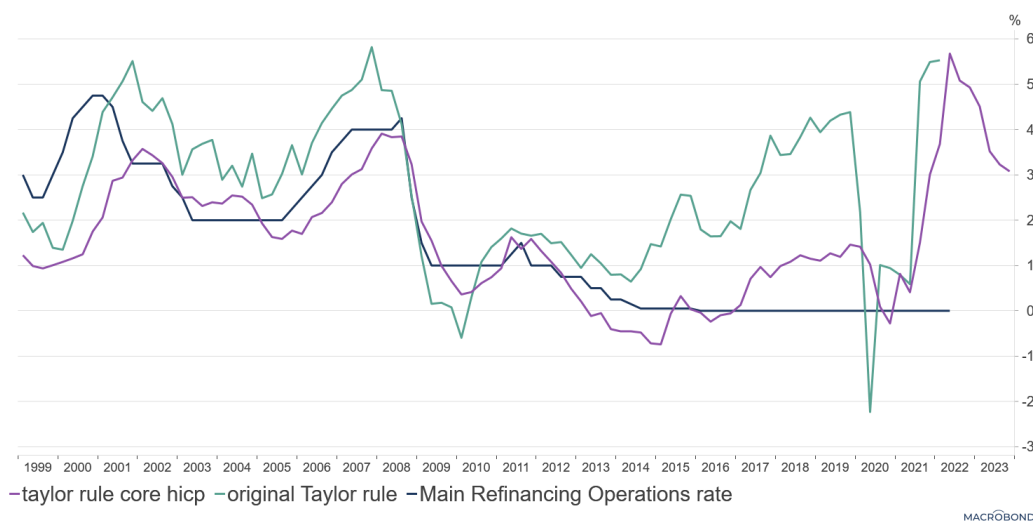


Figure 5.3: MROs rate plus original and dynamic Taylor rule recommendations for the euro area.

Source: ECB and author's calculations.

assess the appropriateness and coherence of current monetary policy in response to inflation, compared to previous policy behaviour. While ensuring that the new policy does not affect the coefficients. The first two years of the euro were not included in the estimation of the coefficients because they distorted the results. The hypothesis may be that first, the rates were initially set too high. Second, these were somewhat special years since the euro was still cohabiting with national currencies, and it is conceivable that it may take some time for the monetary policy to become systematic. Third, at the time of the creation of the euro, monetary aggregates were still important in the minds of some and could play a role in monetary policy decisions. The original 1998 monetary policy strategy stated that: *"money will be assigned a prominent role, ... signalled by the announcement of a quantitative reference value for the growth of a broad monetary aggregate"*¹. This focus on monetary aggregates disappears completely in the latest revision of the monetary policy strategy.

The results obtained after performing our estimations are shown in the table 5.1. The first comment that can be made is that all the coefficients for the three models are significantly different from zero, except the constant. However, only the first equation returns coefficients consistent with the Taylor principle. The inflation coefficient is greater than one, so the policy rate does move more than one-for-one with inflation. The unemployment gap coefficient is also coherent, the key rate decreases when the unemployment rate is higher than the structural rate. The magnitude of

¹See the ECB's website https://www.ecb.europa.eu/press/pr/date/1998/html/pr981013_1.en.html

VARIABLES	(1) MRO	(2) MRO	(3) MRO
core HICP	1.393*** (0.192)		1.997*** (0.189)
unempl. gap	-0.492*** (0.0806)	-0.637*** (0.0832)	
HICP		0.567*** (0.113)	
output gap			0.0886** (0.0445)
Constant	-0.405 (0.325)	0.826*** (0.230)	-1.440*** (0.323)
Observations	82	82	82
R-squared	0.747	0.681	0.646
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			
Estimation sample: 2001:1 - 2021:2			

Table 5.1: Results of the dynamic Taylor rule least square regressions for the euro area.

Source: author's calculations.

the movement is, though, small compared to similar estimate for the US. But it might makes sense, as the ECB's main objective is price stability, whereas the Fed is also interested in maintaining economic output.

Concerning the second equation, the sign of the coefficients is logical but the weight given to inflation rates seems very low and do not coincide with the Taylor principle prescription. This result reinforces the argument that core inflation is a better predictor of medium-term inflation. In the third equation, the core HICP coefficient is high, which could be possible but the output impact on the rates is barely significant. Note that the sign is different from that of the unemployment gap since the output gap is equal to GDP minus potential GDP. Thus, if potential GDP is higher than GDP, rates fall to allow economic output to recover. A coefficient close to zero would indicate that the unemployment rate has a greater impact on inflation than the output.

The analysis of this model seems to indicate that ECB presidents had not a significant impact on the continuation of monetary policy. This conclusion must of course be qualified. Since the European Central Bank became operational it has known 4 presidents: Wim Duisenberg 1999:1 2003:3; Jean-Claude Trichet 2003:4

2011:3; Mario Draghi 2011:4 2019:3; Christine Lagarde 2019:4 today. To express the previous statement in other words, by regressing the model on the samples corresponding to the presidents' terms of office, the model does not return significantly different and consistent results. In the sense that there is no obvious discontinuity, contrary to what the literature has shown with the analysis of US data before and after the appointment of Paul Volcker. It is important to note the limited duration of the time series data and the impact of the zero lower bound, which accounts for a much larger part of the ECB's existence than the Fed. This conclusion is therefore irrelevant, as the recent main changes in monetary policy should probably be found in the practice of quantitative easing.

5.2.3 Taylor Rule recommendations and MROs rate

Based on the coefficients estimated with model one, figure 5.3 illustrates the recommendations of the Taylor rule since the launch of the euro. Alongside the MROs rate, the rule follows well the tendencies of the key rate until the latter reaches the zero lower bound. Some comments about the gap between the target rate and the recommendations, for the first two year of the euro, the policy rate displays the same characteristics as the rule, but with a too high amplitude, which was corrected in 2001. Then, in the aftermath of the financial crisis, a recurring criticism of the ECB was its inability to act strongly enough and quickly enough to set the pace for the markets. It was accused of not having lowered its key rates quickly enough. The same conclusion can be drawn from the estimated Taylor rule. First, the policy rate was not lowered as much as recommended by the rule. Indeed, in 2009 and 2010, rates should have been close to zero. Next, they didn't come down fast enough as the sovereign debt crisis worsened the situation in many states.

In addition to these poor monetary decisions, in recent years, the monetary policy was constrained by the zero lower bound, which prevents the bank from having a greater impact on inflation. This phenomenon is known as a monetary policy rate shortfall, [Rudebusch et al., 2009] defines it as: *"the desired amount of monetary policy stimulus from a lower funds rate that is unavailable because nominal interest rates can't go below zero"*. This situation makes that despite very low key rates, the 2% target is not achieved. Which causes rates to remain low for a prolonged period. It was the zero bound that prompted the ECB to turn to unconventional monetary policy, known as quantitative easing.

Finally, the situation has changed during the second quarter of 2021. The inflation target has been exceeded and inflation continues to rise in the second quarter of 2022 to over 8.0%. To cope with this development, the Taylor rule recommend an increase in the MROs rate to 5.5%. Then, on the basis of projections of core inflation and the unemployment gap, rates are expected to fall to 3.0% in 2023. Provided that the forecasts are correct, i.e. the scenario of temporary inflation, the

Taylor rule recommends a rise in rates but for a limited period. The decision to raise rates only slightly therefore makes sense and avoids unnecessary disruption of the financial markets.

5.3 The Federal Reserve's Reaction Function

5.3.1 The Great Inflation

Among the various factors that explain the Fed's monetary policy changes, changes in the composition of the Federal Open Market Committee (FOMC) are among the most studied. The most important and identifiable change is the Fed chairmanship and with such a long period of recorded activity, the data available for the US allows for a more in-depth historical analysis. A long-debated episode in US monetary policy is the great inflation followed by the Volcker disinflation. Many papers are dedicated to the study of this phenomenon, it is indeed a typical case study to demonstrate the relevance of the Taylor principle. One of these papers, [Clarida et al., 2000], considers the following samples to prove that principle. The first sample goes from 1960:1 to 1979:2, it corresponds to the period during which W.M. Martin, A. Burns, G. W. Miller was Fed's chairmen. The second sample, 1979:3 to 2005:4, has seen the chairmanship of P. Volcker and A. Greenspan.

The estimates of the coefficients of the Taylor rule are presented in the table 5.2. The model with the core PCE was chosen because it had a larger R-squared and more significant coefficients. The difference between the two periods is clear, in the first period, an increase of one in inflation only resulted in a 0.8 response in the interest rate. In contrast, monetary policy in the second period was much tighter with a response of 1.8 to 1. While the unemployment gap was treated in the same way in both periods. This change in the Fed's behaviour is correlated with the fall in inflation, so it has been deduced that this was the right policy to pursue.

5.3.2 The original recommendations of the Taylor Rule

The original Taylor rule has been explicitly designed to match the Fed monetary policy. Figure 5.4 shows how this rule follows the Federal funds rate the last 40 years. The first observation is that the original rule is way more volatile than the FFR due to the volatility of its explanatory variables, see figure A.4. The second observation is that during the first half of the sample, its trend is more flat. The explanation does not come from the data trends, which are relatively similar, but from the importance attached by the Fed to the employment. This is what emerges from the analysis of the estimated coefficients. With the dynamic model, an increase in the unemployment gap of 1 causes a decrease in rates of 1.7, much more than the 0.5 of the original rule. Given the fact that the dynamic model better matches the Fed's policy rate, it does not seem too unrealistic to extrapolate the explanatory

VARIABLES	1960:1-1979:2 FFR	1979:3-2005:4 FFR
core PCE	0.806*** (0.0772)	1.878*** (0.0947)
unempl. gap	-0.849*** (0.145)	-0.804*** (0.167)
Constant	1.811*** (0.373)	0.610* (0.346)
Observations	78	106
R-squared	0.612	0.801

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5.2: Results of the dynamic Taylor rule estimation before and after the appointment of Paul Volcker.

Source: author's calculations.

factor from the model to the FFR.

Moreover, the long-term real rate is probably below 2, especially since the financial crisis, and the inflation rate target has not been met for several years.

5.3.3 The Dynamic model and projections of the Federal Funds rate

Alan Greenspan was the Fed chairman during the longest recorded expansion in the US economy. This period is characterised by its macroeconomic stability, breakeven inflation remained very stable, the unemployment rate relatively low and the output less volatile. Although this success is partly due to good luck, it is also attributed to the Fed's monetary policy. The FOMC has responded well to the surge in inflation by tightening policy, but it has also managed to see productivity growth and not harm the economic expansion. In short, it has successfully managed the shocks. The Fed's policy regime during the Greenspan era is characterised by two points, a commitment to keep prices stable over the long term and a level of production around the trend over the short term, [Judd et al., 1998] and [Yellen, 2004]. This period is cited as a benchmark of successful monetary policy. Afterwards, it turns out that the Fed, in collaboration with the government, laid the foundations for the financial crisis, so all this has to be qualified.

The Taylor rule captures monetary policy movements relatively well during this

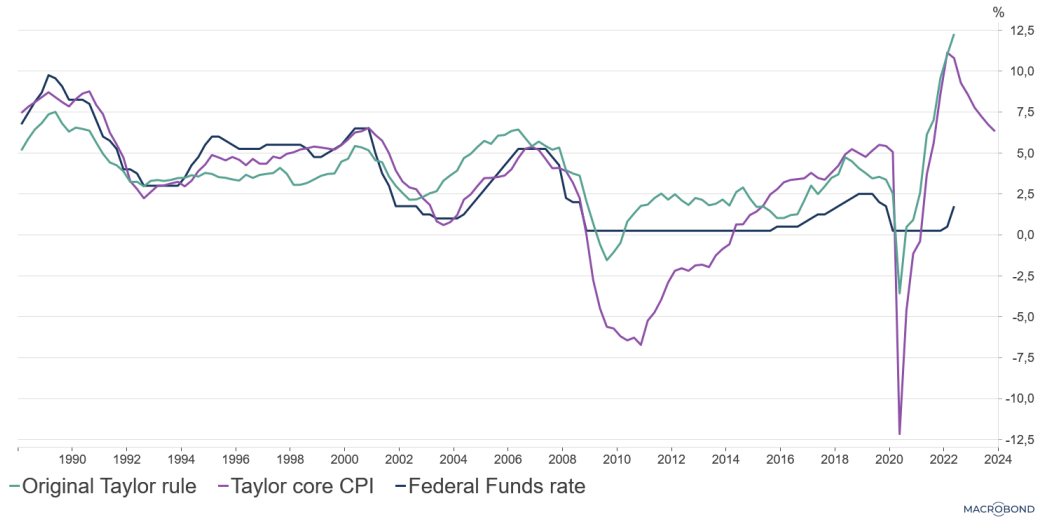


Figure 5.4: Federal funds rate plus original and dynamic Taylor rule recommendations for the US.

Source: Fed and author's calculations.

period. Since on top of that, the Fed's objectives have been met, this time frame will be used as a reference for the estimation of the dynamic model. The estimation sample therefore ranges from 1987:3 to 2005:4. The results are presented in the table 5.3, four alternative models has been estimated. The outcomes are quite similar for the four models, the Fed's response to inflation is greater than 1:1, thus in line with the Taylor principle. About the measure of the economic situation, models 1 and 2 consider the unemployment gap and they both return comparable coefficients. Models 3 and 4 uses instead the output gap, which displays a lower coefficient. Which confirms the fed's focus on the labour market. The R-squared of each model is relatively good but it is the core CPI inflation that best explains the policy rate changes.

Figure 5.4 shows the dynamic Taylor rule recommendations calculated on the basis of the previously estimated model 2. The findings are as follows, until the 2008 financial crisis, the Taylor rule tracks the policy rate particularly well. But of course, this changed when the latter reaches the zero lower bound. The rule recommended an important decrease in the rate as the labour market was performing quite badly. At that time, the monetary policy faced a rate shortfall. To overcome this problem, the Federal Reserve began to use unconventional monetary policies. It expanded its balance sheet by buying long-term securities in the secondary market, the purpose is to reduce borrowing costs for household and businesses by lowering long-term interest rates. The advantage is that operations targeting long-term rates have a much greater impact on the economy than an operation of similar size targeting short-term rates [Rudebusch et al., 2010]. This situation was repeated at the be-

VARIABLES	(1) FFR	(2) FFR	(3) FFR	(4) FFR
core PCE	1.680*** (0.126)		1.829*** (0.151)	
unempl. gap	-1.777*** (0.141)	-1.715*** (0.116)		
core CPI		1.591*** (0.0937)		1.864*** (0.0929)
output gap			1.022*** (0.102)	1.108*** (0.0698)
Constant	0.947*** (0.324)	0.234 (0.296)	1.042*** (0.377)	-0.0588 (0.282)
Observations	72	72	72	72
R-squared	0.804	0.864	0.734	0.878
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				
Estimation sample: 1987:3 - 2005:4				

Table 5.3: Results of the dynamic Taylor rule least square regressions for the US.
Source: author's calculations.

ginning of the COVID crisis. This justifies why the Fed has used its balance sheet to overcome the limitations of conventional monetary policies. In other words, this explains the increase in reserves, figure 2.4.

The recent episodes of zero lower bound have shown how difficult it can be to get out, even with quantitative easing. Therefore the risk of raising rates too fast could be to fall back to the zero bound, while the reverse course is more difficult and requires more QE. This could explain the timid rise in rates between 2015 and 2018, when the Taylor rule recommended a larger increase. This could also be an element that encouraged the FOMC to react slowly.

5.3.4 Residuals

Finally, it should be noted that the Taylor rule is just a guideline. An effective FOMC must be able to assess the risks of structural changes, poor economic conditions or any type of shock and act accordingly. In this perspective, the residuals of the estimated reaction function represent the modelling of these reactions to likely shocks. A large negative residuals may be a response to prevent potential financial instability, [Yellen, 2004].

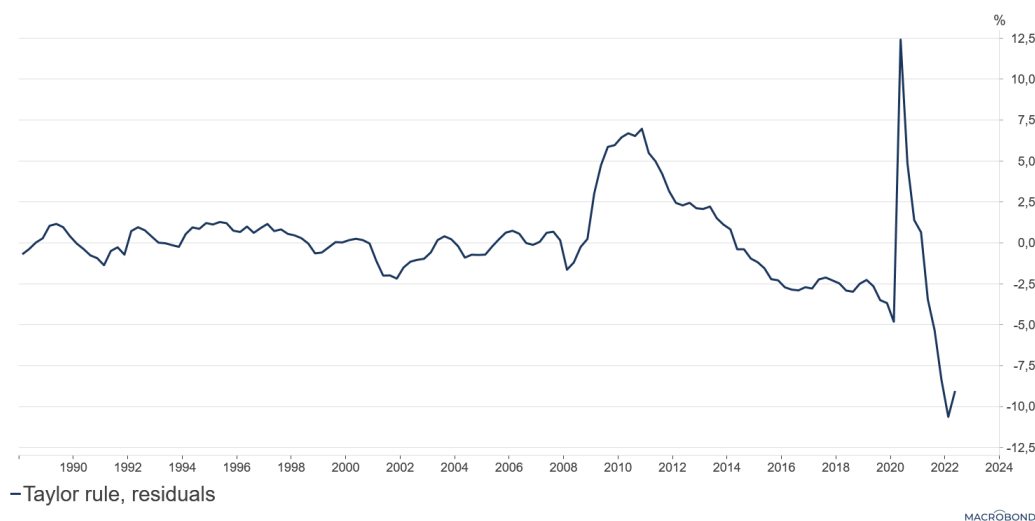


Figure 5.5: Residuals of the dynamic Taylor rule estimated with model 2 for the US.

Source: author's calculations.

Figures 5.5 and 5.6 show the residuals of the dynamic models estimated with the US and euro data. US monetary policy seems to have been more constrained by the zero lower bound, with more large positive residuals. However, last years, rates are often below the recommendations. The recent negative residuals would therefore be due to measures to ensure financial stability, which is in line with their forward-looking policy. The Fed does not want to surprise the financial markets, so as not to risk causing destabilising price adjustments, see section 3.1.1.

The same is true of European monetary policy, with negative residuals over the last few years. This could also mean taking into account potential instability in the financial markets. Another possibility is to take better account of the peripheral countries. Indeed a single monetary policy is not the most appropriate monetary system for economies with different characteristics. A closer look at the recommendations of the Taylor Rule for euro area members would provide a better understanding of the ECB's policy, or rather what it should be.



Figure 5.6: Residuals of the dynamic Taylor rule estimated with model 1 for the euro area.

Source: author's calculations.

Conclusion

Our primary remark, as usual in economics, is that this period of high inflation volatility is accompanied by many uncertainties. The roots of inflation, both in the US and in the euro area are still there. Supply chains have not yet fully recovered from pandemic-related downtime, especially with the Chinese government's zero COVID policy forcing factories to remain closed. Energy prices remain at high levels, especially gas prices in Europe, and prospects for future improvement are not yet visible and will highly depend on the length of the Russian war and its outcome. The fiscal stimulus is over, but its effects are still being felt in the US. Although these inflation factors should fall over time, predicting when is a difficult task.

In view of the many uncertainties facing the economy and in order not to provoke a panic reaction in the financial markets, the Federal Open Market Committee has announced a moderate rate hike path for its policy rate. They admit to being surprised by the magnitude of the inflation and its persistence but the Fed has locked itself into a policy position for 2022. Its cautious attitude towards the financial markets makes it in a way prisoners of its forward guidance policy. Nevertheless, this may well be the most appropriate stance to take. They still see inflation as a temporary phenomenon and inflation expectations continue to coincide with the official scenario, albeit on the rise. Though, this is completely different from what has been done in the past in the way of dealing with inflation and far from a Taylor-type rule.

At the start of the inflation crisis, the ECB chose to take a wait-and-see approach. This behaviour is justified by the fact that inflation in Europe is more imported than in the US. Moreover, the uncertainty about the evolution of the war in Ukraine is hitting Europe harder than the US. However, the latest announcements² made by the ECB suggest that it will take the necessary measures to combat inflation, i.e. increase its rates. However, the days when the bank was only concerned with price stability without regard to the economic health of its members seem to be over. Its President, Christine Lagarde, initially ruled out tightening monetary policy, arguing that the priority was to allow the European economy to return to its pre-pandemic level. Just like the Fed, the governor board affirms that the phenomenon is temporary, and the markets seem to agree with this statement. The difference with the

²<https://www.ecb.europa.eu/press/govcdec/mopo/html/index.en.html>

US is that the ECB has more freedom in its monetary policy decisions. In July 2022 it surprised by raising its rates by 50 basis point, it is 25 more than announced one month sooner. Yet it remains limited given the current inflation rate, a simple Taylor rule would recommend to raise the rates to at least 5.5%, see figure 5.3. For the euro area, it is more difficult to make comparisons with past policies. Indeed, this is the first time that the ECB has to really fight inflation. However, a Taylor rule estimated on the 2 decades of existence of the euro, allows to conclude that the response is soft.

On the side of intra-European divergences, the verdict of the ECB's dilemma is worrisome. The mere fact that the ECB could be constrained by fiscal considerations is a problem in itself. It is a bad signal to the markets and as they say, prevention is better than cure. In this respect, the long-term objective of future reforms must be to restore a sustainable budget, by improving productivity and competitiveness. Another way of improving the situation would be to set up a European fiscal policy with a budget that would no longer rely entirely on the member states. But that is another story. In the shorter term, although the fight against inflation remains the priority for the ECB, it remains cautious in its policy so as not to trigger more harmful effects. A rapid recovery is the best way to resolve the debt sustainability issue and to dispel any potential negative market sentiment.

Overall, are the central banks letting inflation run away? The current high level of inflation is not expected to last for years. At least this is the view that emerges from surveys on inflation expectations and the financial markets do not seem to think otherwise. Even the worst-case scenarios of central banks foresee a return to reasonable levels as early as 2024-25. Of course, the economy is never safe from further shocks. The scenarios put forward by central bankers are credible, in any case, so far they keep inflation expectations anchored. It should be noted, however, that the response in terms of monetary policy tightening is very slight.

This episode also highlights the functioning of the institutions and their shortcomings, especially in Europe. Will the euro system ever be able to overcome its youthful mistakes to pull all countries upwards. On another issue, the feasibility as well as the desirability of a return of inflation to 2% is also debated. [Bianchi and Melosi, 2019] mentions the possibility of inflate away debt in specific situations when public finances do not allow for the repayment of debt incurred during a large recession. This approach should not be ruled out in the future. These are all issues that are coming to the fore and deserve attention.

"L'Europe se fera dans les crises et elle sera la somme des solutions apportées à ces crises" Jean Monnet.

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