



DIPARTIMENTO DI ECONOMIA E FINANZA

Course in Economics and Business

Chair of Money and Banking

“Recent debates on inflation dynamics in developed countries:

End of inflation or new beginning?”

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*To my Parents,
The best part of me.
Thanks to be my safe harbour.*

*“There is only one point on which all advisers have agreed: We must whip inflation right now..
But I say to you with all sincerity that our inflation, our public enemy number one, will, unless whipped, destroy our country, our homes, our liberties, our property, and finally our national pride, as surely as any well-armed wartime enemy.”*
Gerald R. Ford (1974)

“If inflation is the genie, then deflation is the ogre that must be fought decisively.. We see rising risks of deflation, which could prove disastrous for the recovery”
Christine Lagarde (2020)

INTRODUCTION

Since the beginning of last century, inflation has dominated newspapers and the minds of the public. Indeed, in some ways, little seems to have changed over the past 100 years. Price increases of products greatly colorize the perception of the economy. Nonetheless, starting from the second half of the XX century onwards, inflation's outlook has definitely changed: from "*public enemy number one*" (President Ford, 1974) inflation now appears as a valuable ally to boost a recession-plagued economy. Indeed, over the last two decades, developed countries have faced low inflation regardless of the macroeconomic stance and fiscal and monetary policies applied to boost the economy and of employment gains. This has led economists to talk about an "end of inflation", which could be the beginning of something malevolent: consumers could lose the wherewithal to buy, causing prices to decline, and businesses could slow production and accelerate layoffs, further weakening demand. In a reflection of evaporating demand from consumers and businesses due to tough lockdown measures imposed by governments to limit the spread of the virus, the Coronavirus pandemic has sunk the world into the deepest recession for almost a century. In this perspective, a large part of economists sustains that global recession triggered by the coronavirus pandemic could lead to a damaging deflationary spiral, definitely determining an ending of inflation.

Notwithstanding, the stimulative monetary and fiscal policies applied in response of both the Global Financial Crisis and the actual coronavirus pandemic, bring forth fears that a dangerous inflation could awake.

Analyzing the interesting but unforeseen inflation pattern of the last half century and the consequent debate on the future trend of inflation is the objective of this thesis. The research is divided in two main chapters which explore inflation dynamics over the past twenty years focusing on inflation trend in United States and the Eurozone too. Indeed, will be illustrated that the unexpected inflation pattern concerns both areas.

Chapter 1: "Recent debates on inflation" gives an introductory framework of the volatile path of inflation over the last 100 years in order to understand the reasons behind the widespread expressions "*dead*", "*dormant*" and "*well-awake*" inflation. Indeed, understanding what encouraged the diffusion of such expressions is essential to better comprehend the recent debates on inflation. Chapter 1 examines the shift in inflation landscape and its related causes. Finally, the implications of a possible end of inflation are investigated in the light of the impact of the Coronavirus Pandemic on the global economy.

Chapter 2: “Understanding the inflation dynamics in the light of the Phillips curve” aims at describing inflation trend combined with falling unemployment in the USA and the Eurozone, in the light of the Phillips Curve. Actually, the recent evolution of inflation, which has not risen even though job rates have, has challenged the most famous inverse relationship between inflation and unemployment, namely the Phillips Curve. If the connection between labor demand pressure and inflation has weakened, monetary policy becomes less powerful and the reverse is also true. Indeed, a revival of inflation boils down in case of a flat Phillips curve. In light of the relevance that the Phillips curve has as a reliable indicator of demand pressure, Chapter 2 focuses on this inverse relationship between prices and unemployment. Specifically, Chapter 2 looks into the causes of the flattening of the curve and evaluates the prospect of a “death” of the curve. Although a new consensus has emerged that the Phillips Curve has “broken down”, there are also indications of a persistent relationship between labor demand pressure and inflation. For this purpose, in Chapter 2 evidence of a “well alive” Phillips Curve at state and international level is presented. The last paragraph of Chapter 2 focuses on the idea that inflation expectations when included in the inflation pattern analysis render the Phillips curve a reliable and appropriate economic indicator of demand pressure. In this respect, it is finally laid out a new model that may better account for this unforeseen inflation trend.

The main conclusions emerging from this research may be summarized as follows: an abrupt and persistent decline of inflation rates in developed countries and a flattening of the Phillips curve are facts but whether these trends have brought to an “end” of inflation is far from being clear. In the light of the severe shock to the global economy caused by the Coronavirus Pandemic and the uncertain economic consequences, this research work lies at the centre of the inflation debate and highlights that a valid reasoning about future inflation trends is not contained in a single analysis or a single approach but both sides of the debate are based on valid arguments.

Chapter 1

Inflation dynamics in developed countries: recent trends and their determinants

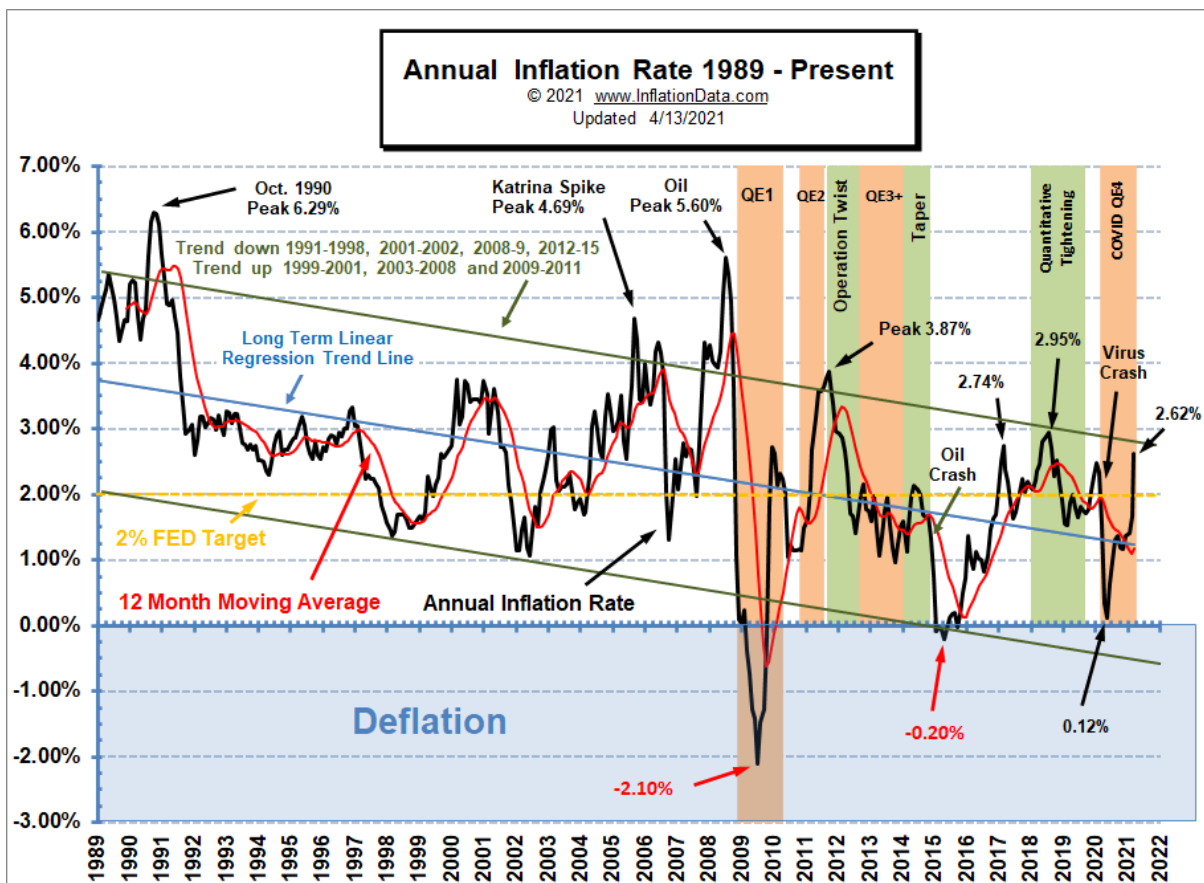
1.1 The end of inflation

Declared to be “*as violent as a mugger, as frightening as an armed robber and as deadly as a hit man*” by Ronald Reagan, who presided during a time of relatively high inflation, inflation used to represent the bane of American presidents and the scourge of the world economy. Given the frustrating stagflation, namely high inflation and high unemployment, in the 1970s, and the subsequent double-digit inflation in the 1980s, inflation became an imperative issue of policymakers who developed a deep-seated fear of it. Governments pulled out all the stops to struggle against runaway prices and the consequent decline in the purchase value of their respective currencies.

Indeed, high inflation distorts the economy, partly because taxes are imperfectly adjusted for inflation and partly because purchasing power over time for recipients and payers of fixed interest rates is distorted, with borrowers of fixed-rate mortgages better off and lenders’ real income suffering.

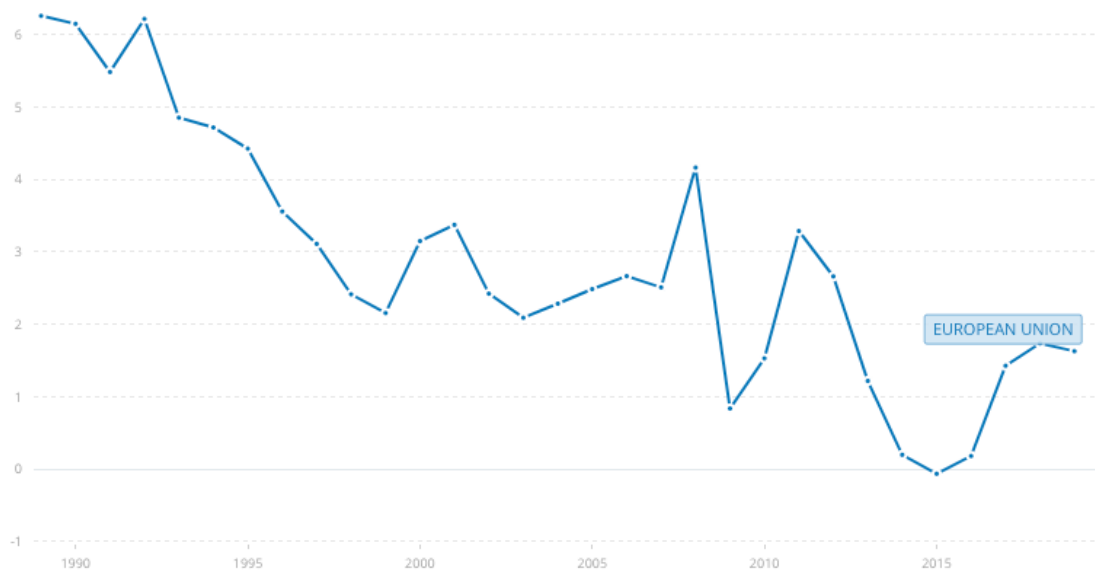
However, since the 1990s, there has been a shift in the inflation landscape in many developed countries including the USA and western European countries. Inflation from a “*mugger*” became a “*stealth pickpocket*”, a phenomenon easy to control, and nowadays is considered outright a “*useful yeast*” for economic growth. Most economies no longer struggle with runaway prices and low inflation is now the international norm. As the inflation chart for United States (Figure 1.1) and Eurozone (Figure 1.2) from 1989 plots, the long-term trend of inflation is falling. Indeed, for United States the peaks at 6.29% in October of 1990 and at 5.60% in July 2008 are followed by successively lower peaks. Figure 1 also shows that the highest inflation value from 2000 to the time being, 5.60% in 2008, is immediately followed by the lowest inflation value, -2.10% in 2009. The reason for this pattern is that high inflation is often a prelude of a recession. In fact, high inflation reflects and a booming economy but at some points the party balloon will burst. Eventually liquidity will contract, inflation will fall and a recession will follow. This explains the recession of 2009-2011 and 2001-2003 too and the consequent sharp reduction of inflation rate in the same period.

Figure 1.1: Annual inflation rate 1989-2021, United States



Source: InflationData.com

Figure 1.2: Annual inflation rate 1989-2019, Eurozone



Source: The World Bank Data

Figure 1.2 shows inflation rates in the Eurozone from 1989 to 2019. Even if it is not displayed in the inflation chart, subsequently to the Coronavirus Crash in the 2020 inflation rates in the Eurozone, like in United States, sharply declined. From mid-2021 inflation rates started to rise. For the Eurozone the highest inflation values are in 1992 with a rate of 6.22% and in 2008 with a rate of 4.17%. As for united states highest inflation peaks are followed by lower inflation peaks, in Europe the value of 6.33% in 2008 is followed by the very low rate of 0.84% in 2009. More in general, Figure 1.1 and Figure 1.2 highlights a key concept: inflation pattern in the euro area and in United States is highly similar. This ultimately reveals that global forces have influenced domestic inflation. For instance, a factor that has remarkably influenced global inflation is oil prices. Between 2003 and 2008, oil prices more than doubled, and this provided an upward pressure on both euro area and US inflation. The similar pattern is also apparent by looking at the high rates in mid-2008 (4.0% in the euro area and more than 5.5% in the United States), which fell sharply to reach negative values by mid-2009 (-0.6% in the euro area and around -2% in the United States).

The problem with this “*modern experience*” of inflation, common to both United States and Eurozone, is not only that inflation is down, but that it is ‘out for the count’: it has been definitively beaten. Governments have judged inflation to be so low as to set inflation targets. The International Monetary Fund (IMF) counts among its members 43 countries in which monetary-policy targets inflation. Notwithstanding, the inflation-targeting world is an “inflation laggard” on this measure since more than a decade of interest rates at rock-bottom has not changed the inflation pattern. Nor

has massive printing of money of America, the Eurozone, Britain and Japan which has expanded their balance-sheets beyond 35% of their combined GDP. Focusing on the chart over the last twenty years, it can be seen that the Federal Reserve (FED) hit the target a total of 6 times out of 300 data points. The Central bank has crossed the target less than 8% of the times and this has undermined the conviction that the FED can effectively control inflation, bringing forth the idea of an end of inflation. The change in the inflation pattern reflects both the effectiveness of economic policy. It is true that the advent of inflation-targeting central banks since the 1990s has been able to gradually immunize economies against runaway prices. Nevertheless, policymakers seem unable to stop inflation falling short of their targets. Another surprising aspect of this *structurally low* inflation of the last twenty years is that unemployment rates have been the lowest for decades. Generally, rises and falls in unemployment matches fairly well with upswings and downswings in the overall economy. Typically, periods of high unemployment reflect times economic growth which, in turn, causes a rise in prices¹.

Nonetheless, in the last twenty years, along with low rates of inflation, unemployment rates have been very low too. Figure 1.3 and Figure 1.4 depict unemployment trend in United States and Eurozone.

¹ This inverse relationship is further deepened in Chapter 2.

Figure 1.3: Unemployment rate from 2001 to 2021, United States

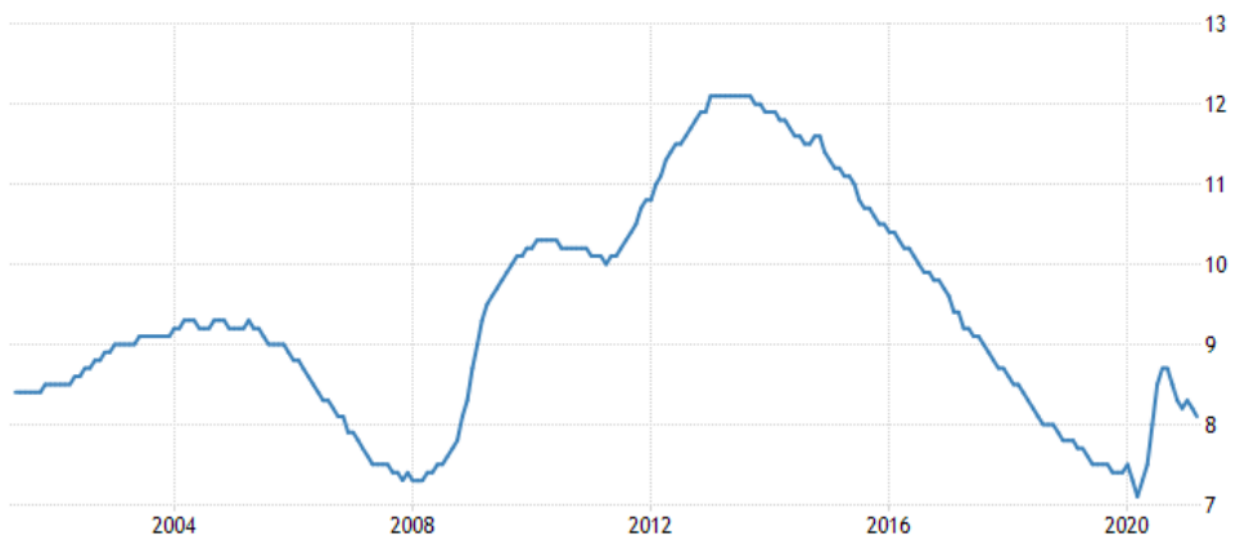
Civilian unemployment rate, seasonally adjusted

Click and drag within the chart to zoom in on time periods



Source: U.S Bureau of Labor Statistics.

Figure 1.4: Unemployment rate from 2001 to 2021, Eurozone

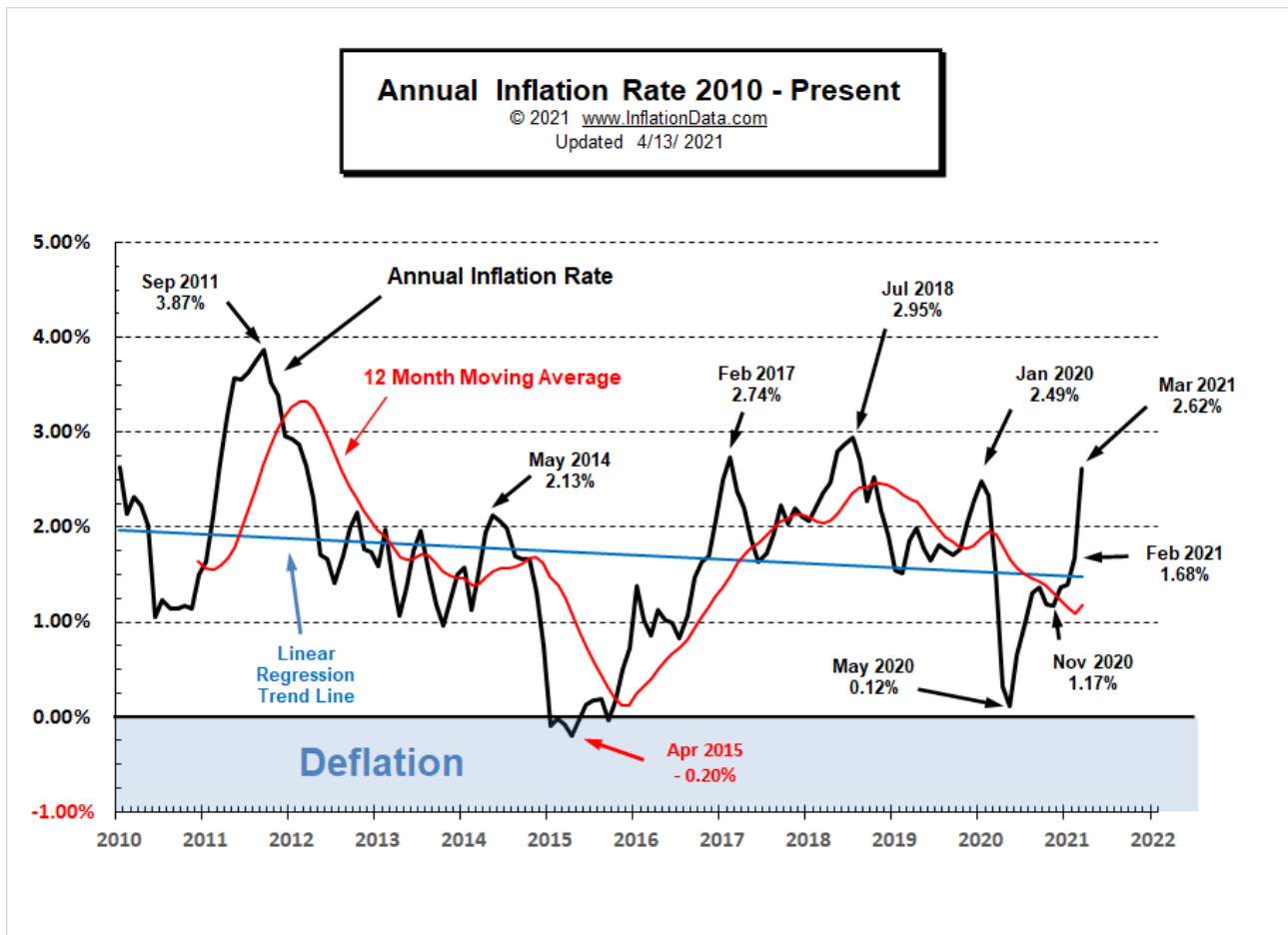


Source: *TradingEconomics.com, Eurostat.*

As shown in the charts above, apart from period of recessions, prior to Coronavirus pandemic unemployment levels were extraordinarily good in both United States and Eurozone (a rate of 3.5% for United States and -0.7% for Eurozone). The COVID worldwide spike took unemployment to unprecedented levels: people have been told not to produce and as the supply side halted, a correspondingly deficiency in demand has resulted. The global economy has experienced a global sudden arrest and this has given economists and investors powerful reason to think that inflation is definitely dead.

However interesting and unquestionable inflation pattern in the last twenty years is, many sceptics remain unconvinced that the inflation relationships have fundamentally changed. Indeed, on the one hand it is possible that the resulting recession will be deeper than the one experienced during the global financial crisis of 2008 and this would be consistent with the persistent view of a lack of inflation around the world. On the other hand, it is also possible that inflation will rise after the pandemic as a result of policies undertaken to spur the economy. In Figure 1.5, which depicts inflation in a shorter-term (since 2010) in United States, it can be seen that despite the longer-term downward inflation channel, inflation is beginning to spike.

Figure 1.5: Annual inflation Rate from 2010 to 2021, United States



Source: *InflationData.com*

In 2020, the Federal Reserve created a massive stimulus through Quantitative Easing (QE) by purchasing securities due to fears of the Coronavirus and falling oil prices early in the year. In 2021 without deflationary pressures the Congress continued to push for more stimulus and finally inflationary forces seem to be building. Historically, the Fed starts to rise its fund rates if inflation climbs toward 3% but clearly, the unusual nature of the current economic crisis, prevents the central bank from taking any tightening monetary policy. The increase in annual inflation rates from the first months of 2020 to the first months of 2021 has been from 1.36% to 1.40%.

In the US, the annual inflation rate from 2.6% in March climbed to 4.2% in April of 2021. The month-to-month gain, which is the highest since 1981, was 0.8%, against the expected 0.2%. A similar rise-up in inflation rates can be sought in the Eurozone as shown in the chart below (Figure 1.6).

Figure 1.6: Annual inflation Rate from 2010 to 2021, Eurozone



Source: *TradingEconomics.com, Eurostat.*

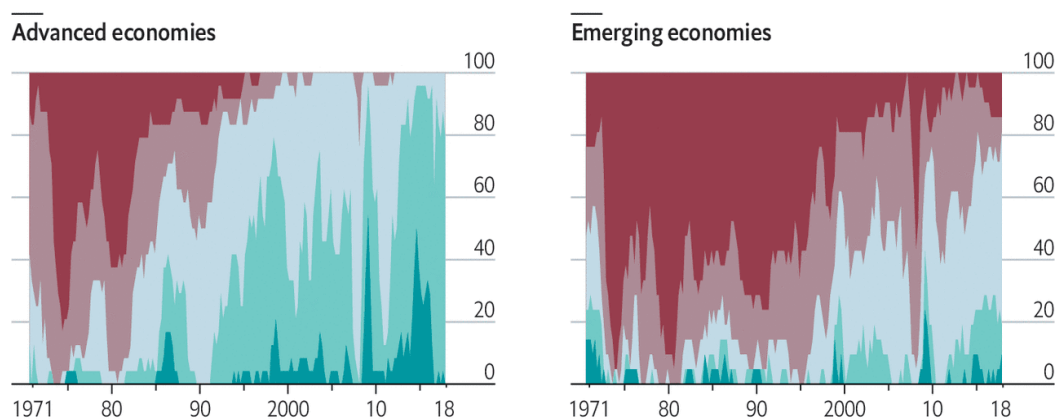
Figure 1.6 show that despite the longer-term downward inflation channel, in the Eurozone, like in United States, inflation is beginning to rise. Focusing on the very recent period, in the Euro Area annual inflation has increased from 0.6% in April 2020 to 1.6% in April 2021, which is the highest since April 2020. As previously discussed in the Chapter, many similarities can be envisaged between the inflation pattern in Eurozone and in United States. The coronavirus pandemic dented economic activity bringing the inflation rate to 0.3% in April 2020 for United States and 0.6% for Eurozone. However, as the inflation rising trend from mid-2020 indicates, a potential revival of production and demand which will eventually outstrip supply must be taken in consideration. In this regard, some economists believe that in the speed up of prices sow the seeds that bring the era of low inflation to a close.

The pandemic will impact distort comparisons between annual inflation rates for at least other few months. For this reason, Federal Open Market Committee has decided to make no changes in its approach, keeping short-term interest rates anchored near zero as it buys at least \$120 billion of bonds each month. The European Central Bank warned that inflation that it may even exceed the central bank of 2% target by the end of the year, but, clearly, the recent spikes may be due to only temporary factors. Clearly the uncertainty of the historical period makes economists far from predicting the evolution of inflation and thus the Federal Reserve (FED) and European Central Bank (ECB) are dismissing the current round of numbers as transitory.

1.2 What caused inflation to fall over the past twenty years

Economist often claim that economic affairs are a mixture of the immutable and the ever-changing. According to the dominant school of thinking, inflation is the fruit of the *immutable* laws of supply and demand and in the realm of the *ever-changing*. Notably, inflation rates have synchronized not only across developed economies but also across developed and emerging markets. Figure 1.7 shows that in the last twenty year the share of advanced economies with an inflation rate below 2% and even below 0 has dramatically increased. From the chart it is emblematic that the extremely of level of inflation that advanced countries are experiencing is the apogee of a trend. In emerging economies inflation is higher, but still it has changed its course in a downstream direction.

Figure 1.7: Shift in inflation landscape

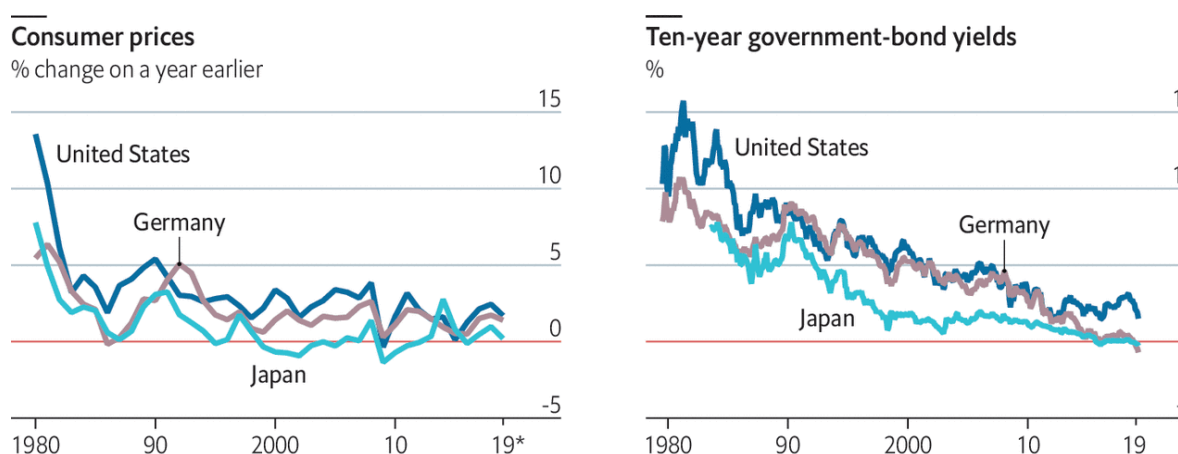


Source. World Bank

This suggests that global factors have played a role in influencing inflation trend. First, commodity prices all around the world have been directed by the boom and busts in emerging markets' demand. Second, globalization has meant an overall reduction of manufactured goods' prices. Indeed, if firms can locate their production chain in countries where cost are lower, they will consequently charge a lower price, speeding up competition. As a result, prices going down reflect downside risks for inflation and only if costs rise everywhere, inflation becomes inevitable. As it can be seen from the

chart below (Figure 1.8), consumer prices for developed countries have generally decreased and the same holds for ten-year government bond-yields. Interest rates both in the short and long run have been driven down, reflecting an excess savings that spill over countries. For this reason, economist identified the flow of capital as another global factor contributing to lowering inflation rates.

Figure 1.8: Consumer prices and ten-year Government bond yields



Sources: Haver Analytics

Central banks can, in principle, adjust interest rates by adopting the adequate monetary policy but if interest rates are already close to zero, cutting interest rates has a very limited scope. For this reason, nonconventional monetary policies have been adopted but these are themselves policies with global effects. Indeed, as the global financial Crisis of 2008 has shown, banks are strongly interconnected and the global banking network causes an adjustment to a bank’s balance-sheet to be reflected in the balance sheets of other banks elsewhere. And the worst of the nonconventional monetary polices adopted to fight deflation is that they have brought the desired result: inflation rates have not risen and when inflation targets are not credible people spend less, preventing inflationary pressures from arising. The shift in inflation landscape is the result of an interaction between the factors of economic nature and factors of economic policy.² On the one hand the sharp drop in the inflation rate is the reflection of economic scenario which has significantly changed in the last twenty years. For instance, the advent of ecommerce and the low-cost labor supplied by dynamic countries, especially China, do

² This distinction among the factors that could have led to “an end of inflation” is set out by Roger Bootle in “The death of inflation”, World Economic Affairs (1997).

limit price increases. On the other hand, inflation-targeting central banks have repeatedly proved wrong and this leads to consider the problems posed by the macroeconomic management.

Factors of economic nature

Factors have been recognized as elements that may have curbed inflation: the success in technology, changes in labor market, decline of trade unions, consumers' increasing price sensitivity and ageing population.

Innovations in technology, such as the rise in ecommerce and the contrasts between online and traditional retail pricing behavior have indeed changed the patterns of commerce for millions of consumers and businesses. In fact, they have provided greater price transparency and more competition for local businesses thereby limiting price increases. Competition from dynamic countries, principally China, operating with much lower cost bases has also brought competitive pressure to bear on western producers. The emergence of China as a major exporting power has created a new source of goods and services at astonishingly cheap prices, triggering a constant stream of price reductions. Low-cost labour migration due to developing countries' competition, flexibility of labour, and collapse of trade union power have prevented inflationary pressures and kept down wages, lowering therefore the demand for goods of which there is large supply. Still on demand side economic researchers mention ageing population as a factor affecting inflation pattern. In developed countries population is composed at a higher percentage by elderly who, on average, have a lower propensity to consume than younger people and this is clearly at odds with any inflationary forces. Consumers' price sensitivity has also increased. This has arisen partly because of the pressures that consumers are under in their role as wage earners, and partly as a reaction to low inflation itself. The result is to force firms to offer value to customers and to concentrate on getting high volumes rather than high margins.

The flow of goods and capital across borders has been no less significant in restraining inflation. As inflation-targeting lifted off in the 1990s, globalization also accelerated. Trade has grown from 39% of world gdp in 1990 to 60.27% in 2019, liberalization of financial services enhanced the integration of financial markets and the internet ripped the cost of communicating³. Global factors such as global value chains, commodity prices, exchange rates, and world slack are significant drivers of Consumer

³ European Central Bank, "The economic implication of rising protectionism: a euro area and global perspective", 2019

Price Index and in fact this inflation indicator has become more synchronized around the world since the 2008 crisis.

As is often the case with complex changes in economic relationships, determining causality is extremely difficult. All the factors above mentioned may have simultaneously played a role but what inflation pattern of the last half century has undoubtedly brought out is the inadequacy of traditional economic models, among which the Phillips Curve, landmark of central banks, is on this regard discussed in the second chapter.

Factors of economic policy

This shift in the inflation landscape reflects both the successes and the failures of economic policy. Inflation targeting has increased economic stability, allowing to protect the economy from runaway prices and this clearly represent a success for policymakers. Nonetheless, non-conventional monetary policies have proved to be not sufficient to stop inflation falling short of the target. Inflation below target reveals deficiencies in the macroeconomic management. Firstly, it represents a missed opportunity. Monetary policy could have been looser, and the economy could have grown faster without strong price pressures. Second, inflation remaining below the target impairs central banks' credibility. Central banks have repeatedly proved wrong and when they are not credible, the future is more likely to spring a costly surprise. In this respect, many economists argue that inflation targeting is a victim of its own success. Indeed, Christian Gillitzer and John Simon (2015) document that inflation behavior has changed in the last twenty years as Central banks, by setting targets, have created long-term inflation expectations firmly anchored at low levels. This has ultimately caused a substantial reduction in the variability of prices directly affected by monetary policy and, hence, in the influence on inflation trend. Indeed, anchored inflation expectations have undeniably played a key role in the inflation-disinflation cycle that has characterized last decades. The course of the economy is fairly influenced by the sentiment of the public and its perception of future inflation. As individuals interact, they influence each other and they create waves of optimism and pessimism emerge, undermining the effectiveness of monetary policies. One of the main reasons why central bank have failed to hit their inflation target is that they failed to "anchor" inflation expectations at roughly 2%. Indeed, because the FED and the ECB have fallen short of their 2% inflation target despite the massive injection of money into the economy, their monetary policies appear little effective. People, skeptical of a rise in inflation levels, have started to get used to low inflation and this is itself helping to keep inflation down.

1.3 Implications of low inflation

Excessively-low inflation poses several dangers. Emblematically, low inflation is a self-reinforcing phenomenon. The public cares about real rather than nominal interest rate and when it expects lower inflation, the real rate rises, weakening demand and pushing inflation down even more. This constraint on monetary policy means that if low inflation persists over the longer term, there is limited scope for avoiding deflation. In other words, in a scenario of persistent low inflation, even a small shock can lead to deflation.

Should the end of inflation be followed by a period of deflation, then the macroeconomic implications are well known. First, the expectation of falling prices delays purchases and investment. Second, a drop in production combined with downwardly rigid nominal wages negatively affects businesses and the demand for labour. Third, deflation means that the repayment of debts becomes harder. Talking about deflation could be too drastic, but even without deflation there are substantial macroeconomic costs that inrush the inflation objective.

The main problem posed by excessively-low is that beneficial macroeconomic adjustments may be hindered. Wages can become sticky. This stickiness is deep-rooted and impedes wages' adjustments to the downside. As a result, in case of an insufficiently positive inflation rate, there is a greater likelihood that a negative area-wide shock will generate higher unemployment rather than a steady adjustment in real wages. In addition, asymmetric shocks in different States means that low inflation is likely to complicate competitiveness adjustments in a monetary union⁴.

Most importantly if low real interest rates are combined with a persistent failure of the inflation objective, monetary policy becomes less effective to contrast future negative shock. Indeed, as already mentioned, the public cares about the real interest rate and this constitutes a problem given the lower bound on interest rates and the option of holding cash at a zero nominal return.

In practice, central banks have demonstrated that the effective lower bound for the policy interest rate is not zero but it is in a negative area. However, the central banks cannot lower policy rates without

⁴ The risks of deflation and excessively low inflation as described above are taken from the speech "Low inflation: macroeconomic risks and the monetary policy stance" by Philip R. Lane, Berlin (11/02/2020).

limit and the exact value of the lower bound is varies over time. For this reason an inflation is below target represents a serious challenge for policy makers. Furthermore, there could even be a reversal rate of interest, below which decreases in the interest rates will not be expansionary. The decline in the steady-state real interest rate is a pressing challenge because inflation expectations will be corroded and a persistent fall in inflation expectations itself further reduces the available policy space through the associated downward pressure on the yield curve. The fact that inflation presents self-reinforcing dynamics undermines interventions of central banks to meet the target. For this reason, central banks must be persistent in responding to prolonged inflation undershoots.

1.4 Deflation or inflation threat after the Covid 19 pandemics?

As exposed in the previous paragraph, there are several reasons to explain why inflation has been so low and has not picked up although unemployment has fallen and central banks have pulled out all necessary policies to reboot the economy. Even if there is a general agreement among economists on this analysis, there are divergent views concerning what will happen in the future especially considering the likely consequences of the monetary policy implemented in response to the actual economic crisis.

There are, indeed, economists who think that inflation is dead: the absence of a recovery after the non-conventional policies adopted by Central Bank and the printing of money to spur the economy indicate a death of inflation, to whom the coronavirus pandemic has given the final stroke. Nonetheless, other economists argue that before the pandemic the economy had slowly started to recover, especially in United States where in 2019 appeared inflationary monetary movements, and that once the pandemic is under control, a big bounce-back in the financial market, in aggregate demand and output is to be envisaged. In this paragraph, evidence for both sides is documented.

A HYBERNATING INFLATION

With Coronavirus-pandemic the world economy has experienced an output fall and unemployment rates comparable to those of the Great Depression. An exceptional feature of the coronavirus-related slump is that the crisis is mainly due to a supply side shock rather than a fall in aggregate demand. Nonetheless, governments have reacted as if the latter was a consequence of the former and consequently their efforts have been to support spending. Notably in US, the aviation sector has received \$50 billion package of grants and loans and the immediate fiscal impulse amounted to \$1940 billion, of which nearly \$600 billion in direct payments, \$349 in Federally guaranteed loans to small businesses and \$117 billion for hospitals and veterans. On the European front, Germany, French, Italy and Spain have implemented relatively similar packages. Germany's immediate fiscal impulse (from

March to June) was of \$284.4 billion, of which \$100 billion to recapitalize and buy stakes in companies affected by coronavirus; France's immediate fiscal impulse (from March to October 2020) was of about \$124 billion, Italy's fiscal measures (from March to May) were of nearly \$61.3 billion, of which \$35.4 billion for keeping people employed and supporting the unemployed⁵. In a similar vein Central Banks have reacted promptly to support Governments, to help finance budget deficits, and the banking sector, to support asset expansion. Remarkably, central banks' response to the current crisis is in sharp contrast to the global Financial Crisis of 2008 in that they have encouraged banks to lend, limiting bad debt provision and relaxing bank capital requirements. Economists who have faith in a high peach of inflation point out that the just mentioned policy reactions to Covid-19 pandemic will produce massive budget deficits which will be monetised and such monetisation combined with official support for emergency bank lending to cash-strained corporate will lead to a surprisingly high growth rates of quantity of money which will ultimately instigate an inflationary boom. The theoretical framework adopted is the Quantity Theory of Money which relates trends in money to changes in nominal GDP and inflation in the medium and in the long run.

Juan Castenada, director of the Institute of International Monetary Research in 2016, and Tim Codgon, economist and businessman, masterly illustrate in their research *"Inflation: next threat?"* (2020) that incorporating changes in the amount of money in the analysis of inflationary pressures provides grounds to believe that inflation targets will most likely be exceeded. The main point is that the impressive volume of their fund-raising will make companies in a better financial position to undertake capacity expansion and long-term investment projects. A boost in the aggregate investment will result in an increase in employment and household wealth will be helped by the upswing in the stock market. Money growth will bring gains in share prices, which will spill out into residential and commercial real estate. Hence the authors predict, that at the end of 2021 or 2022 there will be an inflationary boom, whose size will depend on the rate of growth of money in coming months and the level of unemployment and spare capacity due to lockdowns.

The prediction of an inflationary boom as a consequence of an upsurge in money growth leads back to a debate regarding which model central banks should use when making monetary policy decisions. Indeed, the most common model used by central banks is the New Keynesian model, in which the rate of inflation depends on the output gap, difference between the actual output and the output that could be achieved when the economy operates at full capacity, and the latter depends on the expected gap and the central bank discount rate, which is set in response to inflation pressure and an estimation of the output gap⁶. In this model, money does not affect price level of goods and services and does

⁵ "The fiscal response to the economic fallout from Coronavirus", Bruegel Dataset (2020).

⁶ New Keynesian model is illustrated in the Appendix, see Appendix Table

not determine national wealth as the role played by the banking system is overlooked. Thereby the adoption of quantitative easing, a nonconventional monetary policy that impacts on the quantity of money, would be worthless in the New Keynesian framework. On the contrary, Castenada and Codgon (2020) argue that in United States M3 broad money grew by 4% a year and the rate at which nominal GDP increased was almost the same: this result could have been predicted as a consequence of the stability at a low but positive rate of money growth. It may be drawn the conclusion that the answer to whether the end of inflation has been reached depends on the lenses through which inflation is seen, that is the model adopted. Certainly, choosing a different framework has always the underlying possibility of leading to a reverse result, but ideas of a coming inflation revival have been also grounded on dynamics that prescind from economic models. Such belief seizes on the forecasted rise in consumption, China's demographic trend of aging population and predictions that an era of deglobalization is on the verge, as it is explored hereafter.

At Central Banks, the majority of directors and economists, before Coronavirus emergency claimed that the shocks we were experiencing were temporary. They have advocated an upturn of the global economy, which would adapt to the new situation and once the new factors that shocked the economy would be absorbed, inflation would gradually meet the target of 2%. Relying on this analysis, Central Banks should not take up any non-conventional policy to contrast the crisis and boost the economy but they should just wait that market forces operate.

Likewise, the Coronavirus crisis, despite the increased unemployment and the abrupt decline of goods and services consumption, seems to not shoot down the idea that inflation is alive and will soon reach the target of 2% and, perhaps, be a *mugger* again.

Although inflation expectations are low according to all indicators, the brusque drop in business activities during the lockdown gives way to think that there could be a sharp recovery in the components most severely affected by the pandemic of Coronavirus and correspondingly serious risks of short-term inflation. Certainly, during the pandemic, there has been a marked dispersion among inflation components: demand for food and pandemic-related products such as preventive medical supplies, household cleaning supplies and healthcare products surged in many countries whereas services sector activity has been severely curtailed by the intense containment measures, especially in the transport, tourism and travel-related sector.

While demand for food and health-care products will probably keep on the same level, the others could quickly retrieve, ideally by exceeding expectations, once the health emergency will be left behind. Consumers may become less sensitive to prices when they are allowed to recover activities they could not do during lockdowns. Furthermore, even if consumption of pharmaceutical products has reached levels much higher than usual, people's precautionary motives to save during the

pandemic could turn into incentives to consume in the future. Indeed, across US commercial banks there has been a \$3 trillion of domestic growth, reflecting a pullback in spending which is combined with federal spending that, in the aggregate at least, offset the loss of income from job losses.

Clearly, since consumption has actually declined, even if everybody starts spending at once, the result could be that the economy will just achieve the pre-pandemic levels, but it may also happen that an upsurge will occur such that inflation will enter into a high long-run trend. This could represent an end of inflation hibernation.

In the end, it cannot be ruled out the hypothesis that a shift in the pattern of the last few decades is underway, especially if the long run economic aspects of Chinese policies are taken in consideration. Although China still lags far behind developed countries in terms of social development, standard of living and equality of rights, China's role in the world is that of an economic and technological superpower. Precisely, China's integration into the global economy, the rise of information technology that allowed Western companies to tap labor in developing countries, the economic integration of the former Soviet bloc with Western Europe all contributed to diminish the bargaining power of workers, holding down wage inflation. But now the tides could be reversing. Wages are rising rapidly in China given that its economy has become more advanced and given its worrisome demographic trend of an aging population because of the lagged effect of the bleak "one-child" policy. Limiting the number of children couples, indeed, has the long-term effect that the country contracts the size of its population. As the Chinese Academy of Social Science has recognized, China's "one child" policy may have achieved its original aim of slowing population growth. China's decline in working-age population could lead to a decline in the number of workers and slow consumer spending, impacting the global economy. Given that the world is reliant on China to produce key goods at low prices, if this relationship ends then inflation may follow.

Furthermore the demographic in advanced nations also suggests slow growth or a shrinking work force over the coming years, which, all else being equal, would mean less workers and a consequent more upward pressure on wages, as Charles Goodhart, a leading British economist, and Manoj Pradhan, the founder of the macroeconomic research firm "Talking Heads Macro", argue. The two economists examine megatrends in demographics and globalization reshaping societies and economies and point out that population ageing will lower saving rates, increase real wages, and raise inflationary pressures. Eventually, high inflation will represent a fundamental constraint to monetary policy. Goodhart and Pradhan (2020) postulate three reasons why a reversal of trend should be expected once the Pandemic will be under control. First, a global ageing population will result in an increase in medical costs and, especially, care for the aged. In parallel, as pensioners are people who consume but do not produce, they will outweigh the "dependent workers", who consume less than

they produce, contrasting the deflationary forces and leading to inflationary pressures. This phenomenon is labelled as a decline in the “dependency ratio”. Such decline, by reducing the share of productive labour in the global population, will bring about labour shortages and a rise in the bargaining power of labour relative to capital. This will raise real wages and prices. Goodhart and Pradhan’s results are in line with the finding of Juselius and Takats (2018) who provide a comprehensive analysis of the relationship between inflation and the population age structure for a panel of 22 advanced economies from 1870 to 2016. However, it is important to highlight that there is a lot of uncertainty around the turn of the events and even the authors of “*The Great Demographic Reversal*” warn a shrinking labour supply will result in firms substituting workforce with robotics. The third reason provided by Goodhart and Pradhan for a revival of inflation is that a change in the balance between savings and investment in national economies, that is a consumption greater savings, will be reflected in the rise of the interest rate, especially towards the long end of the yield curve, on, for example, ten-year sovereign bonds and other financial instruments.

In this light, Coronavirus crisis may speed up a transition that may have been foreshadowed.

As Insight Investment, one of the largest global asset management companies, notices, an era of deglobalization could have begun too. The rapid breakdown of global supply chains that has occurred is leading corporations to question their own production models. All the advantages of a globalized supply-chain, higher efficiency and lower cost being the most relevant, have been shown to be highly vulnerable to shocks. The coronavirus may well prove more effective in galvanizing a change in corporate strategies than tools to incentivize corporations to prioritize domestic production have ever done. Needless to say, globalization has represented a milestone of the last century and an era of deglobalization may also signify taking a step back for the world. Notwithstanding, discussing the significance of such phenomenon is outside the scope of this thesis but we focus on the presumably inflation implications. What concerns our research is that in the event supply chains shorten, the labour costs involved in domestic production will be higher and there will be a need to maintain higher inventories and an allocation of resources where the primary driving factor will no longer be lowest production cost. Any combination of these factors is likely to be inflationary, implying prices rising and central banks ultimately forced to worry about inflation that is too high rather than too low. In any case we cannot know when the recovery starts and, even harder, we cannot predict whether there will be a monetary overhang, which feeds into surging demand for goods and into investments triggering a sharp increase in prices, or whether there will be a surge in liquidity, a demographic reversal or an era of deglobalization.

CORONAVIRUS’ S FINAL STROKE

Since the impacts of implemented monetary policies are yet unknown, they may provoke a wave of future inflation but they may equally trigger even greater problems of low inflation, as upheld by economists who believe that inflation has come to an end. The standard way of thinking about inflation that looks at the state of the labor market, inflation expectations, and shocks to commodity and food prices makes implausible an inflation onset. Because the pandemic unemployment has sharply increased, according to the “inflation doubters” when the pandemic will be definitely under control there will not be a strong wage push on the horizon. Of this idea is the famous economist Olivier Blanchard. Analysing the chances of inflation and deflation in the post-covid-19 economy, Professor Blanchard (2020) draws attention to the exceptionally high unemployment and argues that it will be partly matched by extremely high vacancies when the lockdown is relaxed but it will not bring a strong wage pressure. The French economist identifies three conditions that could ultimately lead to an inflationary scenario, namely a fiscal dominance over monetary policy and large increase in the debt-to-GDP ratio and in the neutral rate of interest, but alerts that there is a very low probability that it will occur. When social distancing will be relaxed, demand which has been pent-up till then will surely rise but such burst in spending is unlikely to galvanize inflation. In essence inflation would not be large and long enough to destabilize inflation expectations, but it will be temporary and will disappear quickly. The idea that a near-time inflation is plausible but the economy will not be hit by a sustained upward price pressure is widespread among economists, among whom there are Mark Haefele, chief investment officer at UBS Global Wealth Management, and Carl Weinberg, founder and chief economist of High Frequency Economics. As C. Weinberg contends, although U.S. treasury yields have risen, perhaps reflecting inflation expectations because investors started to believe that central banks will reduce their asset purchases, and market expectations for U.S. inflation rates have reached their highest levels in a decade, inflation expectations are unanchored from reality. According to the economist, the rise in fuel prices and the increase in the Consumer Price Index that will occur, which is likely to increase by 2.75 percentage points, will generate inflation rates in the eyes of people. But Weinberg warns that the points added in the Consumer Price Index (CPI) do not represent inflation and the index itself should not be misidentified as inflation. On the contrary, the effects of rising energy costs and the increase in inflation expectations will just get the economy back to normal from a depressed base but an inflation revival is not in sight. Echoed to Weinberg skepticism is M. Haefele, who contests that fiscal packages will add stimulus to an economy that is still below potential, and that the spending will be spread out over a couple of years. Thus, M. Haefele is one of the economists who think that since much of the short-term inflation pressure results from unusual disparities in supply and demand created by the pandemic, inflationary forces will evaporate as economic activity normalizes. Near-term market inflation expectations higher than longer-term

expectations are consistent with the view that the increase in inflation will not persist and that an excess capacity in the economy could curb the ability of companies to pass higher input prices through to consumers.

Some economists who sustain a surge in inflation have often compared covid pandemic to wars and see the same aftermath following the two events due to a sharp increase in demand. Nonetheless, as “inflation doubters” stress, wars are quite dissimilar. The end of the pandemic is a process rather than an event and consequently supply and demand are expected to gradually rise.

With the distribution of vaccine, infection rates will decline and the number of victims will be under control but returning to normal life will happen slowly. This gradualness implies that the recovery from recession will not reflect a consumer spending surge. Furthermore, the mismatch between supply and demand is very different from that experienced in the aftermath of wars. During wars, government buys large amount of output and acts as an “*employer of first resort*” as argued by David Miles, Professor of Financial Economics at Imperial College Business School and Andre Scott, Professor of Economics at London Business School. Government represents an employer of first resort in that it shifts the overall production to ‘war goods’ and therefore provides jobs to people. However, with coronavirus governments are acting as “*insurer of last resort*”: they are providing support to enterprises, unemployed people, avoiding the most tragic consequences, but NO boost in production has taken place. Indeed, supply chains and services are stuck. There has been a *reconversion* of production for some companies but the overall production is precipitately declined. Finally, “doubter economists” point out that unlike a regular war, there is no capital to rebuild. The constraint of both monetary and fiscal policies will be to circumvent deflation and support demand. Finally, the abrupt outburst of the pandemic and the almost three million deaths for the time being, have given people a masterfully lesson about the uncertainty. For this reason, a drastic increase in consumption is by no means a foregone conclusion. Economic uncertainty could lead to a very restrained increase in consumption and precautionary saving is likely to play a lasting role, inducing low consumption and low investment.

Chapter 2

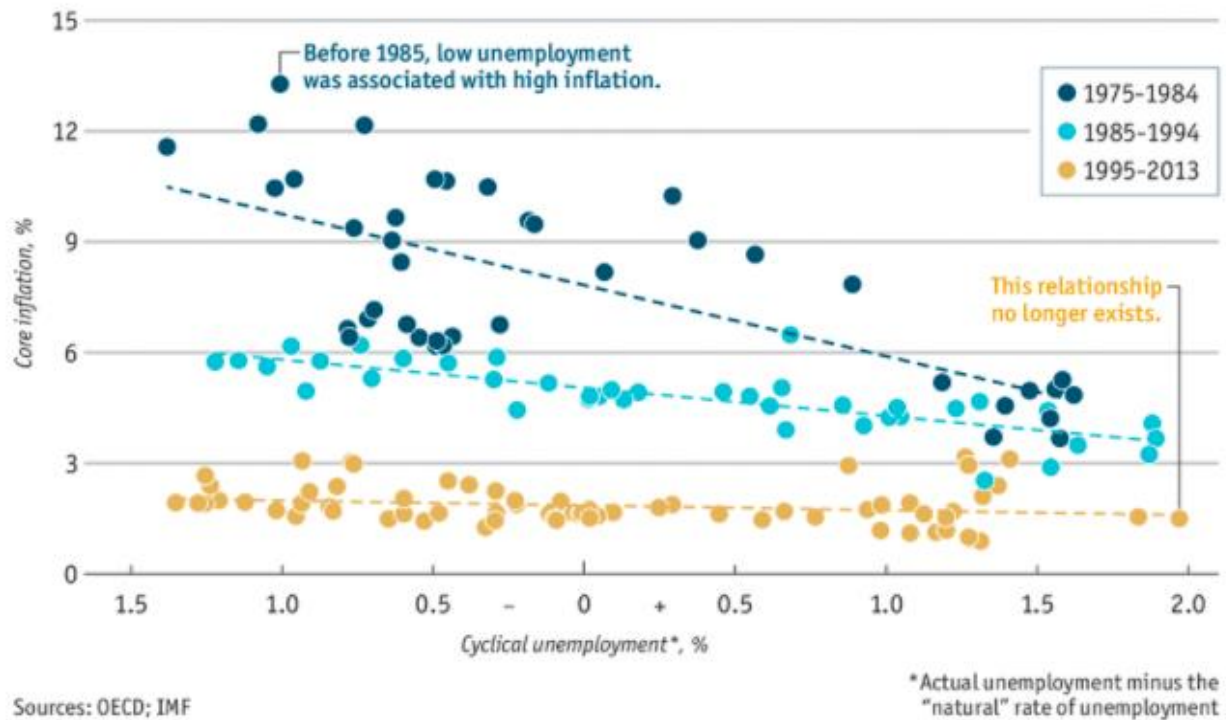
Understanding recent inflation dynamics in the light of the Phillips curve: theoretical considerations and implications for monetary policy

2.1 THE RECENT FLATTENING OF THE PHILLIPS CURVE AND HOW CAN BE EXPLAINED

The end of inflation as a reliable economic indicator of excess demand pressure is associated to the “death of the Phillips curve”. The latter represents the average relationship between unemployment and wage behavior and argues that they are inversely related: as unemployment decreases, economic activity thrives and inflation boosts. The concept became a key aspect of the Fed’s decisions on interest rates, motivating officials to start raising borrowing costs when they feared that inflation could soon take off. Notably, the Phillips curve was described as “*a menu of choice[s] between different degrees of unemployment and price stability*” (Samuelson and Solow, 1960). By the 1970s the Phillips curve started to perform quite badly and this provided confirmation for Friedman’s and Phelps’s fundamental point: an inverse relationship between unemployment and inflation can exist in the short run, but this relationship is instable and in the long run it will no longer hold. Friedman and Phelps argued that the labor market equilibrium is determined by *real* rather than *nominal* wages and that inflation expectations matter a lot. Inflation and unemployment are inversely related as long as the average rate of inflation remains fairly constant but if, for example, policymakers try to push unemployment below the natural rate, changing the average rate of inflation, unemployment will return to the natural rate (inflation expectations have adjusted). The “expectations-augmented” Phillips Curve represents a single combination of long-run and short-run relations. The velocity with which workers’ expectations inflation adjust is correlated to that with which unemployment returns to the natural rate. This will finally determine the success of monetary and fiscal policies will be in reducing unemployment.

However, over the past several years policymakers and economists have noticed that the relationship between inflation and employment has weakened. Indeed, until the mid-1980s, unemployment and wage inflation in United States and other advanced economies did indeed appear to be inversely correlated. Since then, however, the relationship has weakened (Figure 2.1). Since 2010, as the unemployment rate has fallen steadily from 10% to 4.4%, inflation has hovered between 1% and 2%.

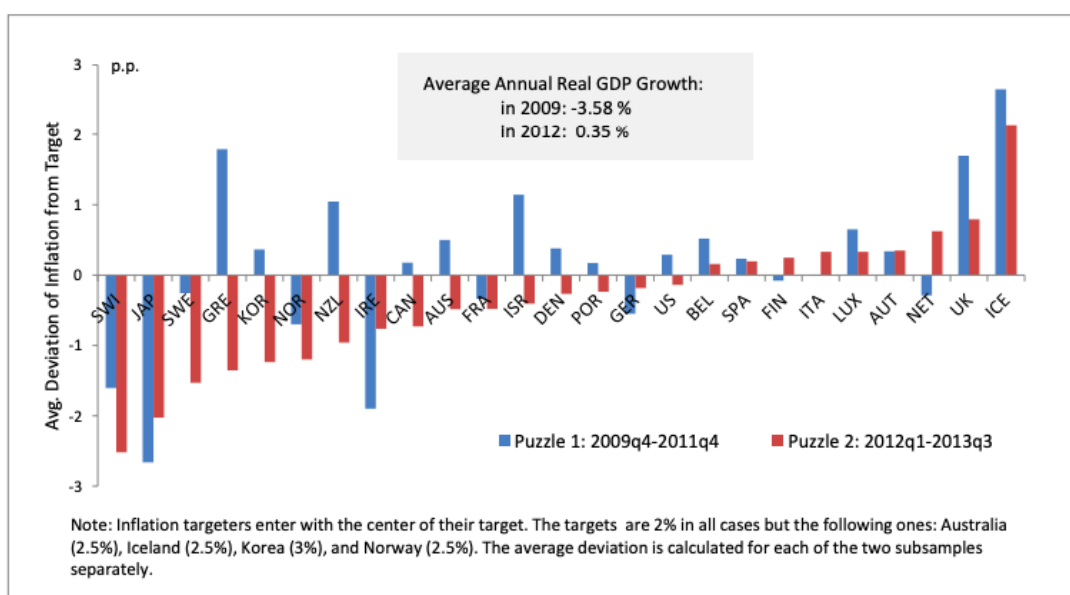
Figure 2.1: Flatlining of the Phillips curve



A flattening of the curve has been observed and two distinct puzzles have emerged. The first puzzle concerns the observation that over the period 2009-2011, inflation rates were consistently higher than expected, even though economic slack in advanced countries was at its highest level in recent history. The unemployment rate has gone from below 5 percent in 2006-07 to 10 percent at the end of 2009, and back down below 4 percent over the past couple of years. While during the Global Financial Crisis of 2008 inflation rates fell sharply and thus behaved as expected, this subsequent post-crisis evolution is much harder to align with economic theory. Figure 2.2 documents the presence of the first puzzle for a broad set of advanced countries. The bars indicate the deviation of quarterly headline inflation from the mean value of the inflation target of the associated central bank. The blue bars describe the deviation of the average inflation rate over the period 2009q4- 2011q4 while the red bars that show the deviation of average inflation from target for the period 2012q1-2013q. It turns out that all countries, with the exception of Switzerland, Japan and Ireland, have exhibited positive or only slightly negative deviations from the target during the first part of the post-crisis period. It is also evident that at the beginning of the first puzzle period, annual real GDP growth across all sample countries amounted to 3.58%. Hence, above-target inflation rates occurred at a time when economic growth was at its lowest level in recent history and one would rather expect deflationary pressures to occur.

The second puzzle concerns the period from 2012 onwards, when inflation rates in many advanced countries suddenly declined despite the ongoing economic recovery. Looking at the red bars, it turns out that most countries have experienced a clearly negative deviation over the second part of the post-crisis period. Although most advanced economies still face substantial amounts of economic slack (especially in Europe), it is specifically puzzling why the phenomenon of falling inflation rates occurs at a time when the economic recovery had set in and economic slack is gradually dissipating in a large number of countries. The figure also shows that at the beginning of the second puzzle period, annual real GDP growth across all sample countries amounted to 0.35%.

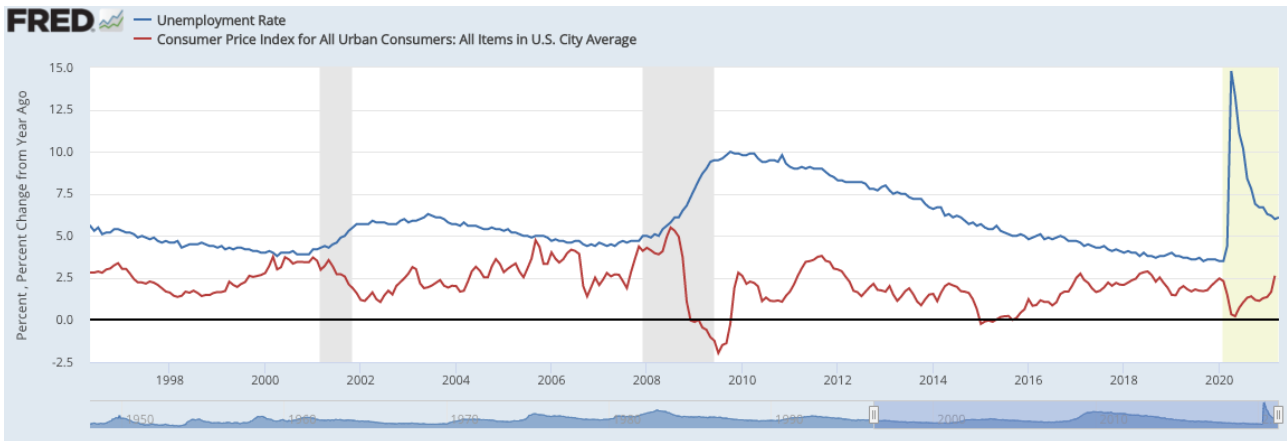
Figure 2.2. Illustration of the two puzzles



Source: Bank of Canada

More in general, the interesting evolution of unemployment and inflation in the last twenty years is displayed in the chart below. Apart from the years of recession due to three economic crises from the beginning of the 21st Century, when unemployment abruptly increased and inflation sharply declined, the relationship between the two variables appears far from clear (Figure 2.3).

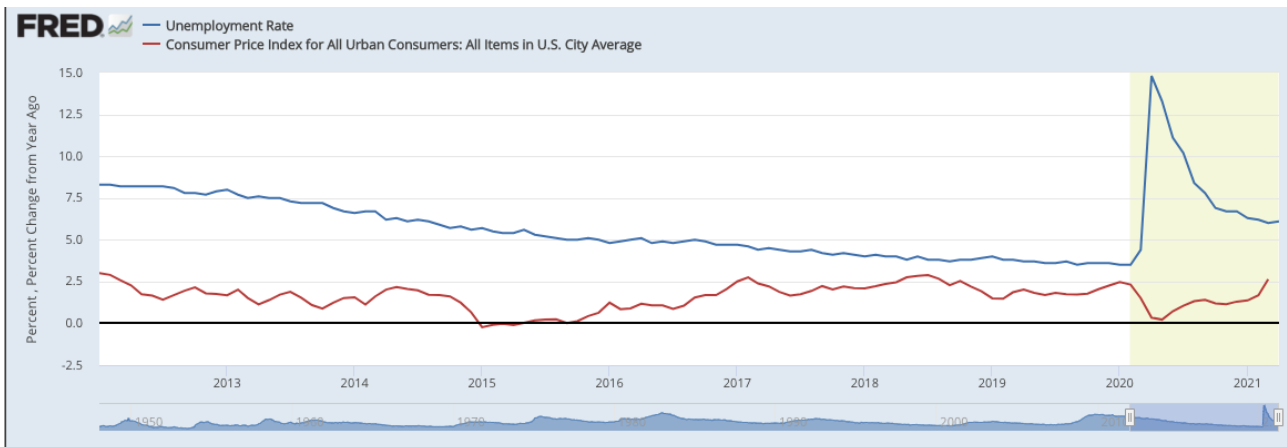
Figure 2.3: Inflation in the last 20 years



Source: U.S. Bureau of Labor Statistics

The most intriguing trend of inflation and unemployment appears in recent years. Zooming on the period from 2012 it can be seen that the unemployment rate has declined to levels not seen in 50 years, inflation has remained low—even below the Fed’s 2% target for most of the period (Figure 2.4).

Figure 2.4: Inflation in the last ten years



Source: U.S. Bureau of Labor Statistics

This suggests that the Phillips curve has “flattened,” or that the relationship might not be as strong as it once was. One reason why the Phillips curve has flattened is that the Federal Reserve, like other central banks, has been much more mindful about targeting inflation in the last 20 years (James Bullard, 2018). That has resulted in a lower and more stable inflation in the U.S., ruling out of a strong relationship between labor market performance and inflation. Another fundamental factor that

has made the connection between economic slack and inflation weaker and weaker in the recent years is given by inflation expectations. If inflation expectations are so settled, this will effectively drive inflation (Jerome Powel, 2019).

The relevance of analysing the causes of the flattening of the Phillips curve is determining the appropriateness of the curve as a reliable indicator of inflation. Flatter is the Phillips curve, less likely is the inflation's revival. In general, if policymakers think that lower unemployment is closely tied to higher inflation, then in periods with low unemployment, they will expect to see higher interest rates than if they do not believe that the two variables are closely tied. If the relationship between inflation and unemployment is not reliable then policymakers have to look elsewhere to discern the most likely direction for inflation.

2.2 HOW THE RECENT FLATTENING OF THE PHILLIPS CURVE CAN BE EXPLAINED

In this paragraph, evidence of a “*well-alive*” Phillips Curve at both regional and international level is discussed.

- **State And City Level Evidence**

Economists who think that the Phillips curve is not dead but it is just “dormant”, are those who think that history could repeat itself. The conjecture is that if labor market tightens further and unemployment rate continues to fall below the natural level for a long period of time, inflation will accelerate. The key reason is that the Phillips curve is probably a curve and not a straight line and, if it is non-linear, with an over-heating labour market, inflationary pressures will rise and eventually the dormant Phillips curve will awake.

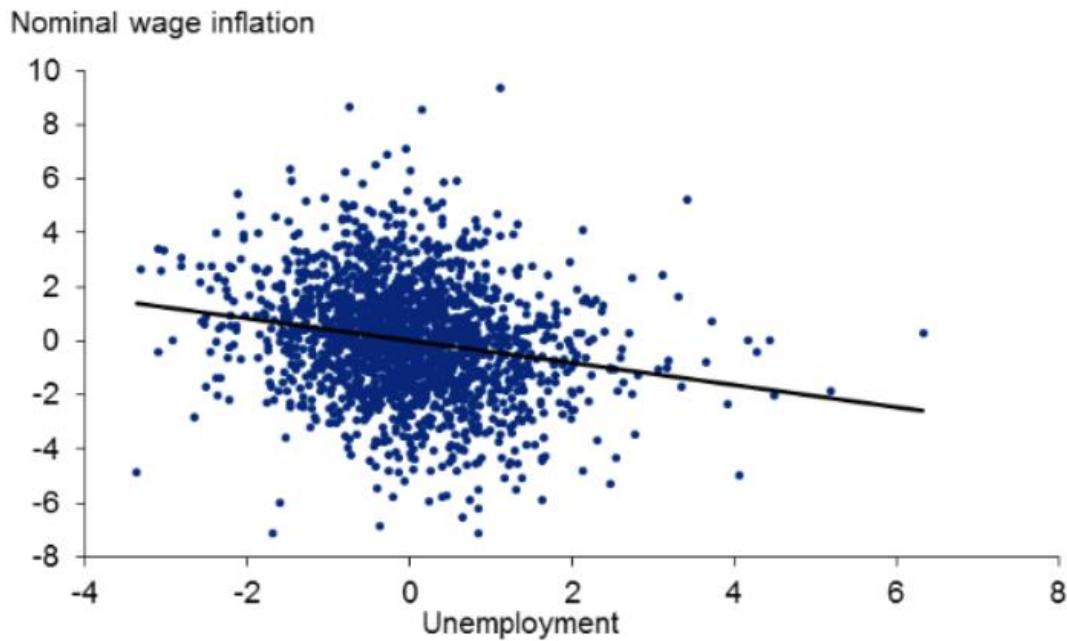
Peter Hooper, Frederic S. Mishkin, Amir Sufi claim that evidence for a dead of the Phillips curve is weak using State and city level estimates. Using data that reach far back to 1950s, the researchers studied US wages and price inflation and observed that at some points in the last half century, the relationship between inflation and unemployment has “unhinged”. Although the economy went through booms and bursts, they concluded that anchored inflation expectations have been the main driver of the apparent death of the Phillips curve and that the Federal Reserve's monetary policy, aiming at stabilizing inflation, has prevented labor market from overheating. When the Federal Reserve assumes that inflation rate can rise above 2%, the Central Bank will rise funds rate so as to limit the unemployment gap to go below-1%. Hooper et al. identify three reasons why the evidence for a dead Phillips curve is weak. First, the Fed's failure to achieve the 2% inflation target has helped

to anchor inflation expectations, weakening the sensitivity of inflation to labour market conditions. Second, the power of tests for the slope of the Phillips curve is low given the too little variability in the data. Indeed, the researchers point out that since the end of last century, there have been very few observations in the macro time-series data for which the unemployment rate is more than 1 percentage point below the natural rate of unemployment and this complicates estimates. Last, there is a possible bias from endogenous monetary policy, which generates a positive correlation between the unemployment gap and inflation, causing a bias toward zero in the slope coefficient of the Phillips curve. This finally suggests that underlying relationship has been understated.

Hoopes et al. have showed that the arguments for the demise of the Phillips curve cannot be trusted and that the Phillips curve is very much alive on the basis of estimates of wage and price Phillips curves with regional data. One of the main advantages of regional data sets is that they typically contain a wider distribution of employment conditions than national level data.

The figure below shows a scatterplot and regression line of nominal wage inflation against the unemployment rate for the state-year level panel. The sample covers the 50 states and reference period goes from 1980s to 2017. Both the unemployment rate and nominal wage inflation are first regressed on state and year fixed effects before being plotted in order to assure that the scatterplot matches the regression specifications. Thus, the scatterplot contains deviations from the state and year mean for each state-year level observation.

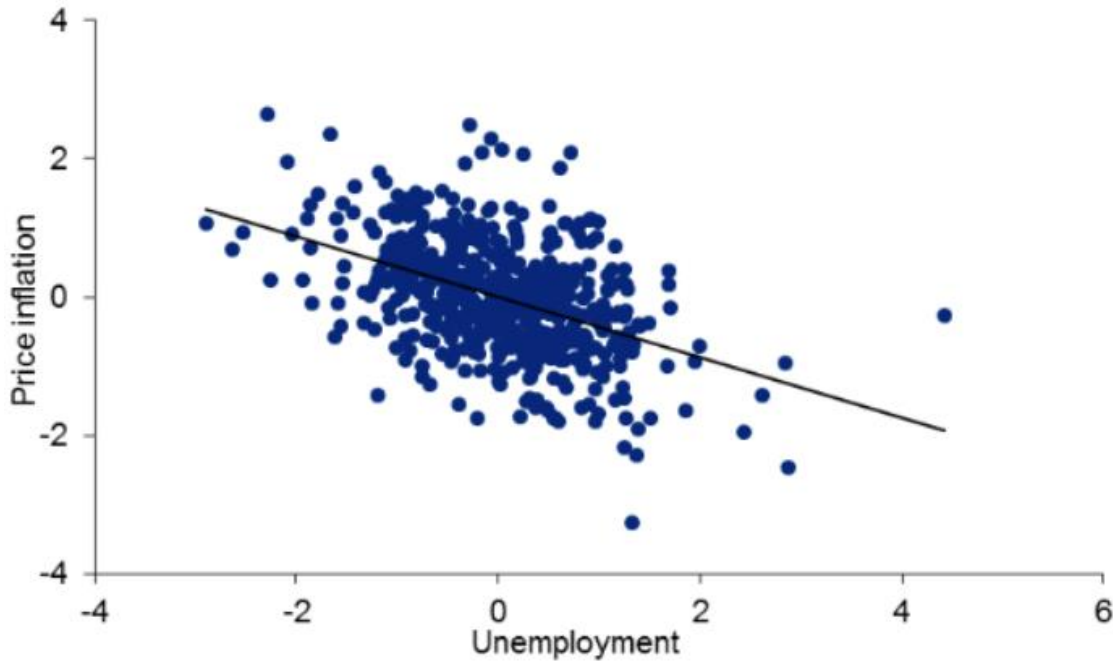
Figure 2.1: Nominal wage Phillips Curve



Source: “The Phillips Curve: dead or alive?”, National Bureau of Economic Research, Inc.

In Figure 2.1 the state-year wage-Phillips curve shows a significant and steep negative slope, with significant non-linearities in the responsiveness of wage and price inflation to tight labour markets. In this estimation, a control variable is included to capture inflation expectations or any other factor that may be determined by lagged inflation in that region. Moreover, the specification includes year fixed effects, which implies that the negative slope coefficient is not driven by national inflation dynamics. Figure 2.2 displays a price-Phillips. The curve also reveals a negative slope.

Figure 2.2: Price Phillips Curve



Source: “The Phillips Curve: dead or alive?”, National Bureau of Economic Research, Inc.

Evidence that the Phillips curve has been hibernating for several decades does not imply a death of the curve. As the empirical evidence in this paper indicates, we cannot be complacent about inflationary pressures. We are far from being confident that inflation will rise in the future but there is a risk of the Phillips curve waking up, with inflationary pressures rising in the face of an overheating labor market.

- **International Evidence**

A flat Phillips curve has been documented for the United States, which is the main focus of our analysis. However, since it is unlikely that this phenomenon is limited to a single country, an analysis that includes other countries for comparison with the United States is required. At following a research investigating changes in the slope of the Phillips curve in eleven OECD countries is presented.

This research, conducted by Annika Alexius, Michael Lundholm, and Linnea Nielsenj, shows that shocks to unemployment typically have significant effects on inflation, indicating that the Phillips curve is still alive and well. The researchers analysed changes in the slope of the Phillips curve in eleven OECD countries and pointed that the results differ between countries and statistical methods. The models are applied with explicitly time varying parameters as well as rolling window estimation since previous studies using models with time varying parameters have rejected the hypothesis that

the Phillips curve has flattened more often than studies relying on rolling window estimation. The set of impulse response functions (IRFs) for each time period and country yielded by the Time varying two variables VAR model (TVP-VAR) as well by the rolling window estimation is shown in Appendix, Table 1. Figures 2.3a to 2.3d illustrate the output from the models in the case of Germany. There are four impulse response functions: two functions estimated using time varying parameters and a twelve-year rolling window for observations in 2005 and 2018. The Phillips curve has flattened according to the rolling window, but not according to the TVP model since the point estimate of the maximum effect is smaller in 2018 than in 2005 if the rolling window method is employed, while if time varying parameters are used the reverse is true. Furthermore, Figure 2.3b it is evident that the effect in 2018 is significant using the TVP-VAR, but not according to the rolling window.

Figure 2.3a: IRF 2018, TVP, Germany

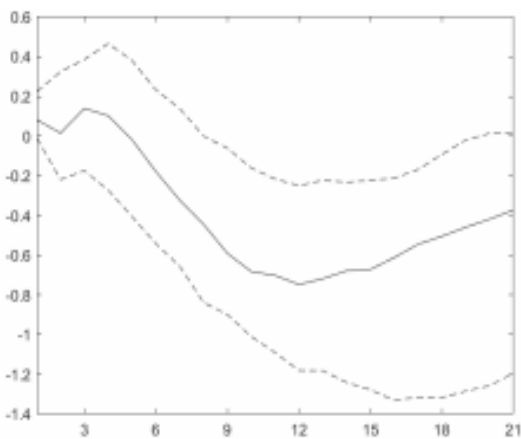


Figure 2.3b: IRF 2018, Rolling window, Germany

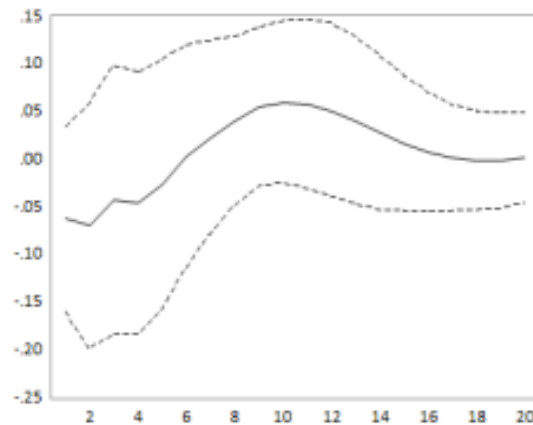
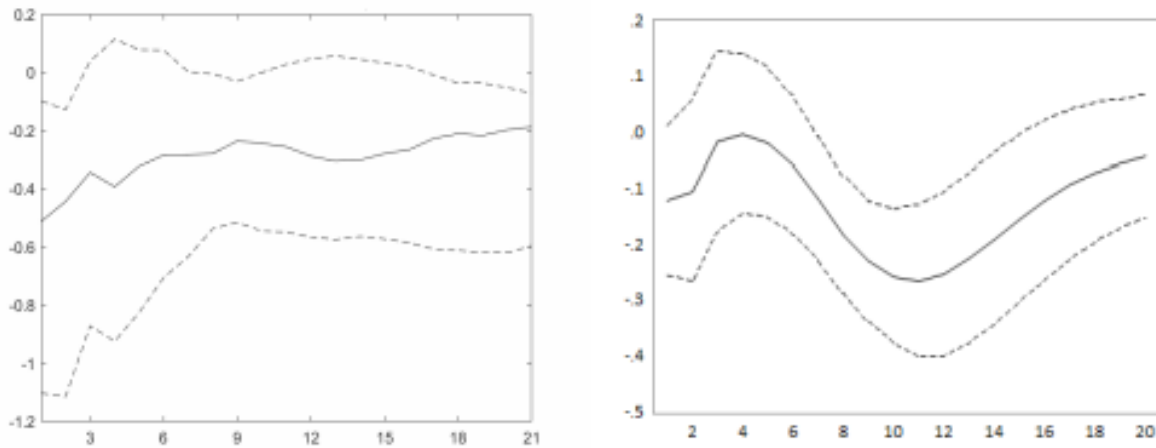


Figure 2.3a: IRF 2005, TVP, Germany

Figure 2.3b: IRF 2005, Rolling window, Germany



Source: “Is the Phillips curve dead? International evidence”, Stockholm University

Given the estimation of a total of 44 impulse functions, in Table 1 are summarized several qualitative aspects of the impulse response functions in 2005 and 2018. The first two columns show whether the effects of shocks to unemployment on inflation are significant (+) or insignificant (-) in 2005 and 2018 according to the two methods. All countries, apart from United Kingdom, display significant effects in 2005 according to the TVP model, while the rolling window indicates insignificant effects in five of the ten non-US countries. In 2018, the TVP model shows insignificant effects also for New Zealand, while insignificant results are now found for four of the ten countries using the rolling window. In conclusion, in 2018 it seems that the Phillips curve is well alive except in United Kingdom and New Zealand. The third column in Table 1 shows whether the slope of the Phillips curve, defined as the maximum effect of shocks to unemployment on inflation, has increased (+) or decreased (-) between 2005 and 2018. The result is that while models with explicitly time varying parameters indicate that the Phillips curve has flattened only in three of the ten non-US countries, models using rolling windows result in a flatter Phillips curve in six of the ten non-US cases. Thus, the estimations indicate that the model with time varying parameters is less prone to exhibit a flatter Phillips curve than the more commonly used rolling window.

Table 1: Qualitative analysis of IRFs

Country	2005 ^a	2018 ^b	Change ^c	Regression ^d
Australia	+/+	+/+	+/-	-/+
Canada	+/+	+/+	+/+	+/+
France	+/-	+/+	-/+	+/+
Germany	+/+	+/-	+/-	-/-
Italy	+/-	+/+	+/+	-/+
Japan	+/-	+/-	+/-	-/-
New Zealand	+/+	-/-	-/-	+/-
Spain	+/-	+/+	+/-	-/+
Sweden	+/+	+/+	+/+	-/+
United Kingdom	-/-	-/-	-/-	-/-
United States	+/+	-/-	-/-	-/-

^a2005: +/- denotes that the effect of shocks to unemployment on inflation in 2005 is significant/insignificant according to the TVP model/rolling window estimation.

^b2018: +/- denotes that the effect of shocks to unemployment on inflation in 2018 is significant/insignificant according to the TVP model/rolling window estimation.

^cChange +/- denotes an increase/decrease in the maximum effect between 2005 and 2018 according to the TVP model/rolling window estimation.

^dRegression: +/- denotes that the effect of shocks to unemployment on inflation in 2005/2018 is significant/insignificant according to a standard OLS regression of contemporaneous unemployment on inflation.

Source: "Is the Phillips curve dead? International evidence", Stockholm University

As regards to results for specific countries, both methods indicate a steepening of the Phillips curve in Canada, Italy, and Sweden, while the effect of shocks to unemployment on inflation has decreased between 2005 and 2018 in New Zealand and the United Kingdom. In the cases of Australia, Germany, Japan, and Spain, the Time varying parameters model produces a steeper Phillips curve, while the rolling window indicates a flattening. In addition, the results for U.S. data confirm a weaker relationship between unemployment and inflation.

Emblematically, it can be concluded that there are systematic differences between the common statistical methods used for studying the Phillips curve and even the same data if employed with different methods may drive in different directions.

2.3 INFLATION EXPECTATIONS AND A NEW VERSION OF THE PHILLIPS CURVE

Understanding which kind of relationship, if any, exists between inflation and employment is extremely relevant on the issue of monetary policy inasmuch the Federal Reserve as well as the European Central Bank have the objective of maintaining a stable level of inflation. The Federal Reserve, in particular, has the dual mandate to promote the maximum sustainable employment and price stability. In light of this, if the connection between labor demand pressure and inflation has weakened, monetary policy becomes less powerful and reverse is also true.

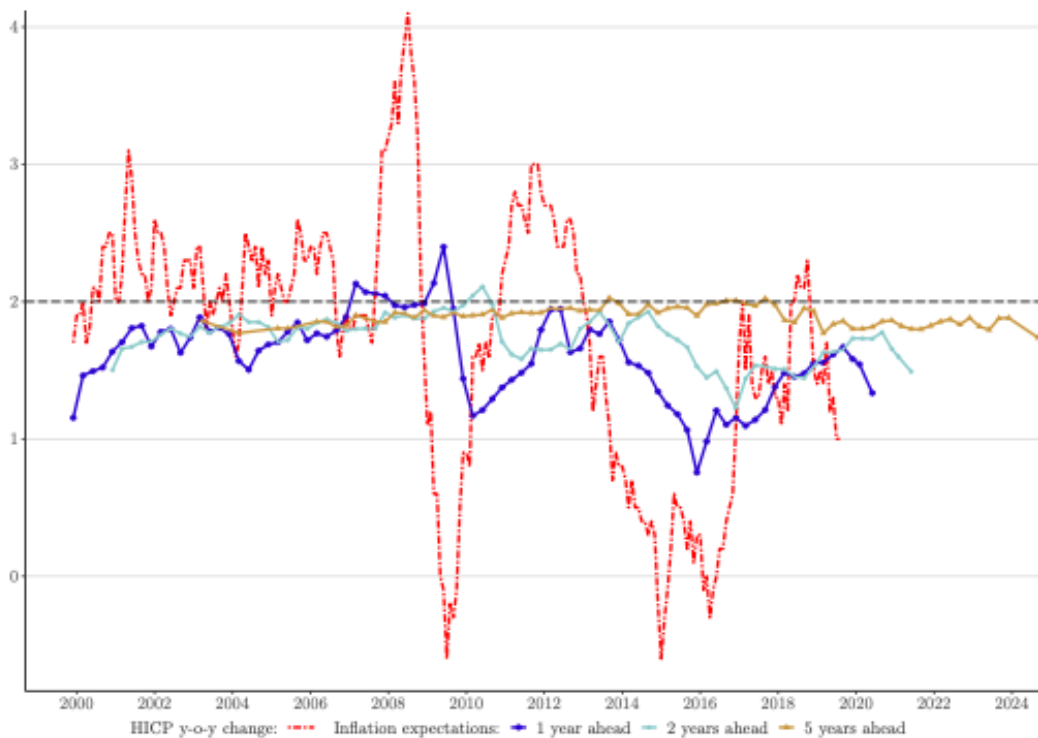
Given the relevance of economic indicators, there is a large body of academic literature that tests the empirical validity of the Phillips curve and other inflation models. Papers that incorporate international elements in domestic Phillips curves to study global financial dynamics before the post-crisis years are by Ciccarelli and Mojon (2005), Hakkio (2009), Monacelli and Sala (2009), and Mumtaz and Surico (2012). Specifically, these papers' finding is that that common components of industrial production, unemployment rates, nominal wages, short- and long-term interest rates, the yield curve, and money aggregates could be important determinants. Inflation has also been linked to longer-term trends, like trade openness. Christian Friedrich (2014) examined global inflation dynamics over the last two decades, with a specific focus on the post-crisis period following the global financial crisis. Friedrich's Phillips curve explains headline inflation explain the change in inflation pattern and reconcile the two puzzles using inflation expectations and a measure of economic slack at the global level. By inserting a large set of potential explanatory variables, such as fiscal policy, unconventional monetary policy, inflation expectation uncertainty and financial variables, the in-sample prediction of global headline inflation is significantly improved. First, the standard factors still play an important role in explaining inflation dynamics. Second, household inflation expectations are a good addition to the global Phillips curve since they significantly improve predictions of global inflation dynamics, especially in periods of economic stress. And third, also the government budget balance seems to make a significant contribution to the explanation of global inflation dynamics in the crisis and post-crisis period.

Another proponent of the argument that the unemployment rate is still an important driver of wages and, thus, of the argument that the Phillips curve is still very relevant and applicable is Gertjan Vlieghe, External MPC member (2018). Vlieghe traces the low wage growth despite the falling unemployment to five factors: weak inflation expectations, a change in the structural unemployment

rate, a public sector wage restraint, lingering effect of downward nominal wage rigidity and low productivity growth. According to the MPC member, the first four factors “keep overall inflationary pressures down for a given unemployment rate, i.e. both wage and price inflation” whilst the fifth, namely, weak productivity, does not as “weaker productivity growth implies weaker wage growth for the same inflationary pressure”.

The importance of inflation expectations in driving inflation’s dynamics is masterfully demonstrated by Dmitry Kulikov and Nicolas Reigl (2019) who use various inflation expectation proxies for analysing inflation-pattern subsequent to the global financial crisis. The authors estimate different models of the Phillips curve using different data series and based on backward and forward-looking specifications and find that almost any Phillips curve model with forward-looking terms performs better than the ones with only backward terms. Another important finding is that the indicators based on financial markets produce a better forecast of the future path of inflation, especially after the start of the Asset Purchase Program in 2015.

Figure 2.5 : SPF Data on euro area inflation expectations at different time horizons Euro area inflation expectations



Source: Eesti Pank

Figure 2.5 displays the series of mean expectations for euro area inflation at different forecasting horizons. It turns out that variability of these data series follows a distinct pattern. As pointed out by the researchers, in the short forecasting horizon (one and two years) there is a volatile pattern that

moves in synchrony with the business cycle. Nonetheless, the hypothesis of the peg of the central bank's medium-term inflation rate to the official target is confirmed in the long horizon. Indeed, the mean inflation rate expected in the forecasts remains stable around 2%. It should be highlighted that when inflation was lower than expected and there was a prolonged decline in inflation rates starting in 2012, the impact was felt by long-term inflation expectations. The researchers notice that the upward trend was arrested in the inflation expectations for five years ahead that lasted from early to 2000-s, and then, at the end of 2014, inflation dipped into negative territory. However, the sharp deflation of 2009 did not cause in a change in long-term inflation expectations and this implies that the series for inflation expectations at different time horizons are likely to contain mutually complementary indicators for the future path of inflation rates. On these grounds Kulikov and Reigl build a thick model which comprehend 2304 estimations of Phillips curve. The estimation of multiple empirical Phillips curve relationships is conducted using inflation expectations series at different time horizons as different specification choices may matter for inflation dynamics. The thick model is specified as follows:

$$\{ \pi_t \} = c + \phi \{ \pi_{t-1} \} + \gamma \{ \pi_{t+1}^e \} + \beta \{ x_{t-1} \} + \theta \{ \delta_{t-1} \} + \epsilon_t$$

where π denotes the rate of euro area consumer price inflation, π^e are various inflation $t+1$ expectation proxies, x_t represents a number of possible measures of economic slack for the euro area economy, and δ_t denotes cost-push shocks selected from a menu of several alternative exogenous price shock measures. All terms in the curly brackets on both sides of equations are allowed to vary across a number of alternative data choices, including the case where explanatory variables in the curly brackets on the right side of this regression may be fully omitted from a particular model specification. Thus, the main characteristic of this thick modelling approach is that such a model spans a large set of backward and forward-looking Phillips curve models and includes a number of naive models that depend only on the driving forces of different measures of slack and cost-push terms, including the most primitive Phillips curve models. On the other hand, in the thin Phillips curve model, which is widely used by central banks around the globe for tracking and forecasting the dynamics of inflation, forward-looking expectational terms are considered and there are specific choices of data series.

Table 2: Two estimated thin Phillips curve models

	<i>Model 1</i>			<i>Model 2</i>		
	Estimate	Std. Error	<i>p</i> -value	Estimate	Std. Error	<i>p</i> -value
Intercept (<i>c</i>)	0.7192	0.8486	0.3997	0.9196	0.8807	0.3000
Lagged inflation term (ϕ)	0.3045	0.1151	0.0101	—	—	—
Forward-looking term (γ)	0.8120	0.2819	0.0053	1.2019	0.2503	0.0000
Slack measure (β)	-0.0986	0.0585	0.0962	-0.1359	0.0591	0.0246
Cost-push shock (θ)	-0.0015	0.0010	0.1427	-0.0022	0.0010	0.0347
Adjusted R^2 :		0.5208			0.4797	
Log-likelihood:		-50.8372			-53.8786	
No. of observations:		74			74	

Source: Eesti Pank

Table 2 offers a moderate degree of surprise in terms of their estimates of the point coefficient estimates because of the counterintuitive sign of θ as well as illustrates the inherent fragility of thin models. In fact, the specific choices of data and models series lay down the statistical uncertainties of the estimated effects. For example, in Table 2 it can be observed that the same data series in the two models generate unclear conclusions. The problem is that in the absence of a larger reference frame of competing models it cannot be tested how good these two models are in a relative sense and whether it can be done better in terms of other statistical criteria. On the contrary, these issues are addressed by Kulikov and Reigl's main thick model presented in Table 3 for the full sample period available. This modelling reveals no surprises in the directions of the effects estimated. In contrast with the results of Table 2, the effects of the cost push shocks on the inflation dynamics in the euro area appear to be weakly positive across all the model specifications estimated. However, there is a considerably less persistence in the HICP inflation rates that exclude energy, food, alcohol and tobacco and this means that the size of the estimated ϕ and γ coefficients appears to be sensitive to the choice of the inflation rate series.

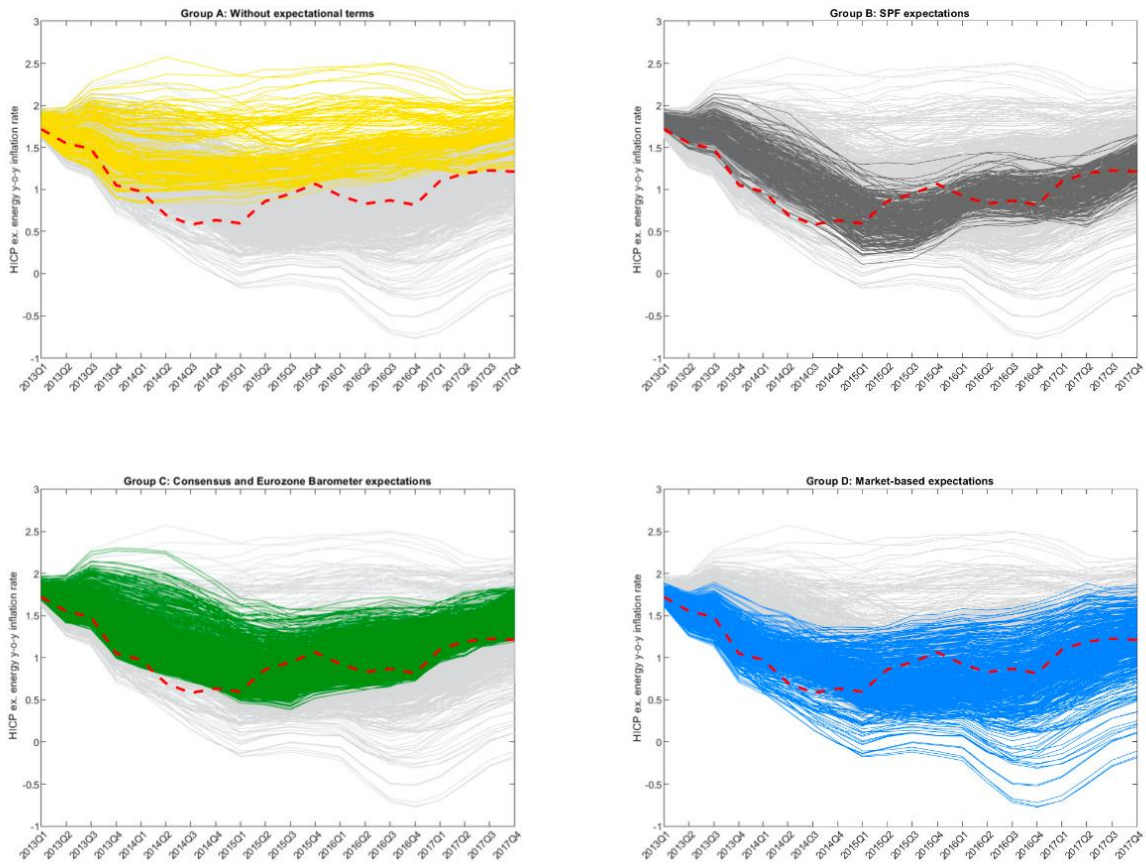
Table 3: Two estimated thick Phillips curve models

	25% quantile	Mean	Median	75% quantile
<i>Model 1</i>				
Intercept (c)	0.0989	0.4462	0.4725	0.7844
Lagged inflation term (ϕ)	0.2385	0.3021	0.3056	0.3640
Forward-looking term (γ)	0.4371	0.6684	0.5799	0.7866
Slack measure (β)	-0.1069	-0.0655	-0.0802	-0.0350
Cost-push shock (θ)	-0.0023	0.0017	0.0012	0.0077
Adjusted R^2 :	0.5284	0.5756	0.5954	0.6453
Log-likelihood:	-41.658	-32.988	-27.241	-23.821
No. of observations:	56.000	60.007	58.000	66.500
<i>Model 2</i>				
Intercept (c)	0.4178	0.7718	0.7366	1.0149
Lagged inflation term (ϕ)	0.0922	0.1704	0.1578	0.2452
Forward-looking term (γ)	0.2527	0.4451	0.3524	0.5177
Slack measure (β)	-0.1041	-0.0678	-0.0834	-0.0211
Cost-push shock (θ)	-0.0006	0.0026	0.0007	0.0063
Adjusted R^2 :	0.3604	0.3919	0.3979	0.4334
Log-likelihood:	-36.218	-30.267	-25.632	-23.055
No. of observations:	56.000	60.007	58.000	66.500

Source: Eesti Pank

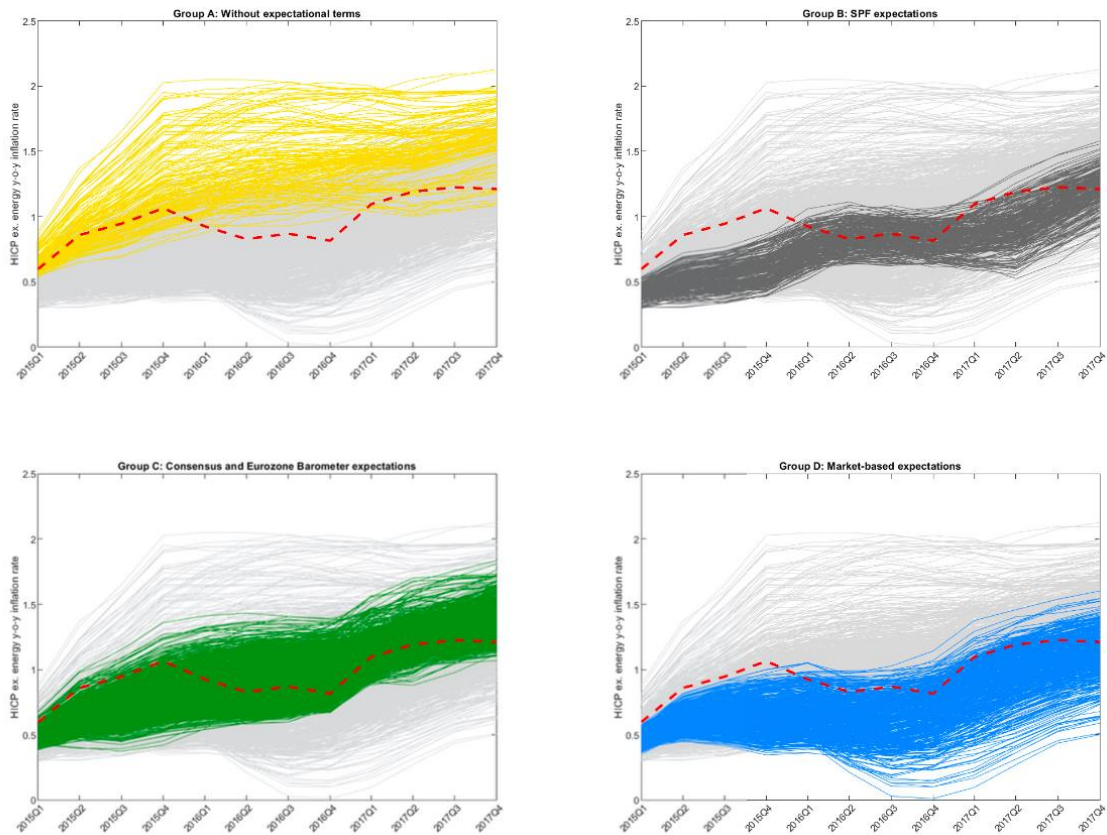
Therefore, it can be concluded that the two thin models in Table 2 are relatively inferior at describing the dynamics of inflation over the full sample period that is available from 1999Q2 to 2017Q4. Figures 2.6 and 2.7 illustrate that the type of expectational data used determines the forecasts. These figures depict for all the 2304 Phillips curve specifications the yearly inflation rates in the euro area and the conditional forecasts. The specifications of the Phillips curves have concern two alternative forecasting periods, the first from 2013 to 2017, and the second from 2015 to 2017.

Figure 2.6: Conditional inflation projections based on Phillips curve models with different expectational data groups over the sample from 2013Q1 to 2017Q4



Source: Eesti Pank

Figure 2.7: Conditional inflation projections based on Phillips curve models with different expectational data groups over the sample from 2015Q1 to 2017Q4



Source: Eesti Pank

In the figures four alternative groups of expectational data are displayed in four different colours: yellow for models without any forward-looking expectational terms, grey for models based on SPF inflation expectations, green for models that use Consensus and Eurozone Barometer survey-based measures, and blue for models based on inflation expectations found from financial markets. In all cases, the models with forward-looking expectational terms produce superior conditional inflation forecasts, for both the sample prior to the start of Asset Purchase Program in Figure 2.6 and the sample which includes the start of the APP in Figure 2.7. This finding shows that the persistence of inflation cannot fully explain inflation’s developments.

The policy implications of o Dmitry Kulikov and Nicolas Reigl’s findings supports the relevance of inflation expectations and of their contribution to the overall dynamics of inflation. In this perspective, to the central bank belongs the fundamental role of driving inflation expectations. Such role is even more important in a forward monetary policy guidance regime given the exit from non-standard monetary policy in the coming years.

Conclusion

Since the 1990s low inflation has become the international norm. Inflation has been very low for years and the problem with such “modern era of low inflation” is that not only it is down but it has not risen despite Central banks have pledged to keep inflation rates low and monetary policy supportive of the economy. By presenting inflation-trend in last twenty years in United States and Europe, this thesis investigates the factors that have driven recent inflation dynamics and that have sparked recent debates on the future inflation trend.

Economists unanimously agree on the causes of persistent low inflation. The *modern era of low inflation* owes partly to economic fundamentals and partly to contained inflation expectations and deficiencies in the macroeconomic management. Indeed, factors such as changes in labor market, globalization, an aging population, technology, collapse of trade unions have been recognized as elements which have curbed inflation. In particular the rise in ecommerce and competition from dynamic countries have provided greater price transparency and have brought competitive pressure on western countries. Aging population, collapse of trade unions and flexibility of labor have kept wages down preventing inflationary forces to operate. Nonetheless central banks have not been unarmed. On the contrary, they have pulled out all necessary policies to reboot the economy and to achieve the inflation target of 2%. The fact that central banks fall short of their target, besides representing a missed opportunity, impairs their credibility and creates long-term inflation expectations firmly anchored at low levels. As discussed in this paper, anchored inflation expectations have undeniably played a key role in the inflation-disinflation cycle that has characterized last decades since inflation is a self-reinforcing phenomenon. If people are skeptical of a rise in prices, as for the most they are, real interest rate rises, weakening demand and pushing inflation down even more.

Despite the longer-term downward inflation channel, inflation rates from 2010 (for both United States and Europe) gave economists way to think that inflation began to spike. Is inflation “*dead*” or simply “*dormant*”? Actually, any answer may be rash. Complicating even more the debate over future inflation dynamics has been the Coronavirus Pandemic which has sunk the world into the deepest recession for almost a century. The tough lockdown measures imposed by governments to limit the spread of the virus had devastating effects on both the demand and the supply side of the economy. Given the hard blow to the global economy but also the strong stimulus of the monetary policy implemented in response to the actual economic crisis, there are divergent views among economists concerning what will happen in the future. On the one hand, the absence of a recovery after the non-conventional policies adopted by Central Bank and the printing of money to spur the economy, indicate a death of inflation, to whom the coronavirus pandemic has given the final stroke. In this

respect, the recent rise in the inflation rates and employment should be interpreted with caution since inflation could not be large and long enough to destabilize inflation expectations, but it may be temporary and disappear quickly. On the other hand, relying on apparent inflationary monetary movements, it may also be that once the pandemic is under control, a big bounce-back in the financial market, in aggregate demand and output could be envisaged.

This research explores both sides of the debate but for the time being takes no position. The main lesson that the Coronavirus has given to the world is about the uncertainty. For this reason, it is claimed that an upsurge in spending and, as a consequence, in inflation rates, maybe not just temporary, must be taken into account. Nonetheless, a drastic increase in consumption is by no means a foregone conclusion. Economic uncertainty could lead to a very restrained increase in consumption and precautionary saving is likely to play a lasting role, inducing low consumption and low investment.

Inflation dynamics have also been analysed in the light of the evolution of the Phillips curve, the most famous inverse relationship between unemployment and inflation. Over the past several years policymakers have noticed that the relationship between inflation and employment has weakened and this has challenged the usefulness of the Phillips Curve as a reliable economic indicator of demand pressure. Indeed, until the mid-1980s, unemployment and wage inflation in United States and Europe did appear to be inversely correlated but since then, however, a flattening of the Phillips Curve has been observed. Specifically, two events have proved particularly puzzling. The first puzzle appeared after the Global Financial crisis when inflation rates were above target despite economic growth was at its lowest level in recent history.

The second puzzle concerns the period from 2012 onwards, when inflation suddenly declined despite the ongoing economic recovery. This research also attempts to give an explanation of the flattening of the Phillips Curve on the basis of the critical link between the sharp decline of inflation and the weakening of the inverse relationship between inflation and unemployment. One reason why the Phillips curve has flattened is that central banks have been much more mindful about targeting inflation in the last 20 years. That has resulted in a lower and more stable inflation. Another key factor that has made the connection between economic slack and inflation weaker and weaker in the recent years is represented by low inflation expectations. If inflation expectations are so settled, this will effectively drive inflation.

However interesting the evolution of the Phillips curve has been, economists do not all agree to rule out the relationship between labor market performance and inflation. In recent years evidence of a “*well alive*” Phillips Curve has been collected at regional, state and international level. Hoopes et al. (2019) using regional data sets, which typically contain a wider distribution of employment

conditions than national level data, give evidence for a Phillips curve with significant and steep negative slope. Three reasons could justify why proofs that the Curve has “broken down” is weak. Anchored inflation expectations reduce the sensitivity of inflation to labour market conditions. Furthermore, when there is too little variability in the data then the power of tests for the slope of the Phillips curve and nonlinearities would be very low. This creates a bias, making it difficult to estimate a significant Phillips curve slope or nonlinearities. Another factor that can bias the slope of the Phillips Curve towards zero is endogenous monetary policy, which creates a positive correlation between inflation and the unemployment gap.

Emblematically, as demonstrated by researches reported in this thesis, even the same data, when employed with different econometric models may lead to different conclusions.

A flat Phillips Curve reduces the chances of a breakout of inflation. In light of the relevance of this economic indicator, used as a forecasting tool by central banks, a large body of academic literature that tests the empirical validity of the inverse relationship between inflation and unemployment. In the light of recent works, this thesis highlights the possibility of building a *modified* Phillips curve. The latter contains both backward and forward-looking expectational terms. When compared models with only backward looking terms and models with forward looking terms too, the formers produce inflation forecasts that are uniformly inferior to those of latter models. Therefore expectations are important in explaining the recent dynamics of inflation rates in the euro area.

The flattening of the Phillips Curve and the abrupt decline of inflation rates are facts. Whether an “*end*” of inflation or a “*death*” of the Phillips Curve has been achieved is much more complicated to clarify. The unforeseen inflation pattern has not convinced all the economists that inflation has reached an “*end*”. For this reason, a debate about the future trend of inflation broke out. In the light of the severe shock to the global economy caused by the Coronavirus Pandemic and the uncertain economic consequences, this research work lies in the centre of the debate and is ground for further researches. Thereby, this paper attempts to offer an explanation of the current believes in order to provide critical tools for interpreting dynamics that colorize the perception of the economy.

Bibliography

Alexius A., Lundholm M., and Nielsen L. (2020). “Is the Phillips curve dead? International evidence”, Research Papers in Economics 2020:1, Stockholm University, Department of Economics.

Anderson J. Bergamini E., Brekelmans S., Cameron A., Darvas Z., Dominguez Jimenez M., Lanaertes K., Midoes C., 24 November 2020. “*The fiscal response to the economic fallout from the coronavirus*” in Bruegel dataset, <https://www.bruegel.org/publications/datasets/covid-national-dataset/>

Blanchard O. (2020). “High inflation is unlikely but not impossible in advanced economies”, *Peterson Institute for International Economics*.

Boote R. (1997). “The death of inflation”, *World Economic Affairs*. (1997), Books. *Economic Affairs*, 17: 51-55.

Dmitry, Kulikov, Nicolas and Reigl, (2020), “Inflation expectations in the Phillips Curves models for the euro area, Bank of Estonia Working Papers, Bank of Estonia.

Elliot Smith, 17 February 2021, “This is not inflation’: Economist says expectations are unanchored from reality”, in CNBC, <https://www.cnbc.com/2021/02/17/this-is-not-inflation-economist-says-expectations-are-unanchored-from-reality>

Előd Takáts and Mikael Juselius (2018). “The enduring link between demography and inflation”, BIS Working Papers, Bank of International Settlements, NO 722.

Engemann K., 15 January 2020, What Is the Phillips Curve (and Why Has It Flattened)?, in *Federal Reserve Bank of St. Louis*, <https://www.stlouisfed.org/open-vault/2020/january/what-is-phillips-curve-why-flattened>.

Friedrich C. (2014). “Global Inflation Dynamics in the Post-Crisis Period: What Explains the Twin Puzzle?”, Staff Working Papers 14-36, Bank of Canada.

Fu C. , Wu J. Lee Myers S. , 17 January 2020, “China’s looming Crisis: a shrinking population”, in *The New York Times*, <https://www.nytimes.com/interactive/2019/01/17/world/asia/china-population-crisis.html>

Goodhart C. and Pradhan M. (2020). “The Great Demographic Reversal”, Palgrave Macmillan, Cham: 117-128.

Hooper P., Mishkin F. S., Sufi A. (2019). “The Phillips curve: Dead or alive”, NBER Working Papers 25792, National Bureau of Economic Research, Inc.

“Inflation is losing its meaning as an economic indicator”, 12 October 2019, in “The Economist”, Special Report “The world economy’s Strange new rules”, <https://www.economist.com/special-report/2019/10/10/inflation-is-losing-its-meaning-as-an-economic-indicator>.

Lane P. R., Member of the Executive Board of the ECB, at the financial markets workshop of the Economic Council, 11 February 2020, “Low inflation: macroeconomic risks and the monetary policy stance”, Speech at European Central Bank, https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200211_2~eae18c54ff.en.html.

“Low inflation is a global phenomenon with global causes”, 12 October 2019, in “The Economist”, Special Report “The world economy’s Strange new rules”, <https://www.economist.com/special-report/2019/10/10/low-inflation-is-a-global-phenomenon-with-global-causes>.

Miles D. and Scott A., 4 April 2020, “Will inflation make a comeback after the crisis ends?” in VoxEU.org eBook, CEPR Press, <https://voxeu.org/article/will-inflation-make-comeback-after-crisis-ends>

Wendy C. and Soskice D. (2005). “The 3-equation New Keynesian Model—A graphical exposition” *The B.E. Journal of Macroeconomics*, De Gruyter, vol. 5(1), pages 1-38,

Motyovszki G. (2013). “The Evolution of Phillips Curve Concepts and Their Implications for Economic Policy”, Federal Reserve Bank of Richmond, vol. 71(Mar), pages 3-22.

Vlieghe G., External Member of the Monetary policy Committee, 23 March 2018, “From asymmetry to symmetry: changing risks to the economic outlook” Speech at Confederation of British Industry, Birmingham, <https://www.bankofengland.co.uk/-/media/boe/files/speech/2018/from-asymmetry-to-symmetry-changing-risks-to-the-economic-outlook-speech-by-gertjan-vlieghe>.

APPENDIX

TABLE 1

Modern monetary macroeconomics is based on what is known as the 3-equation “New Keynesian model” (IS-PC-MR): IS curve, Phillips curve and interest rate based monetary policy rule or Taylor rule. This model is a replacement of the Keynesian IS-LM-AS model. The idea at the basis of the New-Keynesian system is that policy-makers are faced with a vertical Phillips curve in the medium run and by a trade-off between inflation and unemployment in the short run. Moreover it is assumed that the inflation process is persistent and that it takes one year for monetary policy to affect output and a year for a change in output to affect inflation.

The three equation of the IS-PC-MR model:

- IS equation: $y_1 = A - ar_0$.

in which real income y is a positive function of autonomous expenditure A and a negative function of the real interest rate r

- Phillips Curve: $\pi_1 = \pi_0 + \alpha(y_1 - y_e)$

where π is the rate of inflation and y_e , equilibrium output; and the central bank’s Monetary Rule

- Monetary Rule: $(y_1 - y_e) = -\alpha\beta(\pi_1 - \pi^T)$

Which shows the combinations of output $(y_1 - y_e)$ and inflation that the Central Bank chooses given the constraint of the Phillips curve that it faces. When inflation is high, Central bank reduces the aggregate demand, increasing the interest rate with the aim of decreasing inflation.

Whenever the equilibrium (y_e, π^T) is disrupted, political authorities have the role to modify the interest rate in order to bring the economy on the curve MR curve; once on the MR, they have to continue to adjust the interest rate until the economy comes back at (y_e, π^T) .

Let us illustrate the model by consider how the Central bank decides its monetary policy.

Specifically, let us assume that the central bank wants to reduce output to point C. This can be done through a monetary policy, by the Central bank setting the appropriate interest rate . The

central bank, in fact, raises the real interest rate to r' and inflation declines. The central bank faces a new Phillips Curve constraint and will adjust the interest rate downwards. The economy moves along the IS curve from C' to A' and along the MR line from C to A . Ultimately, the target level of inflation is attained and the economy is at equilibrium unemployment, where it will remain until a new shock or policy change arises.

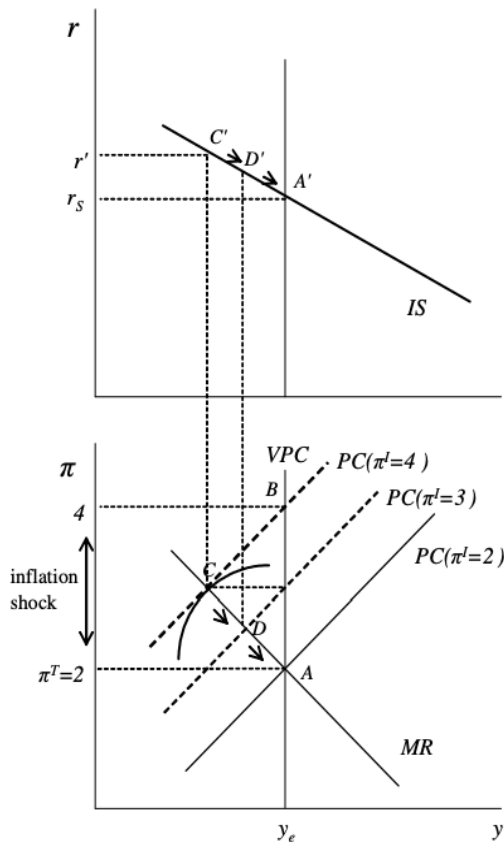


TABLE 2

Monthly Inflation Table:

Month	2017	2018	2019	2020	2021
January	0.58%	0.54%	0.19%	0.39%	0.43%
February	0.31%	0.45%	0.42%	0.27%	0.55%
March	0.08%	0.23%	0.56%	-0.22%	0.71%
April	0.30%	0.40%	0.53%	-0.67%	
May	0.09%	0.42%	0.21%	0.002%	
June	0.09%	0.16%	0.02%	0.55%	
July	-0.07%	0.01%	0.17%	0.51%	
August	0.30%	0.06%	-0.01%	0.32%	
September	0.53%	0.12%	0.08%	0.14%	
October	-0.06%	0.18%	0.23%	0.04%	
November	0.002%	-0.33%	-0.05%	-0.06%	
December	-0.06%	-0.32%	-0.09%	0.09%	

TABLE 3

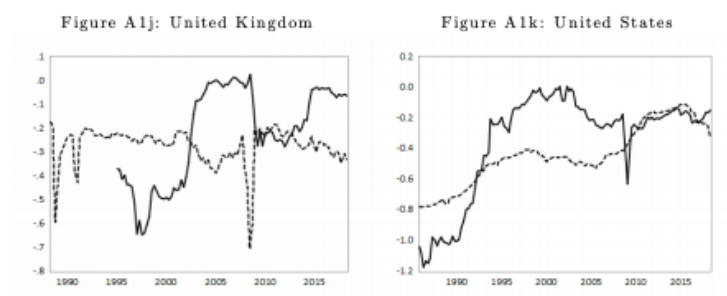


Figure A1a: Australia

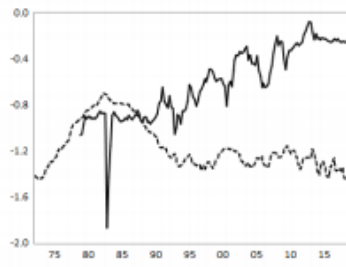


Figure A1b: Canada

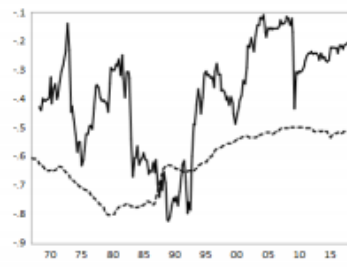


Figure A1c: France



Figure A1d: Germany

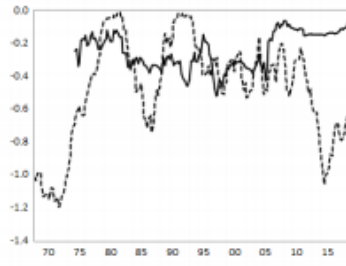


Figure A1e: Italy



Figure A1f: Japan

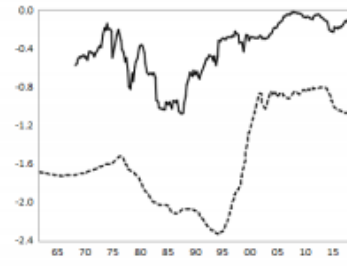


Figure A1g: New Zealand

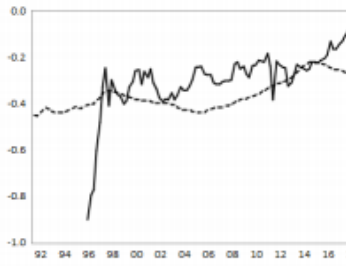


Figure A1h :Spain

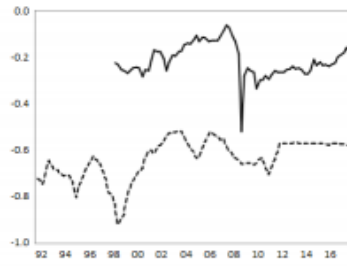


Figure A1i: Sweden



— Rolling window --- TVP