



Research Paper

Examining the New Keynesian Phillips Curve in the U.S.: Why has the relationship between inflation and unemployment weakened?

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ABSTRACT

This paper conducts a comprehensive review of the relationship between inflation and unemployment in the U.S. as described by the Phillips curve in a New Keynesian framework and investigates whether this relationship has changed systematically over time. We also aim to identify possible explanations for these changes. Three different hypotheses are discussed to assess whether they are consistent with more recent developments, such as the evolution of inflation expectations, the impact of globalization, and possible nonlinearities in the functional shape of the Phillips curve. We find that the relationship between inflation and unemployment has weakened since the 1980s and especially during the Covid-19 pandemic due to forces of globalization and better anchored inflation expectations resulting from more credible monetary policy. This has led to question of whether the Phillips curve is outdated. We conclude with the implications of these findings for the conduct of monetary policy.

1. Introduction

In light of the Covid-19 pandemic, the relationship between inflation and unemployment is being re-examined as the unemployment rate dropped sharply, while inflation saw a dramatic rise. This has brought to the forefront the discussion of a changing trade-off between inflation and unemployment. The Phillips curve (Phillips, 1958), which describes this relationship, does not appear to hold during the pandemic. While unemployment reached an all-time high during the early months of the pandemic, inflation did not fall as much as expected. However, inflation continued to rise at an unusually high rate during the subsequent months of economic recovery, causing great uncertainty among economists about future developments. The observation that the performance of the labor market or the economy is not always a stable driver of inflation is not peculiar to the Covid-19 pandemic but has been discussed in previous research (Del Negro et al., 2020). The repeated failure of the Phillips curve in empirical studies has prompted research to explain this gap. Given the recent economic recession triggered by the war in Ukraine, it is particularly interesting to consider whether modern crises represent yet another empirical failure of the Phillips curve and whether different types of recessions require different specifications (Forbes et al., 2021a; Ball et al., 2021).

Seeing that the Phillips curve is a key element of the FRB/US model - the primary macroeconomic model utilized by the Federal Reserve of the U.S. (Fed), it is crucial to regularly assess its validity from a monetary policy perspective. This is because a different response of inflation to capacity utilization, compared to other factors, can impact the effectiveness of monetary policy and its

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prioritization of objectives (Constancio, 2015). The most widely held assumption in macroeconomic research is that central banks face a trade-off between low inflation and low unemployment in the short to medium term, which is represented by the negative slope of the Phillips curve in the inflation-unemployment relationship. This trade-off implies that a targeted reduction in unemployment rate can only be achieved at the cost of temporarily rising inflation. However, if the slope of the Phillips curve changes, the costs paid by central banks in the form of inflation will also change (Constancio, 2015). Therefore, a smaller slope could imply that central banks lose their ability to impact inflation by stimulating aggregate demand and reforming labor markets (Jorgensen and Lansing, 2022).

Against the aforementioned backdrop, the objective of this article is to undertake a comprehensive review of recent inflation and unemployment trends to determine whether the relationship between these two metrics, as represented by the Phillips curve, systematically changed prior to and during the pandemic. Addressing the question of whether the Phillips curve is outdated requires a multi-faceted and in-depth analysis, with a particular focus on one crucial aspect: the evolution of the slope over time. The slope of the Phillips curve measures the strength of the relationship between inflation and the labor market, relative to other factors. Given that different causes for a change in the slope coefficient imply different implications for monetary policy, we explore three potential, non-exclusive explanations for why the Phillips curve changes over time: (i) the increased anchoring of inflation expectations, (ii) globalization and the increasing importance of international prices relative to domestic prices, and (iii) nonlinearities in the inflation-unemployment relationship.

While our examination focuses on the United States, a weakened Philips curve is a global phenomenon (Ari et al., 2023). Given multiple possible explanations for the flattening of the Phillips curve, the objective of this thesis is to conduct a comprehensive review of recent developments in inflation and unemployment to determine whether the Phillips curve's relationship systematically changed before and during the pandemic. In particular, we will focus on the evolution of the slope over time and examine possible explanations for why the Phillips curve is subject to changes over time.

In order to achieve its dual mandate of maximum employment and price stability, monetary policy faces challenges that must be addressed. One approach is to give relatively more emphasis to economic stabilization rather than inflation targeting. Additionally, monetary policy should supplement the use of the Phillips curve as a tool by monitoring other factors that drive inflation closely. These include expectations of businesses and households, external price pressures that are unrelated to import prices, and the interaction between expected inflation levels and expected output gaps. To counteract instability in parameters and systematic forecast errors in inflation predictions, a "thick-modelling" approach can be utilized, where different specifications are averaged to provide some hedging (Blanchard et al., 2021).

The paper is structured as follows. In the next section, a brief overview is presented regarding the theoretical foundations of the Phillips curve, its historical evolution, and its significance for monetary policy in the U.S. Section 3 outlines the current strands of literature and reviews three common mechanisms that explain the structural changes of the Phillips curve before the pandemic. Finally, Section 4 draws implications for monetary policy in light of recent developments during the Covid-19 pandemic, while Section 5 concludes the paper.

2. The evolution of the Phillips curve

The Phillips curve originated as an empirical relationship between wage inflation and unemployment in the U.K. Phillips (1958) suggested a theoretical explanation based on the relative divergence of demand and supply, with the "demand pull" explanation of inflation being favored. Lipsey (1960) provided an influential theoretical framework that stressed the interrelations between wages, excess demand for labor, unemployment, and labor market frictions. Later versions of the Phillips curve focused on price inflation and economic slack, measured by the output gap or unemployment gap, which reflect the deviation between actual and potential output or unemployment. Economic slack and unemployment are highly negatively associated, as expressed by Okun's law (Okun, 1962), which allows the two gap measures to be used interchangeably (Gordon, 2013). Formally, the traditional Phillips curve in level-level form can be represented in its simplest form, as follows:

$$\pi_t = -\kappa(u_t - u^*), \quad (1)$$

where the level of inflation π_t negatively depends on economic slack, here the unemployment gap ($u_t - u^*$), which measures deviation of the unemployment rate u_t from its natural rate u^* . The slope coefficient κ captures the degree of sensitivity to which inflation responds to development in the labor market. In particular, the slope is central subject of research. The Phillips curve specification outlined in Eq. (1) has significant implications for monetary policy. It suggests that there exists a permanent trade-off between inflation and unemployment levels, meaning that the simultaneous achievement of low unemployment and inflation through monetary policy is unattainable. Rather, policy measures aimed at enhancing wage flexibility or reducing labor market frictions can help improve this trade-off, as noted by Snowdon and Vane (2005). Despite the theoretical models, empirical evidence supporting the traditional level-level Phillips curve in the U.S. is limited and largely confined to the 1960s, as argued by Gordon (2013).

Fig. 1 displays the historical trend of U.S. inflation overlaid on the unemployment rate, spanning the period 1960/01 to 2023/01. As seen, the decline in the unemployment rate during the 1960s by approximately 4 percentage points was coupled with an inflation rate increase to about 6 % by 1970. A similar albeit milder trend can be observed in the late 1980s, where unemployment rates dropped to almost 5 %, and inflation accelerated from below 5 % in 1985 to nearly 7 % by 1990. For the remaining sample, the relationship is less clear, or at times, even inverse, such as during the 1969 recession or the period of 1973–1975, where inflation and unemployment were positively correlated. To get a deeper impression about the association, Fig. 2 plots unemployment rate versus inflation. While a clear steep correlation in favor of a Phillips curve is discernible during the 1960s, this correlation appears to have weakened

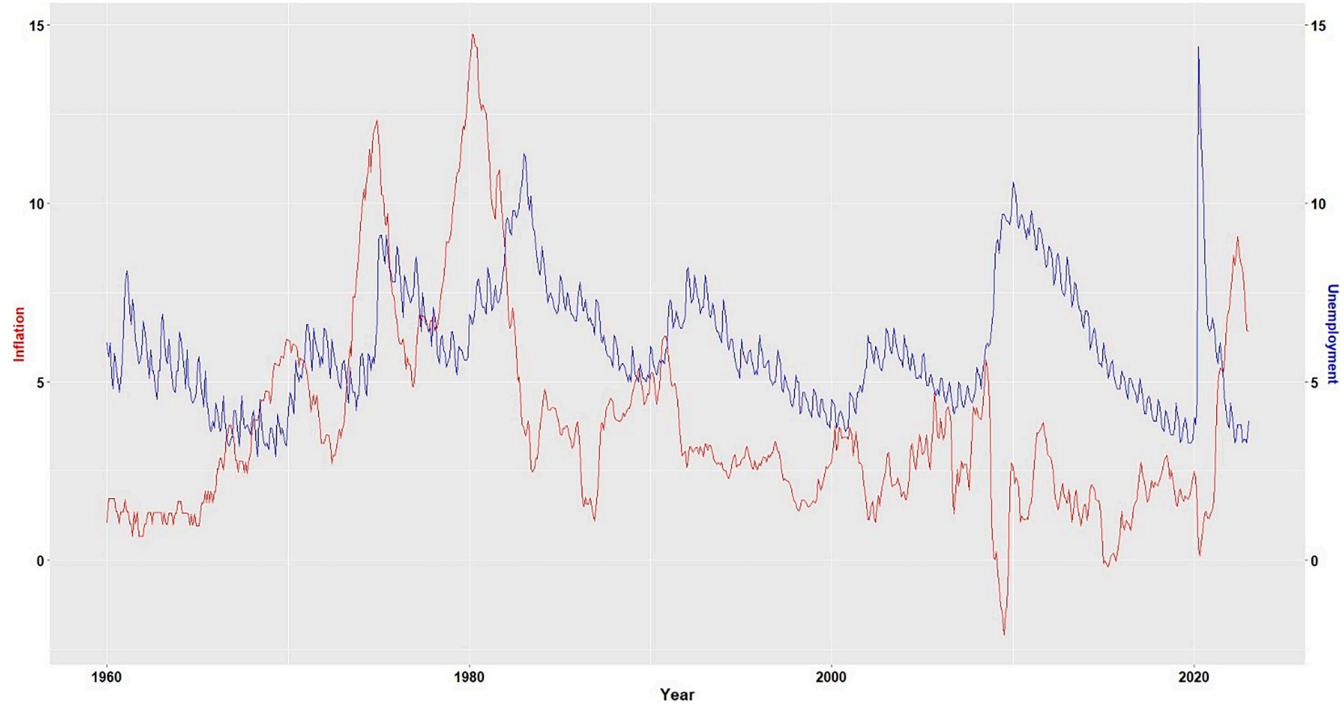


Fig. 1. US Inflation and unemployment rate. Graph created by authors from data obtained from the FRED St. Louis. ^{d1}

considerably over time. Interestingly, during the pandemic, a steep correlation similar to that of the 1960s can be observed, which is due to the high unemployment rates coupled with low inflation at the onset of the pandemic, followed by a sharp decrease in unemployment and a significant increase in inflation.

The breakdown of the consensus on the traditional Phillips curve was due not only to empirical shortcomings but also fundamental revisions of macroeconomic theory, with each development reinforcing the other. The primary theoretical criticism of the original Phillips curve was put forth by Friedman in 1967, who pointed out that the Phillips curve represented nominal wages, rather than real wages (Nelson, 2020). To address this issue, the augmented Phillips curve introduced an additional term for expected inflation, thus accounting for real wages, which were believed to be more relevant to employees when negotiating wages and contracts, and hence, the term "expectation-augmented Phillips curve" (Snowdon and Vane, 2005). Initially, expectations were assumed to be adaptive or "backward-looking", based only on past inflation values.

$$\pi_t = -\kappa(u_t - u^*) + \pi_{t-1}, \quad (2)$$

$$\pi_t = -\kappa(u_t - u^*). \quad (3)$$

The expectation-augmented Phillips curve has two primary implications. Firstly, it is referred to as the "accelerationist Phillips curve" due to its specification in (3), which measures inflation in terms of change rather than level (Ball and Mazumder, 2019). Secondly, in contrast to the traditional specification, the trade-off now exists only in the short run since unemployment is assumed to converge to its natural rate, the steady state, in the long run (Romer, 2011). The concept of a constant natural rate of unemployment, at which inflation stabilizes, referred to as the "natural rate hypothesis," was later extended to the widely-used Non-Accelerating Inflation Rate of Unemployment (NAIRU) concept (Laubach, 2001; Palley, 2018).^e Fig. 1 shows that the expectation-augmented Phillips curve can explain inflation and unemployment dynamics relatively well from 1980 to 1995, where recessions led to a decline in inflation. For instance, during the early 1980s recession, a high unemployment rate corresponded with a decrease in inflation, and generally, higher rates of unemployment were linked to shrinking inflation. Additionally, inflation began to rise as unemployment fell below 6 % in the mid-1980s, and inflation stabilized when unemployment reached 6–7 % by the end of the decade, which was its natural rate at that time. Similar patterns occurred during the early 1990s, consistent with the model (Romer, 2011).

In the 1970s, in addition to the natural rate hypothesis, the rational expectations hypothesis replaced the adaptive expectations hypothesis as an explanation for how agents form their inflation expectations. The rational expectations hypothesis was a key element in the development of classical macroeconomics (Chari, 1998). It assumed that economic agents are forward-looking and form their expectations based on all publicly available information, adjusting their previous expectations as necessary. This is in contrast to the adaptive expectations hypothesis, which assumes that agents form their expectations based on past data without taking into account all available information. As a result, the rational expectations hypothesis replaces π_{t-1} with $\pi_t^e + E_t$ in Eq. (2), reflecting the use of non-lagged information and the consideration of disturbances (Snowdon and Vane, 2005). Adopting rational expectations means that policymakers cannot permanently push unemployment below its natural rate if they are willing to tolerate steadily rising inflation. Instead, firms and workers adjust their behavior in response to continuous increases in inflation. Consequently, the trade-off between inflation and unemployment would depend on both the current inflation rate and expectations of economic agents (Romer, 2011).

The positive association between unemployment and inflation during the "Great Inflation" of the 1970s and 1980s can be partially attributed to higher levels of inflation, which may have affected firm's price-setting behavior. However, according to Gordon (2013), the Phillips curve needed to be further adjusted to account for the impact of supply shocks, such as oil price shocks at that time. By explicitly incorporating supply shock variables into the Phillips curve instead of forcing them into the error term, the "triangle model" became broadly consistent with U.S. data during the 1970s. Consequently, inflation-unemployment dynamics during the "Great Inflation" can be explained by the sharp increase in oil prices, which was accompanied not only by a rise in inflation and a subsequent reduction in purchasing power but also by recessions and a subsequent rise in the unemployment rate (Gordon, 2013).

In the 1980s, the "New Keynesian Phillips Curve" (NKPC) became the dominant approach in literature and research on the Phillips curve. The most important theoretical model for the NKPC was suggested by Roberts (1995). New Keynesians aimed to provide a microeconomic framework to explain the slow adjustment of wages and prices and its impact on the macroeconomy (Snowdon and Vane, 2005). The core New Keynesian proposition is based on Calvo (1983), which assumes staggered price adjustment in a non-competitive and imperfect market. According to this model, firms set their prices equal to the average desired price of all firms at certain points in time, which are determined at the individual level by aggregate price level, unemployment gap, and menu costs associated with price adjustments (Gordon, 2013). Microeconomic data show that menu costs are not insignificant, accounting for about 0.5–1 % of the revenue of average U.S. firms in the 1990s (Romer, 2011). Including the staggered price adjustment model in the Phillips curve has an implication that it does not imply inflation inertia, which is supported by empirical evidence in the U.S. Inflation inertia describes the phenomenon that high inflation tends to persist and is only interrupted by a low output period. Inflation tends to fall during recessions and rise during booms (Romer, 2011). To account for lagged inflation, a widely used strategy is to include the backward-looking component by directly accounting for lagged inflation. Consequently, a "hybrid" expectation-augmented Phillips curve, which has been widely adapted in literature, depends on both past inflation rates and inflation expectations (the forward-looking component) (Romer, 2011).

Despite numerous attempts to improve the New Keynesian Phillips Curve (NKPC) by adjusting its functional form and variables

^e In what follows, the terms are used interchangeably, but technically there are slight differences between the two concepts in terms of the time horizon to which they refer. However, Ball (2006) argues that the natural rate of unemployment is approximately a synonym for the NAIRU.

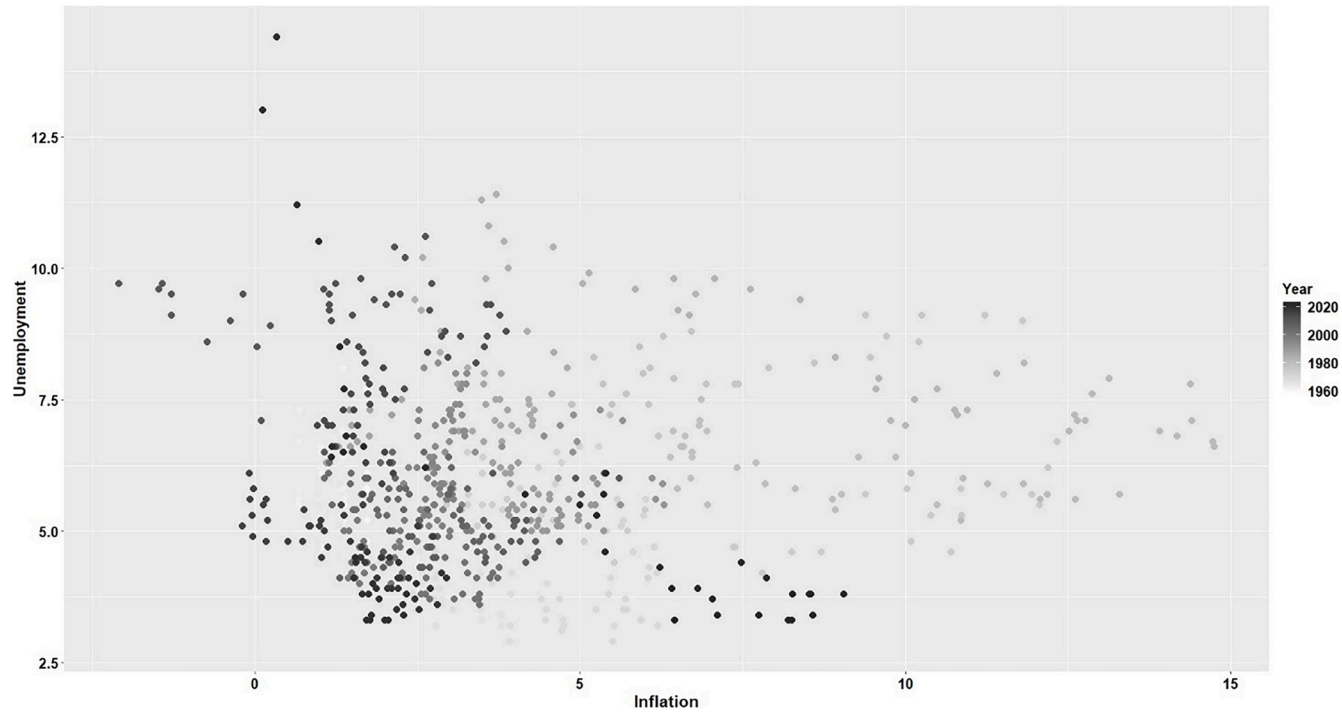


Fig. 2. US unemployment rate vs. inflation. Graph created by authors.

considered, the model has repeatedly failed to match current data. An alternative approach to the Phillips curve has been proposed by post-Keynesian economists, who reject the idea of a vertical Phillips curve in the long run and the existence of a unique value for the non-accelerating inflation rate of unemployment (NAIRU). According to post-Keynesians, changes in economic capacity only cause inflationary or deflationary pressures at extreme levels, implying a Phillips curve that is sloped horizontally in a piece-wise manner, and a range of values for the NAIRU instead of a single value. This new approach would allow further utilization of the labor market without increasing inflation, which has significant implications for monetary policy (Palley, 2018; Kriesler and Lavoie, 2007).

In the years leading up to the pandemic, the Phillips curve debate regained momentum, largely due to the financial crisis and its aftermath. Despite high unemployment rates and its persistence, inflation remained stable in a narrow range of 1–2 % during the crisis, and deflation did not occur, contrary to many historical Phillips curve estimations. This inconsistency is known as the “deflation puzzle”. On the other hand, the “disinflation puzzle” refers to the question of why inflation was slow to recover despite steady improvement in economic activity in the years following the financial crisis (Ball, 2006). In the following, we discuss three widely accepted hypotheses that attempt to solve these puzzles.

3. Overview of existing hypotheses

3.1. Anchored expectations

The first type of explanation is the “anchored expectation hypothesis”. This hypothesis suggests that changes in monetary policy have led to changes in the way economic agents form their inflation expectations. Specifically, when expectations align with a central bank’s numerical inflation target, the slope of the Phillips curve may be reduced, or the structural relationship between inflation and unemployment may be altered through other channels. This theoretical argument has spurred new empirical research, particularly since many central banks, including the Fed, adopted inflation targeting in the early 2000s. The importance of understanding the interplay between expectations, monetary policy actions, and inflation dynamics from the central bank’s perspective continues to motivate both theoretical and empirical research on this topic (Bernanke, 2007). The formation of expectations depends on the expected actions of the central bank as well as the actions that are actually implemented. Changes in the process of expectation formation can strongly influence the central bank’s communication strategies or target weighting. However, economists have become concerned about the deanchoring of inflation expectations since the pandemic (Blanchard, 2021). This process refers to a misalignment of expectations with the Fed’s target, which may have been triggered by three factors: persistent divergence of actual inflation from the 2 % target, slow pace of interest rate increases, and the Biden administration’s extensive fiscal stimulus in response to the pandemic. Therefore, it is interesting to investigate whether inflation expectations have systematically changed during the pandemic and, if so, whether such a change is consistent with observed slopes and thus provides empirical support for the hypothesis.

The term “anchoring of expectations” refers to the trend of economic agents relying more on the central bank’s numerical inflation target, rather than past inflation rates, when forming expectations about future inflation rates (Bernanke, 2007).^f While there is a consensus in the literature that long-term inflation expectations are more firmly anchored today, there is debate about when this process began. On one hand, numerous studies suggest that the change in monetary policy under then-Fed Chairman Volcker in the early 1980s marked the beginning of the anchoring of inflation expectations, even though the Fed did not have an explicit numerical inflation target at that time (Blanchard et al., 2015; Jorgensen and Lansing, 2022; Matheson and Stavrev, 2013; Roberts, 2004). Monetary policy aimed to stabilize inflation by responding more aggressively to fluctuations in output and inflation, leading to increased credibility and a reduced emphasis on past inflation in forming expectations. The accuracy of inflation forecasts also improved as estimates of an economy’s potential output became more precise. On the other hand, other studies point to the Fed’s announcement of a 2 % inflation target in 2012 as the starting point of anchored inflation expectations (Bundick and Smith, 2020). Ball and Mazumder (2011) reconcile both positions by distinguishing between “shock anchoring” and “level anchoring”. Shock anchoring refers to expectations of future inflation rates being less influenced by supply shocks, as evidence suggests since the change in monetary policy regime under Volcker. In contrast, “level anchoring” refers to expectations remaining constant at the level of the communicated inflation target, as has been the case since the introduction of the official inflation target in 2012.

The impact of inflation expectations on the Phillips curve’s slope coefficient was first explained by then-Fed Chairman Bernanke, who suggested that inflation expectations affect firms’ pricing decisions. According to this argument, anchored inflation expectations make prices and inflation less sensitive to economic conditions. This, in turn, implies that a temporary increase in inflation caused by, for instance, a sudden rise in energy prices, would be absorbed rather than translated into permanent inflation (Bernanke, 2007; Bundick and Smith, 2020). Although the link between inflation expectations and firms’ pricing decisions is an essential element of the New Keynesian framework, empirical evidence at the microeconomic level has only recently been found. For example, using data from firms in the U.S. and France, respectively, Afrouzi and Yang (2021) find that firms engage in ex-ante considerations of future inflation to avoid severe profit losses in the long run. At the macroeconomic level, Bundick and Smith (2020) find evidence of a reduction in the slope coefficient over the 2012–2019 period, which is primarily due to better-anchored inflation expectations.

Blanchard et al. (2015) first noted that better anchored expectations not only changed the slope but also the underlying structural

^f Blanchard et al. (2015) uses the term in a slightly different way. According to him, anchoring describes the fact that actual inflation depends less on past inflation rates than on long-term inflation expectations. Although this definition differs from what is understood in the rest of the literature, their implications are complementary: both phenomena imply that actual inflation depends less on past inflation and more on expectations (Ball, 2015).

shape of the Phillips curve, a finding supported by further empirical evidence from [Ball and Mazumder \(2019\)](#) and [Jorgensen and Lansing \(2022\)](#). The authors argue that the Phillips curve has evolved from an accelerationist relationship to a traditional relationship. In periods of weakly anchored inflation expectations, the slope of an accelerationist Phillips curve captures the sensitivity of the change in inflation to economic slack, where inflation is expected to decline as long as the actual state of the economy negatively deviates from its potential. In contrast, when inflation expectations stabilize at a constant level, the Phillips curve returns to a level-level relationship, where the slope captures the impact of economic slack on the level of inflation. Therefore, a lower slope during periods of high unemployment, as seen during the financial crisis, indicates a low level of inflation rather than a continuously declining inflation rate. This is consistent with the inflation dynamics observed in US data. [Jorgensen and Lansing \(2022\)](#) provide empirical support for this argument, showing that the correlation between the change in the inflation rate and output gap has decreased between 1960 and 2019, while the correlation with the level of inflation has increased. [Campbell et al. \(2020\)](#) detect a structural break in 2001Q2, after which the relationship between inflation and the output gap became positive.

The relationship between anchored inflation expectations and the Phillips curve's slope parameter is not universally accepted in the literature. Some studies suggest that the Phillips curve's structural relationship between inflation and unemployment is changed solely by the coefficient of expected inflation, due to anchored expectations ([Ball and Mazumder, 2011](#); [Stock, 2011](#)). This perspective is supported by [Hazell et al. \(2022\)](#), who argue that the slope parameter can be unreliable and biased when inflation expectations fluctuate significantly over time, implying that long-run inflation expectations or their fluctuations may be responsible for the change in inflation rates rather than the curve's steepness. [Stock \(2011\)](#) also argues that the Phillips curve's parameter changes are consistent with a model where the slope is constant, and only the coefficient on past inflation varies over time.

The relationship between inflation and unemployment in the Phillips curve is affected by various factors, including inflation expectations of different economic agents. However, some studies express concerns that the inflation expectations of firms, which are crucial for the price formation process, are not well captured in most Phillips curve specifications due to the absence of systematic and consistent survey data. Therefore, these expectations need to be proxied, although finding a strong and exogenous instrument remains challenging ([Haschka, 2022, 2024a, 2024b](#); [Haschka and Herwartz, 2020, 2022](#)). [Mavroeidis et al. \(2014\)](#) reviewed different instruments to proxy expectations of firms and found that much of the sensitivity of estimates in the literature is due to the variety of instruments. In addition to survey-based measures, inflation expectations can also be represented by market-based data such as financial instruments or derived from reduced-form models. However, survey-based measures dominate the research despite the considerable variation in their dynamics. [Coibion et al. \(2018\)](#) demonstrate that inflation expectations of different economic agents differ in terms of their degree of anchoring. While forecasters' expectations appear to be well-anchored, households' expectations appear to be poorly anchored and more responsive to changes in commodity and energy prices. Replacing firms' inflation expectations with those of households yields a Phillips curve with a constant and smaller slope coefficient, which has important implications for the estimation of the Phillips curve coefficients. [Candia et al. \(2024\)](#) contribute to this research by providing insights from a recent survey on firms' inflation expectations. The data from the survey suggest that firms' forecasts are quite unstable and differ substantially from those of households and professionals, implying that none of the existing expectation measures reflect inflation expectations of firms well. Overall, while the relationship between inflation and unemployment in the Phillips curve is affected by inflation expectations of different economic agents, the lack of consistent and reliable data on firms' expectations remains a challenge in accurately capturing the dynamics of the Phillips curve ([Mavroeidis et al., 2014](#); [Ahn et al., 2020](#); [Coibion et al., 2018](#); [Candia et al., 2024](#)).

In summary, the implications for monetary policy are twofold. First, while inflation expectations may not be the sole explanation for the flattening of the Phillips curve, they do appear to play a significant role in inflation dynamics, particularly the degree to which they are anchored. If inflation expectations become deanchored, as suggested by various factors, there is a risk that current inflation surges may become permanent, and expansionary monetary policy may lose its ability to stimulate the economy ([Caselli et al., 2020](#)). To prevent expectations from deanchoring, it is important to closely monitor them, demonstrate deflationary pressure through higher interest rates, and communicate in a clear and credible manner ([Ball and Mazumder, 2019](#); [Gagnon, 2021](#)).⁸ Additionally, firms' expectations, as the ultimate price-setters, should be taken into account, but given the current lack of systematic and consistent survey data for firms, it would be helpful to collect such data and make them available for use in monetary policy. In the meantime, household expectations should be closely monitored and included in future Phillips curves, as they may reflect firms' expectations in part ([Coibion et al., 2018](#)). Furthermore, it is crucial to analyze detailed household survey data to understand how households form their expectations and how monetary policy can influence aggregate demand and inflation. For instance, during the pandemic, households followed a systematic supply-side interpretation of the Phillips curve, implying that they tend to restrain spending if they expect inflation and higher unemployment rates simultaneously ([Weber et al., 2022](#)). However, the Euler equation, another essential component of the FRB/US model, suggests the opposite, namely that spending increases when higher prices are expected ([Weber et al., 2022](#)). This finding is significant from a monetary policy standpoint since it implies that aggressive monetary policy may be less effective than previously believed. Therefore, studying detailed household survey data can help illuminate the relationship between expectations, spending behavior, and inflation and guide monetary policy accordingly.

The second implication is based on evidence regarding the relationship between inflation and unemployment levels and suggests that the Phillips curve is still valid and not as flat as some economists assume. If monetary policy operates on the mistaken belief that the curve is flat, it risks underestimating the sensitivity of inflation and may be tempted to keep unemployment below its natural rate for longer to exploit the trade-off ([Jorgensen and Lansing, 2022](#)). However, since inflation responds with a lag to changes in labor

⁸ In fact, the Fed has already raised interest rates in March 2022 for the first time since 2018 and are expected to continue to do so throughout the year.

market tightness, this strategy can result in permanently higher inflation rates (Blanchard, 2016). Additionally, monetary policy needs to consider that the already lagged response of inflation is amplified due to the shift of the Phillips curve to a level-level relationship. In a level-level relationship, inflation does not rise and fall as quickly by definition, which further complicates the task of monetary policy (Jorgensen and Lansing, 2022).

3.2. Globalization of inflation

The second hypothesis pertains to globalization and its increasing importance relative to domestic factors. Globalization refers to the increasing interconnectedness of the world's economies and societies. One potential benefit of globalization is that it can lead to lower domestic prices, as businesses have access to cheaper goods and services from other countries. However, this may not always be the case, as the impact of globalization on domestic prices can depend on a variety of factors. In theory, an increasing degree of foreign competition can lead to lower domestic prices, as businesses are forced to lower their prices to remain competitive. However, this may not always happen in practice. For example, if domestic producers can collude to maintain high prices, foreign competition may not have a significant impact on domestic prices. Additionally, if foreign producers are subject to high tariffs or other barriers to entry, they may not be able to compete effectively in the domestic market. In the same vein it is also important to note that globalization can have an impact on inflation. While globalization can lead to lower domestic prices, it can also lead to higher inflation if there is an increase in the price of imported goods, which is subject to the country's dependency on imports. Similarly, the impact of foreign workers on wages can depend on a variety of factors. In theory, the influx of foreign workers could lead to lower wages for domestic workers, as employers may be able to hire foreign workers for lower wages. However, this may not always be the case. For example, if foreign workers have specialized skills that are in high demand, they may be able to command higher wages than domestic workers. Ball (2006) argues that changes in the prices of goods and services produced abroad should not be counted as part of a country's inflation rate, as they do not represent changes in the prices of goods and services produced domestically. However, this theory has been subject to criticism, as it does not take into account the impact of changes in foreign prices on the domestic economy. In practice, changes in foreign prices can have an impact on the domestic economy, and therefore should be taken into account when measuring inflation.

Regarding the Phillips curve, the "globalization of inflation hypothesis" posits that higher levels of globalization are associated with a decreased impact of national economic slack on inflation and a decreasing slope of the country-specific standard Phillips curve (Ihrig et al., 2010). In this context, globalization primarily refers to the integration of both emerging and advanced economies since the 1990s, leading to increased global mobility of goods, capital, and labor (Ball, 2006). Research on this hypothesis gained attention in the mid-2000s, following a strong acceleration phase of globalization in the previous decade. While it receded in the background after the financial crisis, there has been renewed interest in the 2010s to explain the "missing disinflation puzzle." The pandemic and the resulting disruptions to global supply chains and temporary border closures offer an opportunity to revisit whether this hypothesis contributes to our understanding of how the Phillips curve changes over time. Various channels are proposed in the literature for how globalization can alter the inflation process, but their empirical evaluation leads to controversial results.

The first channel through which globalization affects inflation is related to the structural integration of goods markets, resulting in increased competition. As domestic firms share their goods markets with foreign firms, their pricing power declines, leading to downward pressure on prices (Wynne et al., 2012). The possibility of breaking up production processes and moving them to areas with lower costs due to market integration further depresses prices. In contrast to these indirect effects, global factors directly drive domestic prices. For instance, imports, which account for a significant portion of both final goods and intermediate goods baskets, contribute to much of the overall price volatility (Forbes, 2019). The increasing importance of emerging markets, particularly China, to global growth and demand for commodities, has caused considerable volatility in commodity prices (Forbes, 2019). Pricing decisions at the firm level are also influenced by exchange rate fluctuations. This affects both exporting firms, which can price in exchange rate uncertainties, and domestic firms, which pass on exchange rate costs to consumers (Wynne et al., 2012). Overall, the integration of goods markets increases the significance of foreign factors, including foreign costs, demand, and macroeconomic conditions, for domestic prices. The weak association between internationally determined prices and domestic business cycles suggests a decline in the sensitivity of prices to domestic slack, resulting in a flattening of the Phillips curve (Stock and Watson, 2020).

The second channel by which globalization affects the Phillips curve is through the international mobility of labor and capital, resulting in a weakening of the relationship between labor supply and wage demands. This effect is associated with a reduced sensitivity of aggregate price level to labor market tightness, leading to a flatter Phillips curve (Razin and Binyamini, 2007). The international labor markets allow domestic firms in advanced economies to replace their workers with foreign workers with lower wage expectations, resulting in domestic workers losing bargaining power and reducing their wage demands, ultimately affecting the overall price level (Friedrich and Selcuk, 2022). Additionally, financial market integration expands financing options for individuals, allowing them to smooth their consumption over time, which reduces the need for labor supply adjustment and eliminates the need for wage bargaining due to changes in labor supply (Razin and Binyamini, 2007).

Critics of the hypothesis of the "globalization of inflation" argue that the impact of the two channels is weakened by two factors. First, they stress the importance of monetary policy for long-term inflation. According to Ihrig et al. (2010), a change in inflation caused by global price pressures can only have a short- or medium-term effect and is counteracted in the long term by inflation-targeted monetary policy. Second, Ball (2006) suggests that the argument of the "globalization of inflation" hypothesis is based on false conclusions resulting from the "fallacy of accounting inflation theory". In other words, import prices are relative prices, whereas inflation refers to the overall change in nominal prices. In theory, relative prices do not necessarily affect nominal prices, and even a sharp increase in import prices can be consistent with a constant rate of inflation if other relative prices decline at the same time. However, Ball (2006) also finds some empirical evidence for this channel, but only when relative prices change significantly.

Theoretical debates are also mirrored in empirical evidence. Empirical studies differ in how and to what extent globalization enters the Phillips curve. For example, [Gordon \(2013\)](#) typically extends the standard NKPC to control for aggregate supply shock variables, including price changes in food and energy, non-food items, or (non-oil) imports. To account for the fact that demand is increasingly determined at the country rather than the product level, [Borio and Filardo \(2007\)](#) emphasize the importance of integrating global slack measures into the Phillips curve. Other studies explicitly investigate whether the flattening of the Phillips curve is due to globalization. [Forbes \(2019\)](#) provides empirical evidence of a flattening of the Phillips curve that can be attributed in part, though not entirely, to increased volatility in commodity prices. Similarly, the results of [Razin and Binyamini \(2007\)](#) suggest that international mobility of capital, goods and labor jointly contribute to the flattening. These findings contrast with the results of [Milani \(2012\)](#), whose specification of the Phillips curve only yields a marginal flattening despite the substantial increase in trade openness. Similarly, [Ihrig et al. \(2010\)](#) find evidence of a flattening of the Phillips curve in many economies, but no conclusive evidence that this change is due to globalization. One possible explanation for the difficulty in identifying such effects is low variation in inflation in recent decades combined with a relatively short sample for globalization ([Ihrig et al., 2010](#)).

In conclusion, the evidence on whether globalization is the primary cause of the flattening of the Phillips curve before and during the pandemic is not conclusive, despite empirical studies showing that inflation is more responsive to import prices ([Amiti et al., 2021](#); [Friedrich and Selcuk, 2022](#); [Forbes, 2019](#); [Ihrig et al., 2010](#); [Matheson and Stavrev, 2013](#)). Nonetheless, the fact that global factors partly determine domestic inflation has important implications for monetary policy. Central banks should closely monitor external developments to avoid underestimating or overestimating inflation and making inappropriate policy decisions ([Borio and Filardo, 2007](#)). [Razin and Binyamini \(2007\)](#) also demonstrate that when facing global price pressures, it is macroeconomically optimal to prioritize inflation over output stabilization.

3.3. Nonlinearities

The time variation of the Phillips curve relationship can also be explained by the possibility of nonlinearities. Specifically, it is proposed that the slope parameter is path dependent and changes as a function of economic slack or the level of inflation. [Phillips \(1958\)](#) originally recognized this dependence on macroeconomic conditions in the 1960s, observing that "workers are reluctant to offer their services at lower than prevailing rates when demand for labor is low and unemployment is high, so wage rates fall very slowly." However, it was not until after the financial crisis that the issue of nonlinearity was revisited, with the apparent flattening of the curve stimulating theoretical and empirical research on the subject ([Lye and McDonald, 2021](#); [Lye et al. 2001](#)). Today's high inflation rate and current overheating of the economy provide an interesting starting point to contribute to the empirical evidence for the debate on the possible existence of nonlinearities after the low-inflation environment of the past two decades (see, e.g., [Bunn et al., 2022](#); [Brent Bundick and Lee Smith, 2023](#)). For recent evidence of statistically significant nonlinearities, see [Benigno and Eggertsson \(2023\)](#).

One hypothesis related to the Phillips curve is that its slope depends on the level of inflation due to price and wage rigidities. Nominal prices may be rigid because of menu costs, which lead only some firms to change their prices in response to a demand shock. In a low-inflation environment, menu costs are likely to outweigh the benefits of price adjustments, making prices even more rigid. Similarly, firms may enter into longer employment contracts during times of low inflation to minimize the costs of wage negotiations. Furthermore, employees are less willing to accept a decline in nominal wages than a decline in real wages due to money illusion, institutional, or behavioral factors, which implies that nominal wage reductions are rare.

Another argument that motivates an asymmetric relationship between output and inflation is "inflation salience", where the trade-off is less apparent when people are not paying as much attention to price trends, which is more likely when inflation is low ([Blanchard et al., 2015](#)). Although there are various theoretical models that motivate nonlinearities in the level of inflation, empirical studies at both the micro and macro levels do not provide clear evidence ([Ball and Mazumder, 2019](#); [Blanchard et al., 2015](#)).

The second related hypothesis posits that the slope of the Phillips curve is contingent on the sign or size of the gap measure. Inflation is said to only respond to excess demand when the curve is relatively flat, as is the case in recessions when the gap is negative, but steep otherwise. One possible explanation for this capacity constraint model is the difficulty that firms face in increasing their production capacity in the short run when there is an increase in demand. As firms approach their capacity limits, excess demand grows, leading to higher inflation rates. Another model, the downward nominal wage rigidity model, suggests that nominal wage rigidities are correlated with the business cycle. In recessions, for instance, the share of workers who experience no nominal wage change increases with the unemployment rate. This causes firms' marginal costs to not fall as much, resulting in nominal prices falling less. The convex Phillips curve predicted by these models is contrasted with the concave shape predicted by the monopolistic competition model, which considers the competitive aspect of firms' strategic pricing behavior in monopolistic or oligopolistic markets. Empirical evidence favors a convex curve for the U.S. Despite conflicting theoretical arguments economists suggest that the trade-off between inflation and unemployment becomes evident only when the deviation from potential output exceeds a certain threshold. One possible explanatory factor is that discrete wage jumps and correspondingly large price changes occur only when changes in economic conditions become very large. Indeed, studies provide evidence of nonlinearities in the relationship between inflation and the level of the unemployment rate in the U.S. ([Barnes and Olivei, 2003](#); [Daly and Hobijn, 2014](#); [Gross and Semmler, 2019](#); [Mineyama, 2023](#)). [Laxton et al. \(1999\)](#) find that the response of inflation is greater to positive shocks to unemployment than to negative shocks, suggesting that the Phillips curve is in fact asymmetric. The authors also find that the degree of asymmetry varies over time, with greater asymmetry during periods of low inflation. For monetary policy, the Federal Reserve may need to respond differently to positive and negative deviations from full employment. Specifically, the authors argue that the FED should be more aggressive in responding to positive deviations from full employment in order to prevent an increase in inflation.

The "low-inflation bend model" is a nonlinear specification of the Phillips curve that combines the hypotheses of the traditional

Phillips curve and the wage rigidity hypothesis. This model suggests that the slope parameter is particularly low in periods of high unemployment and low inflation. Recent research by [Forbes et al. \(2021b\)](#) finds evidence for this type of nonlinear Phillips curve in the US and attributes the recent flattening of the curve to a structural increase in downward nominal wage rigidities. The existence of a nonlinear Phillips curve has important implications for monetary policy because the same measures can have different real effects. In periods of slack, the effects are stronger than in periods of tightness ([Cristini and Ferri, 2021](#)). However, the appropriate policy response depends on the theoretical framework from which the nonlinearity arises. If the slope parameter depends on the size of the unemployment gap, then it is appropriate to take preventive action against possible inflationary pressures. This can help avoid the higher future costs that would result from a convex Phillips curve as inflation rises ([Dupasquier and Ricketts, 1998](#)). On the other hand, if the nonlinearity exists with respect to the inflation rate, inflation will rise very slowly, at least in a low-inflation environment. This would give the central bank more time to gather relevant information about the state of the economy and tailor its response accordingly ([Cristini and Ferri, 2021](#)). Additionally, [Dolado et al. \(2005\)](#) argue that a nonlinear Phillips curve should also be reflected in a nonlinear Taylor rule. An optimal rule would include an interaction term between expected inflation and expected economic slack, which would induce a stronger monetary policy response when inflation is triggered by a particular high rate of unemployment and help overcome the limited effectiveness of monetary policy due to the relatively low sensitivity of inflation.

4. Recent developments

4.1. COVID 19 dynamics

[Blanchard et al. \(2015\)](#) argue that the Phillips curve has steadily weakened in the U.S., especially during pre-pandemic times. While there is no doubt that the monetary policy's impact on the inflation expectations, households probably did not pay sufficient attention to economic news, especially news on macroeconomic variables. [Ball et al. \(2021\)](#), [Bobeica and Hartwig \(2021\)](#), and [Smith et al. \(2023\)](#) find a significant decline in the slope during the pandemic, indicating well-behaved inflation despite a substantial drop in unemployment. [Bobeica and Hartwig \(2021\)](#) used the NKPC model with four different slack measures and found that the slope fell by about 40–50 % during the first three-quarters of the pandemic in the euro area. [Ball et al. \(2021\)](#) showed that median CPI inflation between 2020Q1 and 2021Q2 did not fall as much as the pre-pandemic Phillips curve would have predicted given the sharp increase in the unemployment rate, suggesting that the slope parameter decreased, and the slack in the economy had a marginal impact on inflation. More recently, [Smith et al. \(2023\)](#) report of a marked flattening in the Phillips curves for US sectoral data and among EU countries, particularly poorer ones. This flattening of the Phillips curve also holds for core inflation ([Constancio, 2015](#)) and is sensitive to fluctuations in energy and food prices since 2007 (Stock and Watson, 2010). Household expectations of inflation have played a role in the divergence between professionals and households during the financial crisis and the pandemic recession, leading to a higher slope parameter when households' inflation expectations are used ([Ball et al., 2021](#); [Bobeica and Hartwig, 2021](#); [Coibion et al., 2018](#)). [Crump et al. \(2024\)](#) suggest that this pattern of diverging expectations may explain recent differences in the evolution of the slope.

Regarding the evolution of pre-pandemic NAIRU, [Matheson and Stavrev \(2013\)](#) and [Gordon \(2013\)](#) argue that the rise of the estimated NAIRU through the 1990s was caused by the two oil price shocks in 1973 and 1979, while subsequent declines were attributed to structural changes in the U.S. labor market, such as demographic shifts, technological advancements, and policy changes. These factors have contributed to changes in labor market efficiency and flexibility. [Snowdon and Vane \(2005\)](#) also support this explanation. Alternatively, hysteresis theories propose that a rising NAIRU is due to path dependence, where actual unemployment rates in previous periods exceed the natural rate of the earlier period, leading to persistent unemployment. The increase in the U.S. NAIRU since the start of the pandemic supports the findings of [Crump et al. \(2024\)](#), which show an increase of about 1.5 percentage points in the estimate between 2019 and 2021, indicating higher structural unemployment.

In contrast with this, other recent empirical works find a steepening of the Phillips curve relationship during the pandemic. [Cerrato and Gitti \(2022\)](#) discovered that the slope of the Phillips curve reached zero during the pandemic and increased more than threefold relative to the pre-COVID period from March 2021 onwards, reaching its highest level since the mid-1970s. An economic recovery driven by demand explains approximately 1.4 percentage points out of the total 5.6 percentage-point increase in all-items inflation observed from March 2021 to September 2022. If the slope of the Phillips curve had not steepened after COVID, the contribution of demand to the inflation rise would have been smaller. [Benigno and Eggertsson \(2023\)](#) identify nonlinearities in the Phillips curve as the driving force behind the increase in inflation during the 2020s. They suggest that the failure of policymakers and market participants to foresee the surge in inflation or its persistence may be attributed to the implicit or explicit assumption of a "flat" Phillips curve. Even as inflation escalated significantly, the belief that expectations were stable provided reassurance that the surge was transitory. One question that arises is why the FED did not raise interest rates more rapidly. One possibility is that the new policy framework announced in 2020 placed greater emphasis on the employment aspect of the Fed's dual objective. However, it also acknowledged the lack of agreement on any precise measure of how close the US economy was to full employment at any given time. This contrasts sharply with the other side of the mandate, namely inflation, where there is broad consensus on how the Fed can achieve its objective ([Higgins, 2021](#)).

The question of whether the Covid-19 pandemic represents another empirical failure of the Phillips curve is an intriguing one that warrants further research. With regards to inflation, the pandemic has disrupted patterns of consumer spending, which are not fully

captured in the most recent CPI expenditure weights (Cavallo, 2024).^h This shift in consumer behavior, driven by pandemic-related lockdown measures, has resulted in a higher share of food and other groceries and a lower share of transportation, which may lead to an underestimation of inflation. The CPI may underweight rising food prices and overweight falling transportation prices, thereby distorting the accuracy of inflation estimates (Reinsdorf, 2020). Moreover, unemployment rates and the estimated natural rate are also subject to considerable uncertainty, and our understanding of actual economic slack may further crystallize in the future (Bobeica and Hartwig, 2021). Finally, the Fed's endogenous stabilization policies, based on the Phillips curve, may to some extent blur the structural relationship between inflation and unemployment (McLeay and Tenreyro, 2020). Given the unprecedented monetary and fiscal policy response during the pandemic, this identification problem may also become more pronounced, particularly during the Ukraine war.

4.2. Specification of the Phillips curve

The issue of a nonlinear Phillips curve and its flattening during the pandemic raises questions about whether the relationship is properly specified in its functional form, and whether its recent dynamics are affected by the choice of variables. Various factors can influence structural parameters, including the choice of inflation measure or the series describing labor market developments (Ball et al., 2021). Additionally, there is evidence that the slope parameter is sensitive to different measures, such as temporary layoffs due to lockdown measures during the pandemic. When controlling for such factors, Ball et al. (2021) found that the slope of the pre-pandemic Phillips curve did not change systematically, and that the specification reflected recent core inflation behavior well.

Previous literature has also shown a close relationship between the slope of the Phillips curve and firms' marginal costs, which can change due to factors such as hiring costs (Gordon, 2013). If the firm's marginal costs increase, it may choose to increase prices to maintain its profit margin. This increase in prices can contribute to an increase in inflation. Conversely, if the firm's marginal costs decrease, it may choose to lower prices to gain market share or increase sales. This decrease in prices can contribute to a decrease in inflation. Specifically, if firms are able to adjust prices quickly and fully in response to changes in marginal costs, the Phillips Curve may be relatively steep, with a large change in inflation for a given change in the unemployment rate. This is because firms are able to quickly pass on changes in their costs to consumers in the form of higher or lower prices. On the other hand, if firms are slow to adjust prices in response to changes in marginal costs, the Phillips Curve may be relatively flat, with a smaller change in inflation for a given change in the unemployment rate. This is because firms are not able to fully pass on changes in their costs to consumers, which can lead to a longer period of adjustment and a smaller impact on inflation. From the work supply side rather than the market side, a higher probability of ending firm-worker relationships and a higher probability of needing to fill vacancies are associated with a lower slope (Ravenna and Walsh, 2008). The opposite effect, where firm-worker relationships were maintained and vacancies did not need to be filled, could explain why the slope rose once labor markets began to normalize during the pandemic (Bobeica and Hartwig, 2021; Ball et al., 2021).

The literature emphasizes that different measures of inflation, inflation expectations, and unemployment significantly affect structural parameters (Mavroeidis et al., 2014). However, choosing the right specification is not easy, as variables involved have to be adjusted depending on the situation to better reflect real inflation dynamics (as was the case for the unemployment rate during the pandemic). Additionally, there is a lack of comprehensive long-term data on firms' inflation expectations, with only a few surveys conducted to date. Monetary policymakers should be aware of this sensitivity, as inflation forecasts can differ greatly across specifications, with varying effects in strength and direction depending on the specification. A "thick-modelling" approach that involves averaging different specifications, as suggested by Bobeica and Hartwig (2021), can provide at least some hedge against parameter instability in inflation forecasting.

Gordon (1975) proposed modifying the Philips curve by incorporating supply shock. While this approach seemed sensible in view of the oil price shocks in the 1970s, it was almost completely forgotten in times of stability. Pre-pandemic (empirical) literature on the Philips curve has not considered taking supply shocks into account. However, globalization coupled with global supply chains and international trade introduces another mechanism that makes the Philips curve more sensitive to shocks. In particular, the escalation of trade conflict between the U.S. and China, the Russia-Ukraine crisis as well as the Israeli-Palestine conflict more recently. While these events have major effect on global supply chain and international trade, the creation of political uncertainty and supply shocks calls for a modification of the Philips curve that requires greater consideration of the impact of shocks.

5. Conclusion

In this study, we explore three notable hypotheses that aim to explain why the Phillips curve, which shows the relationship between inflation and unemployment, has flattened since the early 1980s. Furthermore, we observe that during the initial months of the pandemic, the curve appears to have flattened even further, with a sharp decline in the slope parameter, in contrast to the gradual decline observed over the past 40 years. Upon closer inspection of the validity of these hypotheses, we make four key findings. Firstly, we find that neither the "anchored expectation hypothesis" nor the "globalization of inflation hypothesis" appear to be the primary cause of the flattening of the Phillips curve, both before and during the pandemic. Secondly, there is some weak evidence that the traditional Phillips curve, which focuses on the relationship between the level of inflation and the unemployment rate, may again be more appropriate than the accelerationist specification that currently dominates the literature. Thirdly, we observe that the impact of

^h CPI expenditure weights are updated once a year by most national statistical offices using expenditure data from previous years.

imports on domestic inflation in the US increased during the pandemic, suggesting that external developments should be closely monitored to avoid underestimating or overestimating inflation. Finally, we suggest that nonlinear effects at different levels of inflation and economic slack may play a role in conjunction with the “low-inflation bend model”, where the slope decreases when low inflation and high unemployment coincide.

Considering recent literature, there is a growing concern that the Phillips curve may no longer be a valid framework for understanding the relationship between inflation and unemployment that underpins U.S. monetary policy. The current structure of the Phillips curve may be outdated, which necessitates a discussion on how monetary policy can adjust to meet current challenges and achieve the dual mandate of maximum employment and price stability. The weakening relationship between inflation and unemployment in some periods has two important implications for the dual objective. First, controlling inflation has become more difficult and costlier. A smaller slope limits the scope for monetary policy to control inflation by setting domestic demand, especially when interest rates are already very low, and monetary policy is constrained by the zero-lower bound (Cristini and Ferri, 2021). Second, if the curve is flat, there is a risk that monetary policy will underestimate inflation sensitivity and keep unemployment below the natural rate for an extended period, leading to a sudden inflationary spiral (Blanchard, 2016; Gordon, 2013; Palley, 2018). To account for these effects, monetary policy should prioritize economic slack more than inflation by emphasizing economic stabilization through an “average inflation target” (Constancio, 2015).

Regarding the suitability of the Phillips curve as a monetary policy tool, it should continue to be used as a reference model to identify the most important structural determinants of inflation. However, it is not robust enough as a stand-alone tool for inflation forecasts and needs to be complemented by careful monitoring of other drivers, such as business and household expectations, global external price pressures, and the interaction between expected inflation and the expected output gap. It is also reasonable not to commit to a single specification of the Phillips curve in terms of its functional form and choice of variables. A “thick-modeling” approach can provide a hedge for inflation forecasts to counteract parameter instability (Bobeica and Hartwig, 2021). Moreover, the Phillips curve implied NAIRU should be supplemented by a variety of estimates to account for ongoing structural changes and uncertainty related to its estimation due to its unobservable nature. Despite these necessary additions, the Phillips curve remains a useful model for inflation and primarily serves to increase the transparency of monetary policy, which is particularly important in times of potentially deanchored inflation expectations.

CRedit authorship contribution statement

Rouven E. Haschka: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

None of the authors has conflicts of interest to declare

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