DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

# Is globalization reducing the ability of central banks to control inflation?

## IN-DEPTH ANALYSIS

### Abstract

In the period following the financial crisis, euro area inflation fell to historically low levels. In this report, we investigate the ability of central banks to control inflation. The rising globalization of markets may have changed the determinants of the inflation process, as drivers from the global economy might have gained importance. This could imply that the task to control domestic inflation is becoming more challenging for central banks. In this report, the impact of globalization on inflation is considered in more detail. Specific topics include the potential role of commodity prices and changes in wage-setting behaviour.

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# EXECUTIVE SUMMARY

- Starting from the 1980s, inflation has declined in many countries. Lower inflation might be partially caused by the greater success of monetary policy in controlling the inflation rate. The stronger focus on inflation control, underpinned by more central bank autonomy caused by flexible exchange rates and a greater awareness to act in a pre-emptive manner, resulted in better and more credible policy.

- Euro area inflation fell further following the recent crisis. Still, the evolution might be explained in terms of standard determinants, such as inflation expectations, output gaps and commodity prices. Inflation expectations decreased, in line with actual inflation. Domestic demand is still rather weak and hampered by fiscal consolidation. The fall of commodity prices accelerated the evolution.

- In addition, globalization may have gradually changed the conditions under which economies operate, with potential effects on inflation and inflation control by central banks even long before the financial crisis. Channels include higher competition in integrated markets and cost reductions, commodity price shifts and changes in wage-setting behavior.

- Up to now, the evidence for the presence of global variables in the Phillips curve framework is rather weak. With a few notable exceptions, global output gaps are found to be insignificant. More supportive effects for the impact of globalization on domestic CPI inflation are are detected for the import price channel.

- Depending on their nature, the effects of oil price shocks on domestic inflation may differ. Demand shocks tend to be more important than shocks in the oil supply. The empirical evidence on whether oil price effects have increased in recent times is inconclusive. On the one hand, wage-price spirals are less relevant in recent periods. On the other hand, oil price fluctuations might have a higher impact on domestic inflation in a very low inflation environment.

- The trade-off between inflation and unemployment has weakened. This can be attributed to central banks' success in anchoring long-term inflation expectations before the crisis. In addition, structural changes such as globalization have put downward pressure on wages, making prices and wages less responsive to changes in domestic demand. Hence, cyclical changes in unemployment are less likely to have significant inflationary or disinflationary effects.

- To the extent that domestic inflation is driven by global factors, the task to control inflation becomes more challenging for central banks. While central banks can always control inflation under a floating exchange rate regime, globalization presents more of a problem for the short-run stabilization of output and inflation. Up to now, the empirical results on the globalization effect are rather fragile.

# 1. INTRODUCTION TO THE REPORT

There is widespread agreement among economists that in the long run, when prices can completely adjust, inflation is inherently a monetary phenomenon (Benati, 2009). Since money defines the unit of account, monetary developments are integral for the determination of prices and inflation. Excessive liquidity can provide early signals for the occurrence of speculative bubbles in asset prices with potential risks to inflation and the real economy (Bussiere and Fratzscher, 2006, Adalid and Detken, 2007). Thus, monetary developments play a key role in the two pillar strategy of the ECB. While one pillar is based on the economic analysis of price risks in the short run, the other is built on the monetary analysis of price risks over the medium and long term. The explicit reliance on monetary aggregates is a distinguishing feature of the ECB compared to other central banks (Hall, Swamy and Tavlas, 2012). Over long periods, average inflation can be traced back to the rate of monetary expansion. According to the quantity theory of money:

(1)   $p_t^* = m_t - y_t^*$ .

Thus, long run equilibrium inflation $p^*$ should be equal to the difference between money growth m and potential output growth $y^*$. Other things being equal, an increase in the rate of monetary expansion will ultimately lead to higher inflation pressure in the long run. Following De Grauwe and Plan (2005), tighter linkages between money and prices can be observed, particularly in high-inflation economies. Despite the fact that the impact of money on prices is a long lasting phenomenon, Dreger and Wolters (2014) conclude that monetary aggregates have some potential to improve short term inflation forecasts for the euro area, even in the most recent period. The accuracy rises with the forecasting horizon. In addition, the development of monetary aggregates does not yet indicate inflation pressure in the euro area; see Dreger and Wolters (2015).

Because of the existence of price rigidities, monetary policy can affect real output, but the impact is limited to a transition period when prices do not fully adjust. Monetary policy influences the financial conditions under which economic actors operate. During normal times, the central bank adjusts the policy rate, which typically is set by some kind of rule. In fact, the so-called Taylor rule is often used to describe the monetary policy stance in the period before the crisis. Here, the policy rate reacts to the (expected) gaps in inflation and output; i.e. the deviations of actual inflation from the inflation target and actual output growth from potential output growth. According to the Taylor (1993) principle, the coefficient of the inflation gap should exceed unity to ensure that real interest rates respond to higher inflationary pressure. After the turn of the century, however, rising deviations can be observed, as actual interest rates fell increasingly below the benchmark defined by the rule. However the empirical fit could be improved if the original rule is extended with foreign variables (Belke and Gros, 2005). This accounts for higher dependencies of central bank decisions around the world. Actions by the US Federal Reserve, for example, led to similar moves of other central banks, including the ECB.

In normal times, policy rate changes are passed to the entire term structure, i.e. short and long term interest rates that influence the borrowing costs for firms and households.  Long term interest rates are affected, as they include current and expected future short term rates. Nominal interest rates are targeted, but due to price rigidities, central banks implicitly influence real interest rates. If actual output is above its long run level, inflation pressure is expected to increase. By raising the policy rate, the central bank lowers excess demand, and subsequently inflation declines. Policy measures can also influence expectations about

how the economy will develop in the future, including expectations for wages and prices. For instance, higher inflation expectations may lead households to increase consumption spending. Since expectations can inherently influence current inflation, the appropriate communication of monetary policy and the anchoring of expectations are crucial for achieving policy goals. In the financial crisis, short-term interest rates became fixed at the zero lower bound. Since they are unable to fall much further, central banks introduced unconventional measures to provide additional stimulus to the real economy. The ultimate aim is to reduce long-term interest rates to improve financial conditions (Beckers, Bernoth, König and Grazzini, 2015).

Starting from the 1980s, inflation declined in many countries, including the US and the euro area. A review of the experience is provided by Galati and Melick (2006). Lower inflation might be partially explained by the higher effectivity of monetary policy during the Great Moderation (Bernanke, 2004). The stronger focus on inflation control, underpinned by more central bank autonomy caused by flexible exchange rates and a greater awareness to act in a pre-emptive manner resulted in a better and more credible policy.

According to the standard Phillips curve model

$$(2) \quad p_t = p_t^e + \mathsf{S}\,(y_t - y_t^*) + \} oil_t + \mathsf{v}_t$$

the determinants of actual inflation p include inflation expectations (indexed with a superscript e), pressure from the demand side captured by the output gap, where y (y*) is actual (potential) output growth, and international supply shocks, proxied by commodity (oil) prices (Woodford, 2003). The error term should satisfy the white noise properties, and and are parameters to be estimated. Monetary policy affects all variables on the right hand side, apart from commodity prices, as they are determined by global markets. It should be noted that the determinants on the right hand side still explain the recent inflation experience, at least in part. Due to the inflation decline in the post-crisis period, long run inflation expectations decreased. Euro area demand is also weak and hampered by fiscal consolidation. The fall of commodity prices accelerated the evolution.

In recent years, however, globalization has changed the conditions under which economies operate, with potential effects on inflation. Due to higher openness, the coefficient of the output gap might have declined. Thus, the Phillips curve is somewhat flatter than in the past. This finding is often based on real marginal costs rather than output gaps, as the former appear to be more successful from the empirical point of view (Sbordone 2007). The empirical evidence for a weaker relationship between the output gap and inflation is discussed later in this report. In addition, competition has intensified since markets have become more integrated, thereby reducing markups in wages and prices. The inclusion of firms from emerging markets in international production chains lowered input costs and may have contributed to lower global inflation (Guerrieri, Gust and Lopez-Salido, 2010). In this policy brief, we look at the impact of globalization, the role of commodity price shifts and changes in wage-setting behaviour on inflation.

# 2. GLOBALIZATION AND INFLATION

Due to the integration of product and financial markets, macroeconomic outcomes, such as domestic GDP growth and inflation increasingly depend on international factors. Intensified trade with low cost countries can lead to a decline of inflation through lower import prices for intermediate and final goods. Driven by advances in information and communication technologies, production can be organized in highly fragmented stages, thereby exploiting relative cost advantages of different locations. Hence, the basic Phillips curve specification (2) could be augmented with globalization measures. Low demand in one country may be compensated by high demand in other areas, and supply shortages in one region by more ample supply in another. To the extent that the integration of markets has stimulated global long run output growth, foreign output gaps may have declined. However, these measures are beyond the influence of national authorities. Thus, monetary policy could lose its ability to control inflation, especially in the short run.

## 2.1. The role of global output gaps

The empirical evidence on the impact of globalization on domestic inflation is ambiguous. Tootell (1998) explore a Phillips curve and added trade-weighted measures of capacity utilization for the US major trading partners. The standard model (2) still provides a reasonable fit to the data, as the foreign variables are not significant. In contrast, Gamber and Hung (2001) specify a Phillips curve by including a broader set of countries. Import prices exert a larger impact in industries with larger import penetration. High foreign capacity utilization accounts for much of the decline in US inflation.

Similarly, Pain, Kospke and Sollie (2006) find that consumer prices in the industrialised countries are driven by import prices and that the multiplier has increased over time. While the sensitivity of inflation to the domestic output gap declined, its sensitivity to foreign conditions increased. However, while the transmission comes through import prices, a separate role for foreign output gaps cannot be confirmed. Based on panel regressions for the industrial countries, Ball (2006) finds that the role of the foreign output gap for inflation is smaller than that of the domestic output gap and significant only at the margin. It adds little, if any, explanatory power to the standard model. Globalization changed neither the course of long run inflation nor the structure of the Phillips curve benchmark. Calza (2009) replicate the Tootell analysis for the euro area, finding weak evidence that global capacity constraints have explanatory power for domestic inflation. López-Villavicencio and Saglio (2014) did not find support for the relevance of globalization in making inflation less responsive to output expansions in the main industrial countries.

In contrast, the findings of Borio and Filardo (2007) are heavily in favour of the impact of globalization. While the sensitivity of inflation to domestic output gaps decreased over time, proxies for the global economic slack add explanatory power in a large panel of countries. The presence of the global slack variable reduces the significance of the domestic output gap. However, if the degree of business cycle synchronization between the country under consideration and the global economy is rather high, the individual effects of the domestic and foreign output gap are hard to identify. In any case, the findings appear to be robust even after variables for external shocks on domestic inflation, such as oil and import prices are taken into account. The measure of global slack is constructed through the aggregation of country-individual output gaps. Weights are chosen in line with trade (exports and imports), exchange rates and production. But, as noted by Ihrig, Kamin, Lindner and Marquez (2010), the results likely lack robustness, as they depend highly on the construction of the foreign gap. Plausible variations in the weighting scheme, for instance due to a broader

range of trading partners, led to a deterioration of the evidence. In addition, the treatment of inflation expectations plays a crucial role. The latter authors find little support for an increasing role of globalization. The effect of foreign output gaps on domestic inflation appears to be largely insignificant and often displays the wrong sign. Moreover, the decline in the responsiveness of inflation to the domestic output gap observed in many countries cannot be traced to the globalization phenomenon. The countries where the impact of the output gap declined the most were not those where openness to trade increased. Similarly, Mody and Ohnsorge (2007) conclude that higher shares of trade did not reduce the sensitivity of inflation to domestic output gaps.

The globalization effect is difficult to explore in single regression models. Dynamic effects and interdependencies might not be captured properly by univariate approaches. Indeed impulse responses based on structural time varying VAR models reveal that global output gaps can affect the inflation dynamics in many countries. The conclusion appears to be robust across countries, periods and the choice of the identification scheme. However, in contrast to expectations, the impact of the foreign output gap did not increase over time (Bianchi and Civelli, 2015). The impacts of the global slack on inflation are positively related to the degree of economic integration, the latter proxied by the degree of business cycle synchronization. In addition, the inflation response to foreign output gap shocks is positively related to the degree of openness.

## 2.2. Decreasing production costs

Globalization has boosted competition and can therefore contribute to a decrease in inflation. Chen, Imbs and Scott (2009) look at disaggregated EU data, finding evidence that trade openness lowers prices by reducing firm markups and stimulating productivity. Following Guerrieri, Gust and Lopez-Salido (2010), foreign competition plays a major role in accounting for inflation in the traded goods sector. Since this sector is subject to international competition, the results point to declining markups due to the stronger integration of markets. Due to wage dependencies across the different sectors of the economy, price developments in traded goods will ultimately lead to spillovers to non-traded goods. By applying an IV estimation strategy, Auer and Fisher (2010) and Auer, Degen and Fisher (2012) conclude that import competition from low-wage countries has a more pronounced downward effect on prices and long run inflation in the US and the euro area than previously thought, especially in the labour intensive industries. For instance, if exporters from low wage countries capture 1 percent of the European market share, producer prices in manufacturing will decrease by 3 percent. This result is driven by higher import competition from low-wage countries in Asia, particularly China. However, effects from low wage countries in Central and Eastern Europe are not detected.

By employing the global VAR framework as well as large scale macroeconometric models, Dreger and Zhang (2014) provide evidence that the Chinese integration into the global economy reduced inflation in the main industrial countries following the financial crisis, not just in Japan, due to strong trade relationships, but also in the US and the euro area. However, the effect does not appear to be very strong. Similarly, the panel regressions presented by Côté (2008) point to modest effects. According to Kamin, Marazzi and Schindler (2006) the impact of Chinese exports on global import prices is not negligible, but even lower than in the aforementioned studies. Imports from China had little effects on producer prices in the US.

# 3. COMMODITY PRICE SHIFTS AND INFLATION

The consequences of global commodity price shifts on domestic economic conditions depend on whether the country is a commodity importer or exporter. In the report we focus on net importers of commodities such as the euro area. The commodity can be a final good, for example agricultural products, or an input factor to production, such as oil or metals. As oil is the most important commodity import in advanced economies in terms of import volume relative to other commodities, the discussion centres on the effects of global oil prices on domestic inflation.

## 3.1. Should central banks target core or headline inflation?

The academic literature has reached no consensus on whether central banks should target core inflation, which excludes price inflation of energy and food items, or headline inflation, which includes them (De Gregorio, 2012). The majority of inflation targeting central banks uses headline inflation as their target (Hammond, 2012). Reasons are mainly of practical nature: Inflation targets in terms of headline inflation are easier to communicate to the public and are consistent with other price measures used; for example, in the planning and communication of public balances. In case of persistent shocks in energy and food prices, core inflation will signal actual inflation only with delay, depending on the length of pass-through of shocks to other prices. Here, we focus on the effects of commodity price shocks on headline consumer price index inflation.

## 3.2. Sources of oil price fluctuations

To assess the effect of oil price shocks on domestic inflation, it is important to distinguish between the underlying forces that trigger oil price changes. Kilian (2009) decompose oil price movements into three exogenous contributors: shocks to the physical supply of oil (oil supply shocks), changes in global demand for oil driven by global business cycles (aggregate demand shocks), and shifts in the precautionary demand for oil due to changing expectations about future oil supply or demand conditions (oil-market specific shocks). Depending on the (unobservable) nature of the movements in (observable) oil prices, the effects on domestic inflation can differ considerably.

The author shows that aggregate demand shocks and oil-specific shocks are quantitatively more important than oil supply shocks. Aggregate demand shocks are responsible for long-lasting swings in oil prices, while oil-specific shifts tend to be behind shorter and more pronounced oil price increases and decreases. Kilian (2008) estimates that the median response of CPI inflation in G7 countries to unexpected changes in oil supply, resulting, for example, from political events in the Middle-East, peaks after three to four quarters. He estimates that an exogenous reduction in global oil production of one percent leads to an increase in consumer price inflation in the US of approximately one half percentage point after three quarters. The effects are quantitatively relatively similar in Italy, France, and Germany. In the UK, Canada and Japan the peak increase in inflation is earlier; concentrated in the first two quarters after the oil supply disruption. Overall, however, Kilian (2008) concludes that the evolution of CPI inflation in the G7 countries would have evolved very similar to the actual path observed since the 1970s even in the absence of oil price fluctuations due to unexpected changes in the global supply of oil.

Oil price changes driven by global aggregate demand have strong and long-lasting effects on the evolution of both domestic GDP and inflation (Kilian, 2009). Two offsetting forces are at play. The direct effect of an increase in global demand stimulates the domestic economy, i.e. GDP will increase. At the same time, however, the oil price will increase, thus re-

ducing the initial GDP expansion. Regarding domestic inflation, both the direct and indirect effects work in the same direction. The two effects led to a sustained increase in the CPI level for more than three years.

Lipinska and Millard (2012) provide a theoretical model to investigate the transmission of higher oil prices on output and inflation in advanced economies. The authors determine two main influences on domestic inflation: a headwind effect, in which higher demand for commodities induce prices increases at the global level that feed into domestic inflation, and a tailwind effect, according to which inflation in advanced economies is reduced through productivity spillovers from emerging markets. Similarly, De Gregorio (2012) argues that there are two main effects of commodity price shocks on the domestic economy. First, there is a direct effect on inflation, as can be seen from the Philips curve in equation (2). Second, depending on the oil intensity of the economy, the increase in oil prices leads to a decline in productivity and hence a drop in potential output.

## 3.3.  Did the effect of oil price shocks change over time?

Unlike Kilian (2009), Blanchard and Galí (2007) do not distinguish between different types of sources of oil price shifts but estimate their average effect on macroeconomic aggregates. GDP growth declines and inflation increases in response to positive changes in oil prices. This is consistent with the arguments of Kilian (2009) that oil price fluctuations are mostly driven by shifts in global demand and oil-market specific developments and less by oil supply shocks. Blanchard and Galí then investigate whether the effect of oil price shocks changed over time. In particular, they analyse whether there are differences in the effect of oil prices on GDP and inflation before and after 1984. Both periods are characterised by high oil price volatility. While high oil prices were associated with weak GDP growth and high inflation in the 1970s and early 1980s, GDP growth and inflation in most advanced economies subsequently stabilised; in particular during the 2000s.

The authors estimate that before 1984 an unexpected oil price increase of ten percent led to an increase of US CPI inflation by about 0.5 percentage points after one year. Post-1984, effect vanished quickly, lasting only for about two quarters. In France and the UK, the difference between the pre- and post-1984 period is even more pronounced. While inflation increases in the first period, it hardly reacts to increases in oil prices in the latter period. This is somewhat different in Germany, where the effect on inflation is very small in both periods. The authors attribute the small effects to the hawkish stance of the German Bundesbank.

To explain the reasons for the changing inflation response before and after 1984, Blanchard and Galí highlight three factors. First, the oil intensity of industrial economies has changed over time. As a reaction to early oil price crises, the share of oil in production and consumption goods decreased, which made the economies more resilient to oil price fluctuations. Second, the credibility of monetary policy seems to have increased over time. For example, many countries have adopted implicit or explicit inflation targeting regimes, increased the transparency of central bank decision making, and central banks improved their communication strategies. These arrangements contributed to an anchoring of inflation expectations. In turn, this reduced second-round effects and thereby limited the impact of oil price shocks on actual inflation. Third, unionization and wage indexation seems to have decreased, making labour markets and real wages more flexible. A quicker adjustment of real wages in turn helped to reduce price pressures from oil price increases in the 2000s.

Focusing on oil supply shocks, Baumeister and Peersman (2013) study a time-varying impact on the US during the period 1974 to 2011. They find that the largest impact on CPI

inflation occurs after three to four quarters. Their estimates suggest that the effect of a 10 percent increase in oil prices due to supply disruptions has increased over time. Further, they estimate that oil supply shifts are responsible for about one-third of the variability in domestic CPI inflation in recent years, whereas they accounted only for about one-fifth in the period before 2000. This observation, however, can partly be explained by the lower volatility of inflation itself in more recent years. Overall, the authors conclude that oil supply shocks are still relevant for macroeconomic outcomes in the US but that they do not dominate domestic inflation developments.

Overall, the empirical evidence indicates that the effect of a given change in global oil prices on domestic inflation has become less important. The presumably conflicting empirical findings of Blanchard and Galí (2007) and Baumeister and Peersman (2013) can be reconciled in light of the results of Kilian (2009). As discussed above, the latter authors emphasize that it is important to discriminate between the causes of oil price fluctuations and discusses three thereof. Baumeister and Peersman concentrate only on one of these causes, namely, unexpected changes in oil supply, and find that their effect on domestic inflation has increased over time. Blanchard and Galí instead estimate the average effect of all three causes of oil price shifts on domestic inflation. Given that Kilian (2009) shows that the other two causes, real-activity related global demand for oil and precautionary oil-market specific demand, which are neglected in the analysis of Baumeister and Peersman, are quantitatively much more important for global oil price determination, the results of Blanchard and Galí imply that the effect of a given change in oil prices due to the other two causes on domestic inflation has weakened. Finally, it is worth mentioning that, similar to Baumeister and Peersman, Blanchard and Galí also detect that the share of oil price movements in domestic inflation variability has increased over time. This, however, is rather a symptom of monetary policy success, not failure. As better monetary policy lowered the volatility of inflation rates, while the volatility of oil prices has approximately remained stable over the last decades, the importance of oil price in inflation fluctuations has simply increased.

## 3.4.   How should monetary policy respond to oil prices?

Regarding monetary policy, the empirical findings imply that the question of whether and how central banks should respond to oil price fluctuations is not well posed. Instead, monetary policy needs to distinguish between the sources of oil price fluctuations and tailor its response to the specific underlying causes of oil price shifts. Bodenstein, Guerrieri, and Kilian (2012) analyse this question in a large-scale macroeconomic model of the global economy and the oil market. Here, oil prices move endogenously in response to deeper underlying causes, such as demand or supply shocks in specific countries or sectors. These shocks in turn also imply changes in asset prices, exchange rates, and capital accounts, which come in addition to changes in oil prices and need to be taken into account when setting monetary policy. Their main conclusion is that no two causes underlying oil price changes call for the same response of an inflation-targeting monetary authority. For example, it is not even sufficient to know that demand for oil in China increased, rather the central bank needs to understand why Chinese oil demand changed (could be due to higher GDP growth or a higher oil intensity in production). These conclusions have important implications for the question of whether in a globalised world, monetary policy can still control domestic inflation effectively. The answer is yes, once the central bank successfully differentiates between the underlying factors of oil price fluctuations.

In a related contribution, Bodenstein, Guerrieri, and Gust (2013) show that in the current period, when the main policy rates are at the zero-lower bound in many advanced countries, the objective of central banks to stabilise inflation in response to causes that imply oil price changes has become even easier. In other words, the zero-lower bound weakens the

trade-off that central banks face between stabilising inflation and output. To illustrate this argument, the authors consider the effect of an increase in global demand for oil that triggers an increase in the price of oil. Higher oil prices do increase domestic inflation and lower domestic output. When monetary policy is constrained by the zero-lower bound, the increase in inflation, however, is actually welcome from a welfare point of view as it lowers real interest rates. The latter, in turn, stimulate investment in the home economy and counteract the contractionary effect of higher oil prices.

# 4. WAGE SETTING AND MONETARY POLICY

Has globalization affected the ability of central banks to stabilize employment and inflation? A common view is that the integration of low-wage workers from China and the former Soviet bloc into the global economy has depressed wages and prices, thereby limiting the ability of central banks to target a specific inflation rate. While this view figures prominently in the media, Rogoff (2006) points out that it fails to recognize that globalization constitutes a shock to relative prices: if the price of imports falls, the relative price of domestically-produced goods and services must necessarily rise. This, in itself, should not be a concern for central banks, since they are responsible for stabilising the overall price level, which is determined by aggregate supply and demand conditions and not the relative price of a particular good or service.

A central bank operating under a floating exchange rate regime will thus always be able to set the domestic inflation rate in the long run. Nonetheless, Bernanke (2007) emphasises that globalisation should not be ignored by central bankers as it may alter the trade-off between inflation and unemployment, thereby affecting the efficacy of monetary policy as a stabilization tool. This short-run trade-off between inflation and unemployment is captured by the (expectations-augmented) Phillips curve. In the absence of commodity price shocks, the Phillips curve model (2) can be rewritten as follows:

(3)    $p_t = p_t^e + s\left(y_t - y_t^*\right) + v_t$

To understand the implications for unemployment, Okun's law postulates a (negative) link between the output gap and the unemployment gap. The unemployment gap measures the deviations of actual unemployment u from the NAIRU (Non Accelerating Inflation Rate of Unemployment). The NAIRU u* can be traced back to labour market frictions and mismatch problems:

(4)    $y_t - y_t^* = -r\left(u_t - u_t^*\right)$

Substituting Okun's law (4) into equation (3), one obtains a re-formulated version of the standard Phillips curve, expressed in terms of deviations from the NAIRU:

(5)    $p_t = p_t^e - x\left(u_t - u_t^*\right) + v_t$  ,   $x = rs$

It is important to note that the negative relationship between inflation and unemployment implied by the Phillips curve depends on the presence of nominal price and wage rigidities. For example, if prices and wages were perfectly flexible, the Phillips curve would be vertical, meaning that the unemployment rate would be uniquely determined by supply-side factors and unaffected by monetary conditions. It follows that structural changes (like globalisation) that modify the degree of price and wage flexibility can have important implications for the conduct of monetary policy.

## 4.1 Globalisation and the "Flattening" of the Phillips Curve

There is significant disagreement among economists about how the opening of international trade and labour markets has affected price and wage rigidities. Rogoff (2006) argues that higher competition from emerging markets should translate into increased price and wage flexibility, as it weakens the bargaining power of domestic monopolies and labour unions. This suggests that globalization should lead to a steepening of the Phillips curve (i.e. a worsening of the inflation-unemployment trade-off), thereby dampening the output effects of monetary stimuli. An interesting implication of Rogoff's (2006) argument is that, faced with a less favourable inflation-unemployment trade-off, monetary policymakers will find it easier to commit to a regime of low and stable inflation. This is because changes in the inflation rate would have only marginal effects on the unemployment rate. Thus, monetary stimuli would result in increased price volatility without yielding substantial benefits in terms of lower output volatility.

In contrast, Borio and Filardo (2007) argue that by facilitating the outsourcing of labour, globalisation has put downward pressure on wage growth and has generally made prices and wages less responsive to changes in domestic demand. Several factors can potentially be responsible for this. Bean (2006a), for example, stresses that increased competition from low-wage/labour-abundant countries implies that firms have less scope to raise prices when demand increases. He also emphasizes that workers will struggle to negotiate higher wages due to the threat of offshoring. Bean (2006b) also points out that by increasing the availability of cheap imports, the opening of international markets can be viewed as a positive supply shock, leading workers to enjoy higher real wages without affecting firms' labour costs. Overall, these views suggest that by reducing the sensitivity of inflation to changes in domestic demand conditions, globalisation has led to a flattening of the Phillips curve (i.e. an improvement in the inflation-unemployment trade-off). This means that monetary stimuli targeted toward stabilizing output and employment fluctuations would have only minor inflationary or disinflationary effects.

The link between globalisation and price setting was recently formalised by Guilloux-Nefussi (2015). In line with the two views described above, she identifies two counteracting effects. On the one hand, increased competition tends to reduce domestic firms' market power, thereby reducing real rigidities and making prices more responsive to marginal cost shocks. On the other hand, increased openness tends to favour the selection of larger, higher-productivity firms that are more able to compete in international markets. These firms are less likely to transmit marginal cost shocks into higher prices in order to protect their market share. At the aggregate level, Guilloux-Nefussi (2015) finds that the second (selection) effect dominates the first (competitive) effect, thereby leading to a lower pass-through of marginal costs to overall inflation. In other words, her framework suggests that on average one should expect globalization to lead to an improvement in the inflation-unemployment trade-off faced by central banks.

The view that the Phillips curve has become flatter over the past few decades also squares well with the experience of many, but not all, advanced economies. For example, Iakova (2007) documents a secular decline in the responsiveness of inflation to changes in unemployment since the 1980s for the UK. The results are confirmed by other studies, such as Kuttner and Robinson (2010) for the US and Australia. A notable exception seems to be the euro area. According to Papademos (2007), the ECB has failed to detect any significant structural break in the euro area Phillips curve.

Inter alia, the flattening of the Phillips curve suggests that changes in the unemployment rate may not signal significant inflationary pressure. The recent US experience is a good example in this regard. While unemployment spiked during the 2008/2009 recession, it has

since then returned to a level some consider close to the NAIRU. This steady reduction in unemployment has not, however, been accompanied by a significant increase in inflation, notwithstanding nominal interest rates being set at their effective zero lower bound.

The debate remains opens about why inflation has been so unresponsive to recent monetary stimuli, especially in low unemployment countries. Since wages are the largest source of household income and the largest component of firm operating costs, the lack of significant nominal wage growth may be a primary reason explaining the persistence of low inflation. A prominent view advanced by Daly and Hobijn (2014) is so-called pent-up wage deflation. They argue that since firms struggle to lower wages during recessions due to downward nominal wage rigidities, they face less pressure to raise them even when the economy recovers and slack in the labour market is reduced. As emphasised by Yellen (2014), it is also likely that such short-run cyclical factors interact with longer-run structural factors, including globalisation and the secular decline in the labour income share. According to Kohn (2006), however, the existing evidence suggests that globalisation only has a modest effect on nominal wage growth. Specifically, he argues that models of aggregate labour compensation usually fail to detect a robust relationship between globalisation and aggregate wage dynamics in the US.

Ultimately, the extent to which globalisation is responsible for the flattening of the Phillips curve remains an empirical question. Unfortunately, it is difficult to find a firm consensus among existing studies. Iakova (2007) and Borio and Filardo (2007) find that globalisation has reduced the sensitivity of inflation to the domestic output gap. However, as mentioned above, serious doubts have been raised concerning the robustness of the Borio and Filardo (2007) results. Using quarterly data for euro area countries between 1979 and 2003, Calza (2009) fails to find any effect of global capacity constraints on domestic inflation. Similarly, using a micro-dataset consisting of 2000 Italian firms, Gaiotti (2010) finds no evidence that the sensitivity of prices to capacity utilisation is affected by firms' exposure to competition from emerging markets.

Others authors seek to explain the flattening of the Phillips curve as the outcome of changes in the way monetary policy has been conducted since the 1980s. According to Williams (2006), the weakened relationship between inflation and unemployment (or output gaps, more generally) is nothing more than the result of central banks' success in anchoring long-term inflation expectations. In particular, by lowering trend inflation, central banks have reduced the frequency of nominal price and wage adjustments, which in turn has fed back into a flattening of the Phillips curve. Using long-term interest rate data from 17 industrialised countries, Laxton and N'Diaye (2002) find that the trade-off between unemployment and inflation tends to be less in countries that successfully commit to a low-inflation regime.

## 4.2    Implications for monetary policy

A somewhat paradoxical implication of an improved inflation-unemployment trade-off (or flatter Phillips curve) is that it may weaken monetary discipline and thereby lessen central banks' ability to control inflation (Woodford, 2007). More specifically, if central banks ex-pect significant monetary stimuli to have only marginal effects on the inflation rate, this may lead them to adopt an overly dovish monetary stance. This is especially likely if monetary policymakers view the Phillips curve as a fixed structural relationship, rather than one this is partially determined by monetary policy itself. Abstracting from these commitment problems, Razin and Binyamini (2007) characterise optimal monetary policy in an environment with liberalised trade, labour and capital flows. They find that increased factor mobility flattens the output-inflation trade-off. Compared to an environment with reduced factor mobility, they argue that the optimal policy response consists of central banks reacting

more aggressively to fluctuations in inflation and less aggressively to fluctuations in the output-gap, as globalisation weakens the link between domestic output fluctuations and inflation.

Given its implications for policy, the debate about which economic forces are responsible for the flattening of the Phillips curve is not purely academic. Indeed, a flatter Phillips curve suggests that central banks with an explicit employment mandate (like the Federal Reserve) should be able to target a lower unemployment without fearing destabilising inflation dynamics. For central banks without such a mandate (like the ECB), it suggests that changes in unemployment are less likely to translate into changes in inflation. According to Bean (2006a), globalisation thus serves as a double-edged sword for monetary policymakers. On the one hand, a flatter Phillips curve means that monetary policy errors will not necessarily translate into large deviations of inflation away from its targeted level. On the other hand, central banks will struggle to push inflation up, or bring it down, if it significantly deviates from target.

# 5. CONCLUSIONS

The fall in inflation over the past decades is partially attributed to the success of monetary policy. The focus on inflation control and high awareness to act pre-emptively contributed to a more credible policy. Even the decline since the financial crisis may be interpreted in terms of domestic factors, while the decrease in oil prices accelerated the evolution. In particular, the modest economic upswing in the euro area plays a crucial role for the low inflation environment. Inflation will pick up again if the business cycle swings up again. As the basic determinants of inflation did not change much, central banks should be still able to control inflation. However, the task for the monetary authorities has become more challenging in the short run under the conditions of interconnected and globalised markets. Globalization has likely contributed to a flattening of the output-inflation trade-off. While the empirical evidence is mixed so far, several channels might be important. To the extent that the synchronization of business cycles has increased across countries, the central banks can less affect the domestic output gap. In addition, lower import prices in more competitive markets may exert some downward pressure on inflation.

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