

Article

1 Domestic and global drivers of inflation in the euro area

This article discusses the role of domestic and global drivers of inflation in the euro area and whether and how their relative importance has changed over time. Domestic price pressures result mainly from wage and price-setting behaviour, which is closely linked to the domestic business cycle. In respect of external drivers, import prices – especially of commodities – naturally play an important role in the development of domestic headline inflation, for example via energy and food inflation. However, more recently it has been argued that global integration has increased the influence of the global business cycle on domestic inflation and thereby also supported a convergence of inflation developments across the globe. While inflation developments have indeed increasingly shown a common pattern since the early 1990s, this commonality can to a large extent be explained by a change in monetary policy orientation and global commodity price developments. As concerns the effects of globalisation, the theoretically appealing idea that domestic wage and price pressures are increasingly affected by global developments via higher integration and increasing contestability of labour and product markets is difficult to capture empirically. In this respect we find, for example, only limited support for including measures of global slack and of the integration in global value chains in Phillips curve analyses of inflation in the euro area.

1 Introduction

Over the medium term, the overall rate of inflation in an economy is determined by its central bank's monetary policy. However, over the short term, inflation outcomes are influenced by domestic and external cost and price shocks. On the domestic side, inflation outcomes are typically affected by the balance between aggregate domestic demand and supply, with inflation expectations playing a key role. On the external side, inflation is affected mainly by demand and supply fluctuations in the global economy, which affect the prices of tradable goods, particularly commodities, but also exchange rate developments.

There are a number of reasons why global factors may recently have been playing a more prominent role in shaping domestic inflation dynamics. One argument is that globalisation has made national inflation less responsive to domestic capacity constraints. There are two possible theories for this conclusion: either any sudden expansion in demand for goods would translate into higher imports rather than higher prices; or foreign competition would constrain wage or price increases in industries open to global competition, lowering the sensitivity of wages to domestic demand pressures. It is in this context that China's integration in the global economy, as discussed in Box 1, has played a central role. Another argument emphasises the role of credible monetary policies that stabilised inflation expectations and trend inflation across advanced and many emerging economies

and reduced the volatility of inflation developments and the level of inflation.³⁹ Based on the reduced volatility and the lower level of inflation, proportionally more of the variation in national inflation rates would be explained by inflation developments linked to exogenous global price shocks, such as commodity price changes.

In the literature the concept of “global inflation” has come to the fore. This is the notion that domestic inflation rates have converged because of the increased influence of global developments on domestic inflation. One strand of the literature on global inflation has focused on the common – or global – component in national inflation rates and what role it has played in domestic inflation developments.⁴⁰ A second strand has emphasised the importance of global output gaps and integration in global value chains (GVCs) as a determinant of national inflation processes.⁴¹

Against this background the article discusses the role played by domestic and external factors with regard to inflation and whether their relative importance has changed over time. The article is structured as follows: the following section discusses the domestic and global drivers of inflation. Section 3 discusses commonalities in inflation developments across the globe. The relative importance of domestic and global factors in the development of euro area inflation after the crisis is analysed in Section 4. Section 5 discusses whether globalisation has changed the importance of global slack for the modelling of domestic inflation based on Phillips curves. The last section concludes.

2 Domestic and external drivers of inflation

In the medium term, inflation expectations play a key role in the achievement of a central bank’s inflation target. Inflation expectations that are firmly anchored in line with the inflation target support the achievement of that goal by guiding wage and price-setting decisions in the economy. Deviations of inflation expectations from

³⁹ See also Beechey, M.J., Johannsen, B.K. and Levin, A.T., “Are Long-Run Inflation Expectations Anchored More Firmly in the Euro Area Than in the United States?”, *American Economic Journal: Macroeconomics*, Vol. 3, No 2, 2011, pp. 104-129.

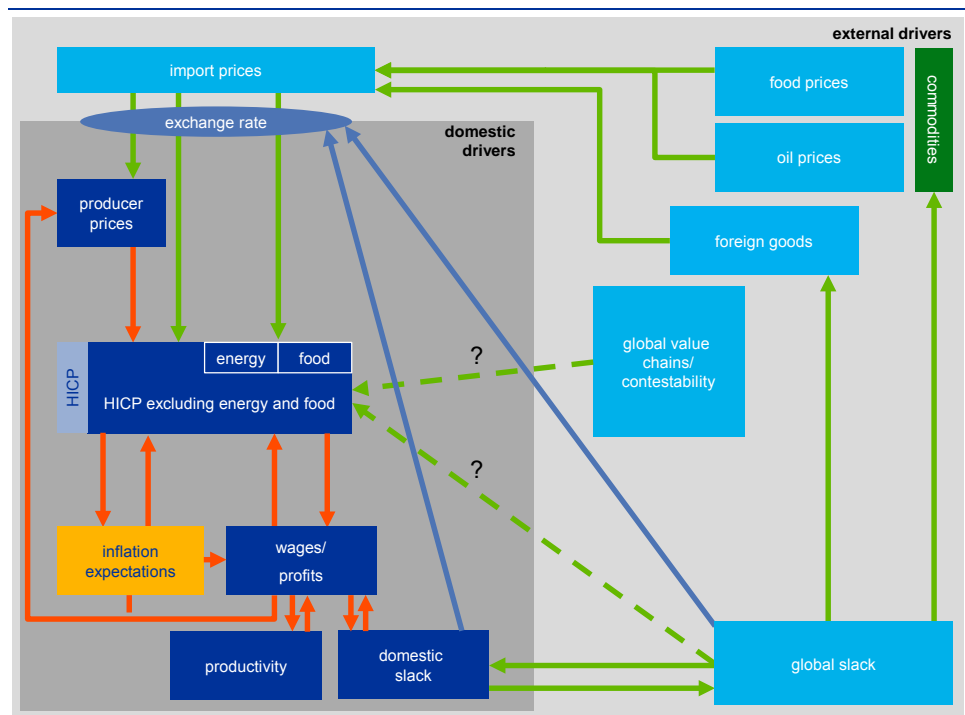
⁴⁰ Ciccarelli and Mojon note significant co-movement in inflation rates across countries and find that models which include a measure of global inflation consistently improve benchmark national inflation forecasts. They conclude that inflation should be modelled as a global rather than a national phenomenon: see Ciccarelli, M. and Mojon, B., “Global Inflation”, *The Review of Economics and Statistics*, Vol. 92, No 3, August 2010, pp. 524-535.

⁴¹ Borio and Filardo, for example, argue that proxies for global economic slack add considerable explanatory power to traditional benchmark inflation equations and that the role of global factors has been growing over time. In follow-up work, Auer, Borio and Filardo link directly what they call the “globalisation of inflation” to the growing integration of the global supply network. See Borio C. and Filardo, A., “Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation”, *BIS Working Papers*, No 227, 2007; Auer, R., Borio, C and Filardo, A., “The globalisation of inflation: the growing importance of global value chains”, *BIS Working Papers*, No 602, 2017; and also Guerrieri, L., Gust, C. and López-Salido, J.D., “International Competition and Inflation: A New Keynesian Perspective”, *American Economic Journal: Macroeconomics*, Vol. 2, No 4, 2010, pp. 247-280.

the inflation target may become self-reinforcing.⁴² The anchoring of inflation expectations is hence a core task for monetary policy.

In the short term, fluctuations in inflation are affected by both domestic and external developments. The following part discusses the main drivers of inflation on the domestic as well as on the external side. Chart 1 gives a stylised overview of the drivers of inflation in terms of the harmonised index of consumer prices (HICP). The HICP, which is the benchmark indicator for the price stability target of the ECB, is based on a broad basket of goods and services. The main components of the consumption basket used to calculate the HICP are commonly grouped into energy, food, services and non-energy industrial goods (NEIG). HICP inflation excluding energy and food, which consists of services and NEIG inflation, is one measure of underlying inflation.

Chart 1
Domestic and external drivers of inflation – stylised overview



Source: ECB illustration. The red arrows reflect domestic drivers of inflation, the green arrows external drivers. Blue arrows illustrate that global and domestic slack are important drivers of exchange rate developments. The dashed green lines reflect the hypotheses discussed in this article – namely that GVCs and global slack have a direct influence on euro area inflation.

On the domestic side, price pressures are largely determined by developments in unit labour costs and profit margins. Wages are an important input cost factor for domestic production. In services, which have a weight of two-thirds in HICP inflation excluding energy and food, wages account for the lion’s share of around 50% of input costs and are also an important cost factor for NEIG, with a share of

⁴² For more details see, for example, the discussion in Ciccarelli, M. and Osbat, C., “Low inflation in the euro area: Causes and consequences”, *Occasional Paper Series*, No 181, ECB, 2017; and Busetti F., Delle Monache, D., Gerali, A. and Locarno, A., “Trust, but verify. De-anchoring of inflation expectations under learning and heterogeneity”, *Working Paper Series*, No 1994, ECB, 2017.

around 20%. To the extent that wages increase more strongly than productivity, they push up unit labour costs and thereby increase cost pressures for firms, which may then feed through to producer prices and, ultimately, consumer prices. The strength of this pass-through depends crucially on profit margin developments, which are closely linked to the pricing power of firms. This pricing power is determined by structural factors, such as the degree of competition and barriers to entry, but varies also cyclically with the ebb and flow of demand.

Domestic price pressures are driven by the domestic business cycle.

Unemployment moves with the cycle and low labour market slack tends to put upward pressure on wage growth.⁴³ In a similar vein excess demand in economic upturns allows firms to increase their margins, whereas sluggish demand in economic downturns is often accompanied by a reduction in margins, as firms freeze or reduce their prices (in order to maintain their sales) or do not pass on higher input costs (in order not to lose market shares).⁴⁴ The development of profit margins and wages also has important feedback effects on demand via investment decisions of firms and consumption decisions of households, which in turn affect again the likelihood of increases in wages and profit margins. Domestic price pressures can be measured by, for example, the sum of unit labour costs and of unit profits, which is a measure of the costs of domestic production.⁴⁵ Chart 2 illustrates the cyclical behaviour of domestic price pressures, which have closely followed the business cycle in the euro area.

⁴³ See, for example, the box entitled “Recent wage trends in the euro area”, *Economic Bulletin*, Issue 3, ECB, 2016; and the article entitled “The Phillips curve relationship in the euro area”, *Monthly Bulletin*, ECB, July 2014.

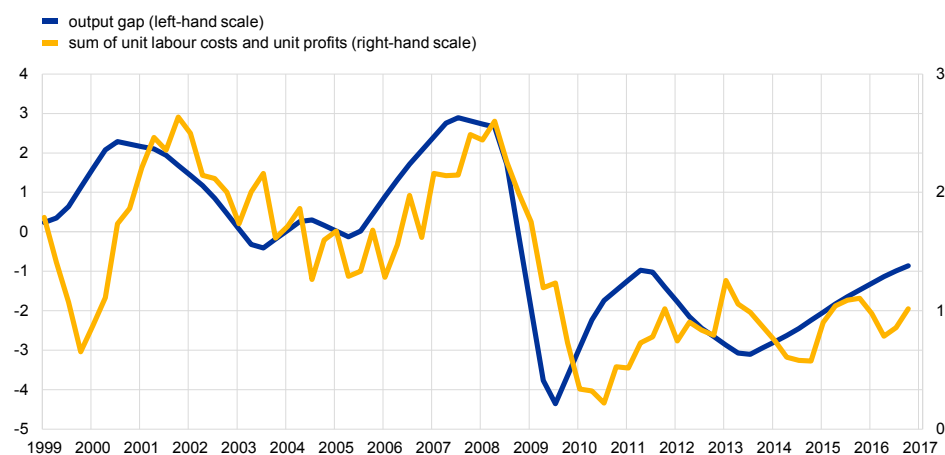
⁴⁴ See the box entitled “Trends in profit margins of euro area non-financial corporations”, *Economic Bulletin*, Issue 1, ECB, 2015.

⁴⁵ Unit labour costs are measured as the average cost of labour per unit of output, while unit profits are defined as gross operating surplus per unit of real GDP. Gross operating surplus is defined as GDP minus compensation of employees minus indirect taxes. See the box entitled “What accounts for the recent decoupling between the euro area GDP deflator and the HICP excluding energy and food?”, *Economic Bulletin*, Issue 6, ECB, 2016 for a discussion of the factors that affect the GDP deflator and the HICP.

Chart 2

Development of domestic price pressures in the euro area over the business cycle

(percentage points, annual percentage changes)



Sources: Eurostat and European Commission.

Notes: The series "sum of unit labour costs and unit profits" reflects the development of the GDP deflator, excluding the impact of unit taxes. The latest observation is for the fourth quarter of 2016.

Turning to the external drivers of inflation, import prices for commodities as well as for intermediate and final goods have a considerable impact on domestic inflation via direct and indirect effects.⁴⁶ For example, oil prices feed directly on energy inflation and imported final goods feed directly on NEIG inflation.

Import prices of commodities and intermediate goods also have indirect effects on producer prices via higher input costs, which then feed through the pricing chain.

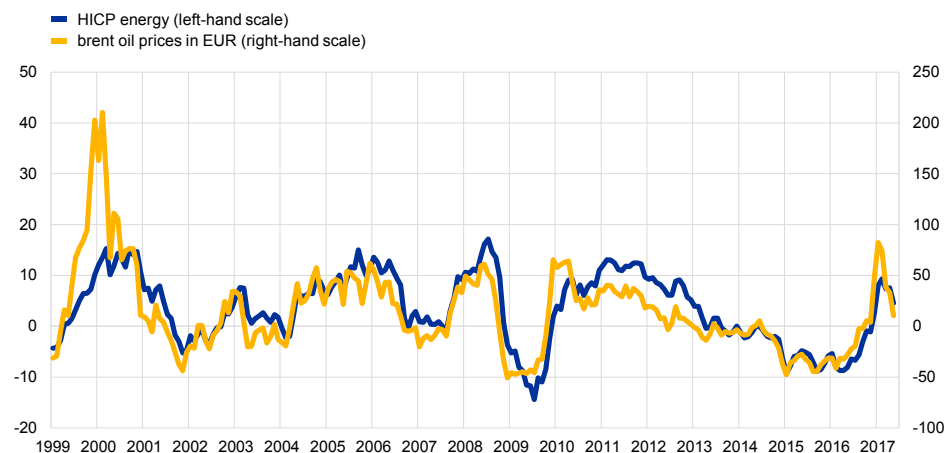
Commodity prices, as with oil and food prices, are especially important in shaping headline inflation developments. Global factors in domestic inflationary developments are most clearly felt via the impact of oil prices on energy inflation. Energy inflation in the euro area, accounting for around 10% of the consumer goods basket used to measure the HICP, is linked fairly closely to the development of crude oil prices, which are determined on global markets (see Chart 3). Food prices in the euro area are affected by the Common Agricultural Policy and the fact that some markets can be influenced by regional factors such as regulation or health scares; however, global demand and supply forces nonetheless play an important role. Food inflation accounts for around 19% of the HICP goods basket and is somewhat volatile as it is also directly affected by weather events around the globe. As shown in Chart 4, domestic food prices tend to correlate with developments in international food price inflation with some time lag.

⁴⁶ See for example the box entitled "The role of global factors in recent developments in euro area inflation", *Monthly Bulletin*, ECB, June 2014.

Chart 3

Oil prices and HICP energy inflation

(annual percentage changes)

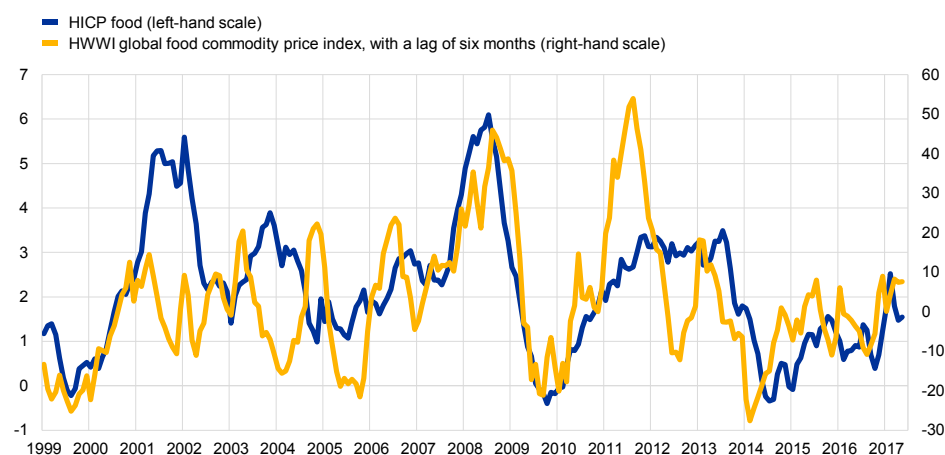


Sources: Eurostat, BIS and Bloomberg.
Note: The latest observation is for May 2017.

Chart 4

HICP food inflation and global food price indices

(annual percentage changes)



Sources: Eurostat, Hamburg Institute of International Economics (HWWI) and Bloomberg.
Notes: The latest observation is for May 2017. The strong divergence of the HICP food inflation and the HWWI global food commodity price index between 2001 and 2003 was the result of strong price increases for meat, caused by the bovine spongiform encephalopathy (BSE) epidemic – commonly known as mad cow disease. In 2011 soaring crop prices, which have a relatively high weight in the HWWI global food commodity price index, passed only partially through to euro area food prices.

Import prices also play an important role in relation to underlying inflation.

One channel works via directly imported goods. This is especially relevant for NEIG, of which around 15% are estimated to be directly imported consumer products. Changes in commodity prices also feed through, with some lag, to underlying inflation; this occurs, for example, via the effects of higher import prices for oil on production costs. Such indirect effects⁴⁷ are obvious in relation to some HICP

⁴⁷ For a discussion of this topic, see the box entitled "Indirect effects of oil price developments on euro area inflation", *Monthly Bulletin*, ECB, December 2014.

services items, such as transportation services (e.g. aviation), where fuel is a major cost factor. They also affect the prices of NEIG and services that are produced with relatively high oil or energy intensity, such as some pharmaceutical products and some materials used for household maintenance and repair. Finally, import price shocks can lead to second-round effects if their inflationary impact influences wage and price-setting behaviour, which then feed through again to inflation.

The exchange rate has an important role at the juncture between the external and domestic economic environments. As shown in Chart 1, the exchange rate moderates or amplifies the transmission of foreign costs and prices into domestic ones. However, it should be noted that the effects of exchange rate fluctuations on inflation in the euro area depend on a variety of factors, including the macroeconomic environment, factors affecting pricing decisions at the firm level and the shocks driving the exchange rate movements.⁴⁸

Does foreign slack play a direct role in domestic inflation? The traditional view is that global slack does affect domestic inflation, albeit indirectly. First, global slack has considerable influence on commodity prices, which then affects domestic inflation via import prices for commodities. Second, foreign output gaps matter for short-run inflation dynamics by affecting import prices for these goods. Third, global cyclical conditions affect the domestic output gap indirectly, since stronger global demand for goods and services supports domestic income via the net exports channel. However, the effect that global slack has on domestic inflation may in fact be more direct, as suggested by the “global slack” view⁴⁹. This view stresses that the range of products that can be traded has broadened and that goods produced in different countries are often close substitutes. This is increasingly also affecting services, which in many instances have become more tradable. Moreover, factor input markets are closely integrated globally due to capital mobility and increasingly similar labour supply characteristics across the globe. In addition, the geographical relocation of production and the fragmentation of production processes into their constituent components have been facilitated by advances in communications technology and the gradual breakdown in trade and financial regulatory barriers.⁵⁰ Another important aspect is that there was also a major longer-term increase in the production potential of the global economy – for example by the integration of China, which plugged an enormous additional labour force, both directly and indirectly, into the global economic system.⁵¹ Based on all these factors, the global slack view argues that in the case of tradable goods and services, what is decisive is no longer solely the domestic tightness or slack of economic conditions, but the global

⁴⁸ For the sake of simplicity, the effects of foreign commodity and goods prices are analysed based on import prices in euro, and the role of exchange rate developments in the transmission process is not discussed explicitly in this article. For more details on this topic, see the article entitled “Exchange rate pass-through into euro area inflation”, *Economic Bulletin*, Issue 7, ECB, 2016.

⁴⁹ As propounded by Borio and Filardo and Milani: see Milani, F., “Global Slack and Domestic Inflation Rates: A Structural Investigation for G-7 Countries”, Federal Reserve Bank of Dallas, *Working Paper*, No 33, 2009.

⁵⁰ Scheve, K. and Slaughter, M., “Economic insecurity and the globalization of production”, NBER Working Paper, No 9339, 2002.

⁵¹ Freeman, R., “Labor Goes Global: The Effects of Globalization on Workers Around the World”, transcript of the 2004 Eighth Annual Rocco C. and Marion S. Siciliano Forum: Considerations on the Status of the American Society, 2005. See also the discussion in Box 1.

tightness or slack as well, because local demand and supply conditions for a given tradable good or service can to varying degrees be offset elsewhere. In effect this could lead to domestic inflation being increasingly sensitive to global slack.

Does integration in GVCs affect the role that foreign slack plays in domestic inflation? Recent research suggests that the direct role of foreign slack in domestic inflation depends on integration into GVCs. The increasing role of GVCs has been facilitated by innovations in information and communication technology; such technology makes it possible to coordinate and track just-in-time production at different production stages by different firms around the globe and to shift firm-specific know-how across borders. These GVCs are also increasingly covering business services. Auer, Borio and Filardo⁵² argue that integration in GVCs further boosts the ability of firms to substitute various production stages across borders via offshoring and outsourcing. This in turn increases the degree of contestability of domestic labour markets as, for example, unions are aware of the credible threat that some production stages may be outsourced to other countries. Such a scenario also makes unions and employers take foreign available production capacity into account in wage negotiations. Moreover, GVC integration also increases the importance of inputs produced abroad, whose prices depend strongly on foreign slack. It is argued that in effect the more the various stages of production take place in intricate networks spanning many countries, the more that external factors and supply conditions elsewhere will tend to have an impact on wage and price-setting decisions of firms; consequently this will also have an impact on the development of domestic inflation.⁵³

3 Commonality in the development of inflation across the globe

Since the late 1990s developments in inflation have increasingly led to a common pattern across the globe being observed. In the last two decades a synchronisation of inflation developments can be seen across a large group of advanced and emerging economies. Euro area inflation has also been very strongly correlated with inflation in the countries of the Organisation for Economic Co-operation and Development (OECD) with two exceptions: from 1999 to 2002, when there was a period of low inflation following the introduction of the euro;⁵⁴ and, to a lesser extent, between 2014 and 2015 (see Charts 5 and 6).

⁵² Auer, R., Borio, C and Filardo, A., "The globalisation of inflation: the growing importance of global value chains", *BIS Working Papers*, No 602, 2017.

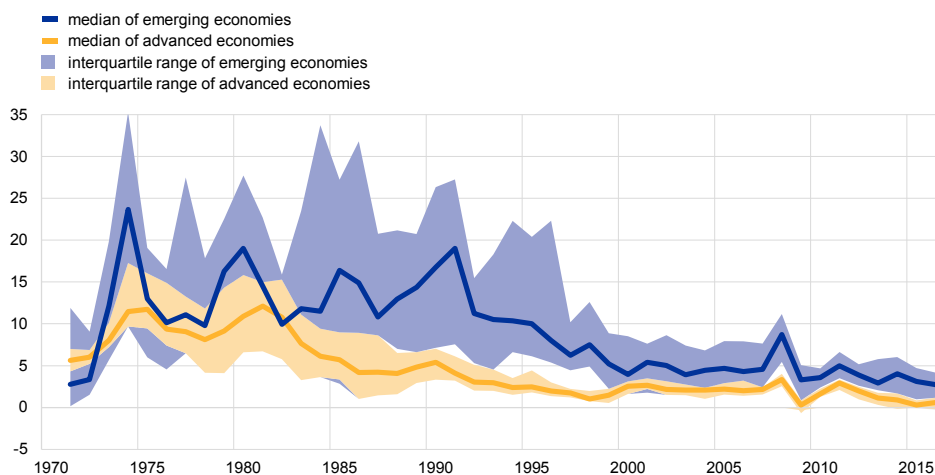
⁵³ See also the article entitled "The impact of global value chain participation on current account balances – a global perspective", *Economic Bulletin*, Issue 2, ECB, 2017.

⁵⁴ See the article entitled "Inflation differentials in the euro area during the last decade", *Monthly Bulletin*, ECB, November 2012.

Chart 5

Range of inflation rates in advanced and emerging economies

(annual percentage changes)



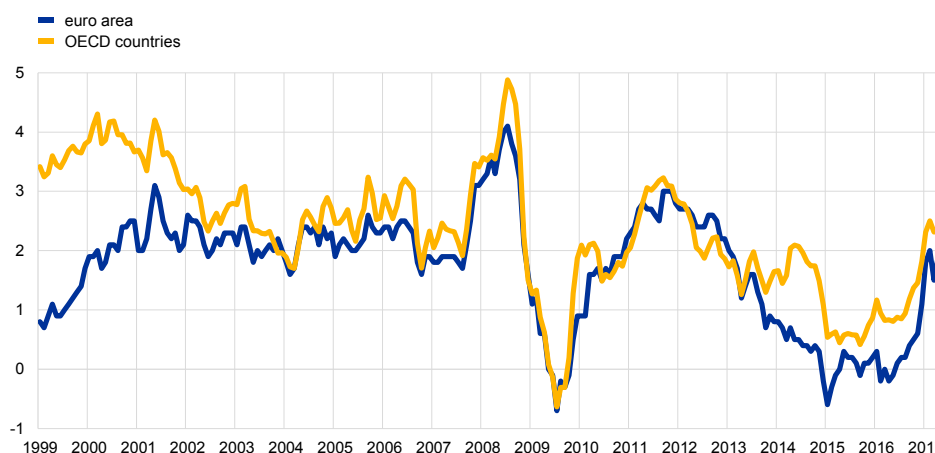
Source: Haver.

Notes: The interquartile range covers 50% of the samples of emerging and advanced economies. The sample includes 17 advanced economies (Australia, Austria, Belgium, Canada, France, Germany, Greece, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United States) and 24 emerging economies (Bolivia, Chile, Colombia, Côte d'Ivoire, Ecuador, Egypt, El Salvador, Guatemala, Honduras, Indonesia, Israel, Jamaica, South Korea, Malaysia, Mauritius, Mexico, Nigeria, Paraguay, the Philippines, Singapore, South Africa, Taiwan, Tunisia, Turkey). Only countries for which data going back to 1970 are available have been included. The latest observation is for 2016.

Chart 6

Development of inflation in the euro area and in the OECD countries

(annual percentage changes)



Sources: OECD, Haver and Eurostat.

Notes: The latest observations are for April 2017 for the OECD countries and May 2017 for the euro area.

Since 2007 inflation has been very volatile in the euro area but also across the OECD countries on average. It included two periods of falling inflation (2008-09 and 2012 to early 2015) and a protracted period of low inflation in 2014-16 (see Chart 6). Headline inflation developments have very much been shaped by global commodity prices, with oil prices collapsing in 2008/2009 only to then recover strongly to a very high level before a period of renewed declines in 2014-16.

The strong co-movement of inflation across developed countries has fuelled a debate about whether inflation is or has increasingly become a global phenomenon and is being determined more and more by global factors.

Ciccarelli and Mojon for example performed a principal component analysis; they found that inflation in 22 OECD countries has a common factor that can account for on average around 70% of the fluctuations of headline inflation in those same countries in a long sample running from 1960 to 2008. In a more recent contribution, Ferroni and Mojon⁵⁵ apply a similar approach to the same countries and find – for the shorter and more recent period 1993-2014 – global factors playing a somewhat smaller role, explaining only around half of the variance in domestic inflation by common (global) inflation.⁵⁶ They also expand the approach to underlying inflation measured in terms of headline inflation excluding food and energy. Their findings show that 40% of the variation in domestic underlying inflation in the 22 OECD countries studied can be explained by global inflation.

How significant global inflation is vis-à-vis domestic inflation seems to largely depend on the time period studied. Applying a similar methodology to that of Ciccarelli and Mojon for 40 developed and developing countries for headline inflation and 34 countries for inflation excluding food and energy over the sample 1999-2016 suggests that global factors account for around half of domestic headline inflation fluctuations (see Chart 7). However, this proportion has changed over time, with global factors playing a far stronger role in the period 2008-16 than in 1999-2007 in terms of headline inflation. Although the role of global factors in headline inflation excluding food and energy is found to be somewhat smaller, at around one quarter on average, the influence that global factors exert also seems to have been stronger more recently.

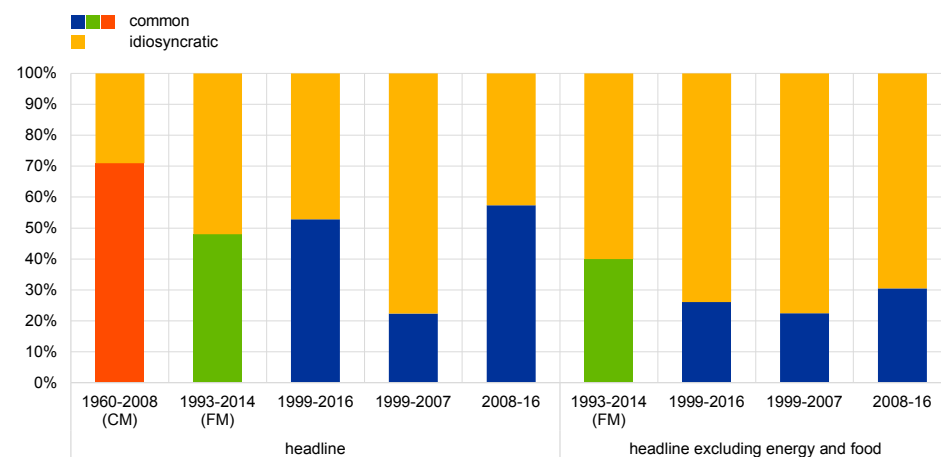
⁵⁵ Ferroni, F. and Mojon, B., *Domestic and Global Inflation*, 2016, mimeo. In a forecasting exercise, Kearns, J., “Global inflation forecasts”, *BIS Working Papers*, No 582, 2016 finds that for most countries global inflation does not improve the survey-based forecasts of domestic inflation. However, this may also mean that survey forecasters incorporate information on global inflation in their forecasts.

⁵⁶ Parker also finds that global factors explain a large share of the variation in national inflation rates in a much larger sample of 223 countries and territories from 1980 to 2012: see Parker, M., “Global inflation: the role of food, housing and energy prices”, *Working Paper Series*, No 2024, ECB, 2017.

Chart 7

The role of global factors in explaining domestic inflation based on common factor analyses

(share of variation that can be explained by common and idiosyncratic factors)



Notes: "CM" (red bar) reflects the share of common factors as calculated by Ciccarelli and Mojon. "FM" (green bars) reflects the share of common factors as calculated by Ferroni and Mojon. The other results (blue bars) are based on ECB staff estimations for 40 developed and developing countries for headline inflation, and 34 countries for headline inflation excluding food and energy.

Monetary policy orientation plays a role with regard to the commonality in inflation fluctuations across countries.

The high degree of synchronisation of inflation across countries (see Chart 5) reflects a common shift in the orientation of monetary policy. The 1990s saw a common downward trend in inflation, particularly in advanced economies, and later on also in some emerging economies. This trend could be attributed to the growing focus of monetary policy authorities towards delivering price stability⁵⁷. The effectiveness of monetary policy in anchoring domestic price expectations and in reducing the volatility of inflation developments and also the level of inflation would mean that proportionally more of the variation in national inflation rates is linked to exogenous global price shocks, such as commodity price changes.

Global commodity price movements are likely to be the main driver of the global common factor in inflation.

In this respect the most important effect stems from global oil price developments, which strongly affect the development of domestic energy inflation.⁵⁸ The common influence of global oil price developments on inflation can be reinforced by the pass-through of energy to underlying inflation, to the extent that this is similar across countries. The same reasoning applies to food and other raw materials inflation, which are also strongly dependent on global commodity price developments. Chart 8 illustrates the importance of commodity prices for the global commonality of headline inflation, as around half of the variation in the common factor can be explained by movements in oil and food commodity

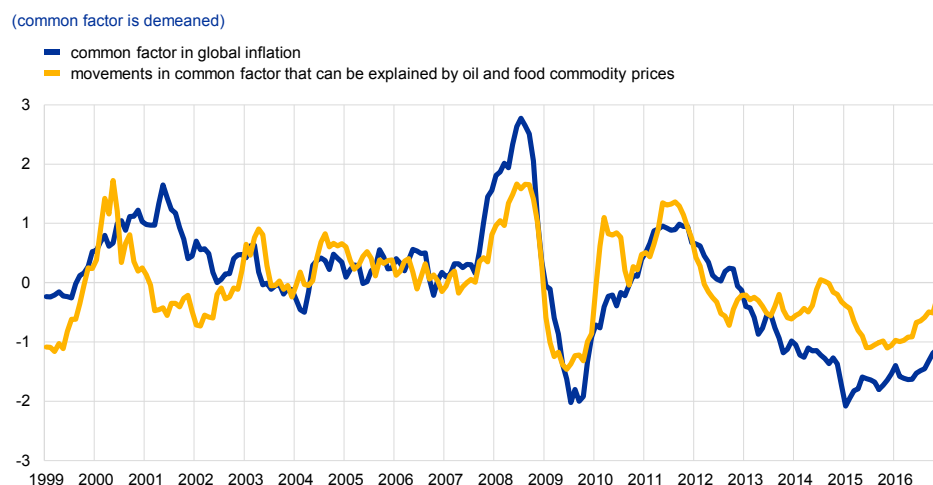
⁵⁷ This occurred in the form of the spreading of "good" monetary policy concepts among central banks: see Ciccarelli, M. and Mojon, B., op. cit.

⁵⁸ See for example the box entitled "The role of global factors in recent developments in euro area inflation", *Monthly Bulletin*, ECB, June 2014; and the box entitled "Oil prices and euro area consumer energy prices", *Economic Bulletin*, Issue 2, ECB, 2016.

prices. This also supports the view that the impact of global factors is changing and depends on how frequent and how large oil and food shocks are.

Chart 8

The relationship between the common factor in global inflation and commodity price developments



Notes: The blue line reflects the zero mean common factor in global inflation as derived by replicating the principal component approach of Ciccarelli and Mojon for a sample of 40 advanced and emerging economies. The yellow line reflects movements of oil and food prices weighted with the coefficients derived by a linear regression of the common factor in oil and food prices (with a lag of three months).

Commodity price cycles contribute to understanding why the importance of global factors in relation to domestic inflation changes so widely over time.

Ciccarelli and Mojon's findings of the very strong influence that global factors can have seem to be partly driven by the inclusion of data from the 1970s, when central banks failed to prevent energy prices from driving up inflation across the world. This explains why analyses that apply a very similar methodology to a shorter sample – during which monetary policy across the world has been far more successful in dampening inflation swings in the face of strong commodity price movements – find that global factors have a substantially smaller effect. The role that strong energy price swings have played in shaping inflation developments after 2008, which have also fed through to underlying inflation via indirect effects, may partly explain the substantial differences in the role of global factors found in the sub-sample analyses for 1999-2007 and 2008-16 in terms of headline and underlying inflation (see Chart 7).

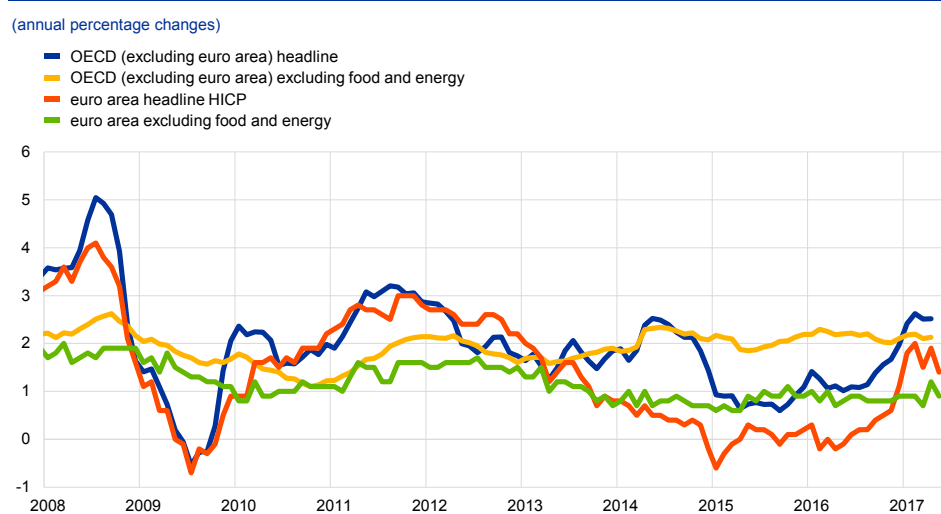
4 Decomposing the effects of global and domestic factors on inflation in the euro area since the crisis

To better understand the role of global and domestic factors in euro area inflation, this section analyses the period after the crisis, disentangling the role of domestic and global factors and their relative importance over time.

Between 2008 and mid-2013, headline inflation in the euro area has shown strong co-movements with headline inflation in other advanced economies

(see Chart 9). Whereas headline inflation peaked in both the non-euro area OECD countries and the euro area in autumn 2011 and fell rapidly thereafter, after 2013 the decline was more pronounced in the euro area. In particular, while inflation dipped into negative territory several times in the euro area in 2015 and 2016, it remained positive for the OECD (excluding the euro area) aggregate. Furthermore, euro area headline inflation continued to hover around zero between end-2014 and autumn-2016.

Chart 9
Euro area and OECD inflation rates



Sources: OECD, Eurostat, and ECB calculations
Note: The latest observations are for May 2017 for the euro area and April 2017 for the non-euro area OECD countries.

Gauging the importance of global versus domestic factors in relation to developments in euro area consumer price inflation is not without its complications. First, the various factors are interrelated and affect domestic variables through multiple channels. Second, the impact of global factors on euro area consumer prices depends on how producers and/or retailers adjust their margins as a result of changes in costs. This is subject to local and international market conditions.

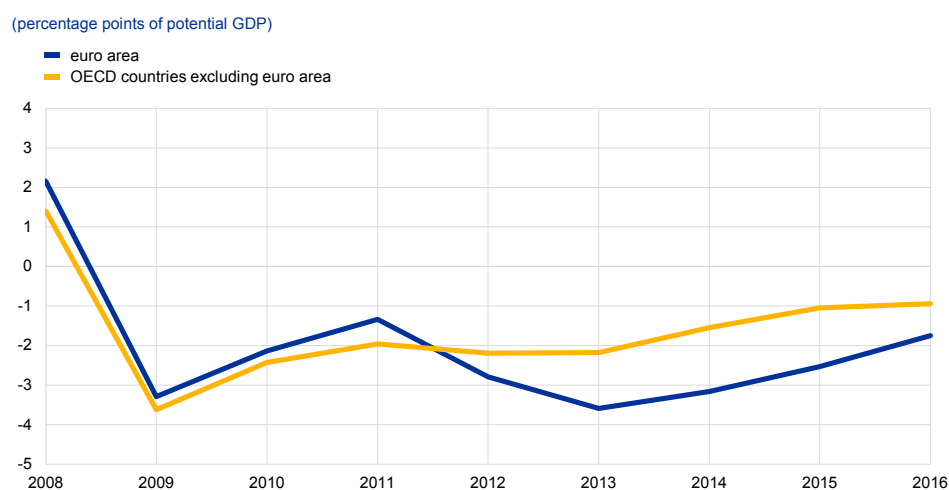
An attempt to assess the relevance of global factors to headline inflation developments could begin by considering the individual HICP components. Certain components, notably energy, are more sensitive to global factors than others, such as services, which are more responsive to domestic factors.

A large part of the decline in headline inflation in the euro area and the OECD countries from the end of 2011 until early 2016 has been on account of a decline in energy prices. The most recent pick-up was also mainly driven by the swing in energy prices.

A striking difference between the euro area and the other OECD countries in general is that, since 2013, lower HICP inflation excluding energy and food can explain a much more important, and more stable, part of the euro area disinflation and persistently low inflation. This points to domestic forces having a

stronger role in the euro area, and contributing to the fact that HICP inflation excluding energy and food is diverging from that of other advanced economies. HICP inflation excluding energy and food in the euro area has hovered consistently between 0.6% and 1.1% since mid-2013. As Chart 10 shows, according to OECD estimates, the OECD (excluding the euro area) and euro area output gaps were very close to each other until 2012; thereafter the difference between them widened, as the euro area experienced a more negative output gap than the rest of the OECD. The divergence in HICP inflation excluding energy and food between the euro area and other advanced economies, in other words, is largely a matter of domestic economic weakness after 2012.

Chart 10
Euro area and OECD output gaps



Sources: OECD and ECB calculations.
Note: The latest observation is for 2016.

One approach for distinguishing domestic from global forces is to identify structural shocks and quantify their relative contributions to the dynamics of inflation. This requires a model-based analysis similar to the one applied in Bobeica and Jarociński⁵⁹, whose approach is replicated and updated here. Based on that analysis, Chart 11 shows the contributions of domestic and global shocks to the deviation of euro area headline inflation from a model-based mean. Global shocks are important most of the time, but domestic shocks have had a greater effect, in particular over the period 2012-14, when inflation was falling, and more recently in explaining inflation developments. Global shocks were the principal driver in the two periods from early 2008 to mid-2009 (mainly a global demand shock) and in 2015 to

⁵⁹ Bobeica, E. and Jarociński, M., “Missing disinflation and missing inflation: the puzzles that aren’t”, *Working Paper Series*, No 2000, ECB, 2017. The analysis in this section is largely based on the model presented in detail in this paper. Bobeica and Jarociński’s empirical model contains seven variables and seven shocks are identified and labelled using a combination of zero and sign restrictions. The variables included are the price of oil, rest-of-the-world real GDP (or the share of domestic real GDP in the world real GDP), real GDP, consumer prices, short-term interest rate, 10-year bond spread and the nominal effective exchange rate. The first two are classified as global shocks (oil supply and global demand shock), while the subsequent ones represent domestic shock. The identification relies on a timing restriction: global shocks affect all variables instantly, whereas there is a delay before domestic shocks affect global variables.

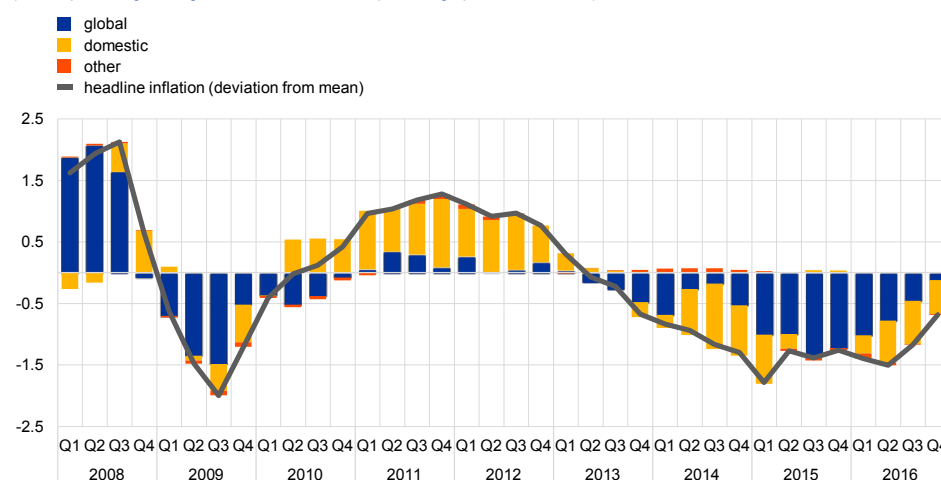
early 2016 (mainly an oil supply shock). They accounted for about 60% and 75% of the deviation respectively. Hence, global factors dominate mainly when large shocks occur that have implications for the whole world economy.

A decomposition of the driving forces of inflation in the euro area thus shows that both global and domestic shocks have played a decisive role in shaping domestic inflation. The relative importance of these shocks can also change quite substantially over time. The empirical results show that both global and domestic factors played a role in determining inflation developments in the euro area from the onset of the crisis. However, the relative importance of global and domestic forces is not so much driven by structural forces, such as globalisation, as by periodic bouts of global shocks, often reflected in large commodity price swings. The next section analyses how the “traditional” Phillips curve fares in terms of explanatory power for euro area underlying inflation developments and whether it can be improved by also taking measures of foreign slack into account.

Chart 11

Historical decomposition of headline inflation – domestic and global shocks

(annual percentage changes; deviation from mean; percentage point contributions)



Sources: Eurostat and ECB staff calculations – based on [Bobeica and Jarociński](#).
 Notes: The chart shows the percentage point contribution of different types of shocks to explain the evolution in headline inflation in the euro area. Global shocks reflect an oil supply and a global demand shock; domestic shocks reflect a domestic demand, a domestic supply, a short-term interest rate and a spread shock. A negative contribution implies that that the specific shock contributed to lowering inflation, whereas a positive contribution indicates that this shock put upward pressure on inflation. The contributions are estimated in a Bayesian vector autoregressive model containing seven variables and seven shocks (two of the shocks are global and four are domestic). For more details, see [Bobeica and Jarociński](#).

Box 1

China’s influence on inflation dynamics in advanced economies

Decelerating activity, excess capacity and falling producer pressures in China in recent years have focused interest on the role of China in shaping global inflation developments.

This box uses a model-based assessment to understand the impact of developments in China on inflation dynamics in advanced economies.

The integration of China into the global economy is likely to have influenced inflation dynamics in other economies through several channels. Supply and demand channels acted

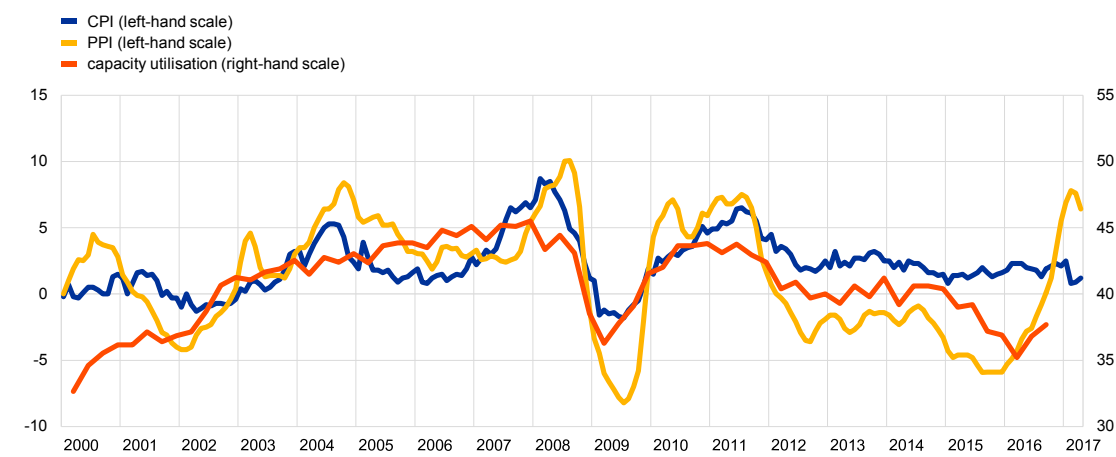
mostly in different ways: on the one hand, the supply-side effect of the entry of lower-cost producers drawing on a large and relatively cheap labour supply has contributed directly to lower global input and import prices.⁶⁰ Heightened competitive pressures from China may also have weighed on inflation in other countries by reducing both the market power of firms and the bargaining power of workers.⁶¹ On the other hand, stronger demand in China could also have contributed to upward price pressure in other countries by strengthening external demand. Rising activity in China has also entailed increased consumption of commodities, driving up their prices. The net impact of these different channels on inflation in other economies is ambiguous and may have changed over time.

Three decades of rapid expansion have meant a marked increase in China’s influence in the global economy, although its growth rate has slowed in recent years. China’s output grew very strongly in the first decade of this century, with GDP increasing by over 10% each year on average. The country has also been a major driver of global commodity consumption: in 2015 it accounted for about 50% of global copper and aluminium and 60% of iron consumption, while 12% of global demand for oil originates in China. Since 2011 China’s pace of expansion has slowed, with GDP growth falling from over 10% in 2011 to under 7% in 2016, although its share of global GDP continues to increase. During much of this period producer prices have also fallen markedly: between September 2011 and February 2016, producer prices in China fell cumulatively by 22% (see Chart A) as excess capacity in China, particularly in tradable sectors such as steel, aluminium, cement and shipbuilding, also contributed to waning price pressures. Over the past year, however, renewed buoyancy in the property market, which has strengthened demand for raw materials, and efforts by authorities to address the capacity overhang in some industries have caused producer prices to rebound.

Chart A

Consumer and producer price inflation and capacity utilisation in China

(left-hand scale: year-on-year percentage changes; right-hand scale: percentage of production capacity)



Sources: National Bureau of Statistics of China and the People’s Bank of China.

Notes: Capacity utilisation is a diffusion index derived from the 5000 Industrial Enterprises Survey. The latest observations are for April 2017 for consumer price inflation (CPI) and producer price inflation (PPI), and the third quarter of 2016 for capacity utilisation.

⁶⁰ See the box entitled “Effects of the rising trade integration of low-cost countries on euro area import prices”, *Monthly Bulletin*, ECB, August 2006.

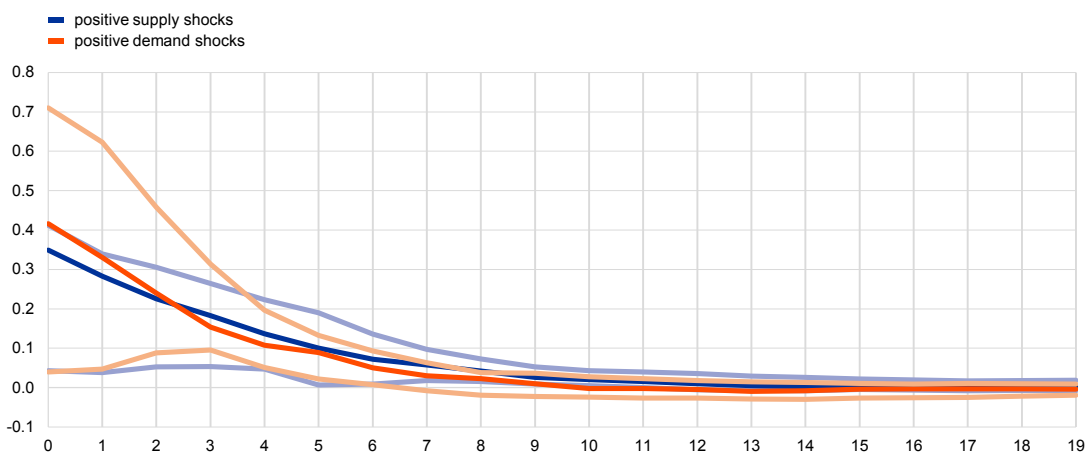
⁶¹ For the euro area, see Pula, G. and Skudelny, F., “Globalisation and euro area prices and labour markets: some evidence on the impact of low-cost countries”, in Anderton, R. and Kenny, G. (eds.), *Macroeconomic Performance in a Globalising Economy*, Cambridge University Press, 2011.

Small-scale structural Bayesian vector autoregressive (BVAR) models provide one means of analysing the impact of developments in China on inflation in other economies. The estimation proceeds in two stages. In a first step, a BVAR model with sign restrictions is used to distinguish supply and demand shocks originating in China from commodity supply shocks and other global demand shocks (i.e. those not associated with cyclical fluctuations in China).⁶² The second step is to trace the impact of these shocks on inflation in advanced economies, again through small-scale BVAR models.⁶³

Chart B

Responses of CPI inflation in advanced economies to shocks originating in China

(deviation of year-on-year growth rates following China shocks equivalent to 1% of GDP growth)



Source: ECB calculations.

Notes: The bold lines show the median response of CPI inflation across a sample of advanced economies to structural shocks originating in China. The lighter lines show the interquartile range of responses of CPI inflation across the sample of advanced economies.

Evidence from the model suggests that economic shocks in China can affect CPI inflation in advanced economies. Impulse responses from the model suggest stronger demand in China tends to increase price pressure in advanced economies (see Chart B). A demand shock that lifts Chinese GDP growth by 1 percentage point would on average increase inflation in advanced economies by around 0.1 percentage point after one year. A boost to China's supply capacity is also

⁶² The first stage BVAR includes China GDP, China producer price inflation, the IMF commodity price index and two relative variables which measure China's share in global GDP and its inflation rate relative to OECD aggregate inflation. Following Eickmeier and Kühnlenz, the sign restrictions use China's share in global GDP to distinguish global from China-specific demand shocks, assuming that shocks that originate in China have a stronger impact on Chinese GDP than on all other countries. A positive Chinese demand shock is therefore assumed to boost GDP and inflation in China and increase China's share in world GDP (relative to the underlying trend). A positive world demand shock is assumed to lift commodity prices, China's GDP and inflation, but to reduce China's share in global GDP relative to underlying trend. To distinguish the commodity supply and China-specific supply shocks, it is assumed that inflation in China reacts less than OECD inflation following a commodity supply shock; this reflects the regulation of many raw material prices in China's domestic markets. Thus a commodity supply shock is assumed to increase commodity prices and to increase inflation in China (but by less than OECD inflation). A supply shock in China is assumed to increase China's GDP and share in world output and to lower China's inflation. See Eickmeier, S. and Kühnlenz, M., "China's role in global inflation dynamics", *Discussion Paper*, No 7, Deutsche Bundesbank, 2013.

⁶³ Separate BVARs are estimated for Australia, Canada, Denmark, Germany, France, Italy, Japan, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States; quarterly data going back to 1999 was used. The models include GDP, CPI inflation, the nominal effective exchange rate and the short-term interest rate as well as the common structural shocks from the first-stage BVAR, which are assumed to be exogenous. Whereas in the case of the small countries exogeneity is probably a reasonable assumption, for the larger countries it carries some caveats.

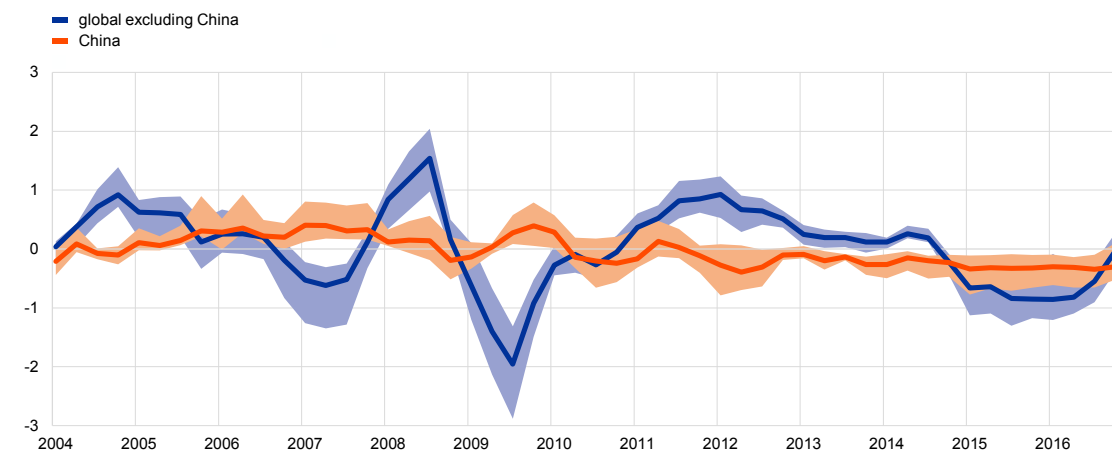
found to increase inflation in other economies by a similar amount. Although an increase in China's supply potential would tend to put downward pressure on prices in China – which would feed through to other economies via lower import prices– the boost to activity also fuels commodity price increases. These results from the model suggest that the direct effects through low-cost production to import prices are outweighed by the effects resulting from stronger dynamics of commodity prices.⁶⁴

As the pace of growth of activity in China has moderated, its influence on inflation in other economies has evolved (see Chart C). The model estimates suggest that in the period when it was growing very rapidly, China tended to provide a modest boost to inflation rates in advanced economies. Between 2004 and mid-2011 shocks originating in China contributed about 0.1 percentage point to annual inflation in advanced economies on average. Since then, as activity growth has slowed, China has exerted a modest drag on advanced economy inflation, with shocks originating in China contributing about -0.2 percentage point on average over the past four years.

Chart C

Estimated contributions of global and China shocks to CPI inflation in a sample of advanced economies

(percentage point contributions to deviations from steady state)



Source: ECB calculations.

Notes: The ranges show the interquartile range of estimates of the contributions of global and China-specific structural shocks to CPI inflation across a sample of advanced economies, including Australia, Canada, Denmark, Germany, France, Italy, Japan, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States. The shocks originating in China include those relating to supply and demand. The global shocks include a commodity supply shock and a global demand shock. The identification of the shocks is described in footnote 24.

⁶⁴ Eickmeier and Kühnlenz present contrasting results, finding that a Chinese supply shock tended to lower CPI inflation in other countries (see Eickmeier, S. and Kühnlenz, M., op. cit.). Differences may partly relate to estimates of the impact of shifts in China's activity on global commodity prices. For a discussion of China's effect on commodity prices, see *World Economic Outlook*, IMF, October 2016, Chapter 4.

5 What role do global factors play in a Phillips curve for the euro area?

The Phillips curve, which is broadly understood as the relationship between inflation and economic slack, is a standard framework for explaining and forecasting developments in inflation. The Phillips curve is an important tool that is embedded explicitly or implicitly in many macroeconomic models. However, especially in its strongly simplified versions, the Phillips curve remains a crude tool relative to the complexity of the inflation process. The uncertainty surrounding the adequate modelling of the Phillips curve adds further complications, and so the curve should only be considered as one element in a broader-based analysis of inflation. Nevertheless, it remains a useful frame for understanding inflation.

Phillips curve analyses have traditionally focused on what role domestic slack has in relation to developments in underlying inflation. The focus on underlying inflation – as measured for example in the form of HICP inflation excluding energy and food – allows for inflation to be disregarded in relation to energy and food, which are determined largely by global developments, and to concentrate on services and NEIG inflation, where domestic developments play a more important role. In a benchmark specification of the Phillips curve for the euro area, HICP inflation excluding energy and food depends on the output gap as a measure of slack in the domestic economy. The output gap is meant to cover the effects of slack on wage and price-setting behaviour: all other things being equal, the lower the amount of slack in an economy is, the higher wage and price pressures will be.

External factors are usually taken into account via import prices in Phillips curve specifications. Import prices can influence HICP inflation excluding energy and food in two ways: directly, via the price of imported final consumer goods; and indirectly, via the price of imported intermediate goods used in euro area domestic production.⁶⁵ Import prices also capture the influence of developments in global commodity markets – for example in the form of oil prices, which affect HICP inflation excluding energy and food via the indirect effects of higher import prices for oil on production costs.⁶⁶ Exchange rate movements can amplify or moderate the effects of foreign price developments on euro area inflation. Import prices – including energy imports measured in euro – are hence an important indicator for capturing the effects of oil price and exchange rate developments on HICP inflation excluding energy and food in the euro area in a Phillips curve framework.

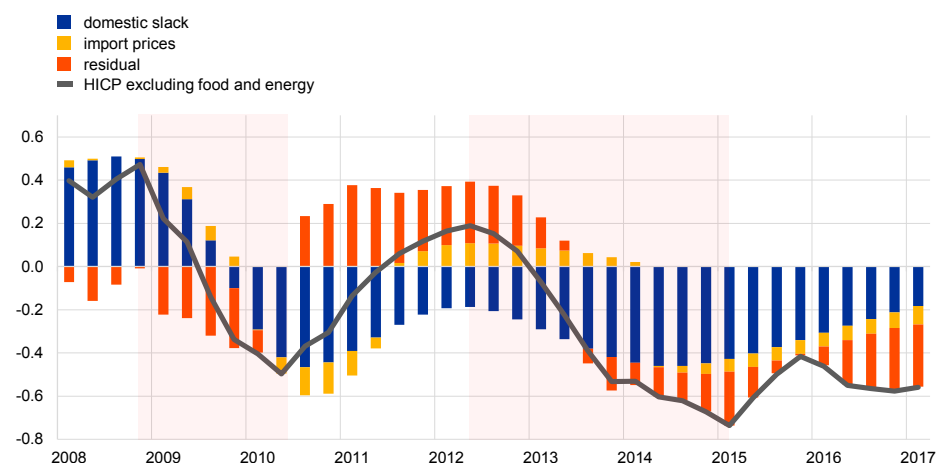
⁶⁵ See the article entitled “Exchange rate pass-through into euro area inflation”, *Economic Bulletin*, Issue 7, ECB, 2016.

⁶⁶ See the box entitled “Indirect effects of oil price developments on euro area inflation”, *Monthly Bulletin*, ECB, December 2014; and the article entitled “Commodity prices and their role in assessing euro area growth and inflation”, *Monthly Bulletin*, ECB, October 2013.

Chart 12

Decomposition of HICP inflation excluding energy and food based on a Phillips curve model

(annual percentage changes and percentage point contributions; all values in terms of deviations of their model-implied mean)



Sources: Eurostat and ECB calculations.

Notes: The black line shows deviations of HICP excluding energy and food inflation from its model-implied mean. Contributions (including residuals) are also shown as deviations from their model-implied mean. Contributions are calculated based on an equation in which HICP excluding energy and food inflation (the annualised quarterly growth rate of the seasonally adjusted series) is regressed against its own lag, the lagged output gap of the European Commission, the third lag of import price inflation and a constant. The shaded areas indicate two disinflation periods.

A traditional Phillips curve decomposition of the changes in underlying inflation since the crisis illustrates reasonably well how inflation developed in the period from 2010 – with the largest impact stemming from domestic slack.

For the purpose of this article, HICP inflation excluding energy and food is modelled using a simple reduced-form “traditional” Phillips curve specification, including a number of explanatory factors, namely: (i) the output gap as a measure of economic slack; (ii) past inflation terms to capture inertia; and (iii) import price inflation expressed in euro to capture the effect of global inflation and the exchange rate.. Chart 12 breaks down HICP inflation excluding energy and food into these factors by showing each factor’s contribution to the deviation of inflation from its long-term mean. In both disinflation periods (2009 until early 2010 and 2012 until early 2015) domestic slack was an important driving factor of the fall in inflation. Lower import prices also had a small downward impact over these periods. The remaining residuals of this Phillips curve decomposition could reflect a number of different factors: these include a potential impact from a mismeasurement of domestic slack in the form of the output gap, but also a potential impact from global factors (over and beyond what is covered by import prices) or the structural impact of reforms on the slope of the Phillips curve.

Is there any indication that globalisation has changed the impact of global cyclical conditions on domestic inflation in a way that cannot be captured by including import prices in Phillips curve analyses?

Some of the channels through which global slack may affect domestic inflation may already be captured (at least implicitly) in traditional Phillips curves. As discussed in Section 2, global slack affects import prices, which are usually included in Phillips curve estimates. Measures of domestic slack also incorporate some information about global

conditions, since global demand for goods and services is reflected in net trade, and expectations on foreign demand affect investment decisions quite strongly. At the same time, other channels of globalisation are not explicitly captured in the standard Phillips curve framework. In particular, the greater importance of foreign slack for tradable and internationally substitutable goods or the increase in competition from firms in lower-cost countries, including because of further integration in GVCs, may be significant determinants for domestic inflation dynamics.

One way of assessing what role global influences have is to augment the traditional Phillips curve with a measure of foreign slack. The simplest indicator of global inflationary pressures is provided by a global output gap, which measures the difference between world GDP and the estimated potential output of the global economy. Like any output gap measure, it is surrounded by considerable uncertainty because potential output is unobserved and must be estimated. Judging output gaps for an economy is particularly challenging in real time as estimates are often subject to substantial revisions. The same is true for global output gaps and the problem is compounded by the question of the appropriate weighting of the individual countries' gaps: GDP weights are commonly used for this specific purpose.⁶⁷

More recently empirical studies have focused on an important transmission channel for the effects of global slack on domestic inflation, i.e. the increasing integration of GVCs. Auer, Borio and Filardo argue that the difference in the sensitivity of domestic inflation with respect to foreign and domestic slack can be explained by integration in GVCs.⁶⁸

However, the literature provides only limited support for including a measure of foreign slack in traditional Phillips curve analyses. On the one hand, Borio and Filardo found that proxies for global economic slack added considerable explanatory power to traditional benchmark Phillips curve approaches in advanced economies and that the role of global factors had grown over time. The relevance of the global output gap was also supported by Milani in the case of the United States after 1985. On the other hand, other studies (Calza⁶⁹, Gerlach et al.⁷⁰, Ihrig et al.⁷¹,

⁶⁷ For a discussion of measurement and conceptual issues with global output gap measures, see Tanaka, M. and Young, C., "The economics of global output gap measures", *Bank of England Quarterly Bulletin*, third quarter of 2008. While measures of the global output gap can provide a broad view of world inflationary pressures, for a specific country a better indicator of external price pressures may be to weight output gaps in other economies. Economic slack in other economies can affect domestic inflation either through the imports channel or through the effects of competition in export markets. Weighting the output gaps of other economies according to the share of each bilateral trade relationship in overall trade could therefore help to better capture external price pressures that are most relevant for a particular country. It would also be possible to construct weights that capture both direct bilateral trade and third-market competition by using the "double weighting" methods used to construct effective exchange rate measures. See Schmitz, M., De Clercq, M., Fidora, M., Lauro, B. and Pinheiro, C., "Revisiting the effective exchange rates of the euro", *Occasional Paper Series*, No 134, ECB, June 2012. An alternative, suggested by Borio and Filardo, is to use exchange-rate weighted global output gaps, which can emphasise the role of the exchange rate regime in exporting inflation.

⁶⁸ For details, see the discussion in Section 2. See also the article entitled "The impact of global value chain participation on current account balances – a global perspective", *Economic Bulletin*, Issue 2, ECB, 2017.

⁶⁹ Calza, A., "Globalisation, Domestic Inflation and Global Output Gaps: Evidence from the Euro Area", Federal Reserve Bank of Dallas, *Working Paper*, No 13, 2008.

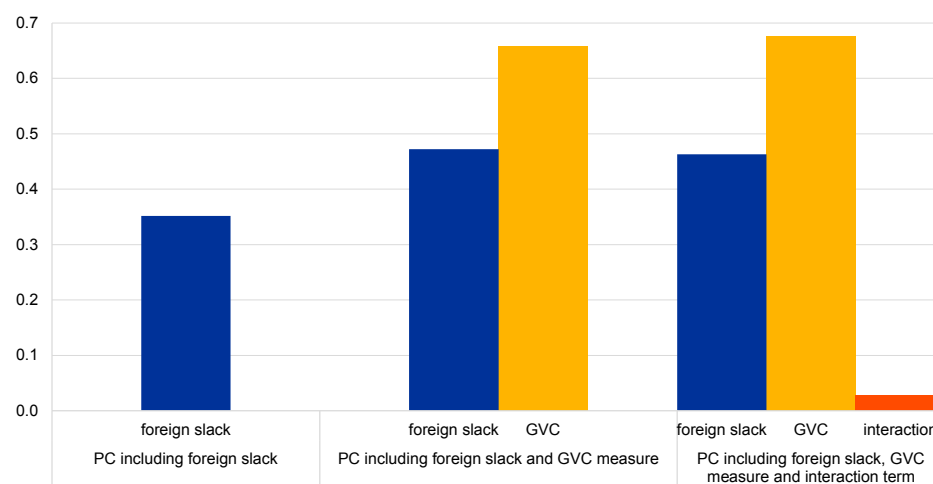
⁷⁰ Gerlach, S., Giovannini, A., Tille, C. and Viñals, J., "Low Inflation: Testing Times for Central Banks", *10th Geneva Report on the World Economy*, 2008.

Martínez-García and Wynne⁷² or Eickmeier and Pijnenburg⁷³) find conflicting evidence and suggest that the Borio and Filardo results are likely to be specific to the estimation sample or particular measurement of the global output. More recently Mikolajun and Lodge⁷⁴ detect no appreciable direct effects of global economic slack on domestic inflation for the majority of advanced economies. Their results provide little evidence of the existence of large direct effects of global slack on domestic inflation and overall suggest that there is little reason to include global factors into traditional reduced-form Phillips curves. However, this analysis is limited to reduced-form Phillips curves and univariate inflation forecasting models. It might be possible that global slack influences inflation through less direct channels that cannot be captured in this framework. Bianchi and Civelli explore less direct relations within a vector autoregressive model. For a set of 18 countries, they estimate the time-varying relationship of inflation with both domestic and foreign output gaps, finding that global slack plays a significant role. However, in contrast to the results reached by Borio and Filardo, who inspired them, Bianchi and Civelli do not find that the relative influence of global output gaps has become stronger over time.

Chart 13

Significance of foreign slack and GVC integration measures in euro area Phillips curve specifications

(share of specifications in which the respective variables are significant as a percentage of total specifications analysed)



Notes: ECB staff calculations. For technical details, see Box 2. Analyses include up to 108 different Phillips curve specifications. "PC" stands for Phillips curve. The results are based on standard significance tests (applying a 10% level of significance), which do not include a variance correction to account for the fact that auxiliary regressions were employed (see Box 2 for further details). The results should hence be interpreted as representing an upper bound with respect to the share of specifications in which foreign slack and GVC variables are significant.

⁷¹ Ihrig, J., Kamin, S., Lindner, D. and Marquez, J., "Some simple tests of the globalization and inflation hypothesis", *International Finance*, Vol. 13, Issue 3, 2010, pp. 343-375.

⁷² Martínez-García, E. and Wynne, M., "The Global Slack Hypothesis", Federal Reserve Bank of Dallas, *Staff Papers*, No 10, 2010.

⁷³ Eickmeier, S. and Pijnenburg, K., "The Global Dimension of Inflation – Evidence from Factor-Augmented Phillips Curves", *Oxford Bulletin of Economics and Statistics*, Vol. 75, Issue 1, 2013, pp. 103-122.

⁷⁴ Mikolajun, I. and Lodge, D., "Advanced economy inflation: the role of global factors", *Working Paper Series*, No 1948, ECB, 2016.

Thick modelling analyses find only mixed support for augmenting a traditional Phillips curve for the euro area with a measure of foreign slack and GVC integration. A thick modelling approach, which includes a broad range of up to 108 different Phillips curve specifications combining three different measures of domestic slack, three different measures of foreign slack (combined with six different weighting schemes) and two different measures of GVC integration, with and without interaction terms, allows for the uncertainty about the correct specification of the Phillips curve and the variables used therein to be addressed (for details of the approach taken, see Box 2). This battery of alternative specifications was estimated on a sample spanning the years 2000-16⁷⁵.⁷⁶ As illustrated in Chart 13, the inclusion of some measure of global slack in the Phillips curve can help establish the significant role that foreign slack plays in around one-third of the specifications. If GVCs and foreign slack are included simultaneously, they are significant in around 50% to 60% of the specifications. The GVC measure captures a downward sloping trend, which in some specifications is significant if included in addition to the weighted foreign slack measure. However, the GVC measure is almost never significant when interacted with the global slack, implying that the integration in GVCs does not seem to have an amplifying effect on the role of foreign slack.

Box 2

Augmenting the traditional Phillips curve with measures of global slack

How much of a role foreign slack plays in domestic HICP inflation excluding energy and food can be assessed by augmenting a traditional Phillips curve with a measure of foreign slack.

Formally, this Phillips curve representation would look as follows:

$$\pi_t = \beta_1 \pi_{t-1} + \beta_2 \text{gapd}_{t-1} + \beta_3 \text{imp}_{t-2} + \beta_4 \pi_t^e + \beta_5 \text{gapf}_{t-1} + c + e_t \quad (1)$$

where π_t represents the annualised quarter-on-quarter rate of HICP inflation excluding energy and food and π^e its corresponding measure of expectations, gapd_{t-1} is a measure of domestic slack (with one lag), imp_{t-2} represents import prices (with two lags), gapf_{t-1} is a measure of foreign slack (excluding the euro area and with one lag) and c is a constant. To address the uncertainty surrounding the specification of the Phillips curve, and especially the measurement of slack, we apply a “thick modelling” approach with a large number of specifications. Three different measures for the domestic slack (the output gap, real GDP growth and the unemployment rate) are combined with three different measures of foreign slack for each country (the output gap from the IMF and the OECD, and a Hodrick-Prescott filter output gap measure) combined with six different weighting schemes.⁷⁷ Additionally, we employ two different measures of GVC integration.⁷⁸ Overall, we analyse 108 different Phillips curve specifications.

⁷⁵ GVC measures from the World Input-Output Database are only available from 2000 onwards.

⁷⁶ Timmer, M.P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G.J., “An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production”, *Review of International Economics*, Vol. 23, 2015, pp. 575-605.

⁷⁷ For details on this approach to the Phillips curve, which has been adapted to this exercise to account for the availability of data, see Ciccarelli and Osbat, “Low inflation in the euro area: Causes and consequences”, *Occasional Paper Series*, No 181, January 2017.

The measure for foreign slack $gapf_t^j$ is constructed for each country j as a weighted average of k output gaps, i.e.

$$gapf_t^j = \sum^k w_t^{j,k} * gapd_t^k \quad (2)$$

where $w_t^{j,k}$ is either the share of bilateral trade flows of country j with country k over country j 's total trade flows or the share of country k in total global output.

We use auxiliary regressions to tackle the distortions arising from the correlation of inflation expectations with past inflation and between domestic and foreign slack.

However, the role of foreign slack may depend on the degree of integration of the country in GVCs. This is essentially what Auer, Borio and Filardo put forward when showing that the relative importance of foreign slack depends to a large extent on integration in GVCs. Therefore, it seems reasonable to augment our equation 1 with an indicator for integration in GVCs. To fully capture the potential impact of GVC integration, we also analyse its interaction with foreign slack.⁷⁹ Indeed, the effect of foreign slack might depend on the level of integration in GVCs (i.e. the more integrated a country is in GVCs, the stronger the effect of foreign slack could be). Therefore, we estimate the following two equations, with an indicator for GVC integration included in equation 3 and also an interaction term with foreign slack in equation 4:

$$\pi_t = \beta_1 \pi_{t-1} + \beta_2 gapd_{t-1} + \beta_3 imp_{t-2} + \beta_4 \pi_t^e + \beta_5 GVC_{t-1} + \beta_6 gapf_{t-1} + c + e_t \quad (3)$$

$$\pi_t = \beta_1 \pi_{t-1} + \beta_2 gapd_{t-1} + \beta_3 imp_{t-2} + \beta_4 \pi_t^e + \beta_5 GVC_{t-1} + \beta_6 gapf_{t-1} + \beta_7 gapf_{t-1} * GVC_{t-1} + c + e_t \quad (4)$$

6 Conclusion

Drawing on evidence from the available data, models and existing literature, this article contributes to a better understanding of the relative importance of domestic and global factors in shaping inflation in the euro area. A number of conclusions can be drawn.

1. Since the early 1990s a common pattern around the world has been identified regarding inflation developments. However this commonality can to a large extent be explained by a change in monetary policy orientation and global commodity price developments.
2. The role of global factors in domestic inflation varies strongly over time, notably on account of developments in commodity prices. In the case of the euro area, for example, the decline in inflation in 2008-09 was driven predominantly by global factors, whereas domestic factors were more decisive in the disinflation

⁷⁸ Imported intermediate, foreign value added (FV), indirect value added (IV) and a GVC participation measure are computed as FV + IV.

⁷⁹ Note also that the regressors used for the interaction terms are demeaned, so for instance the coefficients can be interpreted as the effect of GVCs when foreign slack is at its sample mean.

period of 2012-15. This underlines how important comprehensive analyses of the driving factors of inflation are when formulating adequate policy responses.

3. Global developments are thought to increasingly affect domestic wage and price pressures via the integration and contestability of labour and product markets. Although this theory may seem appealing, it is nevertheless difficult to capture empirically. In this respect we find, for example, only limited support for including measures of global slack and measures of integration in GVCs in Phillips curve analyses when studying inflation in the euro area.