II. Do global factors spell the end of the Phillips Curve?

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This chapter presents evidence that the determinants of domestic inflation present in the traditional Phillips curve framework remain relevant, while quantity-based measures of global shocks are not relevant. While global price shocks mainly related to oil and commodities are significant determinants of domestic inflation, domestic variables remain as significant as ever. These results are relevant as part of the debate on conducting monetary policy. The paper argues that the use of the Phillips curve in the current inflation-targeting framework is still relevant and that any argument against it cannot rely on inflation being determined by global factors (52).

II.1. Introduction

It is an agreed stylised fact that domestic inflation is highly correlated across advanced countries. In other words, domestic inflation in advanced countries shares 'common factors' or 'global factors'.

The existence of common factors as such only points to the existence of co-movements in inflation rates rather than any specific causal relationship. In fact, whether the presence of such common factors points to some causality relationship and the role of those common factors in the causality of inflation is still a subject of discussion. The main issue for discussion from the policy point of view is the extent to which the presence of common factors puts into question the relevance of the Phillips curve model in understanding domestic inflation developments. As far as common factors reflect the existence of global shocks that directly impact domestic inflation independent of domestic channels, they should be reflected in the Phillips curve-based inflation estimates.

This article analyses to what extent and in which way the Phillips curve framework should be adapted to take into account the presence of global determinants of inflation. In particular, the main question that we want to answer is to what extent global determinants, and in particular global demand shocks, can fully substitute for domestic determinants in the Phillips curve framework.

The reply to this question is far from being an academic curiosity. The New Keynesian Phillips curve framework (thereinafter 'NKPC') is the main conceptual framework currently in use to provide a causal explanation of inflation developments and remains the workhorse of monetary policy analysis.

(52) The authors wish to thank Eric Ruscher, Zenon Kontolemis, and Eric Meyermans for useful comments.

Under this view, the domestic output gap, productivity and (past and expected) inflation developments are essential determinants of domestic inflation, along with certain price shocks of a global nature like shocks to oil prices or international prices of goods and their effects (or the effects of other foreign shocks) on the domestic output gap.

Borio and Filardo (2007), among others, have challenged this view. They interpret the increasing co-movements in inflation in advanced economies as evidence that the domestic drivers of inflation have become largely irrelevant and that domestic inflation is mostly determined by global factors(53).

This controversy is relevant from a macroeconomic policy standpoint. If the current view is still correct, traditional macro-policy tools — monetary and fiscal policy — are still effective in fighting domestic inflation (or disinflation) due to their effect on the domestic output gap or on inflation expectations. In the alternative view, as domestic inflation is mostly driven by global factors such as global activity, macroeconomic policies lose their traction over domestic inflation as their effect on domestic activity is not fully transmitted to domestic prices. The reply to this question carries some weight in the current debate on conducting monetary policy. If the Phillips curve is still valid and domestic prices are still driven by domestic factors, we can expect

(53) See Borio C., and A. Filardo (2007), 'Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation,' *BIS WP No 227*. A similar view had been expressed for example by Bean, Ch. (2006), 'Globalisation and inflation' speech given at the London School of Economics, 24 October 2006. For a more complex view on the globalisation process and its consequences see Carney, M. (2017), '[De]globalisation and inflation', speech at the 2017 IMF Michel Camdessus Central Banking Lecture, Washington DC, 18 September 2017, or Constancio, V. (2017), 'Understanding and overcoming low inflation', remarks presented at the ECB conference *Understanding inflation: lessons from the past, lessons for the future?*, Frankfurt am Main, September 2017.

monetary policy to still influence inflation the way it used to. This reduces in part the necessity of international monetary policy cooperation in fighting inflation(54) or the necessity to resort to different instruments.

It also indirectly relates to the debate about the degree to which monetary policy should take into account financial stability considerations(55). The debate sees on the one hand the proponents of focusing monetary policy on financial stability and on the other those who believe that monetary policy should continue targeting inflation (and growth, if in the mandate), while financial stability should remain the remit of macro-prudential policies. Should global factors alone determine domestic prices, this would also influence the relationship between monetary and macro-prudential policy.

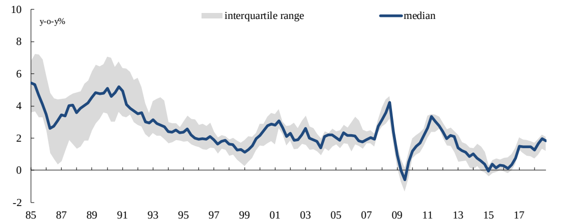
After documenting and discussing the presence of 'global factors' in domestic inflation across OECD countries in Section II.2, this article analyses the relevance of non-domestic inflation determinants within the NKPC framework in Sections II.3 and II.4. In particular, we first test in Section II.3 whether the presence of global demand conditions in the NKPC framework makes domestic inflation determinants superfluous. We then test in Section II.4 whether a direct link can be established between global demand conditions and wage developments.

II.2. Global common trends of inflation

II.2.1. Some stylised facts

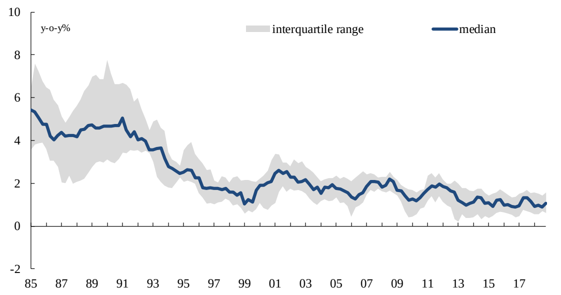
A simple look at the data shows a high correlation of consumer price inflation across developed OECD economies. Graph II.1 shows the median of year-on-year headline Consumer Price Index ('CPI') inflation of OECD countries and the interquartile range — computed as the difference between the 25% and 75% percentiles of the OECD countries' inflation rates ordered by growth rate. The relatively narrow range around the median points to a high correlation of CPI inflation rates across the OECD. It is worth noting that this measure of dispersion of headline inflation rates around the median has been decreasing over time, in particular since 1999 and even more so after the Great Recession(56). The same findings hold for core CPI (see Graph II.2).

Graph II.1: **Headline inflation dispersion, Q1-1985 –Q4-2018**



(1) Sample averages: (a) Q1-1985-Q4-1998: 3.9% and (b) Q1-1999-Q4-2018: 1.7%. National definitions of CPI (all items); the country sample is defined in Footnote 6.
Source: ECFIN calculations based on OECD data.

Graph II.2: **Core CPI inflation dispersion, Q1-1985-Q4-2018**



(1) Sample averages: (a) Q1-1985-Q4-1998: 4.4% and (b) Q1-1999-Q4-2018: 1.5%. CPI all items excluding food and energy; the country sample is defined in Footnote 6.
Source: ECFIN calculations based on OECD data.

II.2.2. The common (global) components of domestic prices

A principal component analysis substantiates the correlation of inflation rates across OECD countries shown above. This analysis points to the existence of a relatively strong common component (usually named 'global factor'). Since Ciccarelli and Mojon (2010)(57), many studies have found evidence of the presence of such a global

(54) There are other reasons that may make such cooperation desirable, like large international spillovers of monetary policy. See Engels, C. (2016), 'International coordination of central bank policy', *Journal of International Money and Finance*, vol. 67, pp.13-24.

(55) Eichengreen, B., M. El-Erian, A. Fraga, T. Ito, J. Pisani-Ferry, E. Prasad, R. Rajan, M. Ramos, C. Reinhart, H. Rey, D. Rodrik, K. Rogoff, H. S. Shin, A. Velasco, B. Weder di Mauro, and Y. Yu (2011), 'Rethinking Central Banking,' Brookings Institution. For an opposite view, Svensson, L. E. O. (2017), 'Cost-benefit analysis of leaning against the wind', *Journal of Monetary Economics*, vol. 90, pp. 193-213.

(56) This is not driven by the convergence happening in the euro area only. Splitting the sample between euro area and OECD non-euro area countries produces very similar results, even if the convergence in the euro area seems more pronounced.

(57) See e.g. Ciccarelli, A. and B. Mojon (2010), 'Global inflation', *The Review of Economics and Statistics*, vol. 92(3), pp. 524-535.

factor of inflation, which is common across developed countries([58]).

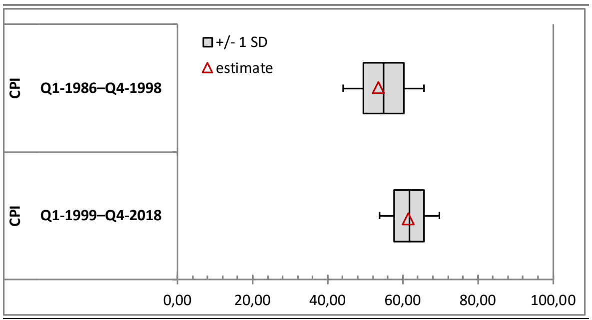
A principal component analysis of CPI inflation for a sample of advanced OECD economies between 1986 and 2018([59]) reveals that approximately 60% of the variability of headline inflation can be attributed to a common underlying component (see Graph II.3). The fact that the first principal component accounts for a large part of the total variance of the original variables is interpreted as the presence of 'global' factor underlying the inflation rates across developed OECD countries.

As euro area countries make up a large subset of the OECD countries, it is useful to check whether there was a structural break around 1999; to this end, we check the presence of such a common factor before and after the creation of the euro by splitting the sample into two sub-periods (before and after 1999)([60]).

In all cases, the first principal component is sufficient to capture a large share of the total variation in inflation rates. The global component explains almost the same percentage of variation in the headline inflation series in the pre-euro and post euro sub-periods([61]). Moreover, the difference between the estimates for the two sub-periods is smaller than two standard deviations([62]). The similarities between the pre-euro and post-euro periods are likely explained by the fact that the existence of a global component is primarily related to shocks in oil and commodity prices, which have not changed dramatically since the turn of the millennium.

We carried out several robustness checks to verify the robustness of the results regarding the time dimension. Various alternative estimations were therefore performed, in particular shortening the other period (after 1999) to 2015, without major effects on the results. In particular, we compared the results with those of the BIS (2014) paper, which most stresses the role of global factors in domestic inflation, by reducing the country dimension to 11 countries and the time span to 2013. Our analysis indicates that the global component explains a slightly lower share of the total variation in inflation rates for both series compared to BIS (2014).

Graph II.3: **Variation in headline inflation explained by global components**



(1) The shaded box represents +/- one standard deviation, the whiskers +/- two standard deviations, and the country sample is defined in Footnote 6. The bootstrapping procedure (see Box 1) is used to compute standard deviations.
Source: ECFIN calculations based on OECD data.

A further analysis of the impact of the creation of the euro on the presence of common components can be performed by restricting the sample to the first 12 euro area countries. This is shown in Graph

([58]) For similar analysis see also the '84th Annual Report' by the Bank for International Settlements (BIS) (2014), and ECB (2017), 'Domestic and global drivers of inflation in the euro area', *ECB Economic Bulletin* No 4, pp. 72-96. For disaggregated approaches, see Monacelli, T., and L. Sala (2009), 'The International Dimension of Inflation: Evidence from Disaggregated Consumer Price Data', *Journal of Money, Credit and Banking*, 41(1), pp. 101-20 and Altansukh, G, Becker, R., Bratsiotis, G. and D. R. Osborn (2017), 'What is the globalisation of inflation?', *Journal of Economic Dynamics & Control*, vol. 74(1), pp. 1-27.

([59]) The sample includes the first 12 euro area countries and Australia, Canada, Denmark, Japan, Sweden, Switzerland, the United Kingdom and the USA. We used both national consumer price indices and core CPI indices (excluding food and energy). All price indices (at a quarterly frequency) come from the OECD database and cover the period between 1980q1 and 2018q4. Since the time series are not adjusted seasonally or for working days, year-on-year growth rates are used for the analysis. See also Box I.1 in European Commission (2018), 'European Economic Forecast', Spring 2018, *ECFIN Institutional paper* No 077, May 2018.

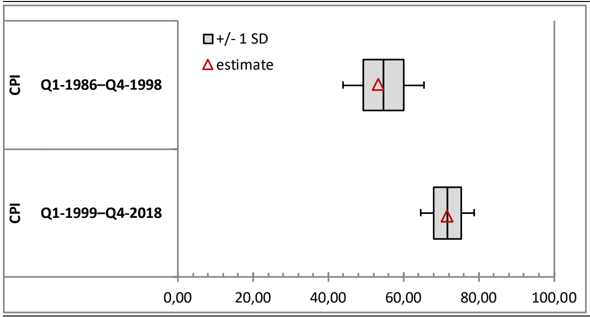
([60]) The choice of the sub-periods is driven by the introduction of the euro, which, by creating a new monetary area of a size comparable to the USA, can potentially have changed the commonalities of inflation in a large number of countries. This is relevant especially because the two sub-periods are roughly the same length. Note that the (beginning of the) sample was chosen to be identical to the one in the Bank for International Settlements (BIS) (2014) so that the findings can be compared. The methodology used here and in BIS (2014) are identical.

([61]) For comparison, Ciccarelli and Mojon (2010) report a global factor accounting for almost 70% of total variation in inflation for 22 OECD countries over the period (1960-2008). BIS (2014) reports almost 58% for a narrower group of 11 OECD countries over the period 1999-2013 (almost 63% for 1986-1998). Maravalle, A., and Ł. Rawdanowicz (2018), 'Changes in Economic and Financial Synchronisation', *OECD WP* No 1517, report a country-specific, regional and global factor for CPI inflation using a sample of advanced economies. The share of inflation explained by those factors increased across the periods 1995-2006 and 2007-2017 from more than 20% to almost 50%.

([62]) The bootstrapping procedure described in Box 1 is used to compute standard deviations. The exercise was repeated using series up to 2013q4 and 2015q2 respectively, with the results almost unchanged.

II.4. This subsample shares a common component, which accounts for almost 60% of the variance of inflation before 1999 and 70% after that. While the intervals delimited by two standard deviations overlap slightly, the difference is very large and points to the fact that the introduction of the single currency implies more co-movements at euro area level.

Graph II.4: **Variation in headline inflation explained by global components, euro area countries**



(1) See Graphs 1 and 3.
Source: ECFIN calculations based on OECD data.

II.2.3. Are commonalities in inflation across the OECD mostly driven by energy prices?

The literature suggests that the most important external variable that affects domestic inflation in advanced economies is the price of oil, or more broadly energy and other commodities. By contrast, the relevance of other possible sources of commonalities, including common shocks and spillovers from other countries, is harder to establish.

To gauge the importance of energy and commodities in the common component of inflation and before analysing the Phillips curve framework, we perform a principal component analysis of core CPI inflation similar to the analysis of the previous section. Core inflation provides a picture of underlying price pressures after excluding volatile components from the consumer basket([63]).

A common component is also present in core inflation, which decreases over time. In the pre-1999 sub-period, the common component accounted for 60% of the total variance of core inflation across OECD countries. However, in the post-1999 period, the common component only explains between 33% and 40% of the total variance of core inflation([64]). First, the commonality of core inflation decreases after 1999, contrary to what happens to CPI inflation. Second, commonalities in core inflation are smaller than the commonality in headline inflation (as is visible by comparing Graphs II.3 and II.5). As such, this finding is not surprising. Oil, among many other commodities, is itself affected by global shocks common to OECD countries([65]). Given that core inflation is only indirectly affected by energy and (most) commodity prices, we should expect core inflation to be less driven by global factors than headline inflation. While the prices of services or non-energy industrial goods that are included in the core inflation index are impacted by certain import prices, they are likely to be affected by domestic determinants like the domestic output gap.

([63]) CPI core inflation is calculated as the CPI excluding prices of volatile components, i.e. food and energy, whose combined weight is around a fifth across the OECD sample of countries.

([64]) Similar findings for 43 developed and developing countries (1990-2017) are reported by Forbes, K. J. (2018), 'Has Globalisation Changed the Inflation Process?', paper prepared for 17th BIS Annual Research Conference, Zurich, 22 June 2018.

([65]) Ciccarelli and Mojon (2010) already discovered this result; a more recent study by Béreau, S., Faubert, V., and K. Schmidt (2018), 'Explaining and Forecasting Euro Area Inflation: the Role of Domestic and Global Factors', *Banque de France WP* No 663 had similar findings. Food prices seem to have a significant global component as well, see Parker, M. (2015), 'Global inflation: the role of food, housing and energy prices', *ECB WP* No 2024, February 2015.

Box II.1: **Bootstrapping procedure.**

To check the stability and reliability of the estimates of the global factor (calculated from the first principal component of the dataset), we carried out a number of bootstrapping exercises. These provide additional information on the uncertainty associated with the principal component extraction algorithm. We show that the uncertainty surrounding the calculation of the percentage of total variance explained by the first principal component is rather large.

More generally, bootstrapping refers to a re-sampling method commonly used to estimate the uncertainty properties of a statistic such as standard error or confidence intervals when more common estimators are not appropriate or cannot be implemented ([1])· There are two broad types of bootstrapping algorithms: non-parametric and parametric.

Non-parametric bootstrapping works by making random draws, with replacement, from the original sample dataset. Using the resampled dataset, the statistic for which the uncertainty is to be established (in our case the share of total variance explained by the first principal component) is re-computed. This procedure is repeated a large number of times (we repeated it 10 000 times)([2]) and the data collected are used to calculate the standard errors (using the standard formula for the sample standard deviation). Non-parametric bootstrapping bases its resampling procedure on the assumption that the observed sample population is representative of the true underlying distribution function of the population. By contrast, parametric bootstrapping assumes that the observed sample is drawn from a given distribution function, whose moments are estimated from the sample.

We implemented a standard parametric bootstrapping algorithm ([3]) that was run with 10,000 simulations to construct a statistical distribution for the estimated share of total variance explained by the first principal component. More specifically, we assumed that the data are drawn from a standard normal distribution and we ensured that the draws reflect the correlation structure in the data([4]). This makes it possible to subsequently calculate 'confidence intervals' (one and two standard deviations) around the 'average' share of total variance explained by the first principal component([5]).

As a robustness check, we also implemented a standard non-parametric bootstrapping algorithm that yields comparable results. Since parametric and non-parametric methods generated similar results, we show those based on the parametric simulation framework in the main text.

Additional robustness checks were performed. These involved increasing the number of simulations (to 100,000) and carrying out a rerun of the Principal Component Analysis algorithm on the sample series after eliminating some quarters linked to the Great Recession (2008 and 2009). The effects of these changes were minor and did not change the conclusions of the bootstrapping exercise.

([1]) Among many, see Efron, B., and R. J. Tibshirani. (1986), "Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy". Statistical Science 1, and Stine, R. (1990), "An introduction to bootstrap methods: Examples and ideas. In Modern Methods of Data Analysis", ed. J. Fox and J. S. Long, Newbury Park, CA.

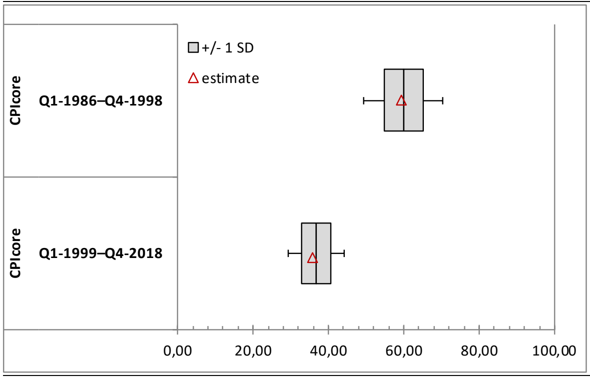
([2]) It is considered that replications of the order of 1,000 already produce good estimates, see Poi, B. P. (2004), "From the help desk: Some bootstrapping techniques" Stata Journal 4.

([3]) The code is in MATLAB and is available upon request to the authors. The particular bootstrapping algorithm implemented is an in-house adaptation of the code originally created by Susan Holmes of Stanford University.

([4]) To ensure that the draws are correlated, we apply the result of a Cholesky decomposition of the original covariance matrix to the random draws which are from a standard normal distribution.

([5]) The same analysis is also performed for core CPI and for hourly wages in the next section.

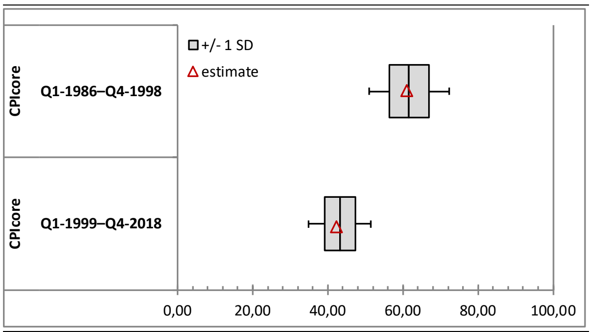
Graph II.5: **Variation in core CPI inflation explained by global components**



(1) See Graphs 1 and 3.
Source: ECFIN calculations based on OECD data.

If we restrict the sample to the euro area, a similar picture emerges (see Graph II.6), pointing to a reduction in the common component of core inflation across euro area countries. However, the decrease is smaller than that observed in the full OECD sample, and the difference between the two sub-periods becomes smaller than two standard deviations.

Graph II.6: **Variation in core inflation explained by global component, euro area countries**



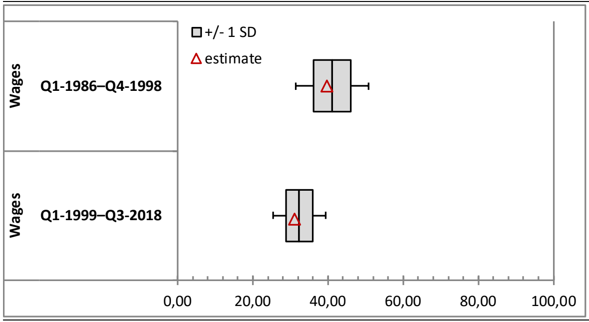
(1) See Graphs 1 and 3.
Source: ECFIN calculations based on OECD data.

The analyses of domestic wages([66]) in Graph II.7 illustrate a similar pattern. Wages in advanced OECD economies also share a common component, which explains more than 40% of the total variation in wages across countries before 1999, and less than 40% after 1999, even though the difference is even smaller than one standard deviation([67]).

The analysis therefore shows that a common component is present in the core inflation and wage datasets, and not only in the CPI inflation dataset. This raises the possibility that global determinants other than oil and import prices affect domestic inflation directly, i.e. on top of the indirect effects that they have via the domestic output gap. This raises the question of whether the NKPC approach needs to be extended to global variables in order to analyse domestic inflation, and in particular whether the domestic output gap is perhaps not relevant in determining domestic inflation.

We will therefore test in the next section which types of global shocks could possibly affect inflation in the NKPC framework. We first look at headline inflation and then at a wage Phillips curve.

Graph II.7: **Shares of total variance explained by the first principal component, hourly wages in manufacturing, Q1-1986-Q3-2018 (advanced OECD countries, %)**



(1) See Graphs 1 and 3.
Source: ECFIN calculations based on OECD data.

II.3. Global inflation drivers in the Phillips curve framework

The data analysis in the previous section shows that CPI inflation is correlated across advanced countries. This correlation is partly driven by global shocks related to energy and commodity prices. However, once these are removed from the equation, domestic prices still tend to co-move across countries. The question is whether these

([66]) We use year-on-year percentage changes of hourly wages in manufacturing.

([67]) As a robustness check, we also analysed year-on-year percentage changes of nominal compensation per employee and unit labour costs. Results are very similar to those presented in the text.

common shocks are sufficient to determine domestic inflation or whether the NKPC framework is still valid.

Traditionally, the Philips curve framework builds on the original observation that wages and unemployment are negatively related(68). It acknowledges the explicit role of expectations in the process of price developments and the transformation of the wage-unemployment relationship into a relationship between consumption prices, economic slack and policy variables(69). The development of NKPC models adds the microeconomic foundations of the trade-off between prices and economic slack to the core of the analysis. In particular, the NKPC builds upon the optimality of agents' behaviour and assumes some degree of price stickiness, which comes from limited possibilities to adjust prices optimally whenever a company wants to. In this context, Galí and Gertler (1999)(70) specify the most commonly used Philips curve model in its hybrid form for the inflation rate π_t. In this form, the main determinants of domestic price developments are typically domestic variables: a measure of 'slack'(71) is the key conceptual variable, or, as in Galí and Gertler (ibid.), a measure of labour costs(72), a measure of (trend or expected) labour productivity, measures of inflation expectations and, in the hybrid version of the model, past inflation(73).

In order to answer the question in this article, this framework, which is based on domestic determinants, is extended to capture the impact of the external environment on domestic price pressures. This extended NKPC framework adds international determinants to the NKPC framework to test their relevance in explaining domestic inflation.

A brief overview of the literature on global determinants of inflation

Extending the NKPC framework to understand whether global variables are causal determinants of domestic inflation has been tested often in the literature(74). Table 1 presents the main results from existing empirical studies(75).

For the sake of readability, we group global determinants of price inflation present in the literature into two different types of variables.

A first group of variables relates to 'price' variables like oil and other commodity prices or import prices. It is well known that oil and commodity price shocks affect headline inflation directly(76) — even more so in countries where the consumption baskets contain larger shares of volatile food and energy items like developing countries. According to the literature, prices of imported goods and international intermediate goods prices typically affect domestic prices directly in a significant

(68) Phillips, A. W. (1958), 'The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861-1957', *Economica*, vol. 25(100), pp. 283-299.

(69) See Friedman, M. (1968), 'The Role of Monetary Policy', *American Economic Review*, vol. 58(1), pp. 1-17.

(70) See Galí, J., and M. Gertler (1999), 'Inflation dynamics: a structural econometric analysis', *Journal of Monetary Economics*, vol. 44(2), pp. 195-222 and also Clarida, R., Galí, J., and M. Gertler (1999), 'The science of monetary policy: a new Keynesian perspective', *Journal of Economic Literature*, vol. XXXVII(4), pp. 1661-1707.

(71) The most widely used measure is the output gap, even if its coefficient has been decreasing recently. For example, see the derivation in Galí, J., M. Gertler, and D. López-Salido (2001), 'European inflation dynamics', *European Economic Review*, vol. 45(7) pp. 1237-1270. However, a definition of the unemployment gap has also been used as in Byrne, D. a Z. Zeikaite (2018), 'Missing wage growth in the euro area: is the wage Phillips curve non-linear?' Central Bank of Ireland, Economic Letters, No 9, November 2018; or industrial production like in Béreau, S., Faubert, V., and K. Schmidt (ibid.). Labour shortages are used in Bonam, D., De Haan, J. and D. van Limbergen (2018), 'Time-varying wage Philips curves in the euro area with a new measure for labor market slack', *DNB WP* No 587, February 2018.

(72) Compensation per employee is used in Bobeica, E., Ciccarelli, M. and I. Vansteenkiste (2018), 'The link between labor costs and price inflation in the euro area', *ECB WP* No 2235. Negotiated wages are used in Bohnam, D., de Hann, J., and D. van Limbergen (2018), 'Time-varying wage Phillips curves in the euro area with a new measure for labor market slack', *DNB WP* No 587, February 2018 (negotiated wages). The labour income share in the non-farm business sector is used in Galí and Gertler (ibid.) and in Paloviita, M. (2006), 'Inflation dynamics in the euro area and the role of expectations', *Empirical Economics*, vol. 31(4), pp. 847-860;.

(73) Various measures of inflation expectations have been used: mainly survey-based or market-based measures. For recent evidence on the impact on results from the choice of different survey-based measures in the euro area, see Abdih, Y., Lin, L., and A-Ch. Paret (2018), 'Understanding Euro Area Inflation Dynamics: Why So Low for So Long?', IMF Working Paper No. 188, August..

(74) The idea of incrementing the set of determinants with global variables is not necessarily associated with the acceleration of globalisation in the late 1990s and 2000s, but goes further back in time, for example Gordon, R. J. (1990), 'The Phillips Curve Now and Then', *NBER WP* No 3393.

(75) For a recent overview, see among many Abbas, S. K., Bhattacharya, and P. Sgro (2016), 'The new Keynesian Philips curve: an update on recent empirical advances', *International Review of Economics and Finance*, vol. 43, pp. 378-403. For a list of global determinants, see also Béreau, S., Faubert, V., and K. Schmidt (ibid.).

(76) The evidence about oil prices is well established. For international food prices or import prices, see Peersman, G. (2018), 'International food commodity prices and missing (dis)inflation in the euro area', *NBB WP* No 350.

Table II.1: **Broad view of literature**

Type	Global variable	Expected sign
Slack or demand measures	Global demand or trade-weighted foreign demand index	= (+ only if demand index is in value)
	Global output gap	–
	Global value chains	–
Price measures	Global intermediate goods prices	+
	(Non-oil) import prices	+
	Oil and commodity prices	+
	Nominal exchange rate	+

"+" stands for typically significant, "=" for ambiguous and "–" for typically insignificant.

Source: Studies listed, own adaptation.

manner(77). This is not surprising as energy and intermediate goods are inputs for companies according to their production function; companies therefore reflect the increase (or decrease) in prices of those goods in consumption prices. The same holds for exchange rates(78), since depreciations of the exchange rate are (partly) reflected directly by companies in domestic prices. These variables therefore significantly influence domestic prices on top of domestic variables. However, they simply reflect the existence of global shocks that are transmitted to the domestic economy via the traditional price channels so that they generally do not affect the relevance of domestic shocks.

A second group of variables ('global activity' variables) comprises measures of global demand or supply factors like exports and imports or foreign demand, measures of global slack, or changes in the structure of production ('global value chains' / GVCs)(79).

The empirical evidence provided by the literature on these global activity variables is mixed as the results, which are referred to in Table II.1, do not provide a conclusive answer to the question as to whether these variables affect domestic prices directly. Results on the global output gap(80), global demand(81) or GVCs(82) depend on the methodology employed and the particular data sample used; very few results indicate that these factors have a direct impact on domestic prices or that they nullify the impact of the domestic output gap on domestic inflation.

From a policy perspective, the global activity variables are the most critical when discussing the 'globalisation of inflation hypothesis': is their impact on domestic inflation mediated via the domestic output gap like in the current NKPC view, or global activity variables have a direct influence on domestic inflation that makes the domestic output gap irrelevant? Under the current NKPC view, the global output gap would increase domestic prices only to the extent that it affects the domestic output gap.

The next section analyses the relevance of the global output gap (as well as a proxy for GVCs in the next section) in an extended NKPC framework for the euro area. These variables are used to extend the traditional NKPC as they allow the possible implications of globalisation to be investigated. While world output gap measures try to capture additional (and more general) effects from foreign aggregated demand on the domestic economy, GVCs represent a very widely discussed channel through which companies can directly or indirectly exert influence on the demand and

(77) Forbes, K. J. (ibid.); Béreau, S., Faubert, V., and K. Schmidt (ibid.). For non-oil import prices, see Oinonen, S., Paloviita, M., Vilmi, L. (2013), 'How have inflation dynamics changed over time? Evidence from the euro area and USA', *Bank of Finland DP* No 6; Abdih, Y., Lin, L., and A.-Ch. Paret (ibid.).

(78) Abdih, Y., Lin, L., and A.-Ch. Paret (ibid.).

(79) See an overview of other determinants in Carney (2017) or ECB (2017), 'Domestic and global drivers of inflation in the euro area', *ECB Economic Bulletin* No 4, pp. 72-96.

(80) The evidence on the global output gap is at best ambiguous; significant effects are mostly found by BIS authors like in Borio, C., and A. Filardo (ibid.). Varying effects of the domestic and global output gap are found in Bianchi, F., and A. Civelli (2015), 'Globalisation and inflation: Evidence from a time-varying VAR', *Review of Economic Dynamics*, vol. 18(2), pp. 406-433. Most studies do not find any such effects. Among many, Ihrig, J., S. B. Kamin, D. Lindner, and J. Marquez (2010), 'Some Simple Tests of Globalisation and Inflation Hypothesis', *International Finance*, vol. 13(3), pp. 343-375 and Mikolajun, S. I., and D. Lodge (2016), 'Advanced economy inflation: the role of global factors', *ECB WP* No 1948.

(81) Béreau, S., Faubert, V., and K. Schmidt (ibid.).

(82) Andrews, D., Gal, P., and W. Witheridge (2018), 'A Genie in a Bottle? Globalisation, Competition and Inflation', *OECD WP* No 1462 or ECB (2017), 'Domestic and global drivers of inflation in the euro area', ECB *Economic Bulletin*, Issue 4, 2017, pp. 72–96.

Table II.2: **Phillips curve estimates**

Dependent Variable: EA QoQ inflation	Baseline	EA & RoW OG	EA & orthog. RoW OG	Non-oil import prices	EA & weighted orthog. RoW OG	RoW OG only
EA QoQ inflation (-1)	0,19 ***	0,19 ***	0,20 ***	0,17 **	0,21 ***	0,24 ***
EA Import Prices	0,03 **	0,03 **	0,04 **		0,03 *	0,03 **
Non-oil Import Prices				0,01		
SPF1	0,19 ***	0,19 ***	0,18 ***	0,19 ***	0,18 ***	0,18 ***
OIL in Eur	0,01 ***	0,01 ***	0,01 ***	0,02 ***	0,01 ***	0,01 ***
Output gap EA	0,03 ***	0,03 **	0,03 ***	0,03 ***	0,03 ***	
Output gap non-EA		-0,01				0,02
Orthog. Output gap non-EA			-0,06 *		-0,02	
Regression R²	0,80	0,80	0,81	0,79	0,80	0,78

(1) Sample quarterly euro area aggregates over the period Q1-2000-Q3-2018. Least squares estimator with robust standard errors (HAC). Significance levels: *** p<0.01, ** p<0.05, * p<0.1.
Source: ECFIN calculations.

supply of particular goods and services in the domestic economy.

The results

We start with the estimate of a NKPC model, which we extend with relevant global price variables. More precisely, in our baseline model headline inflation is a function of lagged inflation, euro area import prices, the euro-denominated oil price, one-year ahead inflation expectations, and the euro area output gap([83]). The corresponding regression model reads:

$$\pi_t = a_1\pi_{t-1} + a_2 imp_t + a_3 E(\pi_{t+1}) + a_4 oil_t + a_5 OG_t + v_t.$$

where v_t represents the error term.

The baseline estimate therefore corresponds to an extended NKPC, where we use only price variables that were chosen based on the indications provided by our previous analysis of the data as well as by the review of the literature for the extensions. The estimates of the baseline model, presented in column (1) of Table II.2, are in line with the theory and with the majority of estimates that currently exist in the literature. All estimated coefficients have the expected signs and are statistically significant at the p-value threshold of 5%.

The size of the estimated coefficient for the output gap is 0.03, which is in line with the literature that typically finds small coefficients for the output gap or other measures of slack. The coefficient for the backward-looking component of inflation is estimated at 0.19, with the coefficient for the forward-looking one-year ahead expected inflation estimated at 0.19. This is in line with the underlying New Keynesian theory, which suggests that the coefficients of inflation should sum to one. When adding the coefficient relating to backward-looking inflation (~0.19) to the coefficient for the forward-looking component after converting it into a quarterly frequency (i.e. 0.19/4), we obtain the sum of 0.24. In annualised terms, this is close to the expected theoretical value of one. The global terms of this extended model are also in line with expectations. A 10% increase in oil prices increases the inflation rate by 0.1. It is worth noting that these are Brent oil prices denominated in euro — the estimated parameter therefore captures the combined effect of an increase in Brent oil prices in dollars and a simultaneous euro depreciation (or appreciation). Similarly, a 10% increase in import prices in euro increases domestic consumption inflation by 0.3.

Given that oil prices could influence industry import prices directly, we also tested the significance of an export-weighted deflator of non-oil imports for euro area countries instead of

([83]) The model is estimated on a quarterly basis. More precisely, all variables are defined as quarter-on-quarter changes, except inflation expectations, which are taken from the Survey of Professional Forecasters (SPF) run by the ECB and from the output gap, which is calculated as the (quarterly) percentage ratio of real GDP (taken from ESTAT) to trend GDP (taken from DG ECFIN's AMECO database). Lagged quarter-on-quarter growth in seasonally adjusted inflation measures lagged inflation, the one-year ahead SPF inflation expectations proxy expected inflation. The quarterly inflation series, which are adjusted seasonally and for working days, are taken from the statistical data warehouse of the ECB. The oil price evolution is the quarter-on-quarter percentage change of the Brent oil price expressed in euro. Quarter-on-quarter growth rates of import prices are constructed using the euro area price index for industry available on the ESTAT website.

industry import prices(84). The results (see column (4) of Table II.2) indicate that this variable is not significant, while the other coefficients remain stable. This points to the fact that globalisation has an impact in particular on domestic inflation via oil prices, which appear to be the main transmission channel of international prices(85).

As the main question concerns the relevance of the domestic output gap in affecting domestic inflation once global slack or demand variables are taken into account, we further extend the baseline model with measures of the non-euro area global output gap.

The analysis shows that global slack variables are not significant in explaining domestic inflation. Column (2) of Table II.2 presents the results of a regression in which an aggregate measure of the output gap for non-euro area countries was added to pick up on possible global forces that drive economic slack(86). The estimated coefficient has a negative sign, which is contrary to what is expected and is not statistically significant with a p-value of 0.8.

Simply adding a rest-of-the-world (i.e. non-euro area) output gap variable to the baseline regression may generate multi-collinearity(87) problems. These arise when the euro area output gap, oil prices and the rest-of-the-world output gap are all employed in the same model. It is therefore possible that the conclusions on the estimated coefficient of the rest-of-the-world output gap variable are not meaningful. However, it is worth noting that the value and significance of all the coefficients of the variables of the baseline regression remain unchanged.

(84) For details on the data, see Abdih, Y., Lin, L., and A.-Ch. Paret (ibid.); we thank A. Ch. Paret-Onorato from the IMF for providing us with the data.

(85) Furthermore, as an additional robustness check, the same baseline regression was also run using the quarterly growth rates of the euro area consumption deflator (household and non-profit institutions serving households (NPISH) final consumption) instead of headline inflation. The overall conclusions obtained are the same and are not reported here.

(86) The rest-of-the-world output gap is computed as the percentage/ratio of rest-of-the-world real GDP over rest-of-the-world trend GDP. Both the numerator and denominator are computed respectively as the sum of the (quarterly) real GDP and of the (quarterly) trend GDP across a large group of non-euro area countries from the rest of the world. The group comprises 25 countries outside the euro area with widespread geographical coverage. Data are taken from the OECD database.

(87) Multi-collinearity occurs when one (or more) of the independent variables in a regression model is correlated with other independent variables. In this situation, the coefficient estimates of the variables concerned tend to be unstable and the standard errors of the affected coefficients tend to be overstated. This makes hypothesis testing of the regression coefficients unreliable.

To better isolate the effects on domestic inflation of the rest-of-the-world output gap independent of the effects of oil prices and euro area output gap, we replace the rest-of-the-world output gap with an 'orthogonal' rest-of-the-world output gap. The latter is computed by taking the residuals obtained after regressing a measure of global output gap (comprised of G20 members) on the euro area output gap and aims to capture the part of the world output gap unrelated to the variations of the domestic output gap(88).

Column (3) of Table II.2 shows the results, and the conclusion does not change: there is no significant statistical evidence to support the claim that global measures of economic slack (originating from outside of the euro area) have a direct impact on domestic euro area inflation. By addressing the issue of multi-collinearity, a clearer interpretation can be given to the euro area output gap coefficient. The euro area output gap coefficient remains unchanged (0.03), with a p-value close to the 1% level, and the other coefficients are broadly unchanged with a slight increase in the coefficient of past inflation (0.20) and import prices (0.04) and a slight decrease in the coefficient of expected inflation (0.18). The coefficient of the 'orthogonal' non-euro area output gap, which is the one of interest, again posts a 'wrong' negative sign that is almost significant at the 5% level (with a p-value of 0.051%).

As an additional robustness check, column (5) of Table II.2 presents the results of integrating another proxy into the regression framework for the 'orthogonal' non-euro area output gap; however, this time it results from aggregating output gaps using trade weights(89). Once again, the results do not change: the coefficients of the base variables remain stable and the coefficient of

(88) Similar empirical results are obtained if we use the residuals after regressing the global output gap on the domestic output gap and oil prices (as a different proxy for the 'orthogonal non-euro area output gap').

(89) In a first step, the output gaps of a large sample of countries (comprised of the EU-28 countries plus others, which are in the G20) were weighted according to their relative share of total export flows. Once this 'trade-weighted' proxy for the world output gap was constructed, the 'orthogonal' non-euro area 'weighted' output gap variable was obtained by taking the residuals from a regression of the 'trade-weighted' world output gap on the euro area output gap.

this indicator of external activity is negative and not significant.

Finally, we test whether, in the absence of the domestic output gap, the rest-of-the-world output gap has explanatory power for domestic inflation. Column (6) of Table II.2 shows the results. While the coefficient is very similar to that of the domestic output gap, it is statistically insignificant (the unreported p-value is around 0.2).

This analysis points to the conclusion that integrating a global dimension into the output gap adds little information to the domestic output gap in terms of the domestic euro area inflation dynamics. This is in line with the findings of most of the literature. The explanation underlying the limited ability of global factors (such as the various measures of global slack that were tested) in explaining domestic price developments despite the high correlation between domestic and global inflation can perhaps be related to a more generally observed synchronisation of business cycles across advanced economies.

II.4. Wages and inflation: is this the channel?

The previous section found that global activity variables do not have a direct impact on domestic inflation. In this section, we check whether the driving forces that (potentially) determine domestic inflation also affect domestic wage dynamics[90] and whether there are any other possible global forces driving wage dynamics. If domestic inflation is transmitted via wages, global factors should directly influence domestic wage formation and their effect should appear in the NKPC estimation. As shown in Section II.2, wages co-move across advanced OECD countries, which provides further motivation for this analysis[91].

To evaluate whether domestic factors remain the main driving force of wage inflation, we replicate the exercise from the previous section by using a New Keynesian wage Phillips curve as the baseline model for euro area wages. We start from a specification of the wage NKPC akin to the one used in the previous section[92].

Quarter-on-quarter wage growth is the dependent variable[93]. Wage changes are traditionally related first to output gap pressures: a large positive output gap tends to increase the bargaining power of workers and their inflation expectations, pushing wages up. The first explanatory variable included is therefore the euro area output gap[94].

Wages are also determined by (i) labour productivity developments, as, at equilibrium, real wages are proportional to labour productivity[95], (ii) by expected inflation[96], and (iii) by past inflation as measured by the second lag of year-on-year core inflation developments in the euro area.

Table II.3: **Wage Phillips curve estimates**

Dependent Variable: QoQ Comp. per employee	Baseline Regression	Regression with non-EA OG	Regression with orthog. non-EA OG
Output gap EA	0,04 ***	0,05 ***	0,04 ***
Output gap non-EA		-0,01	
Orthog. Output gap non-EA			-0,01
QoQ productivity EA	0,21 ***	0,21 ***	0,21 ***
SPF1	0,21 ***	0,22 ***	0,21 ***
YoY core inflation(-2)	0,09 *	0,07	0,08
Regression R^2	0,34	0,35	0,34

(1) Sample quarterly aggregate euro area over the period Q1-2000:Q1-Q3-2018. Least squares estimator with robust standard errors. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.
Source: ECFIN calculations.

The wage NKPC model is then extended to investigate the effect of two global slack determinants. As was the case in the previous section, while domestic economic slack remains a significant determinant of domestic wage developments, proxies for the rest-of-the-world economic slack do not seem to have a direct impact on domestic wage developments.

(90) According to Borio and Filardo (2007), a condition for the existence of such a direct link between global slack and domestic wage inflation is the increased substitutability of goods and especially of capital and labour inputs.
(91) While there is some empirical evidence that globalisation has affected wage levels or at least the wage distribution in advanced economies, there is little evidence of the effect of globalisation on wage inflation (as opposed to wage levels). Determinants referred to include the growing importance of multinational companies and GVCs in international production together with the emergence of China.
(92) It is the same specification used in Box 1 of Vandeplas, A. et al. (2018), 'Wage dynamics in the EMU', *EC Quarterly Review*, vol. 17(3), pp. 9-26, which also discuss factors affecting the wage Phillips curve. Alternatively, a panel of big euro area countries in IMF (2018), '*European wage dynamics and labour market integration*', Regional Economic Outlook, May 2018.
(93) This is measured using compensation per employee taken from EUROSTAT.
(94) As before, the quarterly output gap series are constructed based on the trend real GDP published in DG ECFIN's AMECO database.
(95) These are proxied here by quarter-on-quarter changes in euro area real output per employee.
(96) The latter are proxied here by one-year ahead inflation expectations taken from the ECB's Survey of Professional Forecasters.

Box II.2: **Global Value Chains and wage growth.**

This box presents the results from augmenting the traditional new Keynesian wage Phillips curve with a measure of global value chains ('GVCs')(1). The box analyses whether GVCs are relevant in determining wage developments, with particular attention paid to the effect of adding a GVC proxy to the Phillips curve on the measure of economic slack. We chose to test the link between wages and global value chains by augmenting a new Keynesian wage Phillips curve with a term for GVCs.

Given that most information on the effects of GVCs comes from the comparison across countries rather than from the time series information, we had to depart from the previous specifications and techniques and moved to a panel data specification. More precisely, we used some panels of annual data for EU and euro area countries over the period 2000–2014. Annual data used as GVC proxies are available on an annual basis.

Table 1:

	EU28		EA17		EU15		EA5	
	Baseline	With GVC	Baseline	With GVC	Baseline	With GVC	Baseline	With GVC
Unemployment GAP (NAWRU)	-0.314 ***	-0.242 ***	-0.255 ***	-0.126 *	-0.253 ***	-0.192 ***	-0.245 ***	-0.146 **
1-year inflation expectations	0.634 ***	0.711 ***	0.629 ***	0.716 ***	0.646 ***	0.576 ***	0.633 ***	0.596 ***
HICP lagged 1-year	0.301 ***	0.299 ***	0.337 ***	0.311 ***	0.340 ***	0.346 ***	0.423 ***	0.346 ***
Expected labor productivity	0.492 ***	0.676 ***	0.464 ***	0.555 ***	0.476 ***	0.582 ***	0.255 *	0.215
Global output gap * GVC		0.000103		0.000125		0.000213		0.00154 **
Global output gap		-0.00154		-0.000427		-0.00299		-0.0363 **
GVC		0.0515		-0.00366		-0.0662		0.00234
Constant	0.0457	-1.953	-0.0181	-0.379	-0.0793	1.357	-0.00683	-0.0670
No. Observations	563	258	404	186	465	210	157	90
R-squared	0.752	0.672	0.766	0.637	0.772	0.588	0.788	0.679

(1) fixed effect estimator. Sample: yearly data (2000-2014). EU28 indicates all EU countries, EA17 are all EA members except CY and MT, EU15 are EU "old" members, EA5 are DE, ES, FR, IT, NL. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.
Source: ECFIN calculations.

As a dependent variable, we used year-on-year percentage changes in compensation per employee. In our specification, we include the usual same independent variables as in Vandeplas et al. (2018)(2), on top of country fixed effects. First, as a measure of slack, we use the unemployment gap as measured by the percentage difference between unemployment and the non-accelerating wage rate of unemployment (NAWRU)(3); we then use past and expected price inflation(4), expected labour productivity(5) and the global output gap. The latter is defined as in the main text.

The measure of GVC is the most delicate issue. We measure GVCs by the foreign value-added shares of gross exports, as in most of the literature. For robustness, we also proxied GVCs with the foreign value-added embodied in domestic final demand share, which is the other definition of GVCs commonly found in the literature. The results did not change significantly and are not reported here.

To test the impact at the cyclical frequency relevant for monetary policy, we interacted GVCs with our measure of the global output gap, as we are measuring the impact of GVCs on wage developments at the cyclical frequency.

Table 5 shows results in line with the rest of the paper, with the global output gap (and GVCs) having very little impact, if any, on wage developments. These findings are in line with most of the existing literature on wage and inflation determinants, which finds at best mixed evidence about the effects of GVCs' growing importance on wage inflation.

(1) The box draws on work carried out by L. Lebastard during her internship with DG ECFIN.
(2) Quoted in the main text.
(3) The NAWRU is taken from the DG ECFIN's AMECO database and is the definition used for the computation of the potential output according to the common methodology supported by the Economic and Financial Committee and run by DG ECFIN. The methodology for the computation of NAWRU is described in Havik, K., K. Mc Morrow, F. Orlandi, C. Planas, R. Raciborski, W. Roeger, A. Rossi, A. Thum-Thysen and V. Vandermeulen (2014), "The production function methodology for calculating potential growth rates & output gaps", European Economy, Economic Paper 535.
(4) Past inflation is measured using the harmonised index of consumer prices. Expectations are 1-year ahead inflation expectations obtained from the ECB's Survey of Professional Forecaster.
(5) Expected productivity is measured as changes in trend productivity, where productivity is proxied by real output per employee.

Column (1) of Table II.3 presents the results of the estimated baseline regression. The coefficients and their significance level are in line with existing analysis using a similar baseline wage Phillips curve(97): 0.04 for the euro area output gap, 0.21 for labour productivity, 0.21 for inflation expectations, and 0.09 for lagged core inflation (which is however only significant at the 10% level). They show that the forward-looking inflation component bears more weight than the backward-looking inflation component.

As in the previous section, we have extended the baseline NKPC model to capture the effect of rest-of-the-world slack measures on domestic wages. First, the traditional version of the euro area wage Philips curve has been augmented with an aggregate measure of the rest-of-the-world output gap. As in the previous section, we do not find that these global variables have any effect on euro area wage developments. Columns (2) and (3) of Table II.3 show the same pattern already seen in the previous section and shown in Table II.2. The coefficient for the rest-of-the-world output gap is very small, has the wrong sign and is not significant — this applies to both the case where we used the simple rest-of-the-world output gap and the case where we used the orthogonal rest-of-the-world output gap(98). At the same time, the coefficients of the baseline specification remain stable and significant.

In a parallel exercise we tested the link between the euro area wage dynamics and global value chains (‘GVCs’). GVCs are related to developments in international trade and the globalisation of production and refer to a production process whereby the different stages are located across different countries. GVCs have developed substantially over the last few decades as vertically integrated trade doubled between 1999 and 2008 in the OECD countries(99), reflecting the integration of more countries in the global production and trade system. As the literature suggests, GVCs are expected to reduce wage growth as outsourcing likely exerts a downward pressure on wages.

(97) See Vandeplas et al. (2018), quoted.
(98) Results for the other measures of the rest-of-world output gap are similar and not shown here.
(99) See ‘Globalisation of industrial production chains and measurement of trade in value added’, proceedings of the joint conference organised by the Senate Finance Commission and the Secretariat of the WTO, Paris, October 2010.

The results obtained, which use a slightly different framework, are presented in Box II.2 and indicate that there are no statistically significant direct effects of GVCs on wage dynamics in EU or euro area countries. These results are surprising in view of the large changes in the production structure related to developments in GVCs in recent years make of GVCs.

However, the result that foreign variables like GVCs (and the foreign output gap) are not significant determinants of domestic wage or price inflation once traditional determinants like import prices are taken account of, is relatively common in the literature(100). Concerning wages more specifically, these result is not too surprising for at least two reasons. First, the impact on wages by GVCs depend on the position of the country in the supply chain, with GVCs typically favouring the increase in demand (and wages) of high skilled workers. The overall euro effect remains therefore unclear. Second, Phillips curve analysis focuses on cyclical developments. As far as GVCs affect wage levels over the long term, this impact will not be captured by the present analysis.

II.5. Conclusions

The analysis presented in this article starts from the observation that inflation, core inflation and wage inflation share a common component across OECD developed economies. However, it also shows that there is no solid argument to support the view that the traditional transmission channels of economic shocks on domestic price developments in the euro area are not relevant anymore and have been dominated by new channels in which global determinants of inflation have taken over.

It remains true that some of the domestic price developments are driven by common global shocks, in particular by shocks caused by oil and commodity prices and exchange rates. The global commonalities that we find in Section 2, in line with the literature, have a causal relationship with domestic inflation as companies pass input price increases onto prices.

However, we do not find any statistical evidence that measures of domestic productivity or

(100) See for example ECB (2019), ‘The impact of global value chains on the euro area economy’, *ECB Occasional Paper* No 221.

economic slack are superseded by measures of global developments. We also do not find evidence to support the weaker proposition that direct effects of global output gap variables on domestic price developments outweigh the effects of domestic variables.

In our view, it remains likely that the traditional Phillips curve framework still prevails: while shocks to prices that constitute direct inputs into the domestic economy are sooner or later transferred onto consumer prices, foreign activity shocks are transmitted to the domestic economy via the domestic output gap.

There is one caveat to the interpretation of the results. The analysis was carried out on a quarterly basis, which is relevant for counter-cyclical policy. As a result, these negative results do not preclude effects of globalisation on wages in level terms, but only effects of global factors on wage inflation. Conclusions on structural wage formation over longer-term periods should not be inferred.

The results of the paper are relevant as part of discussions about monetary policy. While most central banks' analytical framework for monetary policy is built on a large set of tools and indicators to assess price developments([101]), the Phillips curve remains the most relevant conceptual framework for policy purposes.

However, the most efficient tools and policy setting to secure this objective are currently under debate. On the one hand, the conceptual framework needed to analyse the interplay between monetary, fiscal and macro-prudential policies is still under construction both at an academic level and within policy institutions([102]). On the other hand, the relevance of the current framework for controlling domestic inflation is an important point in the discussion; some questions are still open for debate, namely how much monetary policy should be leaning against the wind (of asset prices and credit booms) rather than targeting domestic inflation. For inflation targeting to remain the core aspect of monetary policy in its current form, it is necessary that domestic inflation be determined by domestic components (which themselves can however be determined by global shocks) so that monetary policy can effectively impact them. Our findings support the view that counter-cyclical policies — in particular monetary policy — still have an important role to play in controlling domestic inflation due to their impact on the output gap and inflation expectations. There are other questions currently present in the debate concerning possible changes to the monetary policy framework, but these go beyond the scope of this paper.

([101]) For the evolution of the ECB, see Hartmann P. and F. Smets (2018), 'The first 20 years of the European Central Bank: Monetary policy', Brookings Papers on Economic Activity, autumn 2018.

([102]) In the euro area, the supranational nature of certain (but not all) relevant institutions makes this construction even more complex. However, the European Systemic Risk Board set up an expert group to develop a conceptual framework to guide the discussion on macro-prudential policies.