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## Wage Growth and Inflation in Europe: A Puzzle?

by Vizhdan Boranova, Raju Huidrom, Sylwia Nowak,  
Petia Topalova, Volodymyr Tulin, and Richard Varghese

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I N T E R N A T I O N A L M O N E T A R Y F U N D

**IMF Working Paper**

European Department

**Wage Growth and Inflation in Europe: A Puzzle?**

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Volodymyr Tulin, and Richard Varghese <sup>1</sup>**

Authorized for distribution by Laura Papi

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**Abstract**

Wages have been rising faster than productivity in many European countries for the past few years, yet signs of underlying consumer price pressures remain limited. To shed light on this puzzle, this paper examines the historical link between wage growth and inflation in Europe and factors that influence the strength of the passthrough from labor costs to prices. Historically, wage growth has led to higher inflation, but the impact has weakened since 2009. Empirical analysis suggests that the passthrough from wage growth to inflation is significantly lower in periods of subdued inflation and inflation expectations, greater competitive pressures, and robust corporate profitability. Thus the recent pickup in wage growth is likely to have a more muted impact on inflation than in the past.

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## I. INTRODUCTION

Labor market conditions have been improving in Europe since 2013, with strong job growth and unemployment falling to lower-than-pre-crisis levels in most economies. Yet, as discussed in Chapter 2 of the May 2018 Regional Economic Outlook—Europe, nominal wage growth remained subdued for many years (Figure 1, panels 1 and 2). This trend has recently started to reverse, especially in the European Union (EU)’s newer member states (NMS).<sup>2</sup> Spurred by strong labor markets and accompanied by public sector and minimum wage increases in some countries, nominal wage growth averaged nearly 8 percent in NMS since the first quarter of 2017, with sizable gains in compensation across all sectors of the economy.<sup>3</sup> In other European countries (EU15+3), nominal wage growth reached 2 percent. In contrast, core inflation remained, on average, below 2 percent in both groups of countries (Figure 1, panels 5 and 6). In addition to rising faster than prices of goods and services, compensation costs have outpaced improvements in labor productivity, especially in NMS (Figure 1, panels 3 and 4). Productivity-adjusted wage growth in NMS has exceeded inflation by about 3 percentage points on average since early 2017. In EU15+3, the gap between productivity-adjusted wage growth and inflation is smaller, at about 0.4 percentage point, but still sizeable compared to 2000–16 (Figure 2).

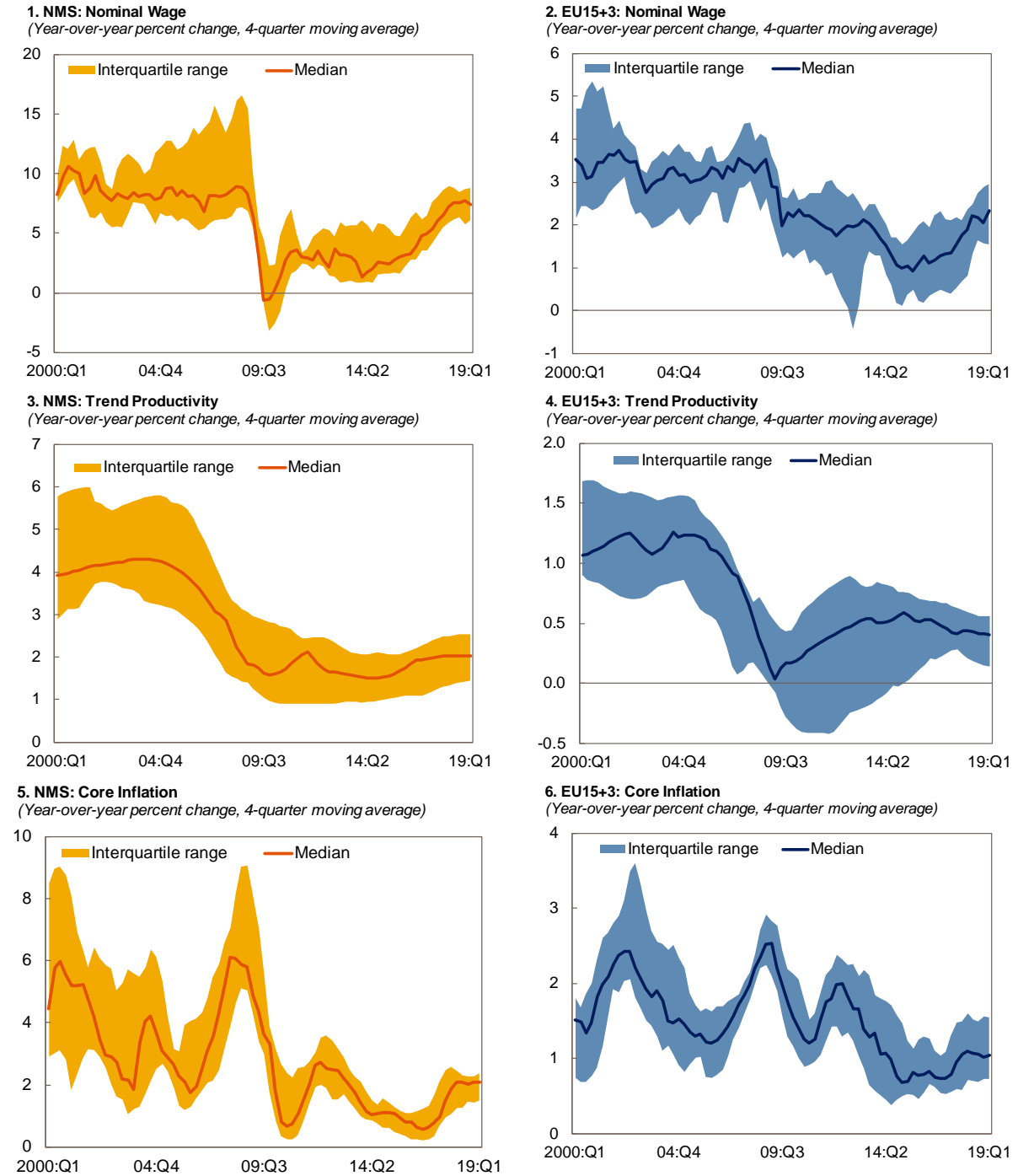
The apparent disconnect between wage and price developments in Europe in the last few years is puzzling. Economic theory suggests that if real wage growth exceeds productivity gains, the higher labor costs faced by businesses should eventually raise the prices of the products and services they provide. Labor costs constitute a large share of business expenses in Europe: almost 50 percent in NMS and 53 percent in EU15+3 countries. And yet, inflation has remained stubbornly below target in many countries, despite closing output gaps and rapid gains in productivity-adjusted wages in the past three years.

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<sup>2</sup> This paper makes a distinction between long-standing and newer EU member states, rather than between “advanced” and “emerging” European economies, to better capture the disparate wage developments in these two sets of countries. Newer EU members (NMS) include Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, the Slovak Republic, and Slovenia. The long-standing EU members are the countries that joined the European Union before May 1, 2004: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom (EU15). Cyprus, Ireland, Luxembourg, and Malta are not included in the analysis because their GDP data distort labor productivity numbers. Israel, Norway, and Switzerland are added to this group, hence the acronym EU15+3.

<sup>3</sup> Significant increases in minimum wages in the newer EU member states accompanied and likely contributed to the strong aggregate wage growth. As depicted in Annex Figure 1, minimum wages in NMS rose, on average, by 46 percent between 2015Q1 and 2019Q1, with even larger gains in Romania, Lithuania, Czech Republic and Bulgaria. Over the same time period, average wages rose by 33 percent. In NMS, nominal wage gains were also widespread across sectors. Annex Figure 2 shows the average growth in nominal compensation per employee across nine broad sectors of the economy for NMS and EU15+3.

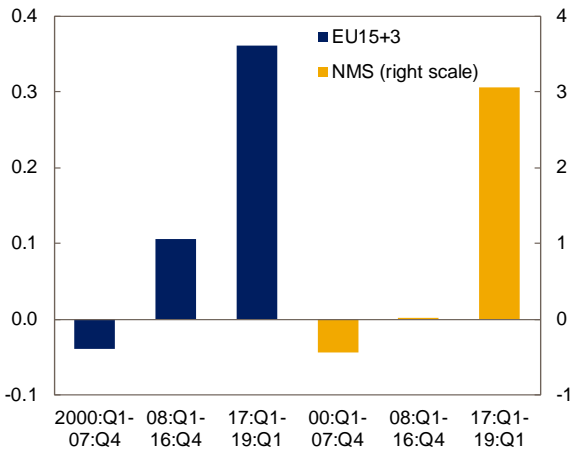
**Figure 1. Wage Growth, Productivity and Inflation**



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook Database*; and IMF staff calculations.

Note: NMS are newer EU members. EU15+3 are the long-standing EU members plus Israel, Norway, and Switzerland. Quarterly seasonally adjusted data are used and weighted by purchasing-power-parity GDP to aggregate across the two country groups. Real wage growth is measured as nominal wage growth minus the GDP deflator growth.

**Figure 2. Evolution of Growth in Labor Costs**  
(Average annual productivity-adjusted real wage growth; percent)



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook Database*; and IMF staff calculations.

Note: NMS are newer EU members. EU15+3 are the long-standing EU members plus Israel, Norway, and Switzerland. Quarterly seasonally adjusted data are used and weighted by purchasing-power-parity GDP to aggregate across the two country groups. Real wages are measured as nominal wage growth minus the GDP deflator growth.

A variety of factors may explain this puzzle. The lack of inflationary pressures may simply reflect delays in the transmission of wage developments to prices, suggesting a pickup in inflation may be imminent (Draghi, 2019). It could also be due to structural changes to the way firms incorporate costs into their pricing decisions that has affected the relationship between wage growth and inflation. If firms and workers expect low inflation going forward, for example due to the improved credibility of the central bank, firms may be reluctant to raise their prices even when faced with higher wage costs as they expect increases in costs to be only temporary (Taylor, 2000). In such a situation, the passthrough of higher wages to prices would be muted due to lower expected persistence of cost and price changes. Alternatively, the rise in competition, either domestically or from

abroad, may have limited the ability of firms to pass cost increases to consumers for fear of losing market share. Another important consideration of a more cyclical nature is firms' profitability, which could determine how much and how fast wage growth feeds into prices. To the extent that firms have buffers—comfortable profit margins, for example due to access to cheaper intermediate inputs—they may be able to absorb higher wage costs without increasing prices. Understanding the extent to which these potential explanations are behind the recent disconnect between inflation and wage growth has important implications for the inflation outlook in Europe and the appropriate policy response.

This paper sets out to shed light on the link between wage growth and inflation in Europe. In particular, it asks the following questions. *First*, how large is the passthrough of labor costs to inflation in Europe, and how long does it take for wage growth to feed into prices? *Second*, have there been notable changes in the extent of passthrough over time? Specifically, has the extent of passthrough changed in the aftermath of the global financial crisis. *Third*, what factors influence the extent of passthrough? How is the passthrough shaped by various country and sectoral characteristics, such as the prevailing inflationary environment, exposure to foreign and domestic competition, corporate profitability and access to cheaper intermediate inputs?

To address these questions, we examine the relationship between wage growth and core inflation at the quarterly frequency in a sample of 27 European countries over 1995Q1-2019Q1. Our empirical strategy relies on a panel vector autoregression (PVAR) model, and its extension, the interacted panel vector autoregression (IPVAR) model. These dynamic and multivariate models

allow us to estimate the dynamic passthrough from wage growth to inflation, while embedding the traditional Philips curve relationships between nominal wage growth, inflation, and labor market slack; and controlling for firms' labor and imported input costs. We use the PVAR model to obtain *unconditional* estimates of the passthrough from wage growth to inflation—i.e. an “average” passthrough across all countries and time periods. The IPVAR model allows us to estimate *conditional* wage passthrough that depends on country characteristics—such as prevailing inflation, aggregate corporate profitability and the like. We complement aggregate country-level analysis with sectoral data, where we zoom in on the role of external competition in shaping the link between producer prices and labor costs.

Our main findings are as follows. *First*, we find that wage growth has historically led to higher inflation in Europe. The impact of a positive wage growth shock on core inflation is small initially, but it builds up and peaks around 6 quarters before dissipating. *Second*, the link between wage growth and inflation has weakened in the decade since the global financial crisis, especially in the newer EU member states. The passthrough from wage growth to core inflation is estimated to be only two-thirds as strong as in the period before the crisis. *Third*, various factors determine the strength of the link between wage growth and inflation. The passthrough is weaker when inflation is subdued and inflation expectations are better anchored. Higher aggregate corporate profitability is also associated with a lower passthrough, including when profitability is supported by access to cheaper inputs, such as investment goods. Finally, we also find evidence that the link between labor costs and prices is lower in sectors which are more exposed to competition, either domestically or from abroad. Given the subdued inflation expectations, strong competitive pressures, and comfortable profit margins in Europe, our results suggest that the recent increase in wage growth is unlikely to meaningfully spur inflation in the near term.

This paper contributes to the large literature spurred by the stubbornly-low inflation in many advanced and European economies since the global financial crisis. Much of this literature analyzes the causes of low inflation and, until recently, low wage growth within a Philips curve framework, focusing on potential changes in the relationship between prices and unemployment (e.g. Blanchard et al. 2015, Bonam et al. 2019), the role of global factors and greater trade integration (e.g. IMF 2017a, Forbes 2019, and IMF 2017b), the persistence of inflation (e.g. Abdih et al. 2018), and mismeasurement of slack (e.g. IMF 2017b, and IMF 2018a, Zhang 2019).

The link between labor costs and inflation, however, has received much less attention. Peneva and Rudd (2017) explore the passthrough of labor costs to price inflation in the United States, and find a limited effect of changes in labor costs on aggregate price inflation. Bobeica, Ciccarelli and Vansteenkiste (2019) document a strong wage passthrough to inflation in the case of four euro area countries (Germany, Italy, France and Spain); they also analyze how the passthrough depends on the state of the economy and the nature of the shock. Bundesbank (2019) finds that the passthrough, though sizable, has diminished over time. Surprisingly, very

few papers examine the wage-price link in NMS. IMF (2018b) examines wage-price linkages in a panel of EU15 and NMS countries, and finds similar passthrough estimates. De Luigi, Huber and Schreiner (2019) focus on selected CESEE countries and find a positive, but relatively weak, relationship between labor costs and price inflation, noting the cross-country heterogeneity in passthrough estimates and the weakening of the passthrough after the global financial crisis. Relative to the existing literature, our contributions are two fold. *First*, previous studies report only passthrough estimates, but do not systematically provide an account of the factors that determine the wage passthrough. Our paper fills this gap in the literature. *Second*, we use a much broader sample of countries that includes the newer EU member states, where the disconnect between recent wage and price developments is most pronounced.

The rest of the paper is organized as follows. Section II describes the empirical approach and discusses the data sources used in the analysis. We present the main results on the size of the passthrough from wage growth to inflation and its evolution in the post crisis period in Section III. Section IV discusses how the passthrough is shaped by various country and sectoral characteristics. Section V concludes.

## II. ANALYTICAL APPROACH

### A. Econometric Models

We rely on two key econometric models to estimate the dynamic link between wage growth and inflation. First, we employ a panel vector autoregression model (PVAR), developed by Love and Zicchino (2006), to obtain the *unconditional* passthrough of wage growth to inflation. To capture how this passthrough is shaped by various time-varying country-level characteristics, we use an interacted panel vector autoregression (IPVAR) model, following Towbin and Weber (2013). This model allows us to obtain *conditional* wage passthrough estimates.

Both models estimate the dynamic wage-price linkages within the traditional Philips curve framework, which formulates the relationship between wage growth/inflation, and labor market slack. We augment the basic framework to include imported input costs, given the increasingly large role played by international prices and competition in domestic price developments (see Forbes 2019; Obstfeld 2019 among others). The VAR systems thus include import price inflation, nominal wage growth adjusted for trend productivity, core price inflation and an unemployment gap, with this causal ordering. By ordering wage growth before inflation, we assume that movements in wage growth have an immediate impact on inflation, but wages take at least a quarter to respond to consumer price movements.<sup>4</sup> This specification is similar to the ones used by Peneva and Rudd (2017), IMF (2018c), and Bobeica, Ciccarelli and Vansteenkiste (2019). The PVAR and IPVAR models are estimated on an unbalanced panel of aggregate

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<sup>4</sup> The main results presented in the paper are robust to alternative ordering of the variables within the PVAR.



country-level quarterly data for the 1995Q1-2019Q1 period for 27 European countries, although the sample is considerably smaller in some of the analysis due to data constraints.

### ***Panel Vector Auto Regression***

The PVAR model, in its structural form, can be represented as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ \alpha_0^{21} & 1 & 0 & 0 \\ \alpha_0^{31} & \alpha_0^{32} & 1 & 0 \\ \alpha_0^{41} & \alpha_0^{42} & \alpha_0^{43} & 1 \end{bmatrix} \begin{bmatrix} \pi_{it}^m \\ w_{it} \\ \pi_{it} \\ u_{it} \end{bmatrix} = \sum_{l=1}^L \begin{bmatrix} \alpha_l^{11} & \alpha_l^{12} & \dots & \alpha_l^{14} \\ \alpha_l^{21} & \alpha_l^{22} & \dots & \alpha_l^{24} \\ \alpha_l^{31} & \vdots & \ddots & \alpha_l^{34} \\ \alpha_l^{41} & \alpha_l^{42} & \dots & \alpha_l^{44} \end{bmatrix} \begin{bmatrix} \pi_{it-l}^m \\ w_{it-l} \\ \pi_{it-l} \\ u_{it-l} \end{bmatrix} + X_i + U_{it}, \quad (1)$$

where for a given country  $i$  in period  $t$ ,  $\pi^m$  represents import price inflation,  $w$  nominal wage growth adjusted for trend productivity,  $\pi$  core consumer price inflation, and  $u$  the unemployment gap. The matrix  $X$  is a set of country fixed effects, which capture the influence of all time-invariant country-specific characteristics, and  $U$  is a vector of structural shocks that are assumed to be uncorrelated with one another. The lag length is denoted by  $L$  and is set to four, which is standard for VAR models with quarterly data.

The matrices  $A_l$ ,  $l = 0, 1, \dots, L$  determine the effects of structural shocks on the dynamics of the endogenous variables in the PVAR system. A Cholesky decomposition is used for the identification of the shocks, which implies that the variables are included in the model in the decreasing order of presumed exogeneity. The lower triangular structure of the impact matrix  $A_0$  and the ordering of the variables in equation (1), taken together, reflect the Cholesky identification. Import prices are assumed to be the most exogenous and the unemployment gap the least exogenous as in Peneva and Rudd (2017). As mentioned above, by ordering wage growth before inflation, it is assumed that movements in wage growth have an immediate impact on inflation, but wages take at least a quarter to respond to consumer price movements.

We estimate the models for all countries in the sample, as well as separately for NMS and EU15+3 country groups. We discuss the details of the variables used in the estimation in the data section below.

### ***Interacted Panel Vector Auto Regression***

To examine the role of various factors or country characteristics in shaping the extent of passthrough, we deploy an IPVAR model, which can be represented as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ \alpha_{0,it}^{21} & 1 & 0 & 0 \\ \alpha_{0,it}^{31} & \alpha_{0,it}^{32} & 1 & 0 \\ \alpha_{0,it}^{41} & \alpha_{0,it}^{42} & \alpha_{0,it}^{43} & 1 \end{bmatrix} \begin{bmatrix} \pi_{it}^m \\ w_{it} \\ \pi_{it} \\ u_{it} \end{bmatrix} = \sum_{l=1}^L \begin{bmatrix} \alpha_{l,it}^{11} & \alpha_{l,it}^{12} & \cdots & \alpha_{l,it}^{14} \\ \alpha_{l,it}^{21} & \alpha_{l,it}^{22} & \cdots & \alpha_{l,it}^{24} \\ \alpha_{l,it}^{31} & \vdots & \ddots & \alpha_{l,it}^{34} \\ \alpha_{l,it}^{41} & \alpha_{l,it}^{42} & \cdots & \alpha_{l,it}^{44} \end{bmatrix} \begin{bmatrix} \pi_{it-l}^m \\ w_{it-l} \\ \pi_{it-l} \\ u_{it-l} \end{bmatrix} + X_i + U_{it}. \quad (2)$$

The difference between equations (1) and (2) lies in allowing the impact matrix  $A_0$  and the coefficient matrices  $A_l, l = 1, \dots, L$  in equation (2) to comprise of time-varying model coefficients that, for any given entry in row  $j$  and column  $k$ , evolve deterministically according to:

$$\alpha_{l,it}^{jk} = \beta_{1,l}^{jk} + \beta_{2,l}^{jk} factor_{it}, \quad (3)$$

where *factor* refers to a time-varying country characteristic (state variable) assumed to have an impact on the passthrough. The IPVAR model is the joint system of equations (2) and (3). By conditioning the law of motion of the coefficients in these matrices on the country characteristic, as in equation (3), the model dynamics, and hence impulse responses, are state-dependent. This results in a framework where model dynamics, and hence impulse responses, are conditional on the country characteristic. For instance, by interacting with a measure of the degree of inflation expectations anchoring, the IPVAR framework allows to assess conditional estimates of wage passthrough that depends on the level of anchoring. By using the full sample of countries and periods, the IPVAR approach has greater statistical power to detect differences in the degree of passthrough when country characteristics change over time. This is the main novelty of the IPVAR framework.

In addition to anchoring, we use the IPVAR framework to examine the role of various factors in shaping the extent of passthrough: corporate profitability, domestic competition as captured by the extent of product market regulation, and the relative price of investment goods. For these, we estimate the IPVAR by conditioning on each of these factors, one at a time. Quantifying the relative importance of different factors is difficult within the IPVAR framework, given the limited country sample and time-period covered, as it requires sufficient heterogeneity across factors. We also use the IPVAR framework to assess how the passthrough has evolved since the global financial crisis and how it depends on low and high inflation regimes. For this, we condition on dummy variables, again one at a time, that reflect pre- and post-crisis periods; and low and high inflation regimes.

When discussing the findings of the IPVAR analysis, the paper reports the cumulative response of inflation to a wage growth shock at different values of the interacting variable. When the latter is a dummy (e.g. pre- versus post-global financial crisis, or high versus low inflation environment), we simply report the impulse response function of inflation to a wage growth shock in the two regimes. When the interacting variable is continuous (e.g. inflation expectations

anchoring, corporate profitability, labor share, product market regulation, and the relative price of investment goods), we report the response of inflation to wage growth at the 25<sup>th</sup> and 75<sup>th</sup> percentile of the interacting variable.

The identification of the shocks relies on the same timing assumptions implicit in the Cholesky ordering as used in the PVAR. The only additional assumption in the IPVAR is that such timing assumptions hold irrespective of the level of the interacting variable. The IPVAR model is estimated as a panel using the full sample of European countries as in the PVAR model. To the extent possible, the paper examines whether these state-dependent differences also hold within the subsample of NMS, where the disconnect between wage growth and inflation has been most pronounced.

## B. Data

The main analysis in the paper relies on two sets of data at different frequencies. The first set, which includes the key variables used in the estimation of the unconditional passthrough—wages adjusted for trend productivity, inflation, import prices, unemployment gaps—are compiled at the quarterly frequency. These are sourced mostly from Eurostat. The second set, which includes the conditioning variables—anchoring of inflation expectations, product market regulation, corporate profits, labor share of income, and relative price of investment—are available at the annual frequency from a variety of sources (Annex Table 1 provides the full list of data sources). We interpolate these series to match the quarterly frequency of the endogenous variables.<sup>5</sup>

Our baseline measure of wages is total compensation per employee, which is based on national accounts and is consistently measured across countries. Conceptually, compensation per hour worked may be more relevant for firms' pricing decisions if companies rely on temporary workers or are able to reduce hours and then pay only for hours worked. However, hours worked tend to be measured with more noise, and compensation per hours worked data are not available for all countries in the sample (OECD 2009).

Regarding inflation, we use core inflation, which allows us to abstract from price volatility that may arise from developments in commodity prices, such as energy prices and non-processed food items. We augment the analysis using services and non-energy industrial goods inflation. Finally, unemployment gaps are defined as the deviation of actual unemployment rates from the OECD estimates for the NAIRU.<sup>6</sup> For countries for which the OECD estimate of the NAIRU is not available, we use a Hodrick-Prescott (HP) filter estimate, with a smoothing parameter of 1600.

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<sup>5</sup> It is important to note that the conditioning variables themselves are not crucial for identification and hence, this interpolation step is relatively innocuous.

<sup>6</sup> We interpolate OECD estimates of the NAIRU, available at the annual frequency, to obtain quarterly estimates.

In the baseline specification, we transform the variables for stationarity by taking year-over-year growth rates of the level variables: wages, core CPI, and import prices. Following Peneva and Rudd (2017), wage growth is further adjusted for trend productivity growth, measured as real gross value added per employee. This transformation is consistent with the idea that only wage movements beyond those already explained by productivity should matter for inflation. Trend productivity growth is estimated as an HP trend of year-over-year growth of labor productivity. Adjusting for trend productivity growth rather than actual productivity growth minimizes measurement errors associated with the estimation of the latter.

Coming to the conditioning variables, our measure of anchoring of inflation expectations is based on Bems et al. (2018) and derived as the deviation of long-term inflation forecasts produced by professional analysts from the central bank's target. The anchoring measure is transformed such that higher numbers imply better anchoring. To capture the degree of domestic competition, we use the product market regulation (PMR) indicators provided by the OECD. For the relative price of investment, we use series from the Penn World Table 9.1. The labor and profit shares of income are constructed using Eurostat and Haver Analytics.

As mentioned above, the combined database covers 27 European countries, 16 advanced economies (EU15+3) and 11 newer EU member states (NMS), over the period 1995Q1-2019Q1. Though the estimation does not strictly require a balanced panel, the start of the sample period reflects the time for which data for most countries are available.

### **III. RESULTS**

#### **A. Main Findings**

Our analysis suggests that, historically, in the sample of European countries, wage growth leads to higher core inflation. Figure 3 shows the impulse response of core inflation to a 1 percentage point shock to nominal wage growth adjusted for trend productivity in the sample of EU15+3 (panel 1) and NMS (panel 2). The initial impact of a wage shock on inflation is rather small, initially, but it builds up over time, peaking after six quarters before slowly dissipating. After three years, the cumulative impact of a 1 percentage point increase in wages is broadly similar across the two groups of European economies. We estimate the same wage shock to lead to 1.1 percentage point higher inflation in the newer EU member states and 1 percentage point higher inflation in other European countries.

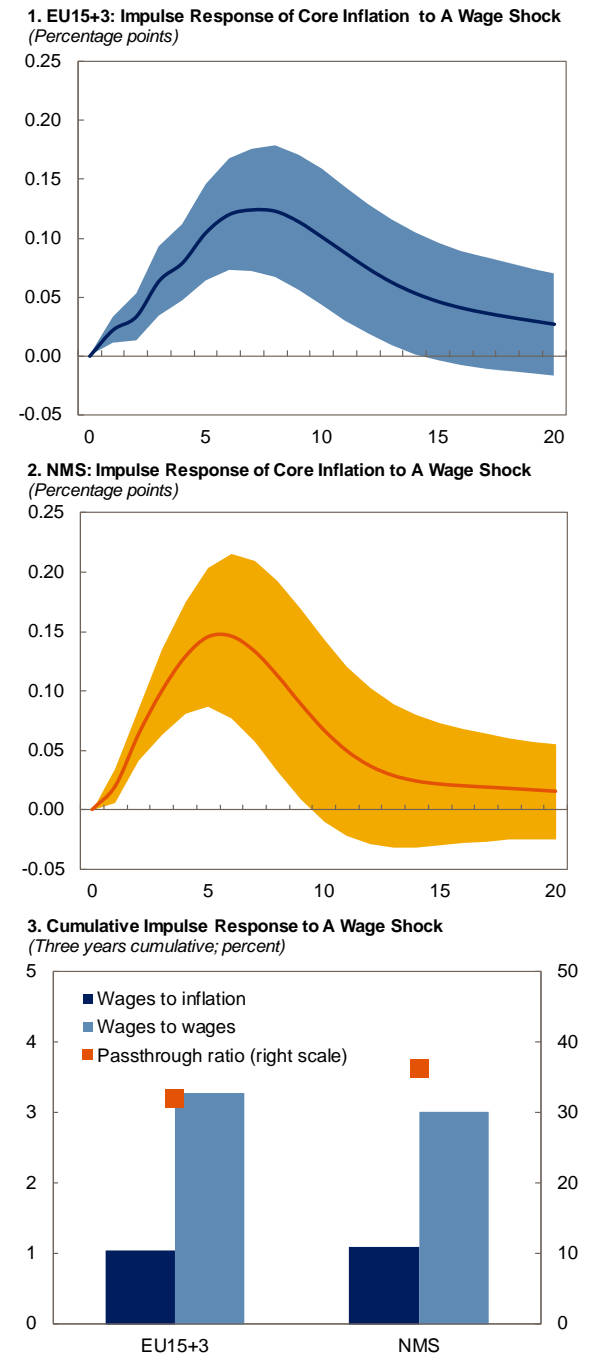
As wages respond to their own shock within the PVAR framework—in other words, the 1 percentage point initial shock to wages is typically followed by subsequent wage increases—it is useful to compare the estimated response of inflation to the cumulative increase in wages. In Figure 3, panel 3, we plot the estimated cumulative increase in prices at the end of 3 years, the estimated cumulative increase in wages over the same time period, and the passthrough ratio, defined as the ratio between the two.

The passthrough from wages to prices at the end of 3 years is about one-third, with a slightly higher estimate for the newer EU member states. Despite methodological differences, our estimates of the passthrough are quite similar to those of Bobeica, Ciccarelli and Vansteenkiste (2019) and Bundesbank (2019).

### B. The passthrough over time

The passthrough of labor costs into core inflation in Europe seems to have weakened in the last decade. Figure 4, panel 1, plots the cumulative response of core inflation to a wage shock in the period before and after the global financial crisis, estimated using the IPVAR framework. The findings suggest that after 2008, the cumulative impact of wage growth on European core inflation has become smaller. The passthrough ratio declined to less than 20 percent (Figure 4, panel 2). This pattern is even more striking among the subset of the newer EU member states (see Annex Figure 3), for which the passthrough ratio in the post-2008 period is estimated to be only one-half of its pre-2008 value. These results corroborate the findings in the recent empirical literature for the United States (Peneva and Rudd 2017), several Central, Eastern, and Southeastern European countries (De Luigi Huber and Schreiner 2019), and Germany (Bundesbank, 2019). Bobeica,

**Figure 3. Response of Core Inflation to a Wage Shock** (Quarters on the horizontal axis; unless indicated otherwise)

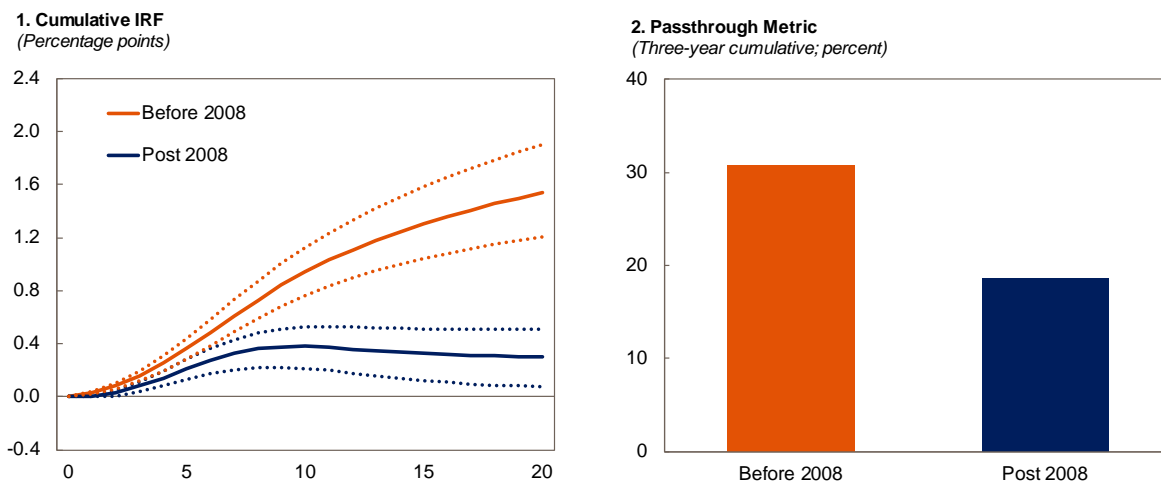


Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; OECD; and IMF staff calculations.

Note: NMS are newer EU members. EU15+3 are the long-standing EU members plus Israel, Norway, and Switzerland. In panels 1 and 2,  $t=1$  is the quarter of the shock. Shaded areas denote the two standard deviation confidence bands. Shocks represent an exogenous 1 percentage point increase in wages.

Ciccarelli and Vansteenkiste (2019), on the other hand, do not detect significant changes in the passthrough from labor costs to inflation in their study of the four largest euro area economies.<sup>8</sup>

**Figure 4. Response of Core Inflation to a Wage Shock Before and After the Great Financial Crisis**



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; OECD; and IMF staff calculations and estimates.

#### IV. THE ROLE OF VARIOUS FACTORS

Why would the relationship between labor costs and inflation change over time? In this section, we examine the role of various factors in determining the size of the wage-inflation passthrough, hoping to shed light on the likely mechanism behind the more subdued labor-cost inflation link in recent years. In particular, we focus on the role of inflation and inflation expectations; domestic and foreign competition; corporate profitability and, its mirror image, the labor share, and, relatedly, access to cheaper inputs in determining the size of the wage-inflation passthrough.<sup>9</sup>

##### A. The role of inflation and inflation expectations

The post-global financial crisis decline in the strength of the passthrough could potentially be due to the subdued inflationary environment that has characterized the last decade. To the extent that the persistently low inflation since the global financial crisis of a decade ago reflects persistently lower inflation expectations, it may have led to changes in the price-setting behavior of firms.

<sup>8</sup> We similarly find a smaller and statistically insignificant decline in the passthrough ratio among the EU15+3 countries in our sample.

<sup>9</sup> For an alternative explanation of the weaker post-crisis passthrough from wage growth to inflation, which focuses on the role of the cumulative wage gap, see Voinea (2019).

(continued...)

Intuitively, if firms expect low inflation, they are likely to perceive cost increases as transitory and may be reluctant to pass higher labor costs onto consumers since they expect their competitors to hike their prices only moderately (Taylor 2000).<sup>10</sup> Thus, price stability, for example due to improved inflation expectations anchoring, is likely to reduce the sensitivity of inflation to wage growth.<sup>11</sup> Conversely, cost increases are likely to be perceived as more persistent in countries with a high inflation environment and higher inflation expectations, in which case wage growth and inflation would be more closely linked.

To shed light on this mechanism, we perform two complementary exercises. First, we examine whether the link between wage growth and inflation depends on the prevailing inflation rate in the economy. Although the prevailing core inflation rate is a crude proxy of inflation expectations, this analysis allows for the largest possible estimation sample given its limited data requirements.<sup>12</sup> We then directly examine the role of inflation expectations anchoring in shaping the responsiveness of core inflation to wage growth.

The first analysis, which relies on the IPVAR empirical framework, uncovers a tight relationship between the prevailing inflation rate and the extent of passthrough from wages to core inflation. The impact of labor cost increases on prices is systematically lower and takes longer to materialize in periods of below-average inflation. As shown in Figure 5, panels 3 and 4, in a low inflation environment, defined as periods during which core inflation is below the country

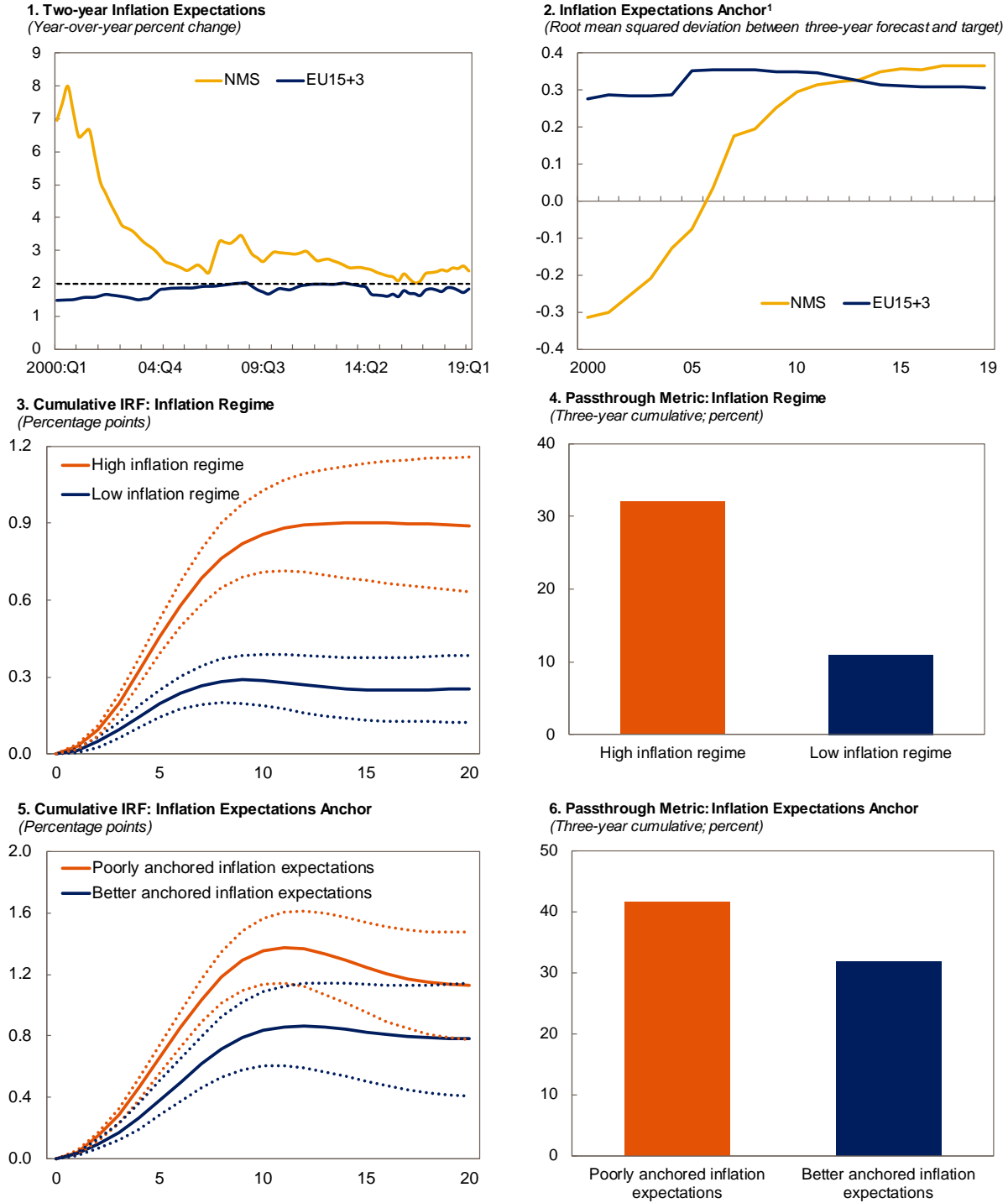
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<sup>10</sup> Using an information treatment that generates exogenous variation in inflation expectations among Italian firms and can thus uncover the causal effect of inflation expectations on economic decisions, Coibon, Gorodnichenko and Ropele (2019) demonstrate that higher inflation expectations on the part of firms lead them to raise their prices.

<sup>11</sup> Similarly, empirical studies have established that lower overall inflation and better-anchored inflation expectations limit the passthrough of currency depreciations to domestic prices. See, for example, Choudhri and Hakura, 2006, Carrière-Swallow et al. 2016, IMF 2018a, and references therein.

<sup>12</sup> See IMF 2018a for a discussion of the role of improvements in inflation expectations anchoring in lowering inflation across emerging markets.

**Figure 5. Inflation Expectations and Anchoring**



Sources: Bems et al. (2018); Consensus Forecast; Eurostat; Haver Analytics; IMF, *World Economic Outlook*; and IMF staff calculations and estimates.

Note: NMS are newer EU members. EU15+3 are the long-standing EU members plus Israel, Norway, and Switzerland. Data are weighted by purchasing-power-parity GDP to aggregate across the two country groups.

<sup>1</sup> Transformed indicator such that higher numbers indicate that inflation expectations are better anchored.



average, a 1 percentage point wage increase raises inflation by a cumulative 0.3 percent over three years, with an estimated passthrough ratio of about 11 percent. In a high inflation environment, defined as periods during which inflation is above the country average, the cumulative impact is significantly higher, with the passthrough ratio of about a third. The relationship between the inflation regime and the passthrough also holds when the estimation is restricted to the subsample of NMS (see Annex Figure 4, panels 1 and 2).

A similar pattern is revealed when using a direct measure of the degree of inflation expectations anchoring. We use the newly constructed index of inflation expectations anchoring developed by Bems et al. (2019), which measures the deviation of long-term inflation forecasts produced by professional analysts from the central bank's target. Intuitively, if inflation expectations are well anchored, predictions of future inflation should be, on average, close to the target pursued by the central bank. According to this metric, long-term inflation expectations are generally well-anchored in Europe. While two-year inflation expectations are somehow higher in NMS than in other European countries (Figure 5, panels 1), anchoring has improved significantly over the past two decades, in line with trends observed in other emerging economies (Figure 5, panels 2). In contrast, inflation expectations have been broadly stable in EU15+3 countries and in fact have remained stubbornly low in the euro area—below the European Central Bank's target—for several years after the global financial crisis.

The empirical results suggest that the wage-to-inflation passthrough depends on the anchoring of inflation expectations. As shown in Figure 5, panel 5, labor cost increases have a more muted impact on inflation when inflation expectations are better anchored. A 1 percentage point wage increase raises inflation by a cumulative 0.9 percentage point over the period of three years when the impulse response is evaluated at the 75<sup>th</sup> percentile of the distribution of the measure of inflation expectations anchoring. This impact increases by about a half—to 1.4 percentage point—when inflation expectations are weakly anchored (i.e. when the cumulative impulse response is evaluated at the 25<sup>th</sup> percentile of the distribution of inflation expectations anchoring). The passthrough ratio is also smaller when expectations are anchored within a low range (Figure 5, panel 6).

This finding is even stronger in the subsample of NMS, where inflation expectations became significantly better anchored in the 2000s as shown in Annex Figure 4, panels 3 and 4. In fact, the improved anchoring of inflation expectations may be an important reason why the passthrough has declined over time in especially in the NMS analyzed in this paper, as well as in several Central, Eastern, and Southeastern European countries studied by De Luigi, Huber, and Schreiner (2019). Yet, the passthrough remained broadly stable in the four largest euro area countries according to Bobeica, Ciccarelli, and Vansteenkiste (2019) where the degree of

anchoring of inflation expectations remained relatively unchanged, inflation expectations have remained fairly stable and even drifted below target in recent years.<sup>13</sup>

## B. The role of competition

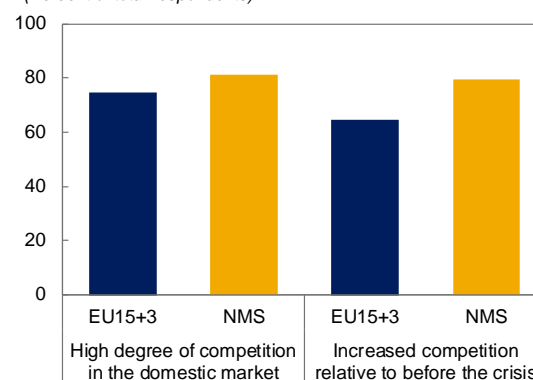
Survey evidence from Europe suggests that firms' pricing strategies depend to a significant extent on their exposure to competition, either domestic or from abroad (see, for example, Lamo and Smets 2009, Bertola et al. 2009). And firms continue to report very intense competitive pressures and increase in competition relative to the period before the global financial crisis. According to the latest Wage Dynamics Network Survey, more than two-thirds of firms report increased competitive pressures compared to the pre-crisis era (Figure 6, panel 1). Despite the slowdown in global trade growth in recent years, in Europe imports have continued to rise as a share of output (Figure 6, panel 2). In a more competitive environment, firms may be reluctant to pass cost increases onto consumers due to fear of losing market share to competitors or being driven out of the market. We present three pieces of analysis in this paper, which suggest an important role of competition in shaping the link between wage growth and inflation.

### Aggregate Evidence: Services vs Industrial Goods' Inflation

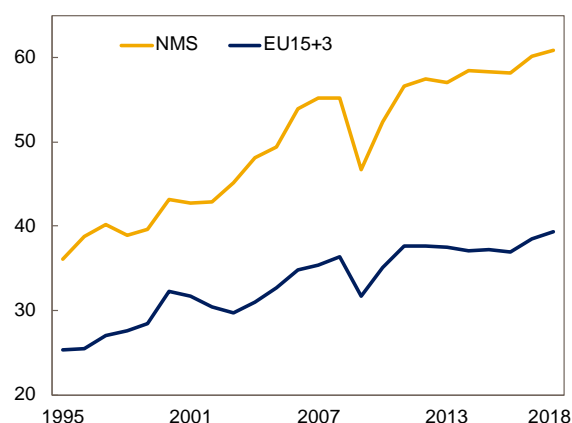
Europe is one of the world's regions most open to international trade and most deeply integrated in global supply chains (see Huidrom et al. 2019). Yet, the economy-wide numbers hide dramatic differences in the exposure to foreign competition across sectors of the economy. Import penetration—measured as the ratio of final imports to sectoral gross value added—is around 60 percent in the manufacturing sector (Figure 7, panel 1). In contrast, in the services

**Figure 6. Competitive Pressures for Europe**

**1. Firms Reporting High or Increased Competition Relative to before the Crisis**  
(Percent of total respondents)



**2. Import-to-GDP Ratio**  
(Percent of GDP)

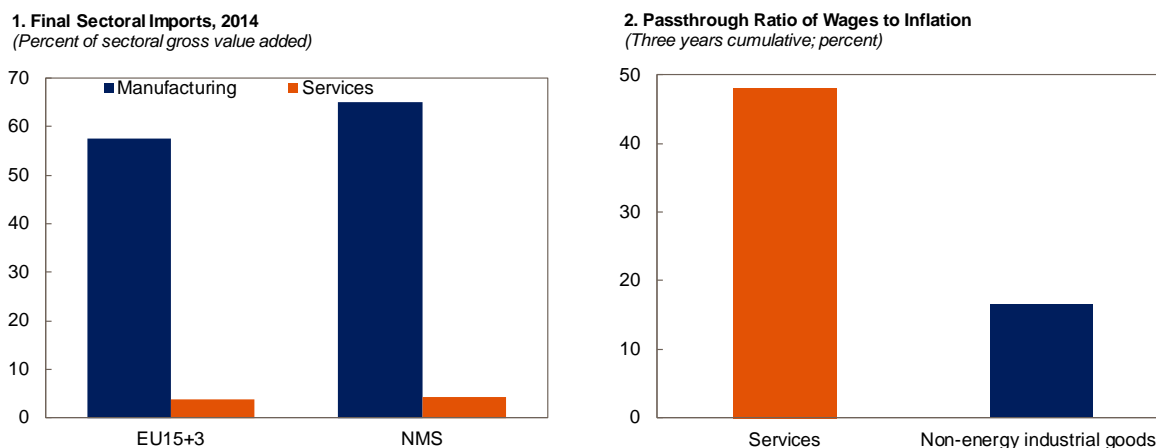


Sources: ECB, *Wage Dynamics Network Survey, third wave, 2014-15*; IMF, *World Economic Outlook*; and IMF staff calculations.

<sup>13</sup> The difference could also be due to a long-run restriction imposed by Bobeica, Ciccarelli and Vansteenkiste (2019) that the gap between productivity-adjusted nominal wage growth and price inflation must disappear in the long-run. The analyses in this paper do not impose such a restriction.

sector, the import penetration ratio is less than 5 percent. These patterns are consistent with the higher barriers to trade in services, relative to the manufacturing sectors, as discussed in Boz, Li and Zhang (2019). Consistent with this higher exposure to foreign competition, non-energy industrial good prices tend to be closely correlated with producer prices in other countries (see, for example, Carney 2017, Forbes 2019). One would also expect a lower wage-to-inflation passthrough in this sector relative to services.

**Figure 7. The Role of Foreign Competition**



Sources: Eurostat; Haver Analytics; Johnson and Noguera (2017) based on World Input-Output Database; IMF, *World Economic Outlook*; OECD; and IMF staff calculations and estimates.

Note: NMS are newer EU members. EU15+3 are the long-standing EU members plus Israel, Norway, and Switzerland. Data are weighted by purchasing-power-parity GDP to aggregate across the two country groups.

We test this hypothesis by estimating the link between economy-wide labor cost increases and the two key components of core inflation: services and non-energy industrial goods price inflation, which reflects mostly prices of manufacturing goods. Namely, we estimate the PVAR models described in Section II, with services and non-energy industrial goods price inflation replacing, alternatively, core inflation in the 4-variable system. Figure 7, panel 2, shows the estimated passthrough ratio for these two subsets of core inflation. The analysis, indeed, confirms that higher economy-wide wage growth is more likely to lead to higher growth in services prices, relative to non-energy industrial goods' prices. This finding is in line with Bobeica, Ciccarelli and Vansteenkiste (2019), who examine differences in the passthrough of sectoral wage growth to inflation in three broad sectors (namely, construction, manufacturing, and services) in Germany, France, Italy, and Spain, and in three out of those four economies find somewhat larger passthrough of wage growth to inflation in the less-traded services sectors.

### **Sectoral Evidence: The Role of Import Competition**

The difference in the passthrough from aggregate wage growth to price changes of services versus manufacturing goods is consistent with the higher exposure to international competition of the manufacturing sector. However, it could reflect many other differences between these two

broad sectors in the economy, such as, among others, cost structures, and markups.<sup>14</sup> We, thus, turn to a more granular sectoral analysis to pin down more precisely the role of import competition. We use disaggregate data on producer prices and wages across 55 sectors in 32 European countries to examine whether the wage-price link is weaker in sectors that are exposed to greater foreign competition.

The analysis relies on the 2016 release of the Socio-Economic Accounts from the World Input-Output Database (WIOD) (see Timmer et al. 2015), which provides annual data for 2000-14 on real gross output, value added, and their price level, labor compensation, number of workers, etc. at the sectoral level for 43 economies.<sup>15</sup> As in the aggregate analysis, nominal wages growth is constructed as growth in labor compensation per person employed, and adjusted for productivity growth, measured as growth in real value added per person employed. The Socio-Economic Accounts data are complemented with series from Johnson and Noguera (2017), who construct, using the 2016 release of the WIOD, sectoral final and intermediate imports. We use the import penetration ratios, the ratio of final imports to sectoral gross output, to capture the competitive pressures experienced by various sectors.

The empirical analysis is based on panel regressions, which relate growth in producer prices, to its lag, growth in productivity-adjusted wages, controlling for country-sector, country-year and sector-year fixed effects. The specification also includes the interaction between productivity adjusted wage growth and import penetration ratio at the sectoral level, as well as the main effect of import penetration.

$$y_{s,c,t} = \alpha \cdot w_{s,c,t} + \delta \cdot w_{s,c,t} \cdot m_{s,c,t} + \mu \cdot m_{s,c,t} + \beta \cdot y_{s,c,t-1} + \gamma_{s,c} + \gamma_{s,t} + \gamma_{c,t} + \varepsilon_{s,c,t-1}, \quad (4)$$

where  $y_{s,c,t}$  is the growth in the value added deflator of sector  $s$ , in country  $c$ , in year  $t$  (measured as the log difference),  $w_{s,c,t}$  in the growth in the labor compensation per person engaged less growth in real value added per person engaged,  $\gamma_{s,c}$  is an indicator for each sector in each country,  $\gamma_{c,t}$  denote country-year fixed effects, while  $\gamma_{s,t}$  denote sector-year fixed effects. The two key coefficients of interest are  $\alpha$ , which captures the association between productivity adjusted wage growth and growth in producer prices, and  $\delta$ , which captures how the association between wage growth and producer prices is shaped by the competitive pressures experienced by different sectors. If higher competition from abroad indeed lowers the likelihood that firms pass

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<sup>14</sup> See Bundesbank (2019) for an analysis of the labor cost share of the consumption of and gross value added of the various subcomponents of the consumer basket in Germany based on the World Input-Output Database. Box 1 and the associated technical annex similarly document differences in the markup between the manufacturing and services sector.

<sup>15</sup> Sectors are defined using the ISIC Revision 4, and comprise 56 distinct categories, of which 19 are in manufacturing.

(continued...)

wage costs increases to the prices they charge for their output, we would expect  $\delta$  to be negative.<sup>16</sup>

The use of sectoral data allows us to control for the effects of numerous aggregate shocks that the PVAR and IPVAR analysis may be unable to capture. For example, the country-year fixed effects capture all country-specific time-varying shocks, such as changes in inflation expectations, economic slack, commodity price shocks and the like. The country-sector fixed effects control for time-invariant differences across sectors within a country, such as in technological requirements that may influence the sectoral cost structure. Sector-year fixed effects capture all changes to a particular sector that are common across countries, such as technological innovations at the sectoral level and the like. Standard errors are clustered at the country-sector level.

Table 1 presents the results from estimating equation (4) with alternative measures of exposure to foreign competition. In columns (1) and (4), competition pressures are measured as the ratio of final imports to gross output. In columns (2) and (5), we use the log of the ratio, while in columns (3) and (6) we use a dummy if the sectoral import penetration is above the sample median. The findings suggest that the passthrough of wage growth to inflation is indeed attenuated in sectors that have higher exposure to foreign competition – the coefficient on the interaction term,  $\delta$ , is negative and statistically significant for all three measures of external competitive pressures. This pattern also holds when restricting the analysis to the 19 manufacturing sectors included in the WIOD (columns 4-6). Higher exposure to foreign competition is also directly associated with lower growth in producer prices, similar to the patterns uncovered in Lian et al. (2019).

Box 1, which focuses on eight of the newer EU member states, uses an alternative sectoral data source and a different econometric approach, presents further corroborating evidence on the importance of exposure to foreign competitive pressures in shaping the passthrough of wage growth into producer prices.

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<sup>16</sup> Higher import penetration could of course directly lead to lower domestic prices, as demonstrated in Lian et al. (2019).

**Table 1. Sectoral Evidence on the Effect of Wage Growth on Producer Prices: The Role of Foreign Competition**

	(1)	(2)	(3)	(4)	(5)	(6)
	All sectors			Manufacturing		
Wage growth	0.164*** (0.035)	0.217*** (0.030)	0.258*** (0.030)	0.192*** (0.042)	0.295*** (0.049)	0.319*** (0.042)
Wage growth * Foreign Competition	-0.013* (0.007)	-0.029* (0.017)	-0.071* (0.041)	-0.031*** (0.011)	-0.053*** (0.020)	-0.092* (0.054)
Foreign Competition	-0.010*** (0.003)	-0.016** (0.008)	-0.006 (0.005)	-0.020*** (0.007)	-0.012 (0.008)	-0.026* (0.016)
Lagged growth in producer prices	-0.079*** (0.025)	-0.078*** (0.025)	-0.078*** (0.025)	-0.076* (0.044)	-0.078* (0.044)	-0.075* (0.045)
Constant	-0.018 (0.012)	0.025*** (0.002)	0.026*** (0.003)	-0.034* (0.018)	0.020*** (0.004)	0.036*** (0.014)
Observations	21,240	21,240	21,240	7,385	7,385	7,385
R-squared	0.339	0.338	0.338	0.401	0.401	0.391

Source: WIOD, Johnson and Noguera (2017), and IMF staff calculations.

Note: The dependent variable is growth in sectoral value added deflators (producer prices). All regressions include country-sector, country-year and sector-year fixed effects. In columns (1) and (4), foreign competition is measured as the ratio of sectoral final imports to gross output. Columns (2) and (5) use the log of the ratio, while columns (3) and (6) use a dummy if the sectoral import penetration is above the sample median. Robust standard errors clustered at the country-sector level in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Product Market Competition

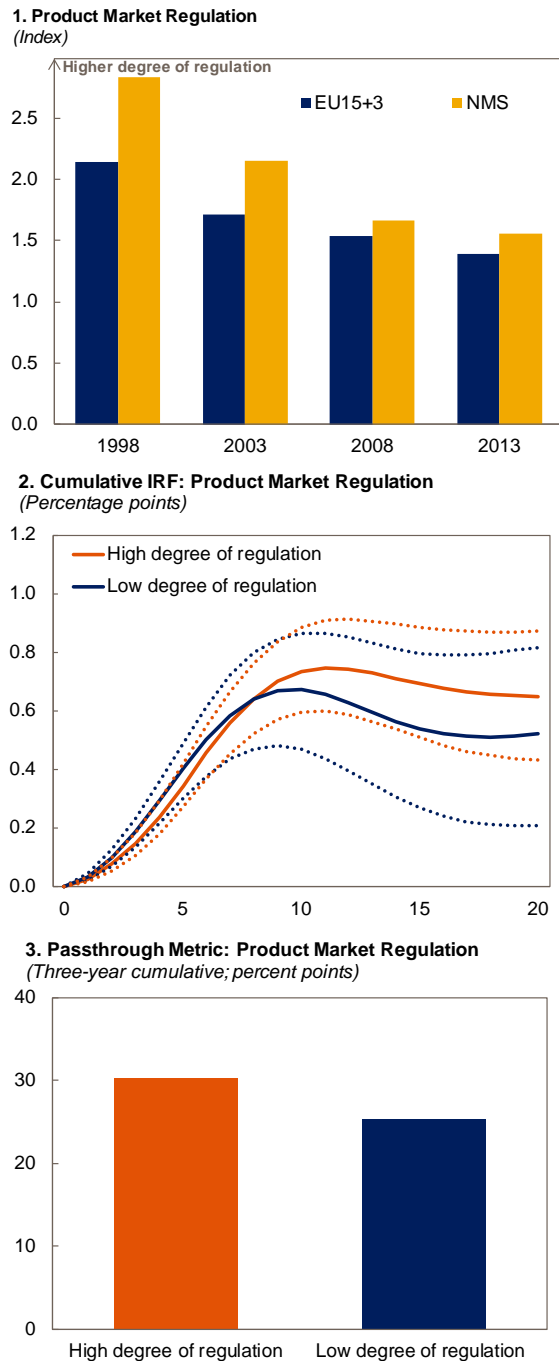
Finally, we also find some suggestive evidence that more fierce domestic product market competition is associated with lower passthrough of wage growth to inflation. The European Central Bank's [Wage Dynamics Network](#) surveys suggest that firms are less likely to raise prices when product market competition is more intense, and similarly, are more likely to reduce other costs rather than increase prices in response to wage shocks when operating in a more competitive environment (Bertola et al. 2009). We leverage the fact that many countries in Europe undertook significant deregulation of their product markets to examine whether the passthrough from wage growth to inflation is lower in countries that deregulated more (Figure 8, panel 1). IPVAR regressions, which rely on the OECD's product market regulation indicator as a measure of domestic competitive pressures, suggest that more vibrant product market competition and fewer barriers to entry mute the sensitivity of consumer prices to wage

increases. The passthrough of wage growth to inflation is marginally higher when evaluated at the 75<sup>th</sup> percentile of a country's PMR score, in other words in countries with higher regulatory barriers in product markets, than at the 25<sup>th</sup> percentile of the PMR indicator (Figure 8, panels 2 and 3). On a sectoral level, Box 1 also finds that fiercer domestic competition, as captured by the Lerner index, weakens the link between wage growth and producer prices in the services sector.

### C. The role of corporate profitability

This final section examines the relationship between corporate profitability and the labor cost-inflation passthrough. Firms with higher profit margins have room to absorb a higher wage bill without passing the cost onto consumers, especially when they strive to retain market share. Overall, economy-wide profit shares remain high in Europe, in particular in NMS (Figure 9, panel 1). At the end of 2018, corporate profits amounted to 47 percent of gross value added in NMS and 40 percent in EU15+3 countries.<sup>17</sup> However, the recent increase in productivity-adjusted wages went hand in hand with a decline in corporate profit shares. Since the beginning of 2017, corporate profits declined each year by about 1 percent of gross value added in NMS and 0.3 percent in other European countries. This pattern suggests that firms are indeed using their profit buffers to absorb the faster wage growth, rather than passing the higher labor costs to their clients.<sup>18</sup>

**Figure 8. The Role of Domestic Competition**



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; OECD; and IMF staff calculations.

Note: Higher product market regulation index indicates higher regulatory barriers.

<sup>17</sup> In contrast, corporate profits account for only a third of gross value added in the United States.

<sup>18</sup> Admittedly, this pattern is to be expected: higher wages, unless accompanied by employment cuts, will have to translate into lower profits as a matter of accounting, absent any changes to the firm's production technology or other inputs' costs.

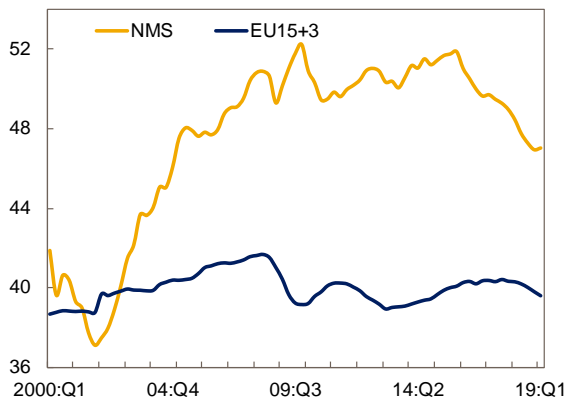
We use the IPVAR framework to examine whether aggregate corporate profitability has a bearing on the extent to which firms raise prices in response to higher wage costs. The analysis confirms the inverse association between the corporate profit share and the wage-to-inflation passthrough. In countries and periods when the economy-wide corporate sector profit share is relatively high, a significantly smaller share of wage growth finds its way into consumer prices inflation (Figure 9, panels 3 and 5): a 1 percentage point increase in labor costs leads to a cumulative increase in inflation of only 0.7 percentage point over the period of three years, when evaluated at the 75<sup>th</sup> percentile of the distribution of corporate profitability. When corporate profits are relatively thin (when profits are at the 25<sup>th</sup> percentile of the distribution of corporate profitability), the impact of wage growth on inflation is significantly higher, with a somewhat stronger passthrough.

Robust corporate profit shares mirror the somewhat subdued share of income that goes to workers (Figure 9, panel 2). Low labor share means that wage developments matter less for inflation.<sup>19</sup> The IPVAR regressions confirm this observation. The cumulative impact of wage increases on inflation in a low labor share regime is significantly lower than in a high labor share regime (Figure 9, panels 4 and 6).<sup>20</sup> This finding is very similar to the pattern uncovered when analyzing the role of corporate profitability.

**Figure 9. The Role of Corporate Profitability**

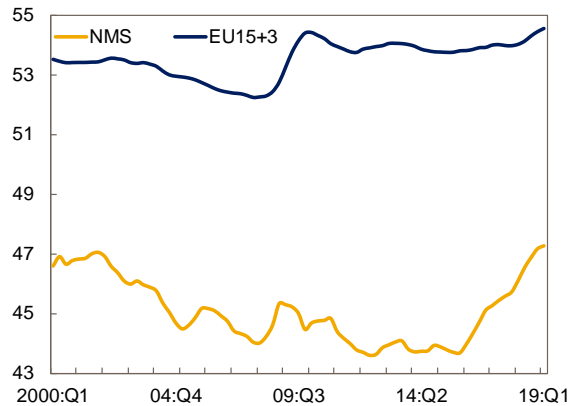
**1. Corporate Profitability**

(Corporate profit as percent of GVA)



**2. Labor Share of Income**

(Compensation of employees as percent of GVA)



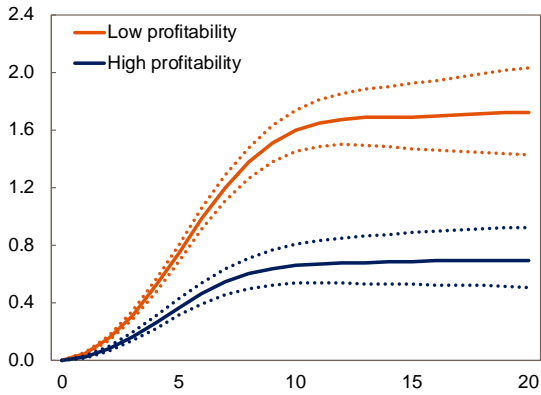
<sup>19</sup> Under the assumption of perfect competition in factor and goods markets, the passthrough from wages to prices is determined by the ratio of the nominal wage bill to the value of the domestic supply of goods (i.e. the labor share). For a derivation, see Bundesbank (2019).

<sup>20</sup> See Annex Figure 5, panels 1 and 2 for estimates based on NMS sample only.

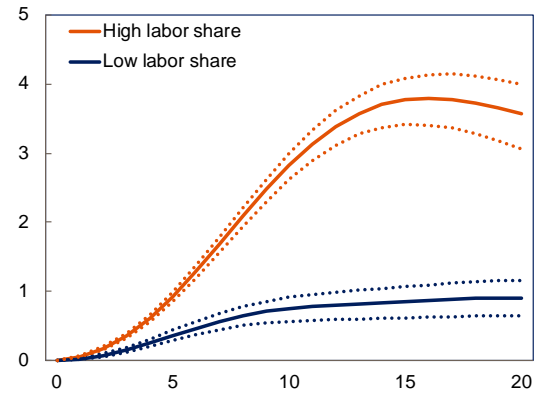


**Figure 9. The Role of Corporate Profitability (Continued)**

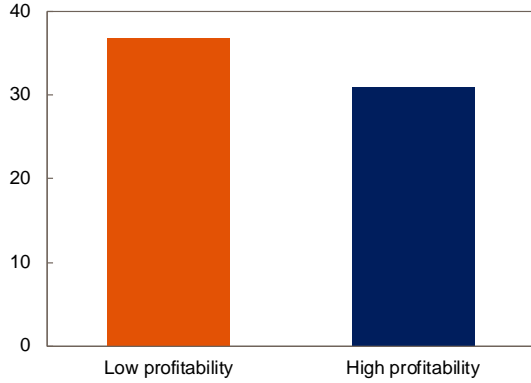
**3. Cumulative IRF: Corporate Profitability**  
(Percentage points)



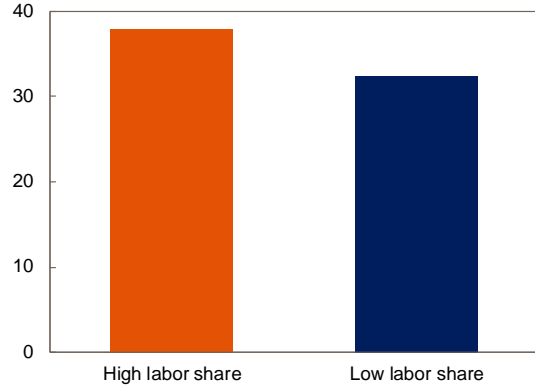
**4. Cumulative IRF: Labor Share of Income**  
(Percentage points)



**5. Passthrough Metric: Corporate Profitability**  
(Three-year cumulative; percent)



**6. Passthrough Metric: Labor Share of Income**  
(Three-year cumulative; percent)



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; and IMF staff calculations and estimates.

Note: Data on corporate profitability covers 20 economies: 6 NMSs and 14 EU15+3 countries.

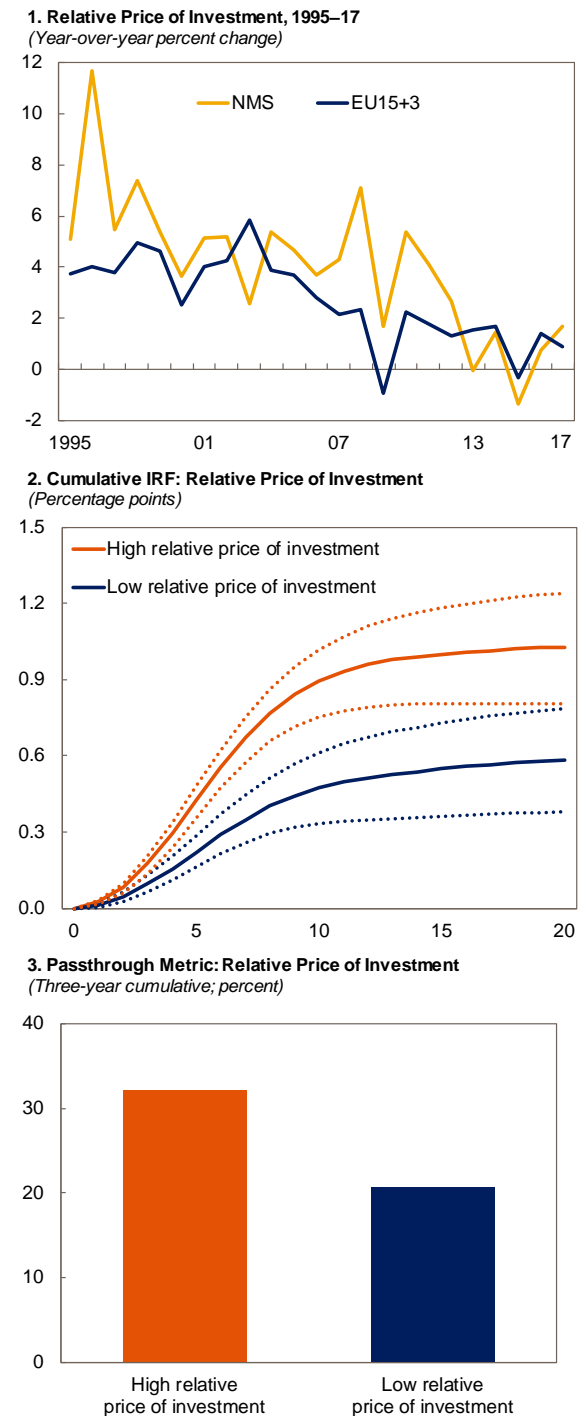
## D. The role of access to cheaper inputs

Finally, enhanced access to relatively cheaper and potentially higher-quality inputs, for example investment goods, allows firms to pay higher wages without raising prices.<sup>21</sup> We take advantage of the dramatic decline in the relative prices of machinery and equipment that has occurred since the 1990s (Figure 10, panel 1). As documented by Lian et al. 2019, this broad-based decline was driven by the faster productivity growth in the capital goods producing sectors relative to the rest of the economy, and deeper trade integration, which induced domestic producers to lower prices and increase their efficiency. We examine whether the passthrough from wage growth to inflation is lower in countries, which experienced a larger decline in the price of investment goods.

As shown in Figure 10, panels 2 and 3, there is strong evidence that this is indeed the case. The impact of wage growth on core inflation is significantly higher when evaluated at the 75<sup>th</sup> percentile of the distribution of the relative price of machinery and equipment versus at its 25<sup>th</sup> percentile. The estimated passthrough ratio is also significantly higher.

More broadly, as the exercise discussed above demonstrates, healthy aggregate corporate profitability and an increase in competition are not necessarily incompatible. Many factors may support corporate profits, even as wages rise, such as access to cheaper intermediate inputs, lower taxation or financing costs, the adoption of new technologies that may reduce the demand for labor, and the like.

**Figure 10. The Role of Other Costs**



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; Penn World Table (version 9.1); and IMF staff calculations and estimates.

<sup>21</sup> See, among others, Carney (2015, 2017), Auer, Borio and Filardo (2017), Andrews, Gal, and Witheridge (2018), Forbes (2019), and Obstfeld (2019) for a discussion of the role of globalization on inflation. Lian et al. (2019)

(continued...)

## V. CONCLUSION

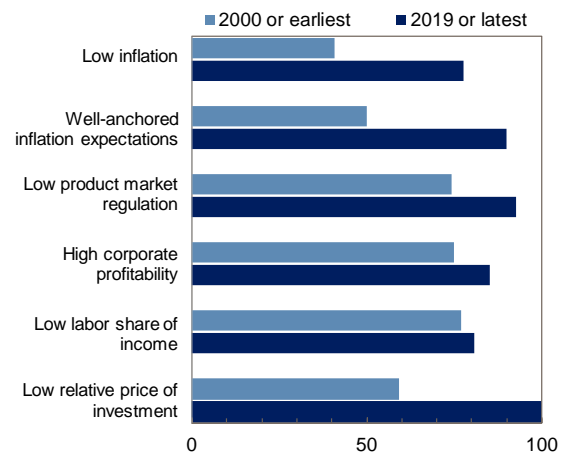
Wage growth has risen above productivity gains, especially in the newer EU member states, yet signs of underlying consumer price pressures remain limited. This paper provided new estimates of the link between labor costs and inflation in a wide sample of European economies and explored several factors that influence the strength of the passthrough of wage growth to inflation.

The evidence presented in this paper suggests that, historically, wage growth has been an important determinant of price developments in Europe. The cumulative impact of a 1 percentage point increase in wages is 1.1 percentage point higher inflation in European countries at the end of three years. The overall passthrough ratio, which takes into account the response of wages to their own increases, is about one third.

However, the link between wage growth and inflation has weakened over time. More precisely, the passthrough from wage growth to core inflation has been only two-thirds as strong in the decade since the global financial crisis as in the period before the crisis. And there are several reasons to expect the passthrough will remain subdued going forward.

As demonstrated in the paper, the passthrough of wage growth to inflation is shaped by a number of factors. Wage increases have a smaller effect on core inflation when inflation and inflation expectations are subdued, corporate profitability is higher, firms have access to cheaper inputs, such as capital goods, and firms are exposed to more fierce competition. Currently, inflation and inflation expectations are near historical lows for three quarters of European economies (Figure 11). Corporate profitability is still healthy. In NMS, corporate profit shares have started to decline, consistent with firms letting their profit margins absorb the rise in labor costs, rather than passing these costs onto consumers. However, corporate profitability remains high from a historical perspective and significantly

**Figure 11. Factors Pointing to Low Wage-Inflation Passthrough Ratio**  
(Percent of total countries)



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; OECD; Penn World Table 9.1; and IMF staff calculations.

Note: The bars represent the share of European countries in the sample that have core inflation above the long-term country average; the metric of inflation expectations anchoring and corporate profitability in the top 75<sup>th</sup> percentile; and other variables in the bottom 25<sup>th</sup> percentile.

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provide direct evidence of the effects of import competition and access to cheaper intermediate inputs on the domestic price of capital goods.

above that of EU15+3. Finally, firms continue to report very high level of competition for their products. Despite the comfortable profit margins at the aggregate level, more than two-thirds of firms report increased competitive pressures compared to the pre-crisis era according to the latest Wage Dynamics Network Survey as depicted in Figure 6. All of these factors suggest that it is unlikely that the recent increase in wage growth will meaningfully spur inflation in the near term. These findings support the need for monetary policy in many European countries to remain accommodative for longer in order to guard against a downshift in inflation expectations. However, as the prolonged period of accommodative financial conditions may have created an environment conducive to greater risk taking, policy makers need to remain vigilant and guard against further buildup of financial vulnerabilities and other undesirable side effects.

### **Box 1. Sectoral Dimension of the Link between Wage Growth to Inflation**

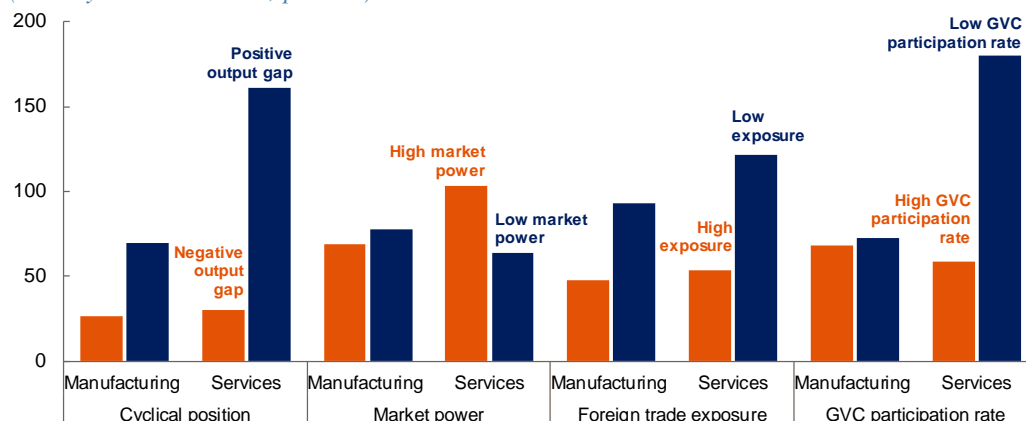
Industry-based analysis reveals a strong link between sectoral wage growth and producer prices across 70 industries in eight of the European Union's newer member states (NMS) during 1995-2016.<sup>1,2</sup> This box presents estimates based on the OECD's Structural Analysis (STAN) database, which includes 22 industries in the manufacturing sector and 40 industries in the services sectors. The impact of wage growth on producer prices at the sectoral level is estimated using error-correction mean-group autoregressive distributed lag regressions since the annual frequency of the available data does not provide sufficient time variation needed for the estimation of a PVAR model. The Annex provides further details on the empirical methodology and data used in the analysis.

Overall, a 1 percentage point increase in unit labor costs is found to increase producer prices by 0.9 percentage point within three years. The three-year cumulative increase is the smallest in Poland and Hungary at about 0.5 percentage point, and the largest in Latvia at 1.3 percentage point.<sup>3</sup>

The transmission of wage increases to sectoral prices is stronger in the services sector compared to manufacturing industries, and in times of an economy-wide excess demand. On average, the cumulative response of sectoral inflation to wage increases reaches 0.7 percentage point in manufacturing and is close to 1 percentage point in services.

The impact of labor compensation on producer prices is much stronger when the economy-wide output gap is positive, and more so in services. When the economy operates above potential, the response of services price inflation to a 1 percentage point increase in wage growth exceeds 1. In times of excess supply, labor compensation's impact on prices is much more muted (Box Figure 1). This result mirrors the economy-wide finding discussed in the main text of a significantly higher passthrough of wage growth to inflation in a high inflation environment, while downward wage rigidity is more binding when estimated output gaps are negative.

**Box Figure 1. Cumulative Response of Producer Prices to Changes in Labor Costs**  
(Three years cumulative; percent)



Sources: IMF, *World Economic Outlook*; OECD, *Structural Analysis Database*; and IMF staff calculations.

Note: Firms' market power is measured using the Lerner index, which is constructed as the price-cost margin (Roeger 1995). High market power is an indicator which takes the value of 1 in periods when the Lerner index exceeds the sectoral average. Firms' exposure to foreign trade is measured as the share of imports of goods and services used for final consumption relative to total gross output of the industry. Subsamples are partitioned into high/low regimes by median values within the two sectors in 2000, except for import of services where a doubled threshold is chosen as the median exposure is low.

Greater exposure to competition is associated with a weaker link between wage hikes and sectoral inflation. The role of competition is examined in subsamples of country-industry groups exposed to either higher- or lower-than-average intensity of competition within each sector. Firms in the services sector with greater domestic market power, as captured by the Lerner index, tend to fully pass the cost of higher wages onto their consumers. In contrast, firms with lower market power limit price increases to only two-thirds of wage hikes. In the manufacturing sector, the evidence on the role of domestic market power is less clear-cut.

Exposure to foreign competition also affects the responsiveness of producer prices to wage growth. The passthrough appears smaller in sectors that are more exposed to foreign competition, as captured in the ratio of imports to goods or services for final consumption to sectoral gross output or via higher participation in GVCs.

<sup>1</sup> The analysis is based on the following countries: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia. Bulgaria, Croatia, and Romania are excluded due to data limitations.

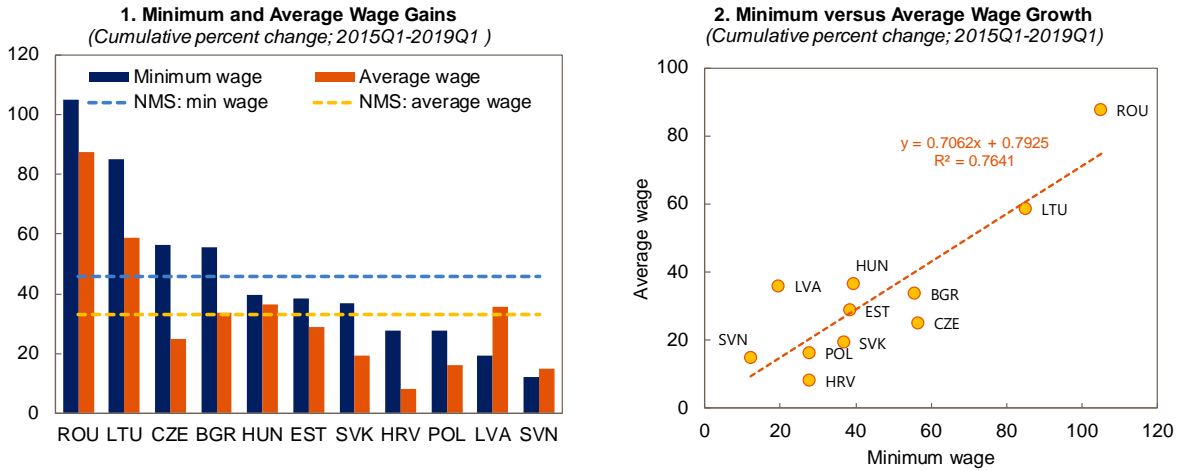
<sup>2</sup> For the Baltics, output volume is proxied by real value-added.

<sup>3</sup> This result is not fully comparable to the average economy-wide cumulative impact in NMS discussed in the main text, since the regressions in this box do not account for the dynamic response of wages to either their own shock over the time period or their relationship with prices due to insufficient time variation in the annual data used in this analysis.

**Annex Table 1. Sources of Information**

<b>Variable</b>	<b>Definition</b>	<b>Frequency</b>	<b>Period</b>	<b>Source</b>
Wages	Compensation of employees/ total employees	quarterly	1995:Q1 – 2019:Q1	Eurostat; Haver Analytics
Relative import prices	Import price deflator/GDP deflator	quarterly	1995:Q1 – 2019:Q1	Eurostat; Haver Analytics
Labor productivity	Real gross value added/total employment	quarterly	1995:Q1 – 2019:Q1	Eurostat; Haver Analytics
Inflation expectation anchor	Deviation of long-term inflation forecasts produced by professional analysts from the central bank's target	annual		Bems et al. (2018)
Core inflation	CPI excl. energy and unprocessed food	quarterly	1995:Q1 – 2019:Q1	Eurostat; Haver Analytics
Services inflation	CPI excl. goods	quarterly	1995:Q1 – 2019:Q1	Eurostat; Haver Analytics
Non-energy industrial goods inflation	CPI for goods excl. food, alcohol, tobacco, and energy	quarterly	1995:Q1 – 2019:Q1	Eurostat; Haver Analytics
Unemployment gap	Unemployment rate – NAIRU (or trend unemployment rate)	quarterly annual (NAIRU)	1995:Q1 – 2019:Q1 1995 - 2019	Eurostat; Haver Analytics; OECD
Profit share	NFCs gross operating surplus/NFCs gross value added	quarterly	1995:Q1 – 2019:Q1	Eurostat; Haver Analytics
Labor share of income	Compensation of employees/gross value added	quarterly	1995:Q1 – 2019:Q1	Eurostat; Haver Analytics
Product market regulation	PMR index	annual	1998, 2003, 2008, and 2013	OECD PMR Database
Relative price of investment	Machinery and equipment price deflator/consumption deflator	annual	1995-2017	Penn World Table 9.1

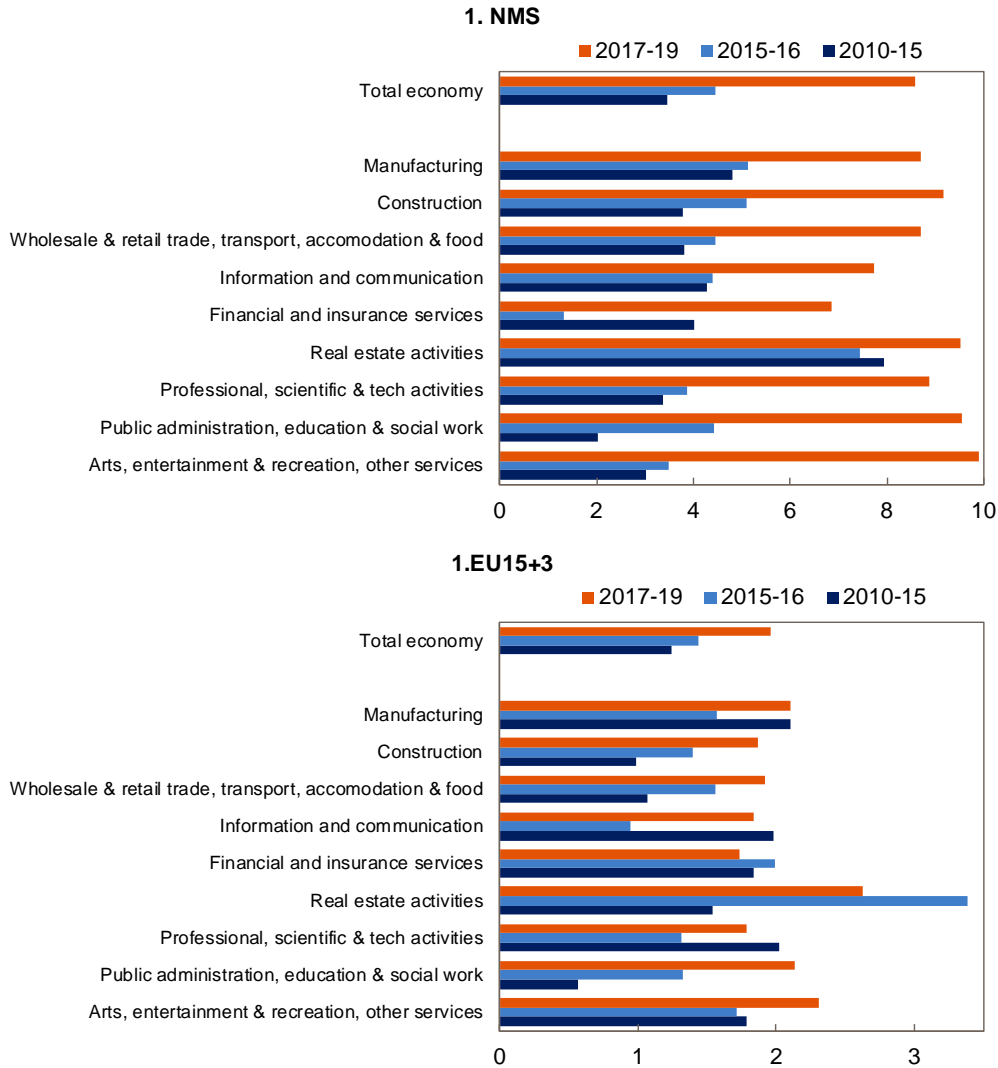
Annex Figure 1. NMS: Minimum and Average Wages



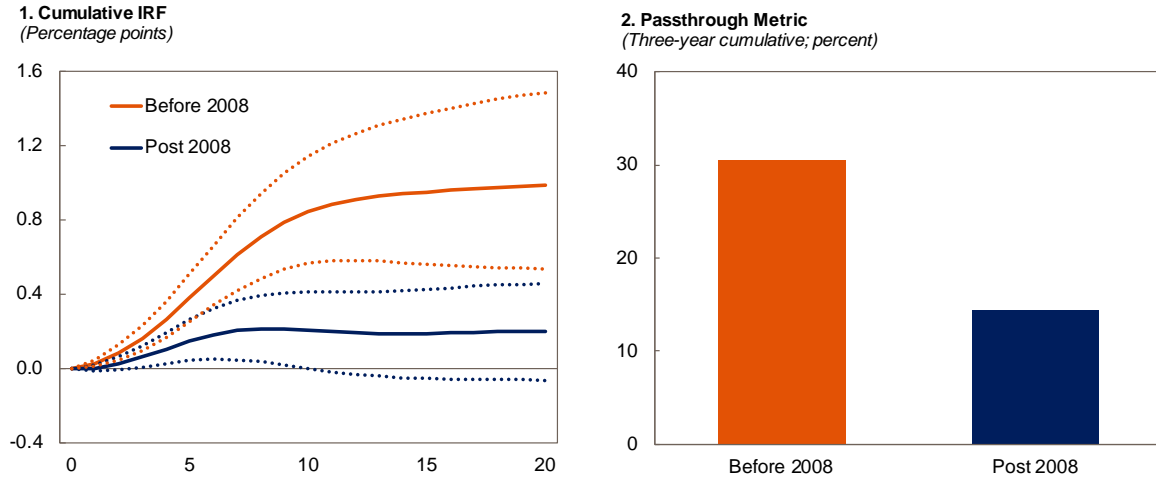
Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; and IMF staff calculations and estimates.

Annex Figure 2. Average Nominal Wage Growth by Sector

(Year-over-year percent change)

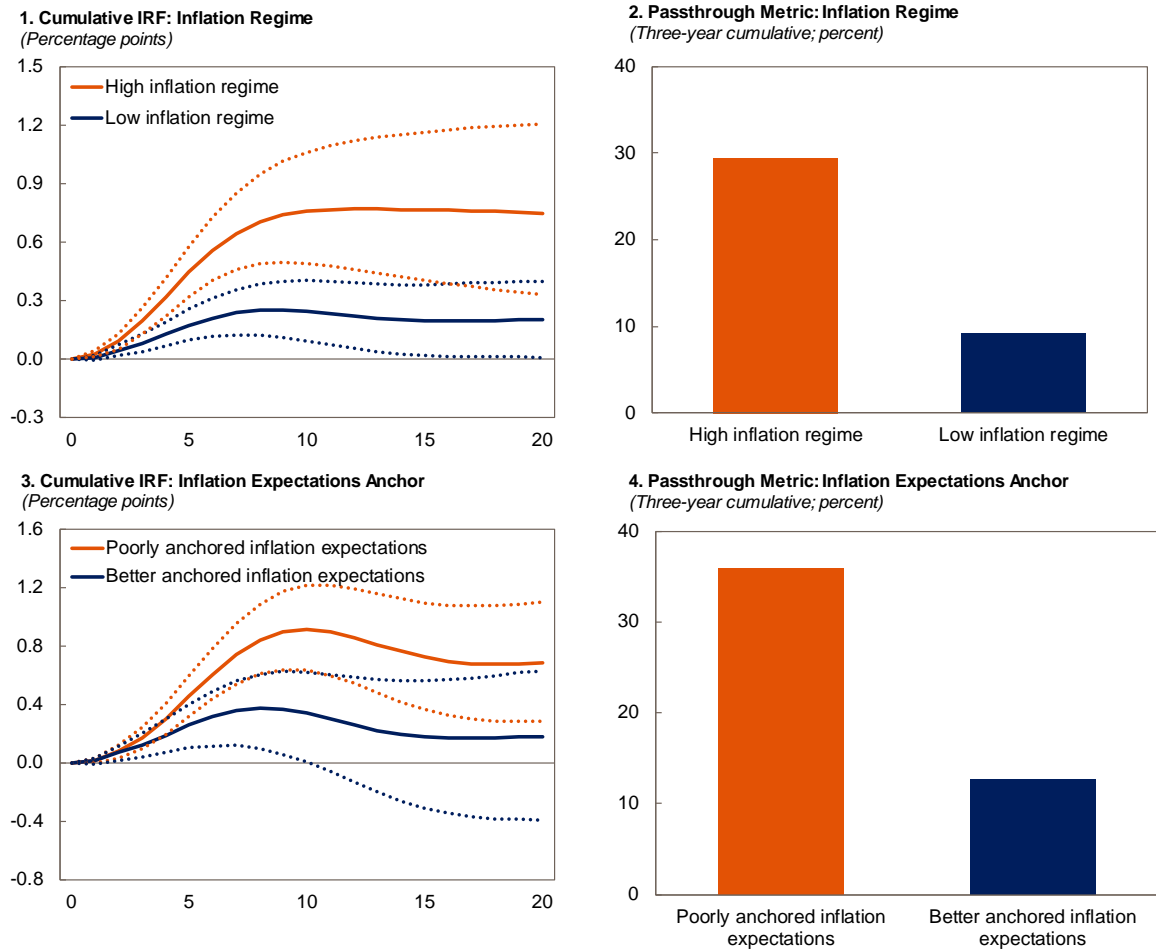


**Annex Figure 3. NMS: Before and After the Great Financial Crisis**



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; and IMF staff calculations and estimates.

**Annex Figure 4. NMS: Inflation Expectations and Anchoring**



Sources: Bems et al. (2018); Consensus Forecast; Eurostat; Haver Analytics; IMF, *World Economic Outlook*; and IMF staff calculations and estimates.

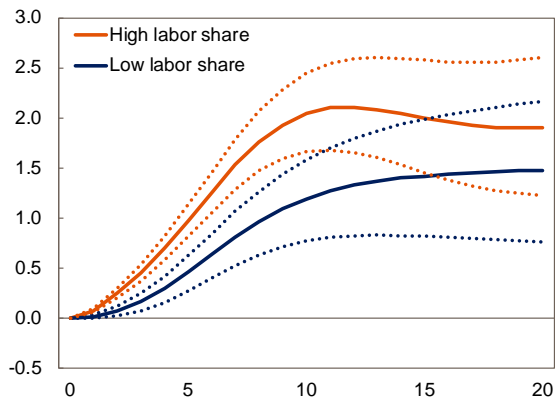
Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; and IMF staff calculations and estimates.

Note: The bars depict the simple average of year-over-year nominal wage growth across the countries and quarters in each subperiod.

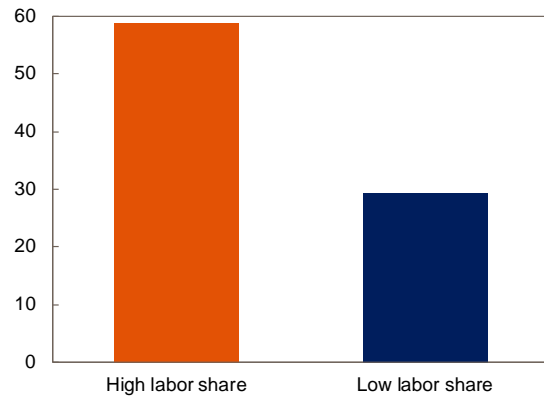


### Annex Figure 5. NMS: The Role of Corporate Profitability

**1. Cumulative IRF: Labor Share of Income**  
(Percentage points)



**2. Passthrough Metric: Labor Share of Income**  
(Three-year cumulative; percent)



Sources: Eurostat; Haver Analytics; IMF, *World Economic Outlook*; and IMF staff calculations and estimates.

Note: Data on corporate profitability covers 20 economies: 6 NMSs and 14 EU15+3 countries.

## ANNEX: EMPIRICAL ANALYSIS AND DATA UNDERLYING RESULTS DISCUSSED IN BOX 1

### Data and Methodology

The empirical methodology relies on estimating disaggregated relationships between prices and wages using a heterogeneous panel data technique that is robust to bi-directional feedback effects, heterogeneous dynamics, and that fact that different sectors may respond differently to identical changes in prices and wages. Specifically, we employ Mean-Group estimator of an autoregressive distributed lag (ARDL) heterogeneous dynamic panel relationship between productivity-adjusted wages and producer prices. A principal feature of cointegrated variables, as prices and wages are in our case, is their responsiveness to any deviation from their long-run equilibrium relationship. This feature implies an error correction model in which the short-run dynamics of the variables are influenced by the deviation from equilibrium, which in the case of ARDL(1,1) model can be presented in the following form:

$$\Delta w_{i,t} = \varphi_i(w_{i,t-1} - \theta_{0i} - \theta_{1i}p_{i,t}) + \delta_{1i}\Delta p_{i,t} + \epsilon_{1i} \quad (1)$$

Where  $w_{i,t}$  denotes logarithm of sector-level productivity-adjusted wage and  $p_{i,t}$  denotes logarithm of producer price. The term in parentheses defines long-run relationship between sector's productivity-adjusted wage and producer prices, and so  $\varphi_i$  is the speed of wage adjustment to deviation from the underlying equilibrium. Note that equation (1) follows conventional presentation of the long-run relationship, namely using the current rather than lagged level of the exogenous regressor (wage), since this allows ARDL(1,0) as the special case. Given the focus of our analysis on the combined cumulative dynamics of wages due to both long-run and short-term factors, we chart cumulative responses that include both long-term, i.e. error-correction, and short-term components, with the latter inclusive of the impact of current period change in prices.

Our panel ARDL specification allows for a significant degree of cross-sector heterogeneity. From among several existing approaches to estimating equation (1), we employ Mean-Group (MG) estimator. MG estimator yields consistent estimates of the averages of the parameters across the cross-section and assumes heterogeneous long-run and short-run relationships and error variances. We also tried estimating the model using the Pooled Mean Group (PMG) estimators, which imposes restriction of homogenous long-run price and wage elasticities while allowing heterogeneous equilibrium adjustment and short-term dynamics. The pooling yields efficient and consistent estimates when the restrictions are true, while the MG estimator is consistent in either case. In most of the cases, however, Hausmann tests were in favor of the MG estimator.

**Data: key variables and underlying considerations.**

The source of sectoral data is OECD's Structural Analysis (STAN) database for Industrial Analysis. It includes annual measures of output, labor input, investment, allowing us to construct a wide range of indicators, including key variables of sectoral producer prices and productivity-adjusted wages. The use of a standard industry list across the OECD, allows aggregation and comparisons across countries. The current version of STAN is based on the International Standard Industrial Classification of all Economic Activities, Revision 4 (ISIC Rev.4) and covers all activities (including services). In practice, average non-overlapping coverage includes about 70 sectors, of which 22 belong to the manufacturing and 40 to the services industries. As STAN's industry classification corresponds to the classification of the World Input-Output Database (WIOD), we include WIOD's sectoral data, such as related to international trade and global value chain participation. The richness of the sectoral data, however, comes at a cost of a limited subset of the newer EU member states covered, namely the Czech Republic, Hungary, Poland, the Slovak Republic, Slovenia, as well as Estonia, Lithuania, and Latvia, for which we construct a modified measure of producer prices.

The following are key considerations in construction of the data:

- **Producer price** is constructed as the output-based price index. The choice of output-based as opposed to value-added based productivity is dictated by the greater sensitivity of the former to the degree of vertical integration (see for example, Cobbold, 2003). For the Baltic states, given the lack of data, output volume is proxied by real value-added.
- **Productivity-adjusted wage** is based on the labor costs or compensation of employees, which comprises of wages and salaries of employees paid by producers as well as supplements such as contributions to social security, private pensions, health insurance, life insurance and similar schemes. The findings do not differ if we include a narrower measure of worker compensation, namely only wages and salaries.
- **Output gap** is from IMF WEO Database.
- **The Lerner index** is a measure of a firm's market power, estimated at a sectoral level for each country using Roeger (1995)'s dual Solow residual approach (see, for example, Bundesbank 2017).

The Lerner index is defined as  $(P - MC) / P$ , where  $P$  is the price and  $MC$  the marginal costs of a firm, or as  $1/|E|$ , where  $|E|$  shows the absolute value of the price elasticity of demand. The index takes values between zero and one, with higher values indicating greater market power.

In the neoclassical growth decomposition model, under its set of assumptions, including profit maximization and perfect competition, Solow residual represents technical change. In case of imperfect competition, Hall (1988) decomposes Solow

residual as a weighted sum of changes to the output-capital ratio and the rate of technical change, where the weights are a function of markups. Hall's approach of obtaining markup from slope coefficient obtained by regressing the Solow residual on the change in the (real) output-capital ratio is difficult in practice, because the latter variable is correlated with the technical change, which is the residual. In turn, Roeger's approach, which we use, overcomes this estimation challenge by relying on nominal values under the assumption that firms seek cost minimization. In formal terms, this implies first estimating the nominal Solow residual ( $\Delta y_t$ ) and the rate of change of the rate of change of output-capital ratio ( $\Delta x_t$ ):

$$\Delta y_t = (\Delta p_t + \Delta Q_t) - \alpha_{N_t}(\Delta w_t + \Delta L_t) - \alpha_{M_t}(\Delta m_t + \Delta M_t) - (1 - \alpha_{N_t} - \alpha_{M_t})(\Delta r_t + \Delta K_t)$$

$$\Delta x_t = (\Delta p_t + \Delta Q_t) - (\Delta r_t + \Delta K_t)$$

Where  $Q$ ,  $L$ , and  $M$  are the natural logarithms of real output, factor inputs for labor, and intermediate goods;  $p$ ,  $w$ , and  $m$  correspond to logarithms of prices; and  $\alpha_{N_t}$  and  $\alpha_{M_t}$  are the shares of the relevant input factors in revenue. Lastly,  $(\Delta r_t + \Delta K_t)$  shows the change in capital costs, where  $K_t$  is the natural logarithm of real net capital stock and  $r_t$  is the logarithm of user cost of capital. With the exception of  $r_t$ , which has to be approximated, all of these variables are calculated directly from STAN data. The user cost of capital ( $r_t = \ln(R_t)$ ) is approximated in accordance with conventional practice, as per Hall and Jorgensen (1967) as  $R_t = P_t(i - \pi + \delta)$ , where  $P_t$  is the country-specific fixed capital formation deflator,  $i - \pi$  is the real interest rate as country's long-term interest rate less 5-year ahead inflation, and  $\delta$  is the depreciation rate of 10 percent.

Sectoral mark-ups are then estimated on the basis of a simple OLS regression of:

$$\Delta y_t = \beta \Delta x_t + \gamma OutputGap_t \Delta x_t + \varepsilon_t$$

Where  $\beta$  is the time-invariant structural component of the Lerner index, while the second term is an interaction term that measures the cyclical component of the markup margins. Note that the estimated are time-invariant, and also rely on the assumption of the constant return to scale.

The obtained markups are in line with literature, with sample's average Lerner index of 0.17 in the Manufacturing sectors, and 0.29 in Services.

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