



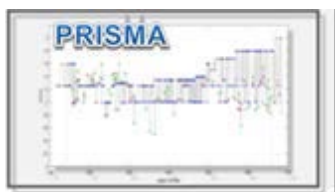
EUROPEAN CENTRAL BANK

EUROSYSTEM

## Working Paper Series

Omiros Kouvavas, Chiara Osbat, Timo Reinelt,  
Isabel Vansteenkiste

### Markups and inflation cyclicality in the euro area



No 2617 / November 2021

### **Price Micro Setting Analysis Network (PRISMA)**

This paper contains research conducted within the Price Micro Setting Analysis Network (PRISMA). PRISMA consists of economists from the ECB and the national central banks (NCBs) of the European System of Central Banks (ESCB).

PRISMA is coordinated by a team chaired by Luca Dedola (ECB), and consisting of Chiara Osbat (ECB), Peter Karadi (ECB) and Georg Strasser (ECB). Fernando Alvarez (University of Chicago), Yuriy Gorodnichenko (University of California Berkeley), Raphael Schoenle (Federal Reserve Bank of Cleveland and Brandeis University) and Michael Weber (University of Chicago) act as external consultants.

PRISMA collects and studies various kinds of price microdata, including data underlying official price indices such as the Consumer Price Index (CPI) and the Producer Price Index (PPI), scanner data and online prices to deepen the understanding of price-setting behaviour and inflation dynamics in the euro area and EU, with a view to gaining new insights into a key aspect of monetary policy transmission (for further information see [https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher\\_prisma.en.html](https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_prisma.en.html))

The refereeing process of this paper has been co-ordinated by a team composed of Luca Dedola (ECB), Anton Nakov (ECB), Chiara Osbat (ECB), Elvira Prades (Banco d'España), Sergio Santoro (ECB), Henning Weber (Bundesbank).

This paper is released in order to make the results of PRISMA research generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the author's own and do not necessarily reflect those of the ESCB.

## **Abstract**

Price inflation in the euro area has been stable and low since the Global Financial Crisis, despite notable changes in output and unemployment. We show that an increasing share of high markup firms is part of the explanation of why inflation remained stubbornly stable and low in the euro area over the past two decades. For this purpose, we exploit a rich firm-level database to show that over the period 1995–2018 the aggregate markup in the euro area has been on the rise, mainly on account of a reallocation towards high-markup firms. We document significant heterogeneity in markups across sectors and countries and, by linking these markup developments to the evolution of sectoral level producer and consumer price inflation, we find that (i) inflation in high-markup sectors tends to be less volatile than in low-markup sectors and (ii) inflation in high-markup sectors responds significantly less to oil supply, global demand and euro area monetary policy shocks.

**JEL classification:** D2, D4, N1, O3.

**Keywords:** Inflation, Price setting, Firm markups

## Non-technical summary

Historically, recessions tended to bring down inflation while low unemployment tended to push up wages and inflation. However, since the Global Financial Crisis, inflation has remained stubbornly stable and low in the euro area, despite notable changes in unemployment and output. This has led to inflation developments being described as a series of *puzzles*: The *missing disinflation puzzle* after the Great Financial Crisis, followed by the *missing inflation puzzle* during the recovery. It has also been the source of much academic and policy debate on the health of the Phillips curve or the *missing cyclicality of inflation*.

Meanwhile, in parallel to the debate on the validity of the Phillips curve, a discussion has emerged on whether aggregate market power has been on the rise. The renewed interest in market power developments has been fueled by an increased availability of firm-level data and by evidence that aggregate markup measures have been rising while the labour share has been falling and concentration ratios increasing. In the United States, this has led to a broad consensus that aggregate market power has increased over recent decades. Evidence for other advanced economies remains more tentative.

This paper bridges these two strands of literature by analysing to what extent changes in the degree of firm market power may have contributed to the recent inflation puzzles. To do so, we estimate firm-level markups in all euro area countries. We then allocate sectors in each country to high-markup and low-markup groups and then study whether inflation in those groups behaves differently. The rationale for asking this question is that markups create a wedge between marginal costs and prices. Hence, larger market power in principle could allow firms to reduce the pass-through of costs to prices, as high markups can be used to buffer changes in marginal costs. As such, an increase in the average markups could allow firms to price less cyclically.

We find that, like in the US, euro area markups have increased, albeit to a lesser extent. This increase in the euro area is mainly due to rising market shares of high-markup firms. However, the sectoral composition of this documented markup increase has been different from that in the US, with markups in the euro area manufacturing sector remaining rather flat. Instead, the increase in the aggregate markup appears to be attributable to some services sectors.

In a next step, we analyse whether the markup increase could explain the *missing cyclicality of inflation*. Descriptive evidence shows that producer and consumer price inflation is less volatile over the business cycle in high-markup sectors. Moreover, a panel analysis of the responsiveness of inflation to aggregate shocks – specifically, global demand shocks, oil supply shocks, and euro area monetary policy shocks – shows that firms in high-markup sectors transmit these shocks to inflation significantly less than firms in low-markup sectors.

Quantitatively, the PPI inflation response in sectors with low markups is roughly 50% larger than the average response to global demand, oil supply, and euro area monetary policy shocks. A back-of-the-envelope calculation suggests shows that, in light of a roughly 10% increase in the aggregate markup, the responsiveness of inflation could have decreased from around a fifth to 40% for PPI inflation and from one sixth to 40% for HICP inflation, depending on the considered shock.

Our results have implications for monetary policy: they suggest that in a high-market power environment inflation may become less sensitive to shocks. As a result, it becomes relatively more difficult for the central bank to steer inflation towards its target. However, it also means the central bank can pursue more accommodative monetary policy without risking an unwelcome increase in inflation.

# 1 Introduction

“The main puzzle pertaining to inflation is aptly summed up by the title of this conference: “What’s (not) up with inflation?” Inflation hasn’t moved up through an expansion that now ranks as the nation’s longest on record.” – Janet Yellen, 3 October 2019

Historically, inflation has evolved in a fairly predictable manner in relation to the business cycle. Inflation typically picks up during an economic expansion, peaks slightly after the onset of a recession, and then continues to decline through the first year or two of a recovery.

In the wake of the Global Financial Crisis, inflation across advanced economies has however been behaving differently. First, the sharp decline in economic activity resulted in only a modest decline in inflation, leading to what has become known as the *missing disinflation puzzle*. Thereafter, during the recovery, inflation has remained stubbornly low despite considerable improvements in the unemployment rate, leading to a *missing inflation puzzle*.

As a result, inflation now seemingly responds less to the business cycle. For the euro area, [Eser et al. \[2020\]](#) find a notable increase in unexplained factors in a Phillips curve based decomposition of HICP inflation. These developments have put in question the reliability of the Phillips curve in forecasting inflation. The disconnect between inflation and economic activity also raises important questions for monetary policy.

At the same time, while the performance of price Phillips curve models has worsened, the Phillips curve for wages has remained largely intact. For the euro area, [Eser et al. \[2020\]](#) show that the wage Phillips curve fits better in sample than the price Phillips curve, implying that while there may be a *price inflation puzzle* there is no *labour cost inflation puzzle*. The weak relationship between labour cost and price inflation developments suggests a decline in the pass-through of labour cost to price inflation (see [Bobeica et al. \[2019\]](#) and [Hahn \[2020\]](#)). This points to an important role for profit margins as buffers in the *missing cyclicalities of inflation*.

These developments have occurred at a time when a global debate has emerged about a rise in firm market power. The debate was triggered by [De Loecker et al. \[2020\]](#), who found that the degree of imperfect competition in the US economy – as proxied by the markup (i.e., the ratio of price to marginal cost) – has increased markedly over the past three decades. This aggregate increase in the markup has mainly occurred due to a substantial increase in the upper tail of the distribution (i.e., due to increased importance of high markup firms).

From a theoretical point of view, aggregate changes in market power can have important macroeconomic implications. [Eggertsson et al. \[2018\]](#) and [De Loecker et al. \[2020\]](#) have already linked the increase in markups to a number of secular trends, including the decrease in labour and capital shares, declining business dynamism and a rise in inequality.<sup>1</sup> However, these long-term developments could also impact the propagation of shocks, the cyclicalities of inflation, and the pass-through of costs to prices ([Goldberg and Hellerstein \[2013\]](#)). At the same time, it is ex ante not clear how. [Nevo and Wong \[2018\]](#) note that there is no theory that implies that the relationship between market power and pass-through is monotonic, thereby implying that

---

<sup>1</sup>[De Loecker et al. \[2021\]](#) quantify the importance of technology and market structure for the increase in market power and the decline in business dynamism.

the shape of this relationship becomes primarily an empirical question. In this regard, for the United States, [Bobeica et al. \[2021\]](#) have documented that the rise in markups has weakened the link between labour cost and price inflation.

In this paper, we analyse to what extent trend markup developments can indeed be linked to the recent inflation puzzles. Concretely, we focus on two questions: (i) Has the average markup increased? and (ii) How does the pass-through of aggregate shocks to price inflation differ across high versus low markup sectors?

To answer these questions, we collect price inflation data across manufacturing and service sectors and compute firm-level markups for all euro area countries over the period 1995–2018. As markups are unobserved and need to be estimated, we rely on the approach by [Hall \[1988\]](#) and [De Loecker and Warzynski \[2012\]](#) to estimate firm-level markups. Subsequently, we estimate local projections in a panel across countries and sectors to analyse whether inflation responds differently to aggregate shocks in high versus low markup sectors. We consider three types of aggregate shocks: a global demand shock and a global oil supply shock, both by [Baumeister and Hamilton \[2019\]](#), and a euro area monetary policy shock estimated using data from [Altavilla et al. \[2019\]](#) and following the identification approach in [Jarociński and Karadi \[2020\]](#).

Our contribution to the literature is two-fold. First, our analysis complements, extends and updates previous firm-level and sectoral markup estimates across euro area countries. Our results show that the increase in markups that has been observed in the United States also appears in euro area countries, albeit to a lesser extent. Second, we find that firms in high-markup sectors increase prices by less after expansionary shocks, which corroborates the interpretation that market power, as proxied by the level of markups, is part of the explanation of why inflation remained stubbornly low in the euro area despite the improvement in unemployment and growth from the sovereign debt crisis to 2019 – which we dub the *missing cyclicalities of inflation*.

Our results are relevant for monetary policy, especially considering that markups could further increase following the pandemic, as suggested by [Georgieva et al. \[2021\]](#). This could continue to put a lid on inflation, on the one hand making it harder for the central bank to achieve its monetary policy target during low growth periods, on the other allowing it to keep an accommodative monetary policy stance without fueling high inflation.

The rest of the paper is structured as follows: Section 2 recalls the main empirical results on the rise of market power and reviews some explanations that have been offered in the literature as to why higher markups may be linked to lower cyclicalities of inflation. Section 3 discusses how we estimate markups and the data sources we use. Section 4 links the markup estimates to inflation dynamics by defining high and low markup sectors and documenting the difference in the behavior of inflation over the business cycle in those sectors; Section 5 presents the results on differential inflation responses to shocks in high- and low-markup sectors. Section 6 presents a back-of-the-envelope calculation that quantifies the aggregate importance of the estimated markup increase for inflation cyclicalities. Section 7 concludes.

## 2 The rise of market power and pricing behaviour: review of the literature

Our paper lies on the nexus between two strands of literature: one strand that aims at understanding recent changes to the inflation process, another that focuses on the macroeconomic implications of changing firm market power. The literature on both strands is extensive but has developed to date largely in parallel. We do not aim to provide a comprehensive survey of both strands, but to highlight our contribution within this universe and to focus in particular on those studies where both strands have connected.

When it comes to understanding recent changes to the inflation process, our work is most closely related to the literature on inflation puzzles. The presence - in the wake of the Global Financial Crisis - of a number of inflation puzzles has been widely documented (see among others [Hasenzagl et al. \[2019\]](#) and [Bobeica and Jarociński \[2019\]](#)). The various puzzles documented in the literature generally point to a reduction in the sensitivity of the cyclical behaviour of inflation to the business cycle (henceforth referred to as the cyclicity of inflation).

The apparent reduced cyclicity of inflation raises important questions for monetary policy. A permanently reduced sensitivity implies it becomes more difficult for the central bank to meet its inflation objective. However, it also means that the central bank can pursue easier monetary policy without risking an unwelcome increase in inflation. At the same time, confounding or temporary factors could also be at play that mask inflation sensitivity. If the central bank fails to account for such confounding factors it risks raising inflation beyond its goal. As a result, it is of key importance for central banks to understand what has been driving this apparent reduced sensitivity.

The literature to date points to a combination of factors that may account for the apparent reduced sensitivity of inflation, though consensus is still lacking as to their relative importance. One important reason is that these factors may be interrelated and reinforcing each other. Anchored inflation expectations, the integration of global economies, demographic change and changes in firm pricing patterns all suggest lower and more stable inflation today than in the past (see [Forbes \[2019\]](#) and [McLeay and Tenreyro \[2019\]](#)). However, also non-linearities could be at play, related for instance to downward nominal rigidities and the state dependence of firms' demand elasticities ([Linde and Trabandt \[2019\]](#)). In addition, special features related to the specific nature of the Global Financial Crisis may also have played a role ([Gilchrist et al. \[2017\]](#)). Finally, some studies also stress that to some extent the apparent decline in sensitivity is an artefact of mismeasurement of economic slack, of the rate of price inflation or of both ([Jarociński and Lenza \[2018\]](#)).

Another avenue – which we explore in this paper – is that there may be a link between the reduced cyclical sensitivity of inflation and the rise in firm market power.

The debate that rising firm market power may have important macro economic implications has been launched by the influential paper by [De Loecker et al. \[2020\]](#). They document a secular trend increase of aggregate markups in the United States using firm-level balance sheet data. The rise in firm market power in the US was subsequently corroborated by a number of other



studies that consider other metrics or methodologies and was also confirmed for other advanced economies (De Loecker and Eeckhout [2021] and Diez et al. [2018]).<sup>2</sup> For the euro area, so far, the evidence has remained however more mixed. While a number of studies indicate that also here firm market power is on the rise, others do not observe such a trend (for an overview see McAdam et al. [2019]).

Rising firm market power may have important macroeconomic implications. However, its impact is far from straightforward. When it comes to the impact on inflation cyclicality, the level and dispersion of markups across sectors could affect inflation cyclicality in various ways. An important consideration is the competitive structure of the economy. In New Keynesian macro models, it is standard to assume monopolistic competition. In this case, no single firm is sufficiently large to have a significant bearing on others' behaviour. Aquilante et al. [2019] find in such a setup that the higher the degree of market power and the markups firms charge, the more cyclical inflation becomes. However, monopolistic competition assumes there is no strategic interaction between firms. In practice this has been found to be important in many markets (see inter alia Bramoulle et al. [2014] and Amiti et al. [2019]). Allowing for such strategic interaction has important implications for pricing and the Phillips curve. In such a case, an increase in firm market power or markups may reduce instead of increase inflation cyclicality (Andrés et al. [2021]).

There are various reasons why high markup firms may optimally choose not to adjust inflation in response to shocks. They may choose to do so to preserve market shares (Atkeson and Burstein [2008]) or to hold back price increases in order to keep the customer base (Chevalier and Scharfstein [1996], Gourio and Rudanko [2014]). Another explanation is that strategic interactions between firms leads to stronger price rigidity (Mongey [2019]). Meier and Reinelt [2020] find that higher-markup firms adjust prices less frequently. Heise et al. [2020] show the presence of foreign competitors may mute the response of inflation to cost push shocks, as foreign firms are less exposed to domestic cost shocks.

While various theoretical arguments can be brought forward as to how the competitive structure of the economy may affect inflation cyclicality, only few studies have to date empirically investigated this link at the macro level. A key complication in the analysis relates to data and measurement challenges. An important difficulty lies in the determination of the degree of market power. In theory, the definition of market power is straightforward: it is measured by the ability of firms to maintain prices above marginal cost. Empirically, however, markups are not directly observable and therefore need to be estimated. In practice, researchers have relied on a suite of approaches to measure the degree of sectoral or national market power, each coming with their own set of challenges and drawbacks. A common approach is to proxy market power with the degree of market concentration. However, the validity of this proxy only holds under very specific market structures (e.g., Cournot quantity competition). A second difficulty relates to the measurement of inflation. While producer price inflation series are available at a sectoral level

---

<sup>2</sup>While there is broad consensus that firm market power is on the rise in the US, not everyone agrees. For instance Traina [2018] questions the methodology by De Loecker et al. [2020] and argues that once one considers marketing and management expenses as variable rather than fixed costs, markups in the United States are actually flat.

that can be matched to markup or market concentration data, this is not the case for consumer price inflation, implying that the analysis can only be conducted for the manufacturing sector.

Two studies that have recently looked into the link between market power and inflation cyclicality, indirectly by focusing on wage pass-through: [Bobeica et al. \[2021\]](#) and [Heise et al. \[2020\]](#). Both studies find that the increase in market power (proxied by market concentration) has contributed to the decline in the pass-through from labour cost to producer price inflation in the United States.

No study has to date however looked into the question of inflation cyclicality beyond the manufacturing sector or the United States. We expand in this paper the existing literature on both fronts: we conduct our analysis for euro area countries and perform a detailed data mapping exercise that allows to match the sectoral markup data not only with sectoral producer prices, but also with sectoral consumer price inflation series. In terms of methodological approach, our paper is closest to the very recent study by [Duval et al. \[2021\]](#). In this paper, the authors compare the impact of monetary policy on the real sales of high- versus low-markup firms. The authors, as we do, use Orbis data to compute markup series and to divide their sample into a high versus low markup bucket. They find for a sample of advanced economies that the real sales of high-markup firms respond less to monetary policy. They offer a rationalisation of their result based on financial frictions, as monetary policy easing alleviates financial constraints that are more binding for low-markup firms.

### 3 Estimating markups for the euro area and its countries

Markups are generally an unobserved variable that needs to be estimated. There is a long-established branch of the industrial organisation literature focusing on estimating markups. However, most early methods rely on very detailed micro data (e.g., on prices, quantities, characteristics of products sold, etc.) to estimate markups. The most recent literature, pioneered by [De Loecker and Warzynski \[2012\]](#) and [De Loecker et al. \[2020\]](#) in the spirit of the [Hall \[1988\]](#), proposes the use of a structural estimation strategy where markups are estimated based on generally observed firm balance sheet data. [Bond et al. \[2021\]](#) raise both identification and estimation issues when the production function approach is used to estimate markups. [Flynn et al. \[2019\]](#) raise a related identification issue and suggest to impose identifying assumptions on the production function, specifically assuming constant returns to scale. However, [De Ridder et al. \[2021\]](#) show that while the level of estimated markups may be biased when revenue data is used, the correlation of estimated markups and true markups is still high. The next subsections explain the approach we follow in this paper, describe the data used, and discuss the results for the euro area firm-level and aggregate markups.

#### 3.1 Estimation

The estimation method, which was proposed by [De Loecker and Warzynski \[2012\]](#) and [De Loecker et al. \[2020\]](#) in the spirit of [Hall \[1988\]](#), relies on the assumptions that firms minimise production costs by adjusting at least one flexible input factor. The markup of firm  $i$  in period  $t$  is defined

as the ratio of its output price to marginal cost,

$$\mu_{i,t} \equiv \frac{P_{i,t}}{MC_{i,t}}. \quad (1)$$

Neither prices nor marginal costs are directly observable. However, by solving firms' cost minimisation problem, [De Loecker and Warzynski \[2012\]](#) derive a simple expression for the markup of firm  $i$  with variable inputs  $V_{i,t}$ :

$$\mu_{i,t} = \theta_{i,t}^V \frac{P_{i,t}^Q Q_{i,t}}{P_{i,t}^V V_{i,t}} \quad (2)$$

where  $\theta_{i,t}^V$  is the input-output elasticity of the variable inputs and  $\frac{P_{i,t}^Q Q_{i,t}}{W_{i,t} L_{i,t}}$  the ratio of sales to variable costs. The ratio in the second part of the expression is directly observable in the data, but the elasticity of output with respect variable inputs,  $\theta_{i,t}^V$ , needs to be estimated based on data on output and on input factors for each firm. For simplicity, we assume a common Cobb-Douglas production function for firms in sector  $s$  and country  $c$ , using labour and material, which we assume to be flexible factors, and capital, which is adjusted with a lag, as inputs:

$$Q_{i,t} = e^{z_{i,t}} e^{\omega_{i,t}} V_{i,t}^{\beta_{s,c}^V} K_{i,t}^{\beta_{s,c}^K} \quad (3)$$

The production function can be estimated in its log-linear form:

$$q_{i,t} = \beta_{s,c}^V v_{i,t} + \beta_{s,c}^K k_{i,t} + \omega_{i,t} + z_{i,t} \quad (4)$$

where the  $z_{i,t}$  is firm-level productivity and  $\omega_{i,t}$  is i.i.d. measurement error. Directly estimating this equation will suffer from simultaneity and selection bias. Hence, to estimate the elasticities we follow the literature and rely on a control function approach ([Olley and Pakes \[1996\]](#), [Levinsohn and Petrin \[2003\]](#), [Akerberg et al. \[2015\]](#)). The approach relies on a two-stage GMM estimation where in the first stage the idiosyncratic measurement error and unanticipated shocks to sales are removed using,

$$q_{i,t} = \phi(v_{i,t}, k_{i,t}) + \omega_{i,t}, \quad (5)$$

yielding estimates for the expected output  $\hat{\phi}$ . In the second stage using the estimate for the expected output and starting values for the coefficients we can calculate the productivity  $z_{i,t}$ , using  $z_{i,t} = \hat{\phi}_{i,t} - \beta_{s,c}^V v_{i,t} - \beta_{s,c}^K k_{i,t}$ . Next we regress  $z_{i,t}$  on its lag, to recover the productivity innovation  $\xi_{i,t}$ , assuming that productivity follows an AR(1) process:

$$z_{i,t} = \rho_{s,c} z_{i,t-1} + \xi_{i,t} \quad (6)$$

Finally we assume the following moment conditions:

$$E \left[ \xi_{i,t} \begin{pmatrix} v_{i,t-1} \\ k_{i,t} \end{pmatrix} \right] = 0 \quad (7)$$

Table 1: Number of firms in Orbis data per country/year

	Year		
	1998	2008	2018
Austria	245	301	4401
Belgium	19294	37984	24533
Cyprus		23	44
Germany	1938	25677	21403
Estonia	5414	26526	35792
Spain	178441	537637	522843
Finland	23060	39656	61938
France	459424	378268	116392
Greece	9179	15826	24044
Ireland	57	73	73
Italy	101086	376350	587093
Lithuania	426	3906	10996
Luxembourg	101	388	271
Latvia	1944	6903	73410
Malta	18	470	34
The Netherlands	2392	4120	1761
Portugal	5956	246067	249143
Slovenia	39	10134	50817
Slovakia	119	30351	105354
Total	809133	1740660	1890342

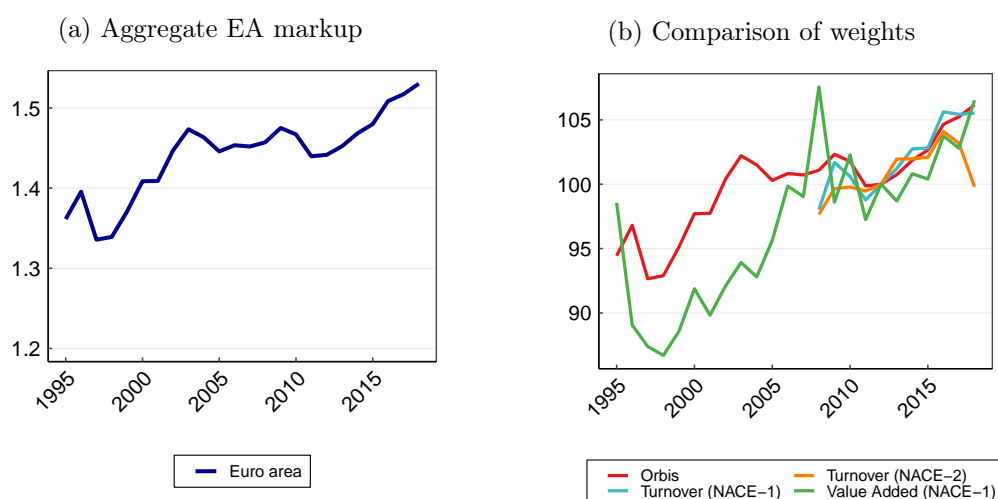
Using the above restrictions we iterate until the moment conditions are satisfied and get the final estimates for the  $\{\beta_{s,c}^V, \beta_{s,c}^K\}$ . This method recovers the country-industry-specific elasticities under the assumption that the variable inputs can respond to productivity shocks but their past values do not and that the current capital stock is predetermined. The elasticities estimated within sector-country cells are constant through time. Hence, any changes in the overall firm-level markups (equation 2) are driven by changes in the revenue share (i.e., the ratio of output to variable costs).

### 3.2 Orbis data: variables and cleaning

To implement the estimation approach outlined above, Orbis balance sheet data are used. The Orbis data are available for all 19 euro area countries at the firm level. Industry classification of the firm-level data is reported at the four-digit NACE level. However, the coverage and representativeness of the data varies across countries and over time. In order to estimate the firm-level markups we need observables for output, variable inputs and fixed inputs. Orbis offers some options, each with different availability and quality across countries. This implies that different observables will be used in different countries, depending on the dominant reporting practice.

To proxy for output two variables are available: `operatingrevenue` or `sales`. For variable inputs one can use `costsofgoodssold` or the sum of `costsofemployees` and `materialcosts`. The choice between the two could differ across countries, due to data

Figure 1: Euro area markup development through time



*Note:* Panel (a): Aggregate euro area markup over time as firm-sales and country-GDP weighted arithmetic mean of firm-level markups. Panel (b): aggregate markup comparison using Structural Business Statistics (SBS) and National account (NA) data to stratify the Orbis sample for turnover and value added of sectors respectively. All aggregate markups are indexed with 2012 as the base year.

availability, but is homogeneous within each country. Nevertheless we cross-validate, for the countries that include both, that the sum of `costsofemployees` and `materialcosts` is almost equal to `costsofgoodssold`. For capital the variable `fixedassets` is used. These variables are deflated by each country's GDP deflator for the production function estimation. Orbis data notoriously contain errors and duplicate observations; to address them we broadly follow the data cleaning procedure detailed in [Kalemli-Ozcan et al. \[2015\]](#), with some modifications, described in Appendix A. The number of firms available in each country once we apply our filters is shown in Table 1.

### 3.3 Markup Developments

Using the approach described in Section 3.1, we estimate firm-level markups for all euro area countries for each year between 1995 to 2018. The firm-level markups have to be aggregated to provide country and euro area level average markups. The firm sales from our sample are used for within-country weighting and GDP weights are used across countries.<sup>3</sup> This effectively allows us to calculate an aggregate euro area markup through time.

The average markup developments for the euro area are presented in Figure 1a. The aggregate markup in the euro area has increased steadily between 1995 and 2018. However, most of the increase occurred towards the end of the sample. The markup evolution thereby mimics the one in the United States (see for instance [De Loecker et al. \[2020\]](#)), although the increase appears less pronounced in the euro area. To make Orbis data more representative

<sup>3</sup>Although the coverage of the Orbis sample is relatively high in terms of output (approximately 60–80%), it is in some cases biased towards larger firms. Even though this does not necessarily imply that using Orbis sales weights will lead to biased aggregate markups, we have cross checked our results with alternative weights based on structural business statistics (SBS) and national accounts. Results for all different weights are presented for the euro area aggregate below.

Figure 2: Markup evolution across euro area country groups



*Note:* The chart shows the weighted average markup using firm sales and country GDP weights. Luxembourg and The Netherlands were dropped from the chart due to the sizeable volatility in the markup evolution.

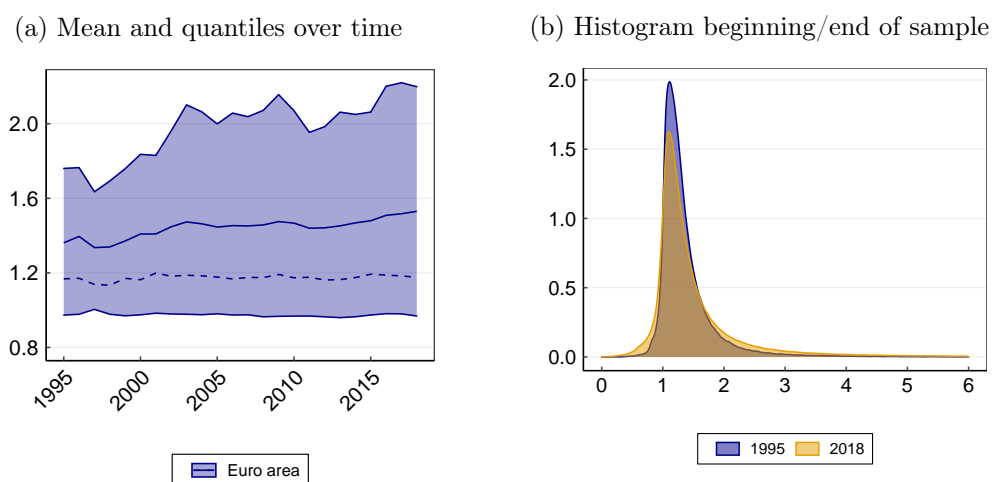
within countries, we alternatively use external weights, based on Structural Business Statistics (SBS) turnover data or National Accounts value added, to stratify the sample across sectors.<sup>4</sup> Figure 1(b) presents the euro area aggregate markup using these different weights. The general upward trend in the aggregate markup is present across all weight combinations and, if anything, the markup based on the internal sales weights might slightly understate the increase. Throughout the rest of the paper all results are based on Orbis sales weights.<sup>5</sup>

Country heterogeneity is sizeable. Figure 2 shows the markup evolution across euro area countries, split according to their average evolution over the sample period. In some euro area

<sup>4</sup>The stratification using external weights is done both on two-digit NACE and one-digit NACE (NACE sections) level depending on data availability. The national account value added data are only available for NACE-1.

<sup>5</sup>All results have been cross-checked using the stratification procedure described above. Our results are robust to the different weighting choices.

Figure 3: Euro area markup distribution



*Note:* Panel (a): The dotted line shows the weighted median, the continuous line the weighted average and the range is between the weighted 10th and 90th percentiles.

countries (seven in total) the average markup has either remained flat or decreased slightly over our sample period. However, in most other countries, including the six largest euro area countries, markups have increased either somewhat or strongly. There are notable level differences which have appreciably increased over our sample period. While in 1995 country aggregate markups ranged between 1 and 1.5, by the end of our sample period, in 2018, they ranged between 1 and 2.25.

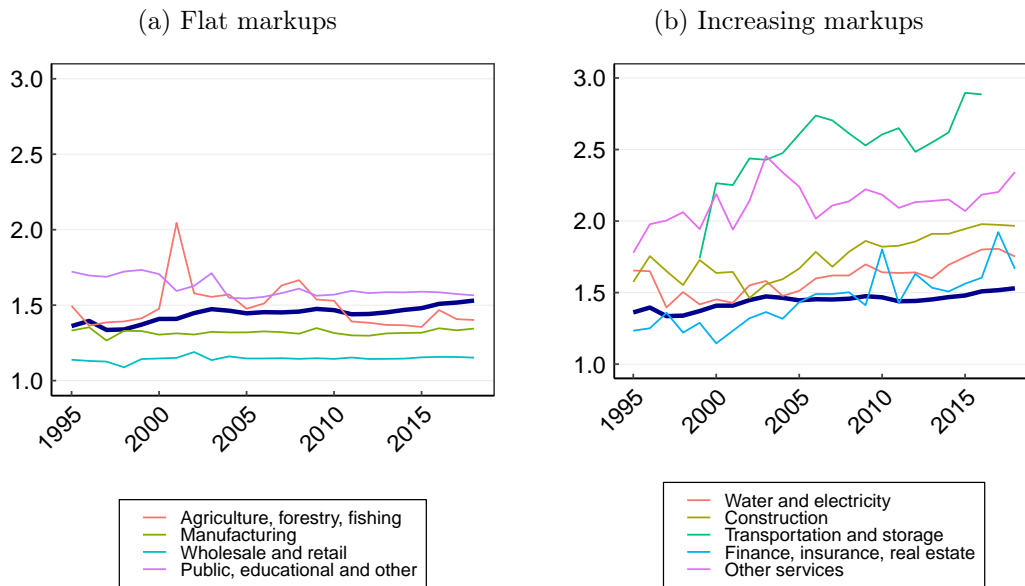
### 3.4 Drivers of the aggregate markup developments

The aggregate markup evolution can mask significant heterogeneity across countries, sectors and firms. Figure 3 shows the evolution of the markup distribution through time. The chart shows that the markup increase in the euro area is predominantly driven by the upper tail of the weighted distribution as demonstrated by fact that although the average markup has increased considerably the median has remained fairly stable.

Looking across sectors (Figure 4), the strong increase in markups is mostly concentrated in two service sectors, namely the “finance, insurance and real estate” sector and the “other services” sector. The latter comprises the “professional, scientific and technical activities” sector and the “information and communications” sector. Those sectors not only recorded the largest increase, but also the highest markup level during the early years of our sample period. Meanwhile, markups remained broadly stable and low in a number of other sectors, including in manufacturing and in wholesale and retail trade (in line with the findings by McAdam et al. [2019]). This clearly contrasts with the evidence for the United States, where the total economy markup rise has been mostly attributed to the latter two sectors.

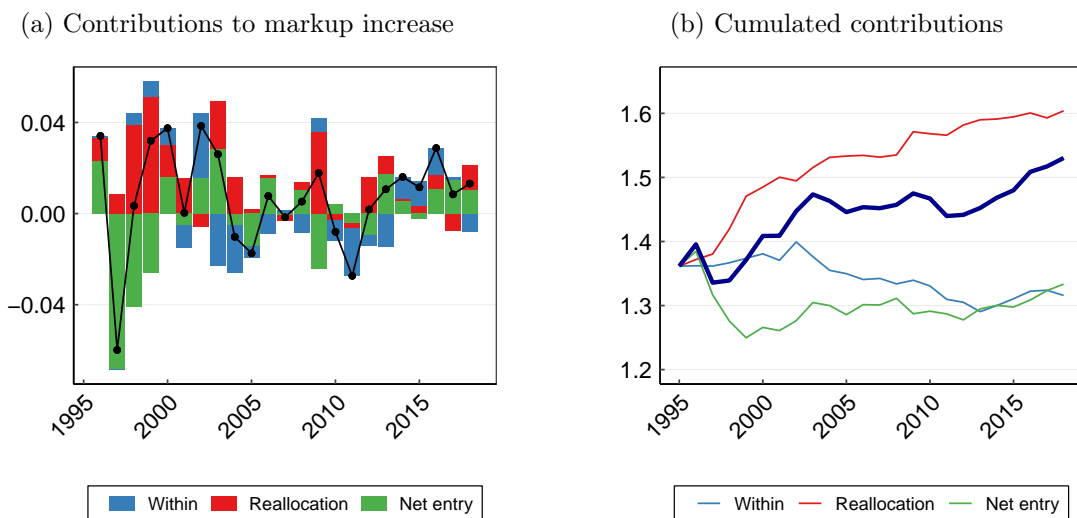
Looking across firms, it is also relevant to analyse to what extent the increase in the aggregate markup is driven by increases in individual firm markups or rather due to a reallocation of economic activity towards high markup firms and sectors. To analyse this, the markup increase can be decomposed in three main sub-components for each year in the

Figure 4: Euro area sectoral markup evolution



Note: The chart shows the weighted average markup using firm sales and country GDP weights.

Figure 5: Decomposition of markups



Note: Firm sales weights within countries, GDP weights across countries. Panel (a): Contributions to the year-on-year markup increase. The bars decompose the changes into within, reallocation, and net entry components. Panel (b): The thick blue line plots the changes in the average euro area markup,  $\Delta \bar{\mu}_t$ .



sample, following De Loecker and Eeckhout [2021]:

$$\Delta \bar{\mu}_t = \underbrace{\sum_i s_{it-1} \Delta \mu_{it}}_{\text{Within}} + \underbrace{\sum_i (\mu_{it-1} - \bar{\mu}_{t-1}) \Delta s_{it} + \sum_i \Delta \mu_{it} \Delta s_{it}}_{\text{Reallocation}} + \text{Net entry} \quad (8)$$

where  $s_{it}$  is the sales–GDP weight of firm  $i$  in year  $t$ . The net entry term, given by  $\text{net entry} = \sum_{i \in \text{Entering}} s_{it} (\mu_{it} - \bar{\mu}_{t-1}) - \sum_{i \in \text{Exiting}} s_{it-1} (\mu_{it-1} - \bar{\mu}_{t-1})$ , can be simply obtained as the residual of the above equation. The first component captures increases of the markup within firms. The second component captures the reallocation of market share towards firms with high markups. Finally the third component captures the impact of entry and exit of firms (e.g., when a low-markup firm enters the market it decreases aggregate markups and vice versa). The results are plotted in Figure 5a. Each separate line is plotted by setting all other components to zero and by cumulating the yearly contributions. These results indicate that reallocation has been the main driver of the aggregate markup increase. This finding points to the increased importance of firms with already high markups due an increase in their market shares. This in principle could be either within sectors or across sectors, which means that it might also point towards a change in the relative importance of sectors across time.

## 4 The relation between markups and inflation cyclicality

The developments documented in the previous section imply a structural change in the average level of markups. In this section we provide descriptive evidence of different price setting strategies of firms with distinctly different levels of markups. We use the estimated firm-level markups and link them to sectoral inflation data. This allows us to analyse whether inflation in high- and low-markup sectors behaves differently.

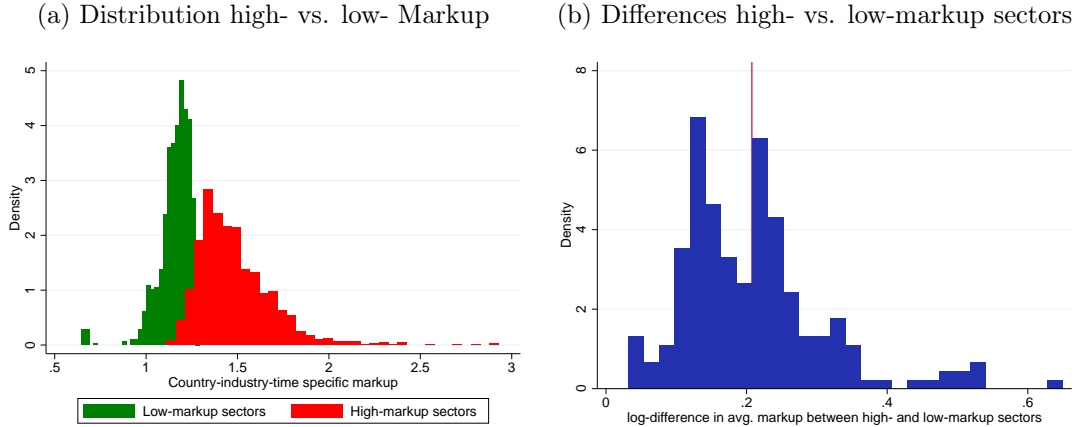
### 4.1 Merging markup and inflation data

To investigate the link to inflation we match the firm-level markup estimates to sectoral inflation data. Prices on a sectoral level can be measured either using producer price index (PPI) data or by consumer price index (HICP) data. As the matching is done at the industry level, we need to aggregate the markups. To achieve that, we use a sales-weighted arithmetic average across firms in sector  $s$  to obtain the sector-level average markup  $\mu_{s,c,t}$ , which will correspond to the PPI or HICP sector-country-quarter-level inflation rate  $\pi_{s,c,t}$ .

The PPI data can be matched directly using the NACE rev. 2 classification both at two-digit NACE (NACE-2, for short) and four-digit NACE (NACE-4) level. The producer price indices are only available at a relatively high level of classification (NACE-2) at quarterly frequency with the required country coverage and adequate sample length. At NACE-4 level, the coverage is restricted to Germany, Spain, Finland, France, and Italy. Conceptually, the PPI are directly measuring the producer prices, but they are only available for the manufacturing sector.

To investigate if the cyclicality of inflation carries through from producer to consumer prices, we use HICP data, which are available at monthly frequency but under a different classification,

Figure 6: High- and low- markup levels



*Note:* Panel (a) shows the distributions of the country-sector-year markups for the high- and low-markup groups. Panel (b) shows the log difference at the country-year level between high-markup sectors and low-markup sectors, i.e.,  $\log(E[\text{markup}|\text{HighMarkup}]_{\text{country},t}) - \log(E[\text{markup}|\text{LowMarkup}]_{\text{country},t})$ .

COICOP, that refers to product categories rather than industries. HICP data are available at the COICOP-5 level. To match the firm-level markups with the product-level HICP a cross-walk between COICOP product categories and NACE industries is required.

We have manually matched the respective categories at a granular COICOP-5 to NACE-4 level. That is, every NACE-4 category is matched to one, or several HICP items at COICOP-5 level.<sup>6</sup> An aggregated overview (COICOP-2–NACE-1) is shown in Figure 7. The matching is done both for manufacturing and for services (also including agriculture, which is matched to unprocessed food). Figure 8 shows the matching within the manufacturing sector. The weights correspond to the percentage of individual granular matches that correspond to each aggregate NACE-2 category shown in the figure. Even though the cross-walk is done at the most disaggregate level possible, the time series for the HICP at the COICOP-5 level are very short; therefore, effectively we are forced to use the COICOP-3 aggregates.

## 4.2 Inflation cyclicity in high- vs. low-markup sectors: A first look at some descriptive evidence

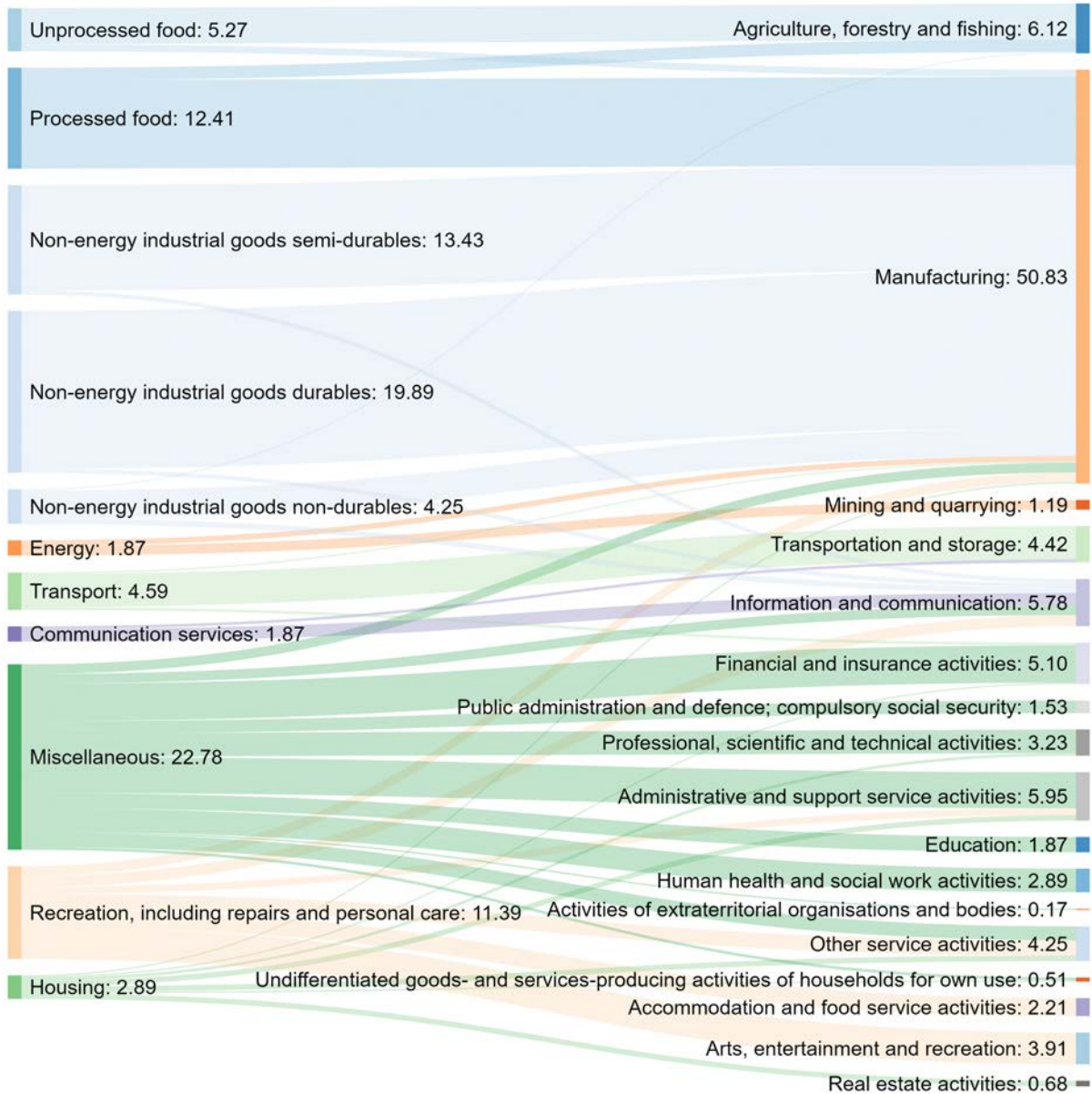
After matching inflation and markup data we define low-markup sectors to be in the lower 33% and high-markup sectors to be in the upper 33% of their corresponding country by year distribution, i.e., we define the low-markup and high-markup classification as follows:

$$\begin{aligned} \text{LowMarkup}_{s,c,t} &:= \mathbb{1}\{\mu_{s,c,t} \leq Q_{c,t}^{0.33}\} \\ \text{HighMarkup}_{s,c,t} &:= \mathbb{1}\{\mu_{s,c,t} \geq Q_{c,t}^{0.67}\} \end{aligned} \quad (9)$$

where  $Q_{c,t}^{0.33}$  is the 33%-quantile of sector markups in country  $c$  in year  $t$  and  $Q_{c,t}^{0.67}$  is the 67%-quantile of sector markups in country  $c$  in year  $t$ . The markup difference between low and

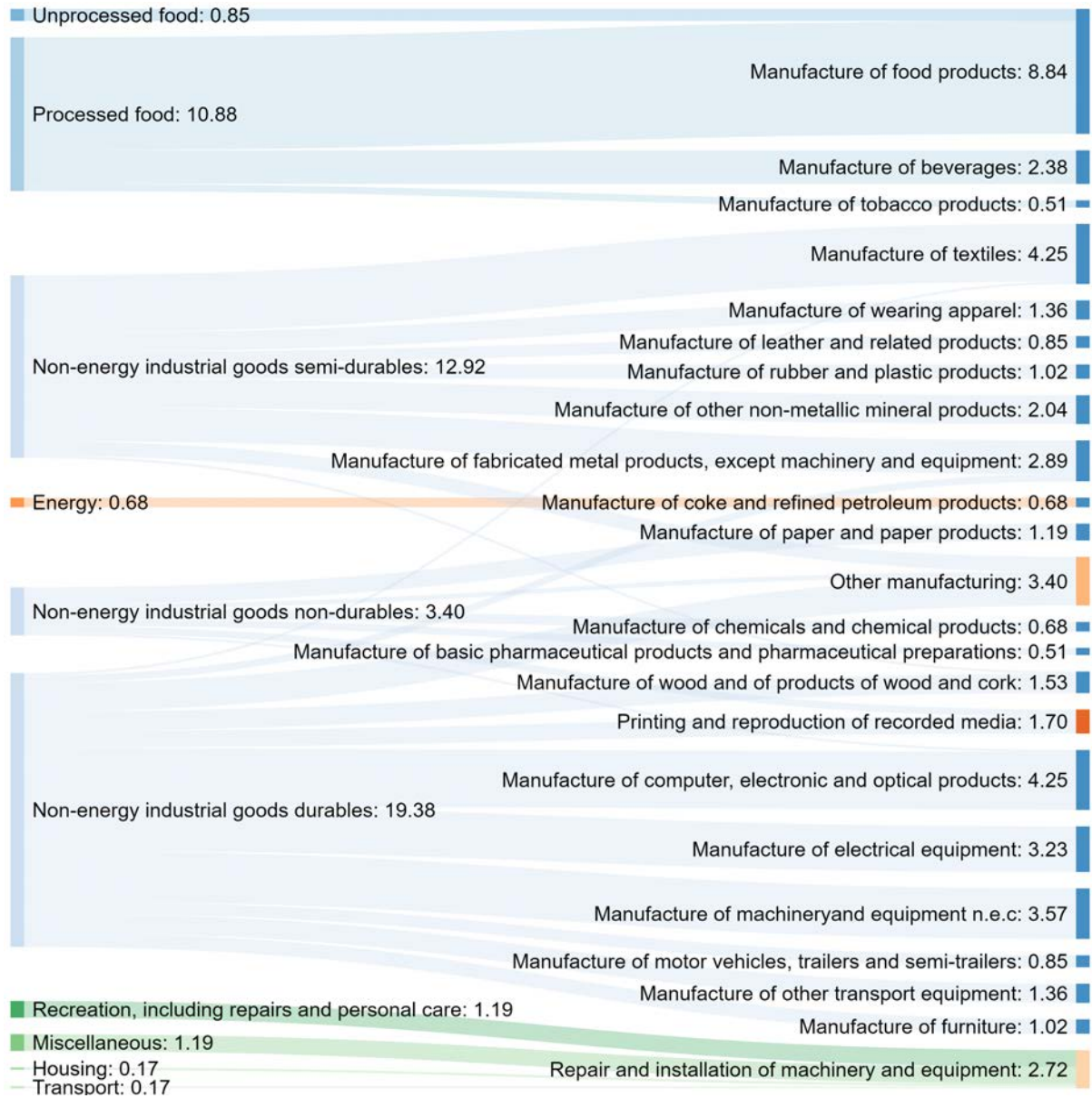
<sup>6</sup>When NACE-4 data are more granular than the respective HICP items then the matching is many to one, otherwise when the HICP data are more granular then the matching is one to many, in which case HICP weights are used to get the aggregated inflation rate of that category.

Figure 7: Mapping COICOP into NACE: All Categories (aggregated view)



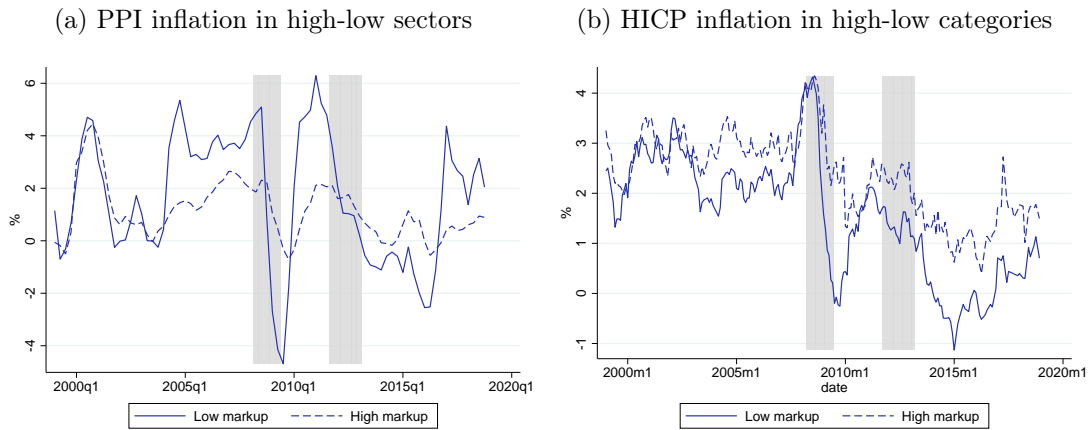
*Note:* The categories shown are at the COICOP-2 and NACE-1 level. The actual matching is done at COICOP-5 and NACE-4 level. The weights represent the percentage of matches in each NACE-1 category with respect to all the NACE categories in the cross-walk.

Figure 8: Mapping COICOP into NACE: Manufacturing (NACE-2–COICOP-2)



*Note:* The categories shown are at the COICOP-2 and NACE-2 level. The actual matching is done at COICOP-5 and NACE-4 level. The weights represent the percentage of matches in each NACE-2 category with respect to all the NACE categories in the cross-walk.

Figure 9: Inflation in high and low markup sectors



*Note:* The continuous (dashed) lines are the simple average of PPI/HICP inflation across countries, including in each country the four-digit NACE sectors or COICOP categories where markups are in the lower 33% and the upper 33% percent of the country and two-digit sector/category specific distribution.

high markup is on average 20%. In Figure 6 the split between sectors is visualised. The left panel shows the distributions of markups (at the country-sector-year level) for the low- and high-markup classification, respectively. The right panel shows the log difference in the average markup.

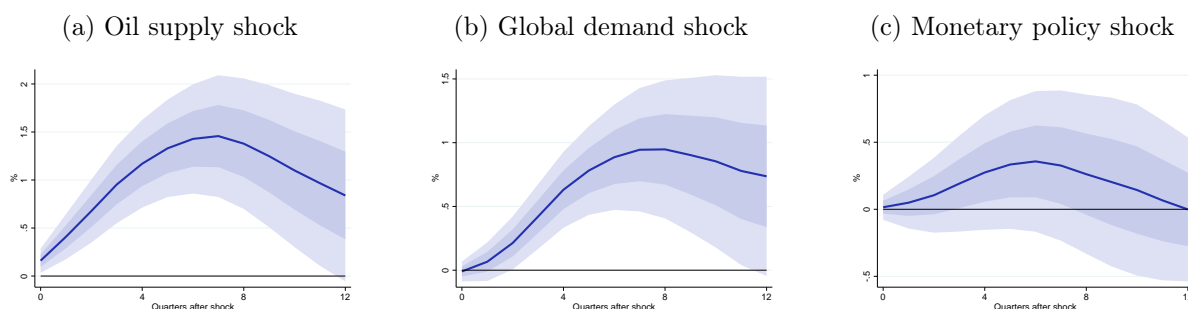
To visualise differences in the price setting behavior between low-markup and high-markup sectors, we plot in Figure 9 the average inflation rate across sectors over time, within the two groups as previously defined. This is done for the PPI data in panel (a) and the HICP data in panel (b). The low-markup sectors have significantly more volatile inflation, compared to their high-markup counterparts, reaching higher levels during upturns of the business cycle and lower levels during downturns. This may point to a less cyclical price setting strategy of high-markup firms. Combining this fact with the long-term increase in the aggregate markup could imply a less cyclical aggregate inflation over time. In the next section, we provide more structural empirical evidence for the differential inflation responses to shocks, conditional on the markup level.

## 5 The response of inflation to aggregate shocks in high- and low-markup sectors

In Section 4 we have demonstrated that inflation in high-markup sectors is less volatile over the business cycle. To see if inflation in high-markup sectors is less cyclical in the sense that high-markup sectors respond less to macroeconomic shocks, we use empirically identified structural shocks and estimate panel local projections à la Jordà [2005], Ottonello and Winberry [2020], Meier and Reinelt [2020].

We use identified global demand shocks and oil supply shocks, both from Baumeister and Hamilton [2019], and identified euro area monetary policy shocks based on Altavilla et al. [2019] and Jarociński and Karadi [2020]. Specifically, Baumeister and Hamilton [2019] estimate a

Figure 10: Average inflation responses to shocks



*Note:* Average PPI inflation response to a one-standard deviation shock. Panel (a): CIRF to an identified oil supply shock from [Baumeister and Hamilton \[2019\]](#). Panel (b) cumulative impulse response to an identified global demand shock from [Baumeister and Hamilton \[2019\]](#). Panel (c): CIRF to an identified monetary policy shock based on [Altavilla et al. \[2019\]](#) and [Jarociński and Karadi \[2020\]](#). The cumulative impulse response plots the coefficients  $\{\beta^h\}$  from equation (10). Inflation rates are trimmed at the 1%/99% quantiles. The shaded areas are 68% and 95% confidence bands, with standard errors two-way clustered at the country-sector and quarter level.

Bayesian VAR with non-dogmatic sign restrictions on oil supply and demand elasticities. We use the original extracted structural shocks from their estimation. Monetary policy shocks are computed with data from [Altavilla et al. \[2019\]](#). We use high-frequency changes in the 3-month OIS rate from before the press release to after the press conference of Governing Council meetings. We then follow [Jarociński and Karadi \[2020\]](#) in *excluding* surprises for which the contemporaneous change of the STOXX50 has the same sign (e.g., a contractionary interest rate surprise goes along with an increase of stock prices); such co-movement indicates a central bank private information release. Figure 15 in the Appendix shows the global demand, oil supply, and euro area monetary policy shock series.<sup>7</sup>

By investigating the differential inflation response of sectors with low versus high markups, we aim to shed a light on whether high-markup firms more strongly absorb increased costs that arise from aggregate shocks, rather than passing them through to prices. In the next subsection we first investigate the average inflation responses to shocks. Then we analyse the differential inflation response of sectors with low markups relative to sectors with high markups. We first present evidence for the manufacturing sector based on producer price index (PPI) inflation and then provide the same evidence for consumer prices based on the consumer price index (HICP).

## 5.1 Average inflation responses to shocks

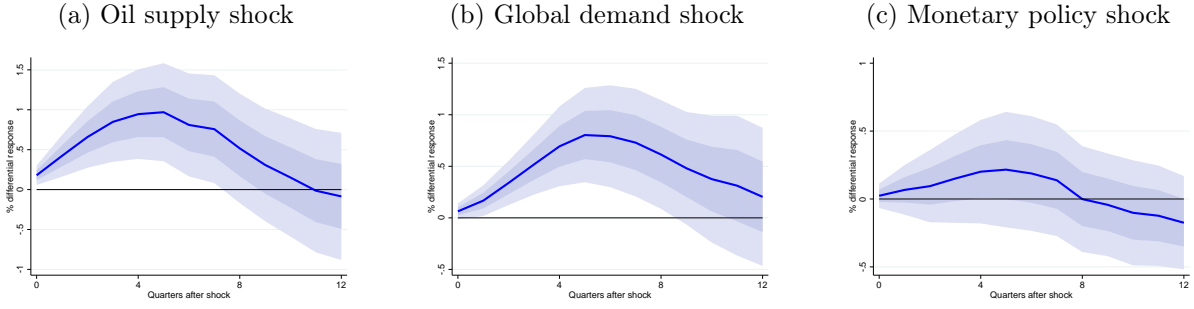
To estimate the average inflation response to our aggregate shocks, we use the following panel local projection. We regress country-sector-quarter-specific cumulative inflation rates on a country fixed effect, which captures country-specific average inflation rates, and either the oil supply shock, global demand shock, or the monetary policy shock:

$$\pi_{country,nace2,t-1,t+h} = \alpha_{country}^h + \beta^h shock_t + u_{country,nace2,t}^h \quad (10)$$

The coefficients  $\{\beta^h\}$  measure the average inflation response across countries and sectors

<sup>7</sup>We aggregate daily shocks to monthly and quarterly frequency by taking simple sums over the daily shocks within the month and quarter, respectively.

Figure 11: Differential inflation response in low-markup sectors



*Note:* Differential PPI inflation response at the two-digit NACE level in low-markup sectors, relative to the inflation response in high-markup sectors. Panel (a): differential response to an identified oil supply shock from Baumeister and Hamilton [2019]. Panel (b): differential response to an identified global demand shock from Baumeister and Hamilton [2019]. Panel (c): differential response to monetary policy shock based on Altavilla et al. [2019] and Jarociński and Karadi [2020]. The differential impulse response plots the coefficients  $\{\beta^h\}$  from equation (11). Inflation rates are trimmed at the 1%/99% quantiles. The shaded areas are 68% and 95% confidence bands, with standard errors two-way clustered at the country-sector and quarter level.

to the global demand, oil supply, or euro area monetary policy shocks, for different horizons  $h$  after the shock. We normalize the shocks by their standard deviations and such that they cause inflation to increase (i.e., contractionary oil supply shocks and expansionary global demand and euro area monetary policy shocks). Figure 10 shows the results for PPI inflation. A one standard deviation oil supply shock increases PPI inflation by up to 1.5% (relative to the country-specific average inflation rate) over a two-year horizon. The response is persistent and highly statistically significant.<sup>8</sup> A one standard deviation global demand shock increases PPI inflation significantly and persistently by 1% over a 1.5-year horizon. A one standard deviation monetary policy shock increases PPI inflation by 0.4% over a 1.5-year horizon. The response is somewhat less statistically significant. In the following, we estimate if the inflation response to those shocks is different between high- and low-markup sectors.

## 5.2 Differential inflation response in low-markup sectors

To estimate the *differential* response of inflation in low-markup sectors, relative to high-markup sectors, we make use of the definition of low-markup and high-markup two-digit NACE sectors from Section 4. Recall that a low-markup sector is defined to have an average markup in the lowest 33% of the country-quarter-specific distribution, while a high-markup sector has an average markup in the highest 33% of that distribution, see equation (9).

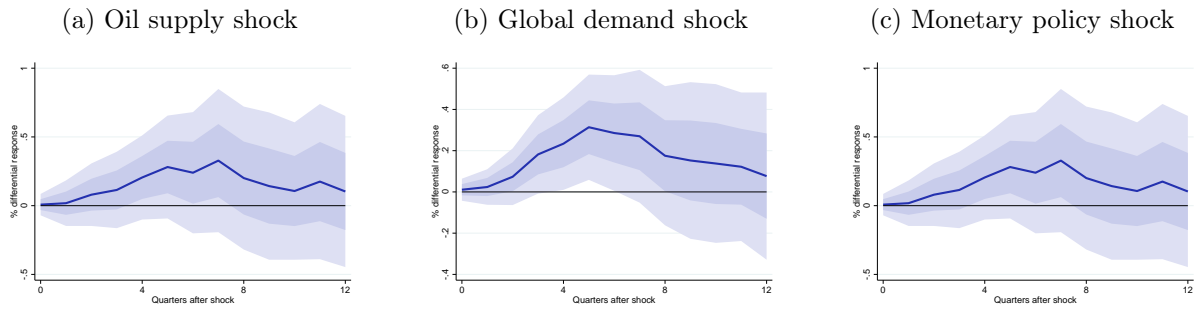
We regress country-sector-quarter-specific inflation rate on a country-quarter fixed effect and the interaction of the *LowMarkup* indicator and the shock measure in the following panel local projection:

$$\begin{aligned} \pi_{country,nace2,t-1,t+h} = & \alpha_{country,t}^h + \beta^h LowMarkup_{country,nace2,t} \times shock_t \\ & + \gamma^h LowMarkup_{country,nace2,t} + u_{country,nace2,t}^h \end{aligned} \quad (11)$$

The sequence of coefficients  $\{\beta^h\}$  quantifies the differential markup response of low-markup

<sup>8</sup>We align in interpreting the significance of the results with going practice in the literature by taking the shocks as observed, i.e., we do not account for their probability distribution.

Figure 12: Differential PPI inflation responses in low-markup 4-digit NACE sectors



*Note:* Differential PPI inflation response at the four-digit NACE level in low-markup sectors, relative to the inflation response in high-markup sectors within the same two-digit NACE industry. Panel (a): differential response to an identified oil supply shock from Baumeister and Hamilton [2019]. Panel (b): differential response to an identified global demand shock from Baumeister and Hamilton [2019]. Panel (c): differential response to monetary policy shock based on Altavilla et al. [2019] and Jarociński and Karadi [2020]. The differential impulse response plots the coefficients  $\{\beta^h\}$  from equation (13). Inflation rates are trimmed at the 1%/99% quantiles. The shaded areas are 68% and 95% confidence bands, with standard errors two-way clustered at the country-sector and quarter level.

two-digit NACE sectors relative to high-markup two-digit NACE sectors. In other words, the coefficients quantify by how much more inflation in a typical low-markup sector responds relative to a typical high-markup sector.

We find that in response to an identified oil supply, global demand or euro area monetary policy shock, the inflation rate in low-markup sectors increases significantly more than in high-markup sectors, see Figure 11. This suggests that firms in high-markup sectors more strongly absorb cost changes into their markups. Quantitatively, a one standard deviation oil supply shock has a roughly 0.75 percentage points larger impact on PPI inflation in sectors with low markups (Figure 11a). Note that this is roughly half of the average PPI response. Hence, there is a significant role of the markup level in determining the strength of inflation responses to shocks. Similarly, a one standard deviation global demand shock increases PPI inflation by 0.8 percentage points more and a monetary policy shock increases PPI inflation by 0.2 percentage points more in low-markup sectors (Figure 11c), also around half of the respective average response.

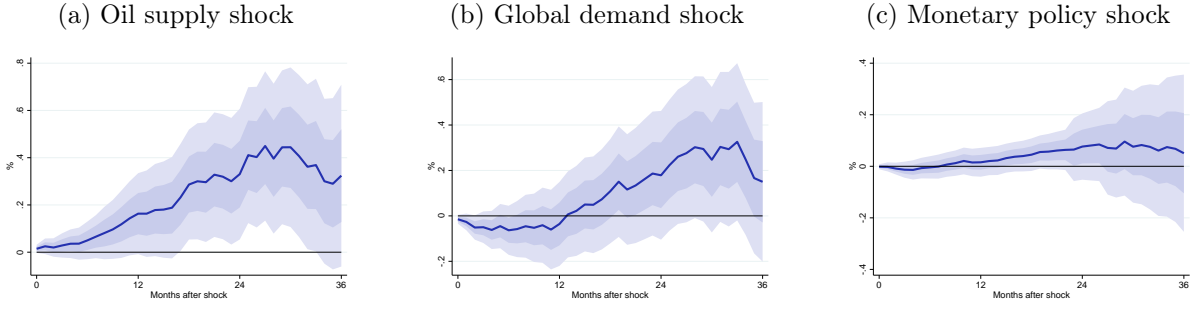
### 5.3 Using only variation within two-digit NACE sectors

The preceding analysis effectively compared two-digit NACE sectors with high or low markups in terms of their inflation response to shocks. However, two-digit NACE sectors may be different in terms of other characteristics that are correlated with markups but also determine their inflation cyclicality. For example, this may include the price elasticity of demand and the share of fixed costs.

To improve on this, we next carry out our analysis by comparing four-digit NACE sectors with high and low markups within the same two-digit NACE group. To this end, we define the



Figure 13: Average HICP inflation responses



*Note:* Average HICP inflation response to a one-standard deviation shock. Panel (a): differential response to an identified oil supply shock from [Baumeister and Hamilton \[2019\]](#). Panel (b): differential response to an identified global demand shock from [Baumeister and Hamilton \[2019\]](#). Panel (c): CIRF to an identified monetary policy shock based on [Altavilla et al. \[2019\]](#) and [Jarociński and Karadi \[2020\]](#). The cumulative impulse response plots the coefficients  $\{\beta^h\}$  from equation (10). Inflation rates are trimmed at the 1%/99% quantiles. The shaded areas are 68% and 95% confidence bands, with standard errors two-way clustered at the country-sector and monthly level.

low-markup and high-markup classification as follows:

$$\begin{aligned} LowMarkup_{nace4,country,t} &:= \mathbb{1}\{\mu_{nace4,country,t} \leq Q_{nace2,country,t}^{0.33}\} \\ HighMarkup_{nace4,country,t} &:= \mathbb{1}\{\mu_{nace4,country,t} \geq Q_{nace2,country,t}^{0.67}\} \end{aligned} \quad (12)$$

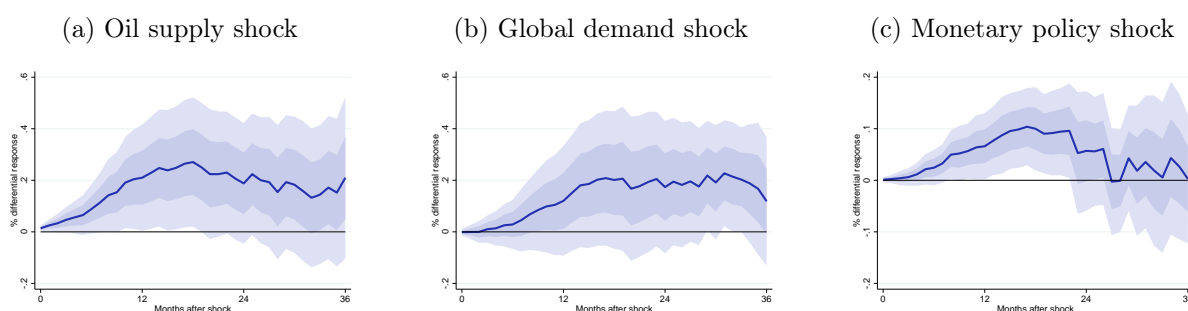
That is, a low-markup sector is defined to be a four-digit NACE sector that has an average markup in the lowest 33% of the distribution of markups within its two-digit-NACE group, country and quarter. Analogously, a high-markup sector is in the highest 33% of markups in that distribution. Due to limited data on PPI inflation rates, we can carry out this analysis only for Germany, France, Spain, Italy and Finland.

We then estimate a panel local projection at the granular four-digit-industry-country-quarter level, comparing inflation rates within given two-digit sector by means of including a two-digit NACE country-year fixed effect:

$$\begin{aligned} \pi_{country,nace4,t-1,t+h} &= \alpha_{country,nace2,t} + \beta^h LowMarkup_{country,nace4,t} \times shock_t \\ &+ \gamma^h LowMarkup_{country,nace4,t} + u_{country,nace4,t}^h \end{aligned} \quad (13)$$

The sequence of coefficients  $\{\beta^h\}$  quantifies the differential markup response of low-markup four-digit NACE sectors relative to high-markup four-digit NACE sectors of the same two-digit NACE industry. The conclusions from [Figure 12](#) are similar to the exercise above at the two-digit NACE level for all euro area countries. A four-digit NACE sector with low markups on average responds by 0.75 percentage points more to an oil supply shock ([Figure 12a](#)), by 0.3 percentage points more to a global demand shock ([Figure 12b](#)), and by 0.4 percentage points more to a monetary policy shock ([Figure 12c](#)). The differential effect after a monetary policy shock is now more significant. Even though we only compare sectors within the same two-digit NACE group, these estimates point again to a quantitatively important role of markups in determining the responsiveness of sectoral level inflation to structural shocks.

Figure 14: Differential HICP inflation responses in low-markup sectors



*Note:* Differential HICP inflation response at the three-digit COICOP category level in low-markup sectors, relative to the inflation response in high-markup categories. Panel (a): differential response to an identified oil supply shock from Baumeister and Hamilton [2019]. Panel (b): differential response to an identified global demand shock from Baumeister and Hamilton [2019]. Panel (c): differential response to a monetary policy shock based on Altavilla et al. [2019] and Jarociński and Karadi [2020]. The differential impulse response plots the coefficients  $\{\beta^h\}$  from equation (11). Inflation rates are trimmed at the 1%/99% quantiles. The shaded areas are 68% and 95% confidence bands, with standard errors two-way clustered at the country-category and monthly level.

## 5.4 Differential HICP inflation responses in low-markup sectors

So far we have focused on the response of producer price inflation in manufacturing. However, the cyclicity of inflation may differ between wholesale and retail prices, since the vertical interactions between producers and retailers are important in determining the ultimate consumer price inflation. Therefore, we also analyse HICP inflation to learn about consumer prices and in particular the differential response of consumer prices in low-markup and high-markup sectors. Moreover, HICP data contains not only manufacturing prices but also services prices.

First, we investigate the average HICP inflation response to the considered shocks. Figure 13 shows that HICP inflation increases significantly after oil supply shocks, but with a markedly longer lag than PPI inflation. This may reflect pipeline effects and the lagged pass-through in the vertical interaction of wholesalers and retailers. The HICP inflation response to global demand shock is similar to the producer price inflation response. Similarly, the inflation response to a global demand shock picks up only slowly. The HICP inflation response to a domestic monetary policy shock is rather imprecisely estimated but shows, in terms of the point estimates, a similar lagged but persistent response.

Figure 14 shows the differential HICP inflation response estimated analogously to equation 11. The results confirm that the patterns in PPI data hold up for HICP data as well. In particular, the consumer price inflation in low-markup sectors respond significantly more to shocks. This supports that high-markup sectors show much less inflation cyclicity, plausibly because they absorb shocks more strongly into their markups instead of passing cost changes on to consumers.

## 6 The effect of markups on euro area inflation cyclicity: a back-of-the-envelope calculation

The previous sections have presented evidence that inflation is less responsive to aggregate shocks in high-markup sectors and that the share of high markup firms in the euro area has

Table 2: Back-of-the-envelope effect of EA markup increase on inflation cyclicality

	(1)	(2)	(3)	(4)	(5)	(6)
	$\pi_{country,nace2,t-1,t+h}$ (in %)					
	PPI ( $h = 6$ quarters)			HICP ( $h = 18$ months)		
Oil supply shock $\times$ <i>LowMarkup</i>	0.810** (0.329)			0.259** (0.129)		
Economic activity shock $\times$ <i>LowMarkup</i>		0.792*** (0.252)			0.191 (0.136)	
Monetary policy shock $\times$ <i>LowMarkup</i>			0.188 (0.215)			0.101** (0.0440)
$N$	8810	8810	8810	40504	40504	40504
Average effect of shock on inflation	1.356	0.846	0.354	0.281	0.102	0.0446
Average low/high log markup difference	-0.221	-0.221	-0.221	-0.565	-0.565	-0.565
Diff. effect of 1% higher markup	-0.0367	-0.0359	-0.00851	-0.00459	-0.00338	-0.00179
Rel. effect of 10% markup increase	<b>-27.1%</b>	<b>-42.4%</b>	<b>-24.0%</b>	<b>-16.4%</b>	<b>-33.1%</b>	<b>-40.0%</b>

Note: Two-way clustered standard errors by country-sector and quarter in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . See main text for details.

been on the rise. Combining these two findings implies that changes in firm market power may indeed have contributed to the declining cyclicality of euro area inflation at the aggregate level. However, a key question is the quantitative importance of this channel. To answer this question, we present a back-of-the-envelope calculation that estimates the effect of the observed increase in the aggregate euro area markup on euro area inflation cyclicality in response to the oil supply, global demand, and monetary policy shocks. Table 2 presents the results: columns (1), (2), and (3) in the top panel reproduce the results from the PPI local projection in equation (11), for horizon  $h = 6$  quarters after each shock. Columns (4), (5), and (6) show the same estimates for HICP at  $h = 18$  months after each shock.

In the lower panel, we first estimate the implied *Differential effect of a 1% higher markup* on the inflation response to shocks follows: we compute the difference between the average log markup in *LowMarkup* versus *HighMarkup* sectors, shown in *Avg. low/high markup difference*, and use this difference to scale the differential effect of a *LowMarkup* sector. For example, in column (1), the differential effect of an oil supply shock arising from a 1% higher markup is  $(0.810/(-0.221)) \times 0.01 = -0.0367$ . For comparison, the row *Average effect of shock* represents the result from the local projection in equation (10).

Finally, we compute the differential effect of a 10% higher markup and relate it *in relative terms* to the average effect. This yields the final row, which approximates the effect of the observed markup increase on the inflation cyclicality conditional on the corresponding shock. According to this back-of-the-envelope calculation, a 10% increase in markups would decrease the impact of a monetary policy shock on PPI by a fourth and on HICP by 40%. For reference, the aggregate EA markup has increased by 12.5% from 1.36 in 1999 to 1.53 in 2018.

## 7 Conclusions

In this paper we document the markup evolution in the euro area across countries and sectors since 1995, using the methodology proposed by De Loecker et al. [2020]. We subsequently

analyse how the response of inflation to shocks (inflation cyclicality) differs depending on the degree of firm market power, which we proxy with our markup measure.

In line with the literature concerning the United States we find that markups in the euro area as a whole have been gradually on the rise. This increase was most pronounced in recent years. Also in line with results for the US, we find that the markup increase has been mainly driven by increased market shares of high-markup firms. Differently from the United States, our results show that markups in manufacturing and in wholesale and retail trade remained broadly flat in the euro area on aggregate. Instead, the markup increase in the euro area stemmed mostly from the finance, insurance and real estate sector and from the other services sector (which comprises the professional, scientific and technical activities sector and the information and communication sector) as well as from the reallocation of market share across sectors.

In the second part of the paper, we analyse the role of higher markups for the inflation response to shocks. To this end, we classify sectors into high- and low-markup groups and, using local projections, compare the sectoral inflation response to aggregate shocks in the two groups. We find that inflation cyclicality is distinctly different across low- and high-markup sectors, with low-markup sectors responding more cyclically to macroeconomic shocks. Quantitatively, the PPI inflation response in sectors with low markups is roughly 0.75 percentage points larger in the case of a one-standard deviation oil supply shock or global demand shock and 0.2 percentage point larger for a one standard deviation monetary policy shock. The response differentials are significant and are around half of the average response. This result for producer price inflation also carries over to consumer prices from HICP data.

Taken together, the documented increase in the euro area aggregate markup and the differential response of producer and consumer prices to aggregate shocks might explain part of the *missing cyclicality* of euro area inflation documented by various authors in recent years.

These results are particularly relevant for monetary policy. Indeed, as suggested by [Georgieva et al. \[2021\]](#), the pandemic could result in a further increase in firm market power. Our findings suggest that in such an environment inflation may become less sensitive to shocks. As a result, it would become more difficult for central banks to meet their inflation objectives. However, it also means that central banks can pursue more accommodative monetary policy without risking an unwelcome increase in inflation. A possible conclusion, as in [Duval et al. \[2021\]](#), is that reducing market power can facilitate the job of monetary policy. However, such a conclusion may also depend on the *source* of this rise in market power and on whether high markups are indeed an indicator of market power. As [Edmond et al. \[2018\]](#) have argued based on their welfare analysis of the cost of markups, there can be a trade-off in terms of misallocation and reduced aggregate productivity depending on what policy mechanisms are used to reduce markups. Moreover, in the euro area, the markup heterogeneity across countries also highlights risks to the homogeneous transmission of monetary policy. Understanding the appropriate policy mechanisms to respond to such developments requires further analysis.

In this regard, gaining a deeper understanding of the driving forces of the increase in markups and the factors that cause it to impact the cyclicality of inflation are key. As regards the factors that drive the increase in markups, there exists already a vast literature in the US but consensus

has not yet been reached. For the euro area, the literature is still in its infancy. As regards the factors that reduce inflation cyclicality, one avenue that can be pursued further is to analyse the role of financial frictions: as highlighted by [Gilchrist et al. \[2017\]](#), financially constrained and unconstrained firms may react differently to adverse shocks, dampening the aggregate response of inflation to the business cycle.

How significant could the increase in markups have been in explaining the stubbornness of low inflation in the past years? A back-of-the-envelope calculation shows that, depending on the shock, the responsiveness of inflation could decrease by between a fifth to 40% for PPI inflation and by between one sixth to 40% for HICP inflation.

## References

- Daniel A. Akerberg, Kevin Caves, and Garth Frazer. Identification properties of recent production function estimators. *Econometrica*, 83, 2015. ISSN 0012-9682. doi: 10.3982/ecta13408.
- Carlo Altavilla, Luca Brugnolini, Refet S. Gürkaynak, Roberto Motto, and Giuseppe Ragusa. Measuring euro area monetary policy. *Journal of Monetary Economics*, 108:162–179, 2019.
- Mary Amiti, Oleg Itskhoki, and Jozef Konings. International Shocks, Variable Markups, and Domestic Prices. *Review of Economic Studies*, 86(6):2356–2402, 2019. URL <https://ideas.repec.org/a/oup/restud/v86y2019i6p2356-2402..html>.
- Javier Andrés, Óscar Arce, and Pablo Burriel. Market polarization and the Phillips curve. Working Papers 2106, Banco de España, February 2021. URL <https://ideas.repec.org/p/bde/wpaper/2106.html>.
- Tommaso Aquilante, Shiv Chowla, Nikola Dacic, Andrew Haldane, Riccardo Masolo, Patrick Schneider, Martin Seneca, and Srdan Tatomir. Market power and monetary policy. Technical Report 798, Bank of England, 2019.
- Andrew Atkeson and Ariel Burstein. Pricing-to-Market, Trade Costs, and International Relative Prices. *American Economic Review*, 98(5):1998–2031, December 2008. URL <https://ideas.repec.org/a/aea/aecrev/v98y2008i5p1998-2031.html>.
- Christiane Baumeister and James D. Hamilton. Structural interpretation of vector autoregressions with incomplete identification: Revisiting the role of oil supply and demand shocks. *American Economic Review*, 109(5):1873–1910, 2019.
- Elena Bobeica and Marek Jarociński. Missing disinflation and missing inflation: A var perspective. *International Journal of Central Banking*, 15(1):199–232, March 2019. URL <https://ideas.repec.org/a/ijc/ijcjou/y2019q1a5.html>.
- Elena Bobeica, Matteo Ciccarelli, and Isabel Vansteenkiste. The link between labor cost and price inflation in the euro area. Technical Report 2235, ECB Working Paper, 2019.
- Elena Bobeica, Matteo Ciccarelli, and Isabel Vansteenkiste. The changing link between labor cost and price inflation in the united states. Technical Report 2583, ECB Working Paper, 2021.
- Steve Bond, Arshia Hashemi, Greg Kaplan, and Piotr Zoch. Some unpleasant markup arithmetic: Production function elasticities and their estimation from production data. *Journal of Monetary Economics*, 2021.
- Yann Bramoulle, Rachel Kranton, and Martin D’Amours. Strategic interaction and networks. *American Economic Review*, 104:898–930, 3 2014.

- Judith Chevalier and David Scharfstein. Capital-market imperfections and countercyclical markups: Theory and evidence. *American Economic Review*, 86(4):703–25, 1996. URL <https://EconPapers.repec.org/RePEc:aea:aecrev:v:86:y:1996:i:4:p:703-25>.
- Jan De Loecker and Jan Eeckhout. Global Market Power. NBER Working Papers 24768, National Bureau of Economic Research, Inc, June 2021.
- Jan De Loecker and Frederic Warzynski. Markups and Firm-Level Export Status. *American Economic Review*, 102(6):2437–2471, October 2012.
- Jan De Loecker, Jan Eeckhout, and Gabriel Unger. The rise of market power and the macroeconomic implications. *Quarterly Journal of Economics*, 135:561–644, 5 2020. ISSN 15314650. doi: 10.1093/qje/qjz041.
- Jan De Loecker, Jan Eeckhout, and Simon Mongey. Quantifying market power and business dynamism in the macroeconomy. Economics Working Papers 1778, Department of Economics and Business, Universitat Pompeu Fabra, April 2021. URL <https://ideas.repec.org/p/upf/upfgen/1778.html>.
- Maarten De Ridder, Basile Grassi, and Giovanni Morzenti. The hitchhiker’s guide to markup estimation. Technical report, Working Paper, 2021.
- Federico Diez, Daniel Leigh, and Suchanan Tambunlertchai. Global market power and its macroeconomic implications. *IMF Working Papers*, 18:1, 2018. ISSN 1018-5941. doi: 10.5089/9781484361672.001.
- Romain Duval, Davide Furceri, Raphael Lee, and Marina Tavares. Market power and monetary policy transmission. Working Papers 184, IMF, 2021. URL <https://www.imf.org/en/Publications/WP/Issues/2021/07/09/Market-Power-and-Monetary-Policy-Transmission-461332>.
- Chris Edmond, Virgiliu Midrigan, and Daniel Yi Xu. How costly are markups? Technical report, National Bureau of Economic Research, 2018.
- Gauti Eggertsson, Jakob Robbins, and Ella Getz Wold. Kaldor and Piketty’s Facts: The Rise of Monopoly Power in the United States. NBER Working Papers 24287, National Bureau of Economic Research, Inc, February 2018.
- Fabian Eser, Peter Karadi, Philip R. Lane, Laura Moretti, and Chiara Osbat. The Phillips Curve at the ECB. *Manchester School*, 88(S1):50–85, September 2020. doi: 10.1111/manc.12339. URL <https://ideas.repec.org/a/bla/manchs/v88y2020is1p50-85.html>.
- Zach Flynn, Amit Gandhi, and James Traina. Identifying market power in production data. *SSRN Electronic Journal*, 2019. ISSN 1556-5068. doi: 10.2139/ssrn.3358472.
- Kirstin Forbes. Has globalizatoin chnaged the inflation process? Technical Report 791, BIS Working Paper, 2019.

- Kristalina Georgieva, Federico Diez, Romain Duval, and Daniel Schwarz. Rising market power - a threat to the recovery. Technical report, IMF blog, 2021.
- Simon Gilchrist, Raphael Schoenle, Jae Sim, and Egon Zakrajsek. Inflation dynamics during the financial crisis. *American Economic Review*, 80:785–823, 3 2017.
- Pinelopi Goldberg and Rebecca Hellerstein. A structural approach to identifying the sources of local currency price stability. *Review of Economic Studies*, 80:175–210, 3 2013. doi: 10.1093/restud/rds015.
- François Gourio and Leena Rudanko. Can intangible capital explain cyclical movements in the labor wedge? *American Economic Review*, 104(5):183–88, May 2014. doi: 10.1257/aer.104.5.183. URL <https://www.aeaweb.org/articles?id=10.1257/aer.104.5.183>.
- Elke Hahn. The wage-price pass-through in the euro area: Does the growth regime matter? Technical report, ECB Working Paper, 2020.
- Robert E. Hall. The relation between price and marginal cost in u.s. industry. *Journal of Political Economy*, 96, 1988. ISSN 0022-3808. doi: 10.1086/261570.
- Thomas Hasenzagl, Filippo Pellegrino, Lucrezia Reichlin, and Giovanni Ricco. The Inflation Puzzle in the Euro Area: It’s the Trend not the Cycle! Voxeu column, VoXEU, October 2019.
- Sebastian Heise, Fatih Karahan, and Ayşegül Şahin. The missing inflation puzzle: The role of the wage-price pass-through. Technical report, National Bureau of Economic Research, 2020.
- Marek Jarociński and Peter Karadi. Deconstructing monetary policy surprises – the role of information shocks. *American Economic Journal: Macroeconomics*, 12(2):1–43, 2020.
- Marek Jarociński and Michele Lenza. An Inflation-Predicting Measure of the Output Gap in the Euro Area. *Journal of Money, Credit and Banking*, 50(6):1189–1224, September 2018. doi: 10.1111/jmcb.12496. URL <https://ideas.repec.org/a/wly/jmoncb/v50y2018i6p1189-1224.html>.
- Òscar Jordà. Estimation and inference of impulse responses by local projections. *American Economic Review*, 95(1):161–182, 2005.
- Sebnem Kalemli-Ozcan, Bent E. Sorensen, Carolina Villegas-Sanchez, Vadym Volosovych, and Sevcan Yesiltas. How to construct nationally representative firm level data from the ORBIS global database. CEPR Discussion Papers 10829, C.E.P.R. Discussion Papers, September 2015.
- James Levinsohn and Amil Petrin. Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, 70, 2003. ISSN 00346527. doi: 10.1111/1467-937X.00246.
- Jesper Linde and Mathias Trabandt. Resolving the missing deflation puzzle. CEPR Discussion Papers 13690, CEPR Discussion Papers, April 2019.



- Peter McAdam, Filippos Petroulakis, Isabel Vansteenkiste, Maria Chiara Cavalleri, Alice Eliet, and Ana Soares. Concentration, market power and dynamism in the euro area. Working Paper Series 2253, European Central Bank, March 2019. URL <https://ideas.repec.org/p/ecb/ecbwps/20192253.html>.
- Michael McLeay and Silvana Tenreyro. Optimal inflation and the identification of the Phillips curve. NBER Working Paper 25892, "National Bureau of Economic Research, May 2019. URL "<http://www.nber.org/papers/w25892>.
- Matthias Meier and Timo Reinelt. Monetary policy, markup dispersion, and aggregate TFP. Technical report, ECB Working Paper, 2020.
- Simon Mongey. Market Structure and Monetary Non-neutrality. Staff Report 558, Federal Reserve Bank of Minneapolis, October 2019. URL <https://ideas.repec.org/p/fip/fedmsr/558.html>.
- Aviv. Nevo and Arlene Wong. Measuring inflation in the modern economy – a micro price-setting view. Presentation at the ECB Forum on Central Banking on “Price and Wage-setting in Advanced Economies”, European Central Bank, June 2018.
- G. Steven Olley and Ariel Pakes. The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64, 1996. ISSN 00129682. doi: 10.2307/2171831.
- Pablo Ottonello and Thomas Winberry. Financial heterogeneity and the investment channel of monetary policy. *Econometrica*, 88(6):2473–2502, 2020.
- James Traina. Is aggregate market power increasing? production trends using financial statements. *SSRN Electronic Journal*, 2018. ISSN 1556-5068. doi: 10.2139/ssrn.3120849.

## A Data cleaning

Orbis data require filtering to remove duplicates and observations that either do not contain all necessary information. It also contains reporting errors, which must be detected and filtered out. The first filter is on the consolidation code, as firms can report under variety of consolidation codes and which one to choose depends on the application. The initial filter is that `consolidationcode` is different from "C2" or "LF". The latter indicates "Limited Financials" which means none of the variables we need are reported. "C2" indicates "statement of a mother company integrating the statements of its controlled subsidiaries or branches with an unconsolidated companion", and for our purposes we want to use unconsolidated statements to the extent possible. Only when there is only a consolidated statement we use the corresponding code "C1".

For observations to be useful for our study the following conditions on selected fields must be satisfied: the NACE-4 sector must be reported, as are either `operatingrevenue` or `sales`; similarly, either `costsofgoodssold` or both `costsofemployees` and `materialcosts` must be available. We also include a more stringent condition, i.e., that `totalassets`, `sales`, `operatingrevenue` and `numberofemployees` must not be all missing.

In line with [Kalemli-Ozcan et al. \[2015\]](#) we also impose that `numberofemployees` should be positive and smaller than 3,000,000. This however eliminates very few observations and for the `numberofemployees` to be an indicator of whether firms reported incorrectly in a given year this variable must be compared with `costsofemployees`.

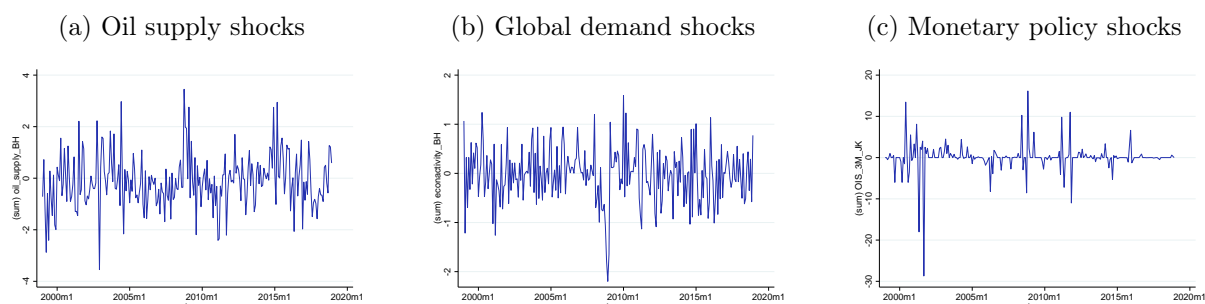
We also impose that `tangiblefixedassets`  $\geq 0$ , `totalassets`  $\geq 0$  and `numberofmonths` = 12. The first two conditions are self-explanatory; the third aims to avoid some duplicates as firms can report many times each year, often to correct reporting mistakes. The field `numberofmonths` allows dropping any partial reporting, but imposing the condition still leaves some duplicate entries for firms-year, which we eliminate by using the exact date of reporting in December and taking the latest one or taking an average of the fields.

Unlike in [Kalemli-Ozcan et al. \[2015\]](#), rather than eliminating all observations for a given firm we drop firm-year observations. One could argue that this adds composition effects; however if the probability of a firm making a reporting mistake in one year is correlated with its productivity, then dropping entire firm histories would bias the results against low-productivity firms. In this trade off we prefer to keep the firm's history except for the year when it made a reporting mistake; to the extent that these mistakes are random, the composition effects will largely wash out in aggregation.

After imposing the "blanket" filters listed above we use ratios of the variables that interest us to identify outliers. We look at outliers within each country and not across countries. In each country, sector, year we drop observations based on the following ratios: employment per million of sales or sales/total assets larger than the 99.9 percentile; sales/variable costs larger than the 99th or smaller than the first percentile. In each case we drop the firm-year observation.

## B Identified shocks

Figure 15: Identified structural shocks



*Note:* Panel (a) shows the oil supply shocks from [Baumeister and Hamilton \[2019\]](#) at monthly frequency. Panel (b) shows the global demand (economic activity) shock from [Baumeister and Hamilton \[2019\]](#) at monthly frequency. Panel (c) shows monetary policy shocks computed using data from [Altavilla et al. \[2019\]](#). We use daily monetary surprises as changes in the 3-month OIS within the “monetary event window”, i.e., from before the press release to after the press conference of Governing Council meetings. We then follow [Jarczyński and Karadi \[2020\]](#) in excluding a surprise if the corresponding change of the STOXX50 has the same sign, i.e., if negative (expansionary) interest rate surprises lead to negative stock market changes or positive (contractionary) interest rate surprises lead to positive stock market changes; such co-movement indicates a central bank private information release. Daily shocks are aggregated to monthly frequency by taking simple sums over the daily shocks within the month.

### **Acknowledgements**

We thank Frank Smets as well as participants of the PAC modeling seminar at the European Central Bank for their helpful comments and suggestions.

This paper should not be reported as representing the views of the European Central Bank (ECB). The views expressed are those of the authors and do not necessarily reflect those of the ECB.

### **Omiros Kouvavas**

European Central Bank, Frankfurt am Main, Germany; University of Warwick, Coventry, United Kingdom;  
email: [omiros.kouvavas@ecb.europa.eu](mailto:omiros.kouvavas@ecb.europa.eu)

### **Chiara Osbat**

European Central Bank, Frankfurt am Main, Germany; email: [chiara.osbat@ecb.europa.eu](mailto:chiara.osbat@ecb.europa.eu)

### **Timo Reinelt**

European Central Bank, Frankfurt am Main, Germany; University of Mannheim, Mannheim, Germany;  
email: [timo.reinelt@gess.uni-mannheim.de](mailto:timo.reinelt@gess.uni-mannheim.de)

### **Isabel Vansteenkiste**

European Central Bank, Frankfurt am Main, Germany; email: [isabel.vansteenkiste@ecb.europa.eu](mailto:isabel.vansteenkiste@ecb.europa.eu)

### **© European Central Bank, 2021**

Postal address 60640 Frankfurt am Main, Germany

Telephone +49 69 1344 0

Website [www.ecb.europa.eu](http://www.ecb.europa.eu)

All rights reserved. Any reproduction, publication and reprint in the form of a different publication, whether printed or produced electronically, in whole or in part, is permitted only with the explicit written authorisation of the ECB or the authors.

This paper can be downloaded without charge from [www.ecb.europa.eu](http://www.ecb.europa.eu), from the [Social Science Research Network electronic library](#) or from [RePEc: Research Papers in Economics](#). Information on all of the papers published in the ECB Working Paper Series can be found on the [ECB's website](#).

PDF

ISBN 978-92-899-4870-8

ISSN 1725-2806

doi:10.2866/658505

QB-AR-21-108-EN-N