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Firm level heterogeneity and the impact of monetary policy on labour demand

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Challenges for Monetary Policy Transmission in a Changing World Network (ChaMP)

This paper contains research conducted within the network “Challenges for Monetary Policy Transmission in a Changing World Network” (ChaMP). It consists of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the European System of Central Banks (ESCB).

ChaMP is coordinated by a team chaired by Philipp Hartmann (ECB), and consisting of Diana Bonfim (Banco de Portugal), Margherita Bottero (Banca d’Italia), Emmanuel Dhyne (Nationale Bank van België/Banque Nationale de Belgique) and Maria T. Valderrama (Oesterreichische Nationalbank), who are supported by Melina Papoutsi and Gonzalo Paz-Pardo (both ECB), 7 central bank advisers and 8 academic consultants.

ChaMP seeks to revisit our knowledge of monetary transmission channels in the euro area in the context of unprecedented shocks, multiple ongoing structural changes and the extension of the monetary policy toolkit over the last decade and a half as well as the recent steep inflation wave and its reversal. More information is provided on its website.

Abstract

Monetary policy asymmetrically affects the response of firms' employment to an output shock and plays a role in cushioning employment adjustment over the business cycle. Combining annual firm-level data until 2020 with quarterly firm-level data until 2023 and high-frequency monetary policy surprises, we show that for a given change in output, monetary policy influences the extent to which firms hold on to labour, or "labour hoard". Furthermore, this effect is asymmetric: a restrictive monetary policy reduces labour hoarding behaviour by 2 to 3 times more than an accommodative policy increases it. Finally, we look at the role of financing conditions and firm demographics.

Keywords: Labour hoarding, Monetary policy transmission, Firm-level heterogeneity, Employment adjustment, Financial constraints.

JEL Codes: E52, J23, E32.

Non-technical summary

In recent years, employment in the euro area has remained remarkably strong, even when economic growth slowed and firms were hit by major shocks. Many companies chose not to lay off workers when demand weakened. Instead, they held on to staff, expecting conditions to improve or fearing that it would be difficult to rehire later. Economists refer to this behaviour as “labour hoarding”.

This paper examines how monetary policy influences this decision. Do lower interest rates encourage firms to keep workers during downturns? And does tighter policy push firms to adjust employment more quickly?

To answer these questions, we combine detailed firm-level data from several euro area countries with high-frequency measures of monetary policy surprises around ECB announcements. This allows us to study how firms change their workforce when output rises or falls, and how this response depends on the monetary policy environment.

We find that monetary policy does matter. When policy is accommodative, firms tend to retain more workers for a given drop in output. When policy is restrictive, firms reduce employment more strongly. Importantly, the effects are not symmetric: tightening has a noticeably stronger impact on employment adjustment than easing. In other words, restrictive policy accelerates job cuts more than accommodative policy prevents them.

Not all firms respond in the same way. Financially constrained firms adjust employment more aggressively when policy tightens. Firms with stronger balance sheets are better able to smooth employment over time. Differences in workforce composition also play a role: while both high- and low-skill firms respond to monetary policy, employment in low-skill firms tends to react more strongly.

Overall, our results show that monetary policy influences labour markets not only by affecting demand in the economy, but also by shaping firms’ ability to retain workers during difficult periods. This helps explain why employment can remain resilient in some downturns, but also why it may weaken more sharply during periods of monetary tightening.

1. Introduction

A striking recent feature of the post-pandemic euro area economy is that employment has remained exceptionally resilient despite sluggish output growth and successive inflationary shocks. This pattern runs counter to the traditional Okun's Law relationship and has been widely attributed to unprecedented labour market tightness and labour hoarding by firms (Doornik et al., 2023) Indeed, many businesses have opted to retain workers even amid demand shortfalls, in anticipation of future recovery or hiring difficulties. For example, an ECB survey of firms in early 2023 found that in a tight labour market companies were keen to hold onto employees they expected to need going forward (Elding et al., 2023). Likewise, during the energy price spike of late 2022, firms were reluctant to shed staff, especially skilled workers, despite deteriorating conditions, given record-high job vacancy rates and concerns about labour shortages. Elevated profit margins in the post-pandemic rebound have also enabled firms to hoard labour by absorbing higher costs: euro area corporate profit rates reached their highest levels in a decade in 2022, improving firms' capacity to keep workers on payroll (Botelho, 2024). Additionally, the inflation shock induced an immediate adjustment of real wages, with prices outpacing nominal pay, which helped contain unit labour costs and supported profitability. These factors jointly explain why employment has been so robust relative to output, with total hours worked recovering faster than expected and average hours per worker remaining subdued.[1] This post-pandemic labour market resilience provides important context for our analysis, as it suggests that firms' employment responses to shocks now crucially depend on their willingness and ability to hoard labour.

At the same time, depicting the economy and labour markets in general terms ignores the rich dynamics that operate at a more granular level. Indeed, over the last decade, the role of individual firm heterogeneity in explaining macroeconomic and labour market aggregate outcomes has garnered considerable attention. This heterogeneity has been shown to explain much of the rise in workers earnings inequality (Haltiwanger and Spletzer, 2020, Song et. al. 2019 and Barth et. al. 2016), fluctuations in GDP growth (Gabaix, 2011), unemployment dynamics (Moscarini and Postel-Vinay 2012), international trade (di Giovannni et al. 2014), aggregate prices (Amiti et al. 2019); market power and monetary policy transmission (Akcigit et al. 2021); as well as the impact of climate change related shocks (Bijnens et al. 2026).

1 Speech by Christine Lagarde, President of the ECB, at the ECB Forum on Central Banking 2023 on "Macroeconomic stabilisation in a volatile inflation environment" in Sintra, Portugal.

When confronted with changes in the macroeconomic outlook, firms adjust employment levels to different degrees, which can differ considerably even within very narrowly defined industries (Syverson, 2011). Our empirical strategy is also related to Melcangi (2018), who uses industry-level shocks to identify firm-level hiring responses and emphasizes the role of cross-firm heterogeneity in labour demand adjustment. That being said, the source of the heterogeneous response by firms is important. If it is based on the different productivity levels of firms, the seminal model of Hopenhayn (1992) shows that this has positive aggregate outcomes. However, if the source reflects unfavourable macro financing conditions, then the heterogeneous response has a negative impact on employment (Cantor 1990, Benmelech et al. 2011, Giroud and Mueller 2017). In this context, a role for monetary policy emerges in affecting firms' expectations on the macroeconomy and financing conditions, which might in turn influence their employment demand and labour hoarding behaviour. Graves et al. (2023) find that contractionary monetary policy shock generates quantitatively important increases in labour supply, in part because workers reduce the rate at which they quit jobs to non-employment. Bäurle et al. (2021) show based on Swiss data that in the case of a negative output shock financially constrained firms lay off twice as many employees than unconstrained firms. Giroud and Mueller (2017) study the great recession in the U.S. and find that establishments of more highly levered firms experienced significantly larger employment losses in response to declines in local consumer demand. The intuition behind the mechanism is that a firm will need to invest in excess labour for a certain period and that the desired level of hoarding can only be obtained if the firm has the necessary financing capacity to do so.[2] When an output shock materialises, firms that face tighter financing conditions adjust employment more – are less able to obtain their desired level of labour hoarding – than less financially constrained firms. In other words, firms' financing conditions amplify the impact of the ebbs and flows of the economy on the labour demand for workers.

In this paper, we examine how monetary policy amplifies the impact of an output shock on employment and how it can cushion employment adjustment over the business cycle. To this end, the primary contribution of our paper is to empirically test a direct link between high-frequency monetary policy surprises and firm-level employment decisions in the form of labour hoarding for a selection of the large euro area countries. Combining annual firm-level data until 2020 with quarterly firm-level data until 2023 and high-frequency monetary policy surprises, we show that for a given change in output, monetary policy influences the extent to which firms hold on to labour, or "labour hoard". Furthermore, this effect is asymmetric: a restrictive monetary policy reduces labour hoarding

[2] Over the past decades a large literature has been developed on how financially constrained firms have larger reactions to monetary policy shocks (e.g., Bernanke and Gertler 1995, Hutchinson and Xavier 2006) and how it affects corporate investment (e.g., Fazzari et al. 1987).

behaviour by 2 to 3 times more than an accommodative policy increases it. Finally, we also find a significant role of financing conditions in explaining firms' labour hoarding behaviour, in that firms that are financially constrained tend to labour hoard less.

Our paper contributes to the growing empirical literature that studies the heterogenous effects of monetary policy on the economy. Recent examples include Aaronson et al. (2019), which shows that the cyclical sensitivity of employment for minorities is higher than for non-minorities. Akcigit et al. (2021) argue that high mark-up firms' output responds less to changes in central banks' policy rates. Yu (2022) finds evidence that in the U.S., employment by younger and smaller firms responds more to monetary policy shocks than that by older and larger firms since the former are more sensitive to interest rate changes. Bijnens et al. (2026) observe how financially constraint firms respond more to climate related shocks. Our paper also contributes to the strand of literature studying potential asymmetries in the transmission of monetary policy over the business cycle. Tenreyo and Thwaites (2016) find that the effects of monetary policy are less powerful in recessions, and that contractionary policy shocks are more powerful than expansionary shocks. Ottonello and Winberry (2020) find that firms with low default risk—those with low debt burdens and high "distance to default"— are the most responsive to monetary shocks. Therefore, the aggregate effect of monetary policy may therefore depend on the distribution of default risk, which varies over time. Last, our results also have repercussions for the overall labour market, insofar as the ability of monetary policy to stabilize output and employment over the business cycle might be weakened when firms' financing conditions deteriorate. In addition, it may be optimal for governments to implement policies that support firms to labour hoard when faced with pronounced output shocks (Giroud and Mueller 2017).

This paper continues as follows. The next section explains the empirical model, estimation method and the data used. Section 3 shows the econometric results. Section 4 and 5 discuss heterogeneity and the impact of financial constraints. Section 6 includes robustness checks and section 7 concludes.

2. Empirical model and data

Estimation approach

To study the impact of an output shock and monetary policy transmission on labour demand we draw on the workhorse model for empirical labour economics developed by Nickel (1986). This model has solid micro-foundations and allows to include dynamic effects. It explicitly accounts for the costs associated with changing the level of employment. Adjustment costs may arise from either

institutional (e.g., firing costs), economic (e.g., hiring costs, training) or technological adjustment obstacles (e.g., capital stock is rather fixed). These costs may lead to the situation that firms do not change their demand for labour significantly after an exogenous shock because the adjustment costs outweigh the benefits of a change of the level of employment. This will make firms merely adjust their workforce slowly and employment will be rather persistent.

In Nickel's (1986) model employment decisions are made in such a manner that the firm maximises the present value of its earnings net of adjustment cost of hiring/firing labour. Then it can be shown that the actual demand for employment can be estimated, via a log approximation, as

$$emp_{it} = \alpha_i + \mu_1 emp_{it-1} + \mu_2 wage_{it} + \mu_3 capital_{it} + \mu_4 output_{it} + \epsilon_{it}. \quad (1)$$

Where emp_{it}, $wage_{it}$, $output_{it}$ and $capital_{it}$ stand for the natural logarithm of employment (*emp*), average wage (*wage*), output (*output*) and capital stock (*capital*) of firm *i* in year *t*. The advantage of using this log-linear model is that we can interpret the coefficients μ_j as elasticities. α_i is a firm-level fixed effect that accounts for firm-specific characteristics that impact employment and are constant over time. X_{it} represents a vector of additional control variables on top of the firm-level fixed effects.

Taking the first difference, we transform Eq. 1 to

$$\Delta emp_{it} = \mu_1 \Delta emp_{it-1} + \mu_2 \Delta wage_{it} + \mu_3 \Delta output_{it} + \xi X_{it} + \epsilon'_{it}. \quad (2)$$

X_{it} represents a vector of additional control variables that are time variant and hence not absorbed by first differencing.

The variable measuring the impact of an output shock on employment in Eq. 2 is μ_3. μ_3 captures to what extent firms adjust employment in line with output. The lower μ_3, the less firms align employment with output, i.e. they labour hoard.

We now allow the coefficient for labour hoarding behaviour (μ_3) to vary with the level of monetary policy shocks (described more clearly below). We therefore interact change of *output* with Euro area monetary policy shocks (*MP*) in the period *t-1*.

Eq. 2 becomes

$$\Delta emp_{it} = \mu_1 \Delta emp_{it-1} + \mu_2 \Delta wage_{it} + \mu_3 \Delta output_{it} + \mu_4 \Delta output_{it} \times MP_{t-1} + \mu_5 MP_{t-1} + \xi' X'_{it} + \epsilon'_{it}. \quad (3)$$

The variable of interest in Eq. 3 is μ_4. This is the measure for how monetary policy changes short term firm-level employment responses in the event of a change of output. In other words, μ_4 proxies to what extent monetary policy influences labour hoarding.

X'_{it} contains the control variables. Next to time and the interaction of time X country dummies (country fixed effects are absorbed by first differencing) we also control for the change of capital stock since monetary policy influences firm-level financial constraints and therefore investment decisions. Subsequently labour-capital complementarities will drive firms to adjust their their labour force (Caggese and Cunat, 2008 or Benmelech et al., 2011).

To allow for asymmetry of the monetary policy shock, we also split the interaction $\Delta output_{it} \times MP_{t-1}$ between a shock with a positive sign (a more accommodative shock) and a negative sign (a more restrictive shock).

Yearly firm-level data for Spain, France, Germany and Italy until 2020

Table 1: Firm level employment statistics

Country	# firms	Average employment				Total employment
		Mean	Median	p10	p90	
Germany	60,846	203	62	14	374	12,353,160
Spain	365,322	36	15	10	49	13,252,948
France	268,905	59	18	11	80	15,736,271
Italy	412,124	42	16	11	58	17,225,868
TOTAL (ORBIS)	*1,107,197*	*53*	*17*	*11*	*73*	*58,568,248*
Belgium	44,980	44	16	11	58	1,977,671

Note: The number of firms refers to the number of unique firms appearing 1 or more years in the dataset. The employment statistics refer to the average number of employees over the years the firm appears in the dataset.

We obtain information on the other firm-level variables from ORBIS maintained by Bureau Van Dijk. We include firms in Spain, France, Germany and Italy. The studied period is 1999 - 2020. Employment refers to the number of employees. Micro firms with less than 10 employees are excluded as these are generally not well reported in Orbis. Firm where debt represents less than 10% of tangible fixed assets are excluded too. Table 1 shows the summary statistics of firm-level employment per country.Output is defined as turnover. Wage is obtained by dividing the total wage bill by the number employees.

Quarterly firm-level data for Belgium until 2023

We rely on Belgian quarterly VAT returns that report sales and investment. Since we do not have data on the quarterly capital stock, we use investment instead. We combined these data with declarations to the National Social Security Office reporting quarterly employment, the number of paid days worked in full time equivalents and the total wage bill. Wage is calculated as wage bill divided by full time equivalents. The number of paid days worked is used a measure for firm-level employment.

For both the yearly and quarterly analysis we only include firms with NACE codes 10 – 82 that have at least 10 employees. Outliers with respect to sales growth and employment growth are removed.

Monetary policy shock data

The Euro Area Monetary Policy Event-Study Database is described in Altavilla et al. (2019). It is obtained by tracing asset price changes in a narrow time window around ECB monetary policy announcements (press releases, press conferences) for a range of monetary assets such as the main euro area sovereign bonds.[3] The database is a proxy for monetary policy surprises. The tracked assets do not only include the risk-free rate but also individual country sovereign yields. This allows to capture both dimensions of the monetary policy impulse, namely the stance (injecting additional accommodation) and the transmission (addressing impairments in the transmission mechanism across credit segments and countries). The Euro Area Monetary Policy Event-Study Database can therefore be regarded as an exogenous variation in both the level of Euribor as well as to what extent this transmits to firm-level interest rates.

We aggregate these shocks over the past 6 months and multiplied by (−1). In this way, when interpreting the results from the regressions, higher values should be understood as more forceful monetary accommodation.

For the multi-country analysis based on yearly data we exploit the fact that not all firms close their yearly financial accounts in December. For those firms closing their account in December of year *t*, MP_{t-1} aggregates the shocks of July to December of year *t-1*. A firm closing its accounts in April of year *t*, MP_{t-1} aggregates the shocks from October in year *t-2* to March year *t-1*.

For the quarterly analysis using Belgian data, MP_{t-1} aggregates the shocks of the 2 preceding quarters.

[3] The assets covered are the Overnight Index Swap (OIS) rates with 1, 3, 6 month and 1 to 10, 15, and 20 year maturities, German bund yields with 3 and 6 month and 1 to 10, 15, 20, and 30 year maturities, French, Italian, and Spanish sovereign yields with 2, 5, and 10 year maturities, the stock market price index and the stock price index comprising only banks, and the exchange rate of the euro.

3. Results

The table below shows the estimation results for the model described in Eq. 3 above, both for annual firm-level data and quarterly firm-level data. The coefficient for Δoutput gives the short-term adjustment (elasticity) of employment in case of a change in output (holding all other things equal). A value of 0.3 implies that when an output change of 1% occurs, firms will adjust employment with 0.3%. The coefficient is smaller than 1 which implies that firms do not immediately adjust output in line with output, i.e. they labour hoard. As it takes time to adjust a firm's labour force, the coefficient for Δoutput is larger for yearly adjustments (columns 1 and 2) than for quarterly adjustments (columns 2 and 3).

The coefficient for the interaction term Δoutput × MP, our main coefficient of interest, indicates to what extent the output elasticity (μ_3 in Equation 3) is influenced by a monetary policy shock (MP). The value in column (1) of -0.0007 for this coefficient means that the elasticity decreases with 0.007 for a positive (more accommodative) monetary policy shock of +10. Similarly, a negative (more restrictive) monetary policy shock of -10 increases the elasticity with 0.007. The range of -10 to +10 roughly corresponds with the 10th and 90th percentile of monetary policy shocks observed in the period 1999 – 2020. Based on the result of column (1), we conclude that accommodative monetary policy entices firms to labour hoard more albeit modestly: the labour hoarding coefficient[4] for +10 accommodative shock would be 0.296 compared to 0.310 for a -10 restrictive shock.

The above description implies a symmetric effect of monetary policy: increased labour hoarding behaviour driven by accommodative monetary policy is reversed by a restrictive shock of the same magnitude. Column (2) now tests this supposed symmetry and does not confirm it. The coefficient for Δoutput × MP in the case of a restrictive shock (MP ≤ 0) is approximately double the coefficient in the case of an accommodative shock (MP > 0). This implies that the increase labour hoarding behaviour following an accommodative shock is undone by a restrictive shock of half the magnitude of the initial one.

The drawback of the yearly ORBIS data used for column (1) and (2) is that is only spans until 2020 where accommodative shocks where more frequent than restrictive shocks. Furthermore, the use of

[4] The coefficient of Δoutput + the coefficient of Δoutput × MP.

yearly data does not allow to fully exploit the high frequency of the shocks. We therefore also estimate Eq. 3 on Belgian quarterly data spanning until 2023 in columns (3) and (4).

Table 2: Regression results

	(1) Yearly data *Δemployment*	(2) Yearly data *Δemployment*	(3) Quarterly data *Δemployment*	(4) Quarterly data *Δemployment*
$\Delta employement_{t-1}$	0.0338***	0.0338***	-0.174***	-0.174***
	(0.00211)	(0.00212)	(0.00233)	(0.00233)
Δoutput	0.303***	0.301***	0.0958***	0.0946***
	(0.00192)	(0.00164)	(0.000986)	(0.00107)
Δoutput × MP	-0.000724***		-0.000441***	
	(0.0000957)		(0.0000435)	
Δoutput × MP *(MP > 0)*		-0.000549***		-0.000366***
		(0.000141)		(0.0000510)
Δoutput × MP *(MP ≤ 0)*		-0.00107***		-0.000900***
		(0.000225)		(0.0001783)
Δwage	-0.500***	-0.501***	-0.0189***	-0.0189***
	(0.0118)	(0.0118)	(0.00142)	(0.00142)
Δcapital	0.00828***	0.00828***	0.000333***	0.000332***
	(0.000138)	(0.000138)	(0.0000252)	(0.0000252)
Fixed effects	year, year × country	year, year × country	quarter	quarter
N	3201478	3201478	775816	775816
R square	0.394	0.394	0.300	0.300

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Regressions estimation Eq. 3. Regression (1) and (2) use yearly data for Spain, France, Germany and Italy for the period 1999 - 2020. Regression (3) and (4) use quarterly data for Belgium for the period 2010 – 2023.

The quarterly data confirms the main finding of the analysis using the yearly data. Accommodative (restrictive) monetary policy increase (decreases) firm-level labour hoarding behaviour. Column (4) also confirms the asymmetry, which is, in the case of quarterly data, more outspoken. The negative effect on labour hoarding from restrictive monetary policy is approximately 3 times larger than the positive effect from accommodative policy. Using the coefficient from column (4), a positive (more accommodative) shock of +10 implies a quarterly labour hoarding coefficient of 0.091 vs 0.104 for a negative (more restrictive) shock of -10. We can make these numbers more concrete: a firm employing 1000 FTE that experiences a negative output shock of -10% would reduce its work force with 9.1 FTE in case of +10 accommodative shock, 9.5 FTE in case of a neutral monetary policy and with 10.4 FTE in case of -10 restrictive shock. This implies a difference in workforce of 0.13%. Recurring shocks with the same sign can hence have a sizable impact on employment.

4. Heterogeneity

We now also study to what extent firm demographics influence the link between monetary policy and labour hoarding behaviour. The main findings that a monetary policy shock asymmetrically amplifies labour hoarding behaviour holds if we split the data based on industry or based on firm size. Table 3 summarizes the main parameters of interest based on yearly data for the main Eurozone countries (Table 3) and based on Belgian quarterly data (Table 4). Detailed regression results can be found in Appendix.

Most interestingly, the effect of a monetary policy shock on labour hoarding is larger for small than for large firms.

Table 3: Summary of regression results based on yearly data for main Euro countries

	Manufacturing	Services	Large firms	Small firms
Δoutput × MP	-0.000303*	-0.000692***	0.0000829	-0.00106***
Δoutput × MP *(MP > 0)*	-0.0000837	-0.000732***	0.00146***	-0.00179***
Δoutput × MP *(MP ≤ 0)*	-0.000777*	-0.000623*	-0.00272***	0.000306

Table 4: Summary of regression results based on quarterly data for Belgium

	Manufacturing	Services	Large firms	Small firms
Δoutput × MP	-0.000593***	-0.000392***	-0.000236***	-0.000540***
Δoutput × MP *(MP > 0)*	-0.000584***	-0.000301***	-0.000104	-0.000460***
Δoutput × MP *(MP ≤ 0)*	-0.000648+	-0.000935***	-0.00104***	-0.00102***

The incentives to hoard labour may depend on the skill composition of the workforce and the degree of skill–job complementarity. We therefore further exploit the richness of the Belgian quarterly data and split firms according to their skill intensity. Using annual account information, we classify a firm as high-skill if at least 75% of its full-time equivalent employees hold a tertiary degree. All other firms are labelled low-skill. Table 5 reports the corresponding estimates. Two findings stand out. First, monetary policy significantly affects labour hoarding behaviour in both groups, confirming that the interaction between output shocks and the monetary stance is not confined to a particular segment of the labour market. Second, the magnitude of the effect is larger for low-skill firms. This suggests that firms with a highly educated workforce adjust employment somewhat less in response to changes

in financing conditions, consistent with stronger skill-specific complementarities and higher replacement costs that make them structurally more prone to hoard labour. At the same time, even in skill-intensive activities, labour hoarding decisions are shaped by the monetary environment.

Table 5: Summary of regression results based on quarterly data for Belgium, high-skill vs. low-skill firms

	High-skill firms	Low-skill firms
Δoutput × MP	-0.000309**	-0.000515***
Δoutput × MP *(MP > 0)*	-0.000247*	-0.000466***
Δoutput × MP *(MP ≤ 0)*	-0.000667+	-0.000816***

5. Role of financial constraints

We also shed light a potential channel responsible for the effect described in the previous, i.e. firm level financial constraints. We examine to what extent an additional source of firm-level heterogeneity, i.e. financial constraints, lead to a heterogeneous response to labour hoaring. Over the past decades, a large literature has shown that financially-constrained firms experience larger reactions to monetary policy shocks (e.g., Bernanke and Gertler 1995, Hutchinson and Xavier 2006, Cloyne et al. 2023), with some tangible impact on labour hoarding (Bäurle et al. 2021).

For the purpose of our study we limit ourselves to several proxies for financial constraints:[5]

- Gearing ratio : (total liabilities - equity) / equity
- Interest cover: Earnings Before Interest and Taxes (EBITDA) / interest paid
- Profitability: EBITDA / turnover

We interact the labour hoarding coefficient (coefficient of Δoutput) with these measure for firm-level financial constraints. Table 6 shows the results.

The coefficient have the expected sign. A higher gearing coefficient implies that firms show less labour hoarding behaviour. If firms increase their interest cover or profitability they increase labour hoarding behaviour.

[5] Gearing, interest cover and ROE are log transformed.

Table 6: Regression results – *Financial constraints*

	(1) Yearly data *Δemployment*	(2) Yearly data *Δemployment*	(3) Yearly data *Δemployment*
$\Delta employement_{t-1}$	0.0346***	0.0341***	0.0353***
	(0.00210)	(0.00215)	(0.00222)
Δoutput	0.296***	0.301***	0.253***
	(0.00192)	(0.00204)	(0.00310)
Δoutput × gearing	0.00489***		
	(0.000597)		
Δoutput × interest cover		-0.000659*	
		(0.000305)	
Δoutput × profitability			-0.0190***
			(0.000936)
Δwage	-0.512***	-0.505***	-0.529***
	(0.0118)	(0.0121)	(0.0123)
Δcapital	0.00832***	0.00820***	0.00826***
	(0.000149)	-0.505***	(0.000149)
Fixed effects	year, year × country	year, year × country	year, year × country
N	3046170	3183645	2835537
R square	0.398	0.398	0.402

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Regressions estimation Eq. 3. Regression using yearly data for Spain, France, Germany and Italy for the period 1999 - 2020.

6. Robustness

Endogeneity

Firm-level variation in output is utilised as an explanatory variable to proxy for demand shocks. A potential issue with this approach is that shocks to firm-specific employment might influence the firms' output. To address this endogeneity, we instrument firm-level output growth with output growth at the industry level (3-digit NACE), excluding the firm itself. The relevance of the instrument follows from common demand and technology shocks that affect firms within narrowly defined industries. This identification strategy closely follows Melcangi (2018), who exploits industry-level shocks to isolate firm-level labour demand responses, relying on the fact that individual firms are too small to affect aggregate industry conditions. Furthermore, Aghion et al. (2015) suggest that using output at a higher level of aggregation can mitigate the risk of reverse causality because changes in employment at an individual firm do not affect the characteristics of an entire industry Consequently, we estimate Equation 3 using Two-Stage Least Squares (2SLS), where we instrument log-changes in firm-level output of firm i, with log-changes in industry-level output of industry j, to which firm i

belongs. The first-stage results indicate a strong relationship between industry and firm output growth. The first-stage F-statistics are 5,573 for the yearly sample and 2,691 for the quarterly sample (Table 7), well above the conventional threshold of 10, indicating that weak-instrument concerns are not quantitatively relevant in our setting. This reflects the strong co-movement between firm-level and narrowly defined industry-level output growth, consistent with the presence of common demand and technology shocks at the industry level. The second-stage estimates (Table 7) confirm our baseline findings: the interaction between output shocks and monetary policy remains negative and statistically significant in both the annual multi-country sample and the Belgian quarterly data. The stability of the coefficients across OLS and IV specifications supports the validity of the instrument and suggests that reverse causality does not drive our main results.

Table 7: Regression results – *Two stage least square*

	(1) Yearly data Δemployment	(2) Quarterly data *Δemployment*
$\Delta employement_{t-1}$	0.0269*** (0.000568)	-0.179*** (0.00156)
Δoutput	0.380*** (0.00389)	0.230*** (0.00574)
Δoutput × MP	-0.000892*** (0.000175)	-0.00245*** (0.000737)
Δwage	-0.512*** (0.000933)	-0.0372*** (0.000960)
Δcapital	0.00713*** (0.000103)	0.000276*** (0.0000294)
Fixed effects	year, year × country	quarter
N	3201423	477266
R square	0.251	0.275
First stage F-test	5573	2691

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Regressions estimation Eq. 3. Regression (1) uses yearly data for Spain, France, Germany and Italy for the period 1999 - 2020. Regression (2) uses quarterly data for Belgium for the period 2010 – 2023.

Alternative definition for labour hoarding

So far we used to what extent firms adjust their labour in the case of demand shock as the level of labour hoarding. The Belgian social security data allows us to explore a different measure for labour hoarding, i.e. the difference between employment counted based on heads and employment counted based on full time equivalents (FTE), a proxy for effective hours worked. A firm can adjust its labour force by adjusting how much a person effectively works, either voluntarily or via government

supported furlough schemes. In Belgium furlough schemes are generous, even before the COVID pandemic (Konings et al. 2023).[6] If a worker switched from full-time employment to part-time employment or is put on a furlough scheme, it still counts as a worker at the firm, but is no longer counting towards the FTE number. Adjusting the share of part-time workers is less costly than hiring or firing employees and furlough schemes are government supported. We therefore replace overall employment at the firm in Eq. 3 by $\Delta\left(\frac{FTE}{heads}\right)$. If this measure changes, firms have adjusted the usage of part-time labour or furlough schemes. The results are shown in Table 8 and confirm previous findings.

Table 8: Regression results – ***Alternative definition for labour hoarding***

	(1) Quarterly data Δ(FTE/heads)	(2) Quarterly data Δ(FTE/heads)	(3) Quarterly data Δ(FTE/heads)	(4) Quarterly data Δ(FTE/heads)
$\Delta\left(\frac{FTE}{heads}\right)_{t-1}$		-0.378***		-0.378***
		(0.00148)		(0.00148)
Δoutput	0.0316***	0.0250***	0.0312***	0.0234***
	(0.000497)	(0.000451)	(0.000576)	(0.000516)
Δoutput × MP	-0.000353***	-0.000413***		
	(0.0000330)	(0.0000309)		
Δoutput × MP *(MP > 0)*			-0.000317***	-0.000242***
			(0.0000445)	(0.0000412)
Δoutput × MP *(MP ≤ 0)*			-0.000424***	-0.000748***
			(0.0000746)	(0.0000701)
Δwage	-0.0531***	-0.0437***	-0.0531***	-0.0437***
	(0.000911)	(0.000822)	(0.000911)	(0.000822)
Δcapital	0.0000825***	0.0000622***	0.0000824***	0.0000621***
	(0.0000181)	(0.0000158)	(0.0000181)	(0.0000158)
Fixed effects	quarter	quarter	quarter	quarter
N	869558	788578	869558	788578
R square	0.0940	0.227	0.0940	0.227

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ *p < 0.10,* * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

Note: Regression use quarterly data for Belgium for the period 2005 – 2023.

Not surprisingly, in the case of an output shock first adjust how much hours employees effectively work. The coefficient of Δoutput implies that in the case of an output shock of 10%, firms adjust $\left(\frac{FTE}{heads}\right)$ with 0.3 percentage points. An accommodative shock (MP > 0) reduces the level of adjusting

[6] In Belgium, the system of temporary unemployment was already in place for certain exceptional situations before Covid-19. Enterprises can apply for compensation for their employees in case of force majeure or economic circumstances. If approved, employees receive 65% of their gross wage, which is paid by the social security system rather than the firm.

the $\left(\frac{FTE}{heads}\right)$. This means that in the case of a positive output shock, firms rely more on hiring additional employees over adjusting hours worked when monetary policy is accommodative. It therefore supports the number of heads working. A restrictive shock (MP ≤ 0) as the opposite effect: firms will rely more on adjusting hours worked rather than hiring additional heads in the case of a positive output shock. In the case of negative output shock, here too, if accompanied by an accommodative monetary policy shock, firms will rely more on adjusting hours worked compared to adjusting heads employment than when accompanied by a restrictive shock.

Table 7 also confirms the asymmetric effect from monetary policy shock. A restrictive shock of similar size has a bigger impact than an accommodative shock.

7. Conclusion

In this paper we show that monetary policy asymmetrically affects the impact of an output shock on employment in a selection of euro area economies. Combining firm-level data with high frequency monetary policy surprises we show how the monetary policy stance amplifies the labour hoarding behaviour of firms in response to an output shock. We analyse both annual data for the major Euro countries until 2020 and quarterly data for Belgium until 2023.

We show that accommodative monetary policy can cushion the employment adjustment over the business cycle, where restrictive monetary policy amplifies employment changes. This impact is asymmetric, with a restrictive monetary policy reducing labour hoarding behaviour by 2 to 3 times more than an accommodative policy that increases labour hoarding behaviour.

These findings highlight the role of monetary policy in explaining labour market dynamics, particularly in times of economic flux.

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Appendix

Table A.1: Regression results – *Manufacturing* sector

	(1) Yearly data *Δemployment*	(2) Yearly data *Δemployment*	(3) Quarterly data *Δemployment*	(4) Quarterly data *Δemployment*
$\Delta employement_{t-1}$	0.0307***	0.0308***	-0.182***	-0.182***
	(0.00383)	(0.00384)	(0.00418)	(0.00418)
Δoutput	0.267***	0.265***	0.107***	0.106***
	(0.00310)	(0.00266)	(0.00187)	(0.00209)
Δoutput × MP	-0.000303*		-0.000593***	
	(0.000121)		(0.0000836)	
Δoutput × MP *(MP > 0)*		-0.0000837		-0.000584***
		(0.000192)		(0.0000989)
Δoutput × MP *(MP ≤ 0)*		-0.000777*		-0.000648+
		(0.000327)		(0.000355)
Δwage	-0.493***	-0.493***	0.0297***	0.0297***
	(0.0222)	(0.0222)	(0.00317)	(0.00317)
Δcapital	0.00961***	0.00961***	0.000232***	0.000232***
	(0.000318)	(0.000318)	(0.0000524)	(0.0000524)
Fixed effects	year, year × country	year, year × country	quarter	quarter
N	1064273	1064273	173430	775816
R square	0.390	0.390	0.465	0.300

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Manufacturing defined as Nace 2-digit below or equal to 33. Regressions estimation Eq. 3. Regression (1) and (2) use yearly data for Spain, France, Germany and Italy for the period 1999 - 2020. Regression (3) and (4) use quarterly data for Belgium for the period 2010 – 2023.

Table A.2: Regression results – *Services* sector

	(1) Yearly data *Δemployment*	(2) Yearly data *Δemployment*	(3) Quarterly data *Δemployment*	(4) Quarterly data *Δemployment*
$\Delta employement_{t-1}$	0.0336***	0.0336***	-0.166***	-0.166***
	(0.00254)	(0.00255)	(0.00278)	(0.00278)
Δoutput	0.317***	0.318***	0.0922***	0.0908***
	(0.00237)	(0.00206)	(0.00112)	(0.00121)
Δoutput × MP	-0.000692***		-0.000392***	
	(0.000129)		(0.0000505)	
Δoutput × MP *(MP > 0)*		-0.000732***		-0.000301***
		(0.000189)		(0.0000590)
Δoutput × MP *(MP ≤ 0)*		-0.000623*		-0.000935***
		(0.000281)		(0.000204)
Δwage	-0.503***	-0.503***	-0.0363***	-0.0363***
	(0.0140)	(0.0140)	(0.00154)	(0.00154)

Δcapital	0.00785***	0.00785***	0.000357***	0.000357***
	(0.000152)	(0.000152)	(0.0000283)	(0.0000283)
Fixed effects	year, year × country	year, year × country	quarter	quarter
N	2137205	2137205	602386	602386
R square	0.398	0.398	0.267	0.267

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ *p < 0.10,* * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

Note: Manufacturing defined as Nace 2-digit above 33. Regressions estimation Eq. 3. Regression (1) and (2) use yearly data for Spain, France, Germany and Italy for the period 1999 - 2020. Regression (3) and (4) use quarterly data for Belgium for the period 2010 – 2023.

Table A.3: Regression results – *Firms with more than 20 employees*

	(1) Yearly data *Δemployment*	(2) Yearly data *Δemployment*	(3) Quarterly data *Δemployment*	(4) Quarterly data *Δemployment*
$\Delta employement_{t-1}$	-0.0355***	-0.0352***	-0.188***	-0.188***
	(0.00387)	(0.00389)	(0.00333)	(0.00333)
Δoutput	0.248***	0.233***	0.0827***	0.0807***
	(0.00290)	(0.00237)	(0.00127)	(0.00141)
Δoutput × MP	0.0000829		-0.000236***	
	(0.000146)		(0.0000713)	
Δoutput × MP (MP > 0)		0.00146***		-0.000104
		(0.000206)		(0.0000831)
Δoutput × MP (MP ≤ 0)		-0.00272***		-0.00104***
		(0.000330)		(0.000274)
Δwage	-0.422***	-0.423***	0.00359+	0.00361+
	(0.0166)	(0.0167)	(0.00205)	(0.00205)
Δcapital	0.00594***	0.00596***	0.000352***	0.000352***
	(0.000175)	(0.000175)	(0.0000367)	(0.0000367)
Fixed effects	year, year × country	year, year × country	quarter	quarter
N	1306478	1306478	264631	264631
R square	0.345	0.345	0.269	0.269

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ *p < 0.10,* * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

Note: Regressions estimation Eq. 3. Regression (1) and (2) use yearly data for Spain, France, Germany and Italy for the period 1999 - 2020. Regression (3) and (4) use quarterly data for Belgium for the period 2010 – 2023.

Table A.4: Regression results – *Firms with 20 employees or less*

	(1) Yearly data *Δemployment*	(2) Yearly data *Δemployment*	(3) Quarterly data *Δemployment*	(4) Quarterly data *Δemployment*
$\Delta employement_{t-1}$	0.0529***	0.0527***	-0.168***	-0.168***
	(0.00236)	(0.00237)	(0.00300)	(0.00300)
Δoutput	0.338***	0.346***	0.102***	0.101***
	(0.00230)	(0.00213)	(0.00129)	(0.00139)
Δoutput × MP	-0.00106***		-0.000540***	
	(0.000119)		(0.0000550)	
Δoutput × MP (MP > 0)		-0.00179***		-0.000460***
		(0.000178)		(0.0000647)
Δoutput × MP (MP ≤ 0)		0.000306		-0.00102***
		(0.000283)		(0.000231)
Δwage	-0.547***	-0.547***	-0.0311***	-0.0311***
	(0.0145)	(0.0145)	(0.00183)	(0.00183)
Δcapital	0.0103***	0.0103***	0.000319***	0.000319***
	(0.000199)	(0.000199)	(0.0000342)	(0.0000342)
Fixed effects	year, year × country	year, year × country	quarter	quarter
N	1895000	1895000	511185	511185
R square	0.434	0.434	0.323	0.323

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ *p < 0.10,* * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

Note: Regressions estimation Eq. 3. Regression (1) and (2) use yearly data for Spain, France, Germany and Italy for the period 1999 - 2020. Regression (3) and (4) use quarterly data for Belgium for the period 2010 – 2023.

Table A.5: Regression results – *High vs. low skills (quarterly data)*

	(1) High skills *Δemployment*	(2) High skills *Δemployment*	(3) Low skills *Δemployment*	(4) Low skills *Δemployment*
$\Delta employement_{t-1}$	0.0841***	0.0841***	-0.185***	-0.185***
	(0.00739)	(0.00739)	(0.00240)	(0.00240)
Δoutput	0.0266***	0.0257***	0.105***	0.104***
	(0.00138)	(0.00159)	(0.00108)	(0.00117)
Δoutput × MP	-0.000309**		-0.000515***	
	(0.0000975)		(0.0000480)	
Δoutput × MP (MP > 0)		-0.000247*		-0.000466***
		(0.000114)		(0.0000562)
Δoutput × MP (MP ≤ 0)		-0.000667+		-0.000816***
		(0.000363)		(0.000196)
Δwage	-0.0365***	-0.0365***	-0.0141***	-0.0141***
	(0.00234)	(0.00234)	(0.00161)	(0.00161)
Δcapital	0.000487***	0.000487***	0.000315***	0.000315***
	(0.0000646)	(0.0000646)	(0.0000270)	(0.0000270)
Fixed effects	quarter	quarter	quarter	quarter
N	72872	72872	671346	671346
R square	0.123	0.123	0.333	0.333

Robust standard errors, clustered at the firm-level, in parentheses.
$^{+}$ p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001

Note: Regressions based on quarterly data for Belgium for the period 2010 – 2023.

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