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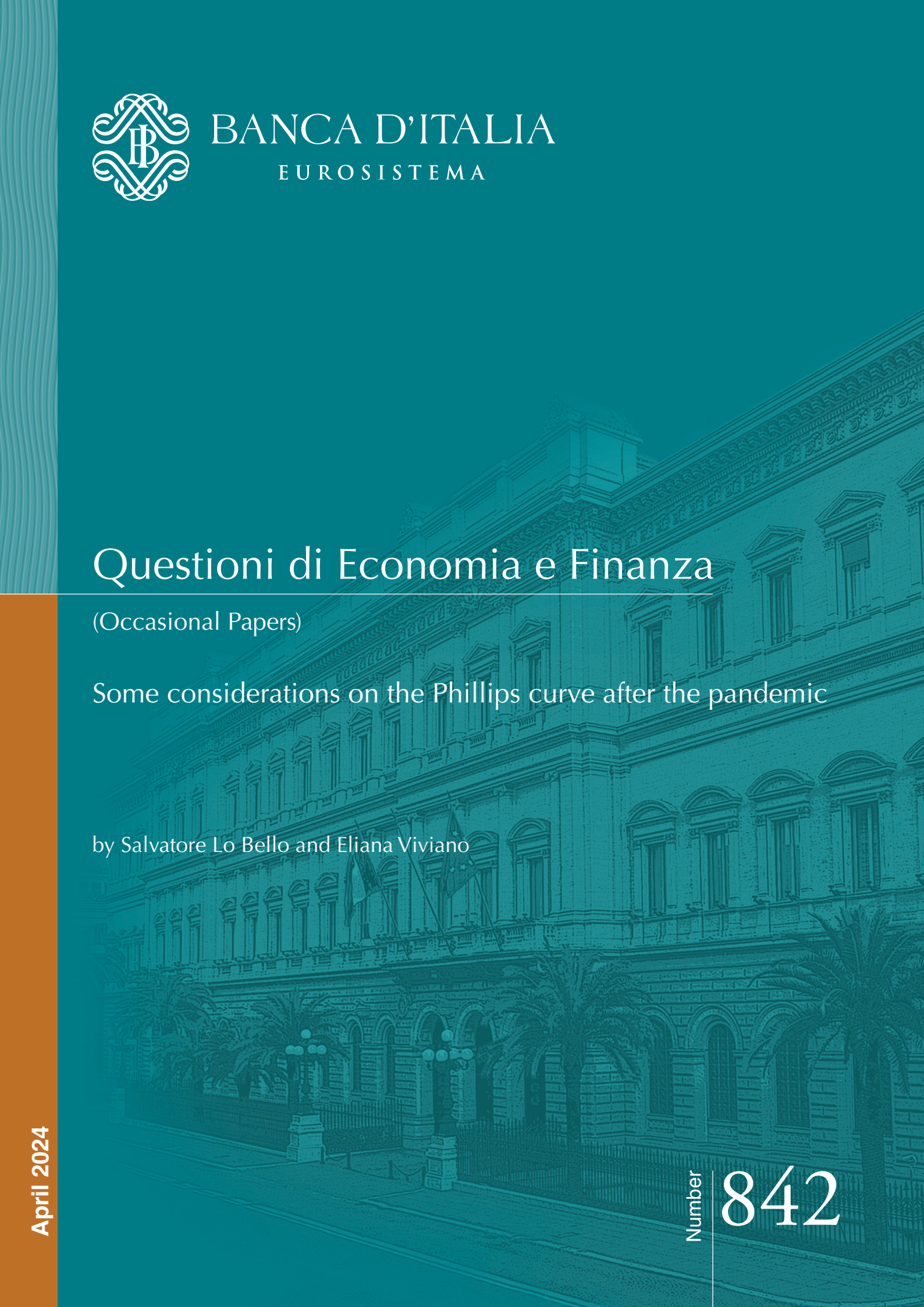

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SOME CONSIDERATIONS ON THE PHILLIPS CURVE AFTER THE PANDEMIC

by Salvatore Lo Bello* and Eliana Viviano*

Abstract

In the economic literature, the appropriateness of the Phillips curve as a potential tool for analysing the trade-off between price stability and unemployment (or the output gap) is often questioned. This paper briefly reviews the most recent contributions to the literature on the Phillips curve (especially after the pandemic) and offers some novel evidence for the euro area. In contrast with what was documented for the US economy, we find no clear evidence of a non-linear effect of labour market slack on wage inflation. However, we do find that a model including the dynamics of both the unemployment rate and labour market tightness, above and beyond their level, substantially helps predict wage inflation in the last years. This is consistent with a strand of the literature that claims that hysteresis in the labour market is important to explain wage growth. Using our preferred specification of the Phillips curve, we find that the historically high level of labour market tightness experienced in 2022-23 has not brought about significant wage pressures so far.

JEL Classification: E31, J31, J63, J64.

Keywords: wage inflation, unemployment, labor market tightness, economic slack.

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1. Introduction[1]

The Phillips curve is one of the fundamental building blocks behind the conduct of monetary policy. In the economic literature, however, the appropriateness of the Phillips curve as a potential tool for analysing the trade-off between price stability and unemployment (or the output gap) is often questioned. The debate about changes in the Phillips curve has intensified considerably in the aftermath of the Global financial crisis, when a large number of papers started to document a flattening of the Phillips curve. In the major advanced economies, the return of inflation and a labor market characterised by low unemployment have recently revitalised the debate. Thus, this paper reviews the most recent contributions to the literature on the Phillips curve (especially after the pandemic) and offers some novel evidence for the euro area. The main results are as follows:

- Several studies, mostly focused on the US, conclude that the Phillips curve may still be a useful framework, despite its failure to predict current inflation. A commonly held view is that non-linear effects, typically not included in the Phillips curve, may explain its poor predictive performance, especially after the pandemic. As such, their inclusion in the model may significantly boost the responsiveness of inflation to slack.
- Recent literature focuses also on additional measures of labor market slack, such as labor market tightness (i.e. the vacancy-to-unemployment ratio), as important determinants of wage inflation, above and beyond the effect of the unemployment rate.
- We find no clear evidence of non-linearities for the euro area. However, since the estimation of non-linear effects is empirically challenging as it requires long series with substantial variation, we argue that the available evidence does not allow for a definitive answer to this question.
- We do find instead that a model including both the dynamic of the unemployment rate and of labor market tightness, above and beyond their level, substantially helps at predicting wage inflation in the last years. This is consistent with a strand of the literature that claims that hysteresis in the labor market is important to explain wage growth.
- Using our preferred version of the Phillips curve, we uncover the sources of the recent wage dynamics in the euro area. According to our estimates, the historically high level of labor market tightness experienced in 2022-2023 did not bring about significant wage pressures so far.

2. Recent evolution of the Phillips curve

The Phillips embeds an inverse relationship between the inflation rate and the economy's slack. Concerning the inflation rate, different studies in the literature use interchangeably both wage and price inflation. Even though these two variables are highly correlated with one another, from a theoretical standpoint the reaction of the two types of inflation can potentially differ, depending on the specificities of the underlying model. In this note, following the original work of Phillips (1958), we focus exclusively on wage inflation.

Starting from the aftermath of the Great financial crisis (GFC), and until the Covid crisis, several papers have documented the flattening of the Phillips curve in most developed economies.[2] Indeed,

[1] We thank Gaetano Basso, Fabio Busetti, Alex Tagliabracci and Roberto Torrini for their valuable comments.
[2] Among many others, see Blanchard et al. (2015), Coibion and Gorodnichenko (2015), Ciccarelli and Osbat (2017) and Deroose and Stevens (2017).

the recovery following the GFC has been accompanied only by mild changes in the inflation rate, sometimes not in the expected direction. Several potential solutions to this puzzle have been proposed in the literature. The debate revolves around two main hypotheses:

(i) the shape of the Phillips curve may have changed, due to structural factors and/or the presence of non-linearities;
(ii) the unemployment rate may have become a poor measure of slack.

Some papers have related the flattening of the Phillips curve to increased monetary policy credibility and better anchoring of inflation expectations (e.g. Hazell et al. 2022, among many others). These forces have reduced the risks of prolonged second round effects, but contemporaneously have posed challenges for the identification of the Phillips curve parameters (McLeay and Tenreyro, 2020). Indeed, if central banks actively engage in policy interventions to correct deviations of inflation from the target, this mechanically induces a negative relationship between inflation and the output gap.

Other papers have pointed to structural changes that may put downward pressures on inflation, thereby weakening its relationship with slack. For instance, population ageing may have determined a negative trend in the natural interest rate, which in turn may cause a negative trend inflation in the case such forces are not taken into account by monetary policy (Carvalho et al., 2016). Similarly, it has been argued that technological change may have also dampened the response of prices and wages to marginal cost shocks, through an increase in automation and a less intensive use of the labor input. Another potential long-term factor may have been trade: globalization might have weakened the response of prices to domestic slack (see e.g. Borio and Filardo 2007). Indeed, Stock and Watson (2018) have shown evidence consistent with the view that prices are highly responsive to domestic conditions especially in sectors in which they are determined locally (typically in non-tradable services). Lombardi, Riggi and Viviano (2023) have argued that the flattening observed since the nineties is a consequence of the long-term decline in workers' bargaining power, which affects how firms adjust the extensive and intensive margins of labor utilisation: its decline has weakened the response of inflation to fluctuations in the output gap. Finally, recent studies have focused on the impact of market power in a setting with heterogeneous firms (Baqaee, Farhi and Sangani, 2021): lower competition in the output market allows firms to obtain higher markups and better absorb cost-push shocks.

Another strand of the literature emphasizes the fact that external factors, such as supply shocks not properly accounted for within the Phillips curve framework, may have caused a weakening of the estimated relationship. For instance, Ciccarelli and Osbat (2017) and Deroose and Stevens (2017) have argued that the low-inflation regime in the euro area was primarily due to a mix of a negatively-sloped trend inflation, an increase in inflation persistence and the occurrence of domestic and international supply shocks.

More recently, to explain the rapid increase in inflation after the Covid crisis, Bernanke and Blanchard (2023a) and Gopinath (2023) claim that the US inflation surge has been due to a rapid and unexpected increase in input prices, quickly amplifying through the global value chain. Relatedly, some commentators argue that the severe disruptions in global supply chains during Covid may have increased again the slope of the Phillips curve with respect to the pre-pandemic period. This is the hypothesis of Ari et al. (2023), who test it on US and EA data (including Italy). They find evidence of a steepening of the Phillips curve in some countries, but admit that their model does not fully explain recent inflation dynamics. Neri et al. (2023) estimate a price Phillips curve with time varying coefficients, energy prices and a wide set of indicators of economic slack. They find that in the euro area the correlation between prices and slack has not changed much.

A growing number of recent papers have focused on possible non-linearities in the relationship between slack and inflation. For the euro area, Busetti et al. (2021) find supportive evidence of non-linear effects of the output gap, documenting that its estimated impact is larger in the right tail of the conditional distribution of inflation. Benigno and Eggertsson (2023) estimate a price Phillips curve for the US and they measure slack by the use of the vacancy/unemployment ratio (labor market tightness). They find a steepening of the price Phillips curve after the pandemic, due to significant non-linearities, and propose a model that generates a Phillips curve with such characteristics. In standard search and matching models, wages are a function of labor market tightness, which is an index of the strength of competition for workers across firms. In Benigno and Eggertsson (2023), non-linearities in this relationship are generated by the introduction of downward wage rigidities. When labor demand is high, firms outbid one another in order to attract workers, determining fast wage growth; on the contrary, when labor demand is low, workers are reluctant to accept wage cuts, ultimately curbing the drop in wages. Based on their estimates, they also conclude that, given the currently high tightness, the costs of disinflating the US economy (i.e. of reducing tightness) could be low. Empirically, Ball et al. (2022) show that allowing for non-linearities can significantly improve the performance of the Phillips curve in the post-pandemic period. Similarly, both Gopinath (2023) and Bernanke and Blanchard (2023a) argue that a very tight labor market may have strong and long-lasting effects on inflation, pointing at the existence of a non-linear relationship. In Bernanke and Blanchard (2023a), labor market shocks have persistent effects because they jointly affect the wage setting and the expectations about future inflation. Finally, non-linearities in the Phillips curve may also stem from the workings of product markets. Harding et al. (2023) show that a quasi-kinked demand structure induces firms to revise their prices upwards, at a much faster rate when inflation is already high, due to the change in demand elasticity.

Another hot debate is about which variables are best at capturing economic slack. Barnichon and Shapiro (2022) compare the different indicators of slack in the US and find that the vacancy-unemployment ratio better explains price inflation in the period 1995-2021. Domash and Summers (2022) use time-series and cross-section data to compare alternative labor market indicators as predictors of wage inflation and find that an indicator that combines both the unemployment rate and the vacancy and quit rates is a good predictor for wage growth in the US. They also show that their indicator captures US wage dynamics in early 2023 in a standard Phillips curve framework (Domash and Summers, 2023), and conclude that since their indicator of slack is at a very high level, the risks of a "hard landing" for the US economy are also quite high (Domash and Summers 2022).

3. Empirical evidence for the euro area

We first investigate whether additional variables of labor market slack, beyond the unemployment rate, help at predicting wage inflation in the euro area. To do so, we estimate a basic version of the Phillips curve in which the only measure of slack is the unemployment rate (Equation 2), and compare its predictive capability to that of a model that also includes the intensive margin (hours per worker, as in Bulligan and Viviano, 2017) and a measure of labor market tightness, computed as the ratio between the number of vacancies and that of unemployed workers (Equation 3).[3] We estimate the following equations:

$$\pi_{w,t} = \alpha + \beta u_t + \gamma \pi_{p,t} + \delta E_t \pi_{p,t+4} + \varphi z_t + \varepsilon_t, \qquad (2)$$

[3] This is a key variable in most search and matching models; see Michaillat and Saez (2022) for a recent survey.

$$\pi_{w,t} = \alpha + \beta_1 u_t + \beta_2 \frac{H_t}{E_t} + \beta_3 \theta_t + \gamma \pi_{p,t} + \delta E_t \pi_{p,t+4} + \varphi z_t + \varepsilon_t, \qquad (3)$$

where $\pi_{w,t}$ is wage inflation (annualized quarterly growth rate of hourly wage), u_t is the unemployment rate pre-filtered with an HP filter, $\pi_{p,t}$ is price inflation (annualized quarterly growth rate of the HICP), $E_t \pi_{p,t+4}$ are 1-year-ahead inflation expectations, z_t is labor productivity dynamics (annualized quarterly growth rate of value added per hour), $\frac{H_t}{E_t}$ is the intensive margin (average hours per worker) pre-filtered with an HP filter,[4] and θ_t is labor market tightness. All variables are at quarterly frequency. The sample period varies by country depending on data availability (for details see Table 1). Finally, we also add to the model a set of 4 lags of each variable and an autoregressive term.

In order to study whether the relevance of these variables has changed in the last years, we repeat the estimation over two sample periods: until the end of 2019[5] (pre-Covid), and including all most recent observations (post-Covid). For each model we compute the adjusted R^2 statistics, a measure of the goodness of fit. Results reported in Table 1 reveal that accounting for additional variables measuring labor market slack – i.e. the intensive margin and labor market tightness – is important to predict wage inflation in the euro area. Indeed, the predictive capability of models including these additional variables is substantially higher than that of a model that only exploits variation in the unemployment rate. For instance, for the euro area the adjusted R^2 of the Phillips curve estimated over the period 2009Q1-2023Q2 increases from 0.83 to 0.95 when adding these other measures of slack. When looking at the single countries, we find an important degree of heterogeneity: the gains from using these additional variables are very large for Germany (the adjusted R^2 increases from 0.60 to 0.84) and for Spain (from 0.77 to 0.94), whereas they are more limited for France and Italy. For the latter countries, only the intensive margin seems to be a useful predictor of wage inflation, echoing results of Bulligan and Viviano (2017). In general, we notice that the gains from adding both additional variables are much smaller than the sum of the gains of adding each variable at the time, suggesting a positive correlation between the intensive margin and the labor market tightness.

[4] Results are nearly unchanged if use unfiltered data (both for the intensive margin and the unemployment rate).
[5] Unfortunately, vacancy data are not available prior to 2009 for the euro area and prior to 2010 for Germany and Spain. Therefore, our historical analysis is somewhat limited by these data requirements.

Table 1 – Goodness of in-sample fit of the wage Phillips curve

Country	Sample period	Adjusted R^2			
		Equation 2	Equation 3 Only $\frac{H_t}{E_t}$	Equation 3 Only $\boldsymbol{\theta_t}$	Equation 3 Both $\frac{H_t}{E_t}$ and $\boldsymbol{\theta_t}$
Euro area	2009Q1-2019Q4	0.10	0.20	0.39	0.20
	2009Q1-2023Q2	0.83	0.94	0.87	0.95
Germany	2010Q4-2019Q4	-0.67	0.58	-0.25	0.90
	2010Q4-2023Q2	0.60	0.79	0.83	0.84
France	2003Q2-2019Q4	0.45	0.42	0.53	0.50
	2003Q2-2023Q2	0.94	0.97	0.62	0.71
Spain	2010Q1-2019Q4	0.33	0.48	0.18	0.44
	2010Q1-2023Q2	0.77	0.87	0.83	0.94
Italy	2004Q1-2019Q4	0.12	0.15	0.11	0.13
	2004Q1-2023Q2	0.46	0.55	0.50	0.57

Source: Eurostat, Consensus (for inflation expectations); own calculations.

Having established that the intensive margin and labor market tightness are important determinants of wage inflation in the euro area, we now study whether changes in the shape of the Phillips curve, possibly occurring in the latest period, can be detected in the data. To do so, we first estimate the Phillips curve in Equation (3) – i.e. the one including the additional measures of slack – for the euro area and for each of the four largest countries up to 2017Q4;[6] we then use the estimated coefficients to predict wage inflation out-of-sample for the subsequent quarters.[7] If the shape of the curve did not change over time, then we would expect the model to generate relatively accurate predictions also for the following quarters.

Figure 1 (panel a) reveals that the performance of the Phillips curve has significantly worsened in the period 2019-2023. In particular, the model largely misses the dynamics of wage inflation both at the onset of the pandemic and during the subsequent recovery, with different-sign errors across countries. Among other things, the pandemic triggered a strong response in labor demand, with a sudden drop in the vacancy rate and a consequent rise in the unemployment rate in several countries (Figure A1).[8] This caused a marked drop in labor market tightness, which was followed by a very quick recovery in 2022 (Figure 1, panel b). In particular, labor market tightness reached unprecedented levels since the start of the time series.

This brings the question whether these pronounced dynamics of labor market tightness, which in theory are linked to wage dynamics, are properly accounted for by the wage Phillips curve. For

[6] We limit our estimating sample to 2017 because we are interested in testing whether the out-of-sample performance of the model worsens already prior to the pandemic crisis (in 2018 or 2019).

[7] For the euro area, Germany and Spain, the regression models do not include labor productivity. This is due to the limited number of available observations, which would not allow to identify the parameters.

[8] In a number of countries, the response of the unemployment rate was also confounded by the response of labor supply, i.e. discouragement effects. For instance, in Italy these counterveiling effects were so strong that unemployment actually *declined* (D'Amuri et al., 2022).

instance, this may not be the case in the presence of strong non-linearities that are not accommodated by the model. To study whether the data suggests the presence of significant non-linearities, we study the correlation between the dynamic of the residuals of the Phillips curve and that of labor market tightness. Figure 2 shows the lack of positive correlation between the two series, denying support to the existence of non-linear effects that materialize at very high levels of tightness (see Figure A2 for the same graph for the single countries). A more general way to test whether the empirical evidence is supportive of non-linearities is to inspect the scatter plot of wage inflation vis-a-vis labor market slack, as in Benigno and Eggertsson (2023). Contrary to the findings for the US, Figures 3 and 4 show that non-linearities cannot be detected for the euro area: even at very high levels of tightness – above the 75th percentile of its distribution – the relationship with wage inflation remains relatively flat.[9] Figure A3-A6 repeat the same experiment distinguishing before and after the Covid crisis, confirming that non-linearities with respect to the tightness are not easily detectable, but uncovering some mild evidence of non-linearities in the unemployment rate. However, the patterns of the single countries make clear that the steepening of the curve is mainly due to a very limited number of observations, right at the onset of the pandemic, with values well out of the historical range of variation.[10] Indeed, excluding the observations of the years 2020 and 2021 causes the disappearance of such non-linearities for all countries except for France (Figure A7).

In order to formally test for whether these non-linearities can actually explain the failure of the Phillips curve to predict current wage inflation, we estimate again Equation (3) allowing for non-linear terms and then evaluate the predictive out-of-sample performance of these enhanced models. We have experimented different versions of the Phillips curve including additional elements: an interaction term between labor market tightness and a dummy indicating whether the value of tightness is above/below the median, the same interaction with a dummy indicating above/below the 75th percentile, a quadratic polynomial of tightness, a quadratic polynomial of the unemployment rate, and others.[11] Our estimates indicate that none of the variations of the Phillips curve clearly outperforms the version in which only linear terms are included (see Figure 5 for the results for the euro area for a selection of these models[12]).

4. New problems, old answers? Possible directions for future research

Overall, we do not find evidence that non-linear effects of labor market slack are one of the reasons for the poor performance of the Phillips curve in the latest time period for the euro area. However, it is possible that the relatively little variation in labor market tightness before the Covid crisis does not allow the estimated model to properly identify non-linear effects, consistent with the arguments made by Hooper et al. (2019). Therefore, more research is needed in order to gauge the extent of these possible non-linearities in the Phillips curve.

We believe however that other possible specifications are worth analysing in the current context. An important strand of the literature dating back to the 80's argues that in the presence of *hysteresis* – i.e. the phenomenon for which slack variables are highly persistent over time – it is necessary to include in the Phillips curve the time change of these variables on top of their level (see for instance

[9] Results are very similar if we consider the split above/below the median.
[10] Importantly, these observations may be contaminated by measurement issues related to the way statistical agencies accounted for the use of short-time working schemes.
[11] These alternative models are estimated using data until 2019Q4, in order to maximize the available observations to identify the additional parameters.
[12] Very similar results were found for the single countries.

Gordon, 1989; Bodo and Sestito 1991, for Italy). This procedure guarantees to properly account for the evolution over time of the natural level of these variables.[13]

Therefore, we investigate whether incorporating changes of the slack variables over time helps at improving the fit. We first study the correlation between $\boldsymbol{\Delta u_t}$, $\boldsymbol{\Delta \theta_t}$ and $\boldsymbol{\Delta \frac{H_t}{E_t}}$, in order to understand whether these variables can in principle provide different sources of information to the estimation. [14] Table 2 reveals that the most robust feature is the marked negative correlation between $\boldsymbol{\Delta u_t}$ and $\boldsymbol{\Delta \theta_t}$, which is visible in all major countries (Figures 6 and A8). At least in part, this correlation is mechanical, precisely due to the fact that the unemployment rate appears at the denominator of the labor market tightness indicator. However, we stress that the estimated correlation coefficients range between -0.3 and -0.6, significantly far from perfect (negative) correlation, implying a substantial degree of variation in the vacancy rate (the numerator of the tightness ratio). In turn, the time change in the intensive margin of labor utilization – i.e. hours per worker – is correlated with the time change in the unemployment rate only in France and Italy. Finally, the correlation between the time change in labor market tightness and the intensive margin is positive, reflecting the fact that firms expand (or shrink) their labor input by simultaneously adjusting both the hiring margin and the amount of hours worked by the incumbent workers.[15] Overall, these results suggest that the different slack variables provide at least partly independent information, so that the addition of these variables can potentially improve the performance of the Phillips curve.

Table 2 – Correlation of time changes of slack variables

	Euro area	Germany	France	Spain	Italy
Corr($\boldsymbol{\Delta u_t}$, $\boldsymbol{\Delta \theta_t}$)	-0.47***	-0.63***	-0.49***	-0.50***	-0.29*
Corr($\boldsymbol{\Delta u_t}$, $\boldsymbol{\Delta \frac{H_t}{E_t}}$)	0.11	-0.17	0.50***	-0.05	0.40***
Corr($\boldsymbol{\Delta \theta_t}$, $\boldsymbol{\Delta \frac{H_t}{E_t}}$)	0.43***	0.44**	-0.32**	0.47***	0.07

Source: Eurostat, Consensus (for inflation expectations); own calculations.

We estimate again Equation (3) by adding $\boldsymbol{\Delta u_t}$, $\boldsymbol{\Delta \theta_t}$ and $\boldsymbol{\Delta \frac{H_t}{E_t}}$ as additional variables, along with their set of lags. We find that the Phillips curve augmented by the time change of the unemployment rate and of labor market tightness does significantly better than the baseline curve (see Table 3, and Figures 7 and A9). Indeed, as shown in Table 3, the root mean squared error of the predictions, reported separately by year, shrink quite considerably with the specifications including either the unemployment rate or the tightness (or both).

[13] Filtering the data is an alternative way to implicitly estimate the natural level of the slack variables.
[14] We follow the assumptions of Gordon (1989), under which taking first differences suffices to deal with the time-varying nature of natural levels. Consequently, in this part of the analysis we use unfiltered data for the unemployment rate.
[15] Note that, when adding the 1-period lag of the time change of labor market tightness, the correlation turns positive also for France and Italy, suggesting a more sluggish intensive margin adjustment than in the other countries.

Table 3 – Root mean squared error of different wage Phillips curve, euro area

	Specification (slack variables)						
Year	Baseline	Δu_t	$\Delta \theta_t$	$\Delta \frac{H_t}{E_t}$	Δu_t, $\Delta \theta_t$	Δu_t, $\Delta \frac{H_t}{E_t}$	$\Delta \theta_t$, $\Delta \frac{H_t}{E_t}$
2020	39.92	15.96	12.66	11.63	9.65	11.60	16.02
2021	38.65	6.22	11.29	12.51	13.34	12.44	21.09
2022	15.67	5.06	9.03	12.62	6.55	12.57	19.60
2023 (Q1-Q2)	12.01	6.07	2.29	2.91	0.53	2.88	7.91

Source: Eurostat, Consensus (for inflation expectations); own calculations.

Therefore, it seems that the dynamic of these variables– that is, whether and how quickly they are growing or shrinking – is a useful predictor of wage pressures, above and beyond the sheer effect of their level. This is particularly evident in the post-Covid period (2022-2023); see Figures A10-A11. Overall, the specification including both Δu_t and $\Delta \theta_t$ seems to outperform the others across the board, whereas the variable $\Delta \frac{H_t}{E_t}$ stands out as important only for France and Italy. However, we also stress that the average prediction error remains relatively high in most cases, highlighting the difficulty of forecasting wage dynamics during the Covid crisis and its recovery.

We use our preferred model, which is the one including the time change of both the tightness and the unemployment rate, to investigate the drivers of recent wage dynamics.[16] To do so, we perform a Yellen decomposition, that splits the explained variation of the dependent variable into components attributable to changes in the different covariates. We apply the decomposition to the in-sample predictions of the model (Equation 3) estimated over the full period and we sum all the lags of each variable.

As shown in Figure 8, the variables capturing slack (unemployment rate, tightness, hours per worker) were important determinants of the wage dynamics over the whole period. Starting in 2022, the dynamics of price inflation have become progressively more important. This is consistent with results of Bernanke and Blanchard (2023b) that documents a large pass-through of price inflation on wage inflation for the euro area.[17] An important takeaway from Figure 8 is that, according to our model, the high tightness of labor markets has not exerted strong pressures on wages. This reflects the absence of non-linear effects of the tightness on wage inflation for the euro area, as documented in this paper, differently from what was found for the US economy (see Benigno and Eggertsson, 2023).

The relatively little role played by the high levels of tightness after the pandemic is also confirmed by comparing its estimated coefficients (from Equation 3) over the full sample to those estimated using the pre-Covid sample only: the effect of the tightness markedly drops when one adds to the sample the observations of the period 2020-2023 (Figure 9).[18] This implies that, given the observed

[16] Results are robust to using the different specifications of the Phillips curve.
[17] Bernanke and Blanchard (2023b), in particular, document that wage inflation follows price inflation with a substantial time lag.
[18] In contrast, the change in the coefficients of the other variables is comparatively smaller.

level of tightness, the observed wage inflation during the pandemic recession was much lower than what would have been predicted using models estimated on older data (i.e. until 2019Q4). This flattening is not easy to explain and can be probably connected to the results of Lombardi, Riggi and Viviano (2023), i.e. that the lower the workers' bargaining power, the higher the propensity of firms to adjust the extensive margin of labor utilization (relative to the intensive one) i.e. to create new vacancies.

5. Conclusions

This short note provides evidence that the most recent wage dynamics in the euro area are better captured by specifications of the Phillips curve that include: i) multiple slack variables; and ii) time changes of these variables. With respect to the latter, this is consistent with a strand of literature that claims that hysteresis is a relevant phenomenon in the labor market. Indeed, hysteresis implies that the natural level of slack (that is, of both the unemployment rate and of labor market tightness) changes over time in response to shocks. If that is the case, then using the raw variables, or residualizing the time series using standard filtering techniques, does not yield a correct measure of slack. In order to correct for this, as shown by Gordon (1989) and Bodo and Sestito (1991), it is necessary to include time changes of the slack variables as additional regressors. This implies that the *direction of change* of these variables, above and beyond their sheer level, matters for wage dynamics. Therefore, while more research is needed in order to further improve the Phillips curve specification and to confirm the overall validity of our results beyond the Covid crisis, we offer some preliminary evidence that adding time changes of the slack variables to the regression may be a fruitful avenue to pursue.

Leveraging our preferred model, that is the one including the time change of both the tightness and the unemployment rate, we offer novel insights on the source of wage pressures in the euro area. Our estimates reveal the high level of tightness of the labor markets has not translated into strong wage pressures so far. This suggests that the cooling of the labor market in the euro area does not seem a first-order issue in order to keep inflation pressures under control.

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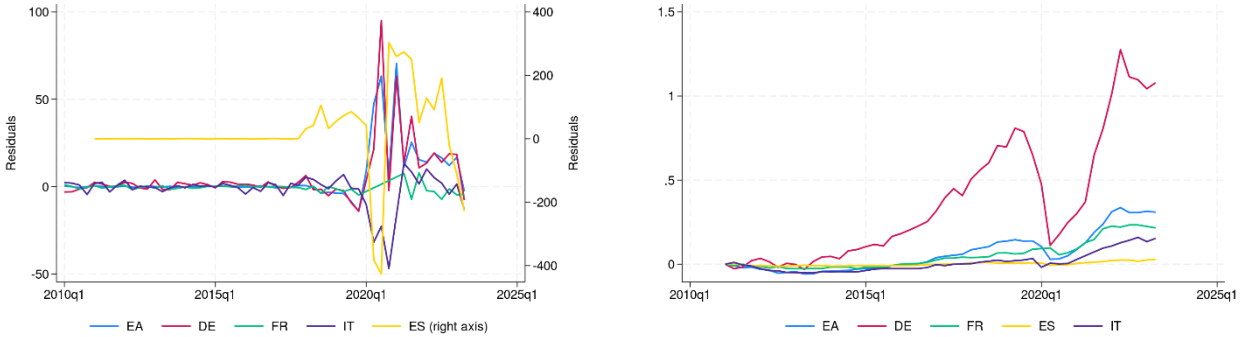
Figures

Figure 1

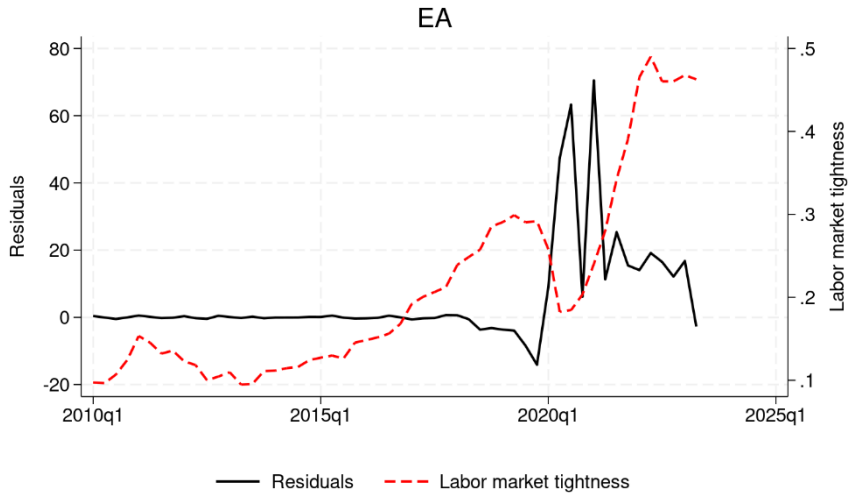
a) OLS residuals of the Wage Phillips curve

b) Labor Market Tightness



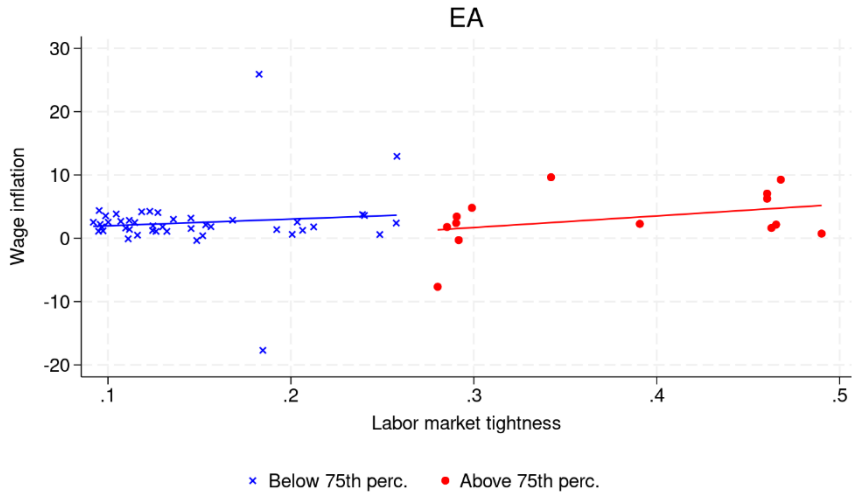
Source: Eurostat, Consensus (for inflation expectations); own calculations. Panel a: the wage Phillips curve is estimated using data until 2017Q4. Panel b: labor market tightness is defined as the ratio between the vacancies and the number of unemployed. The values of tightness are expressed in difference from their level in 2011Q1.

Figure 2. Residuals of the Phillips curve and labor market tightness in the euro area



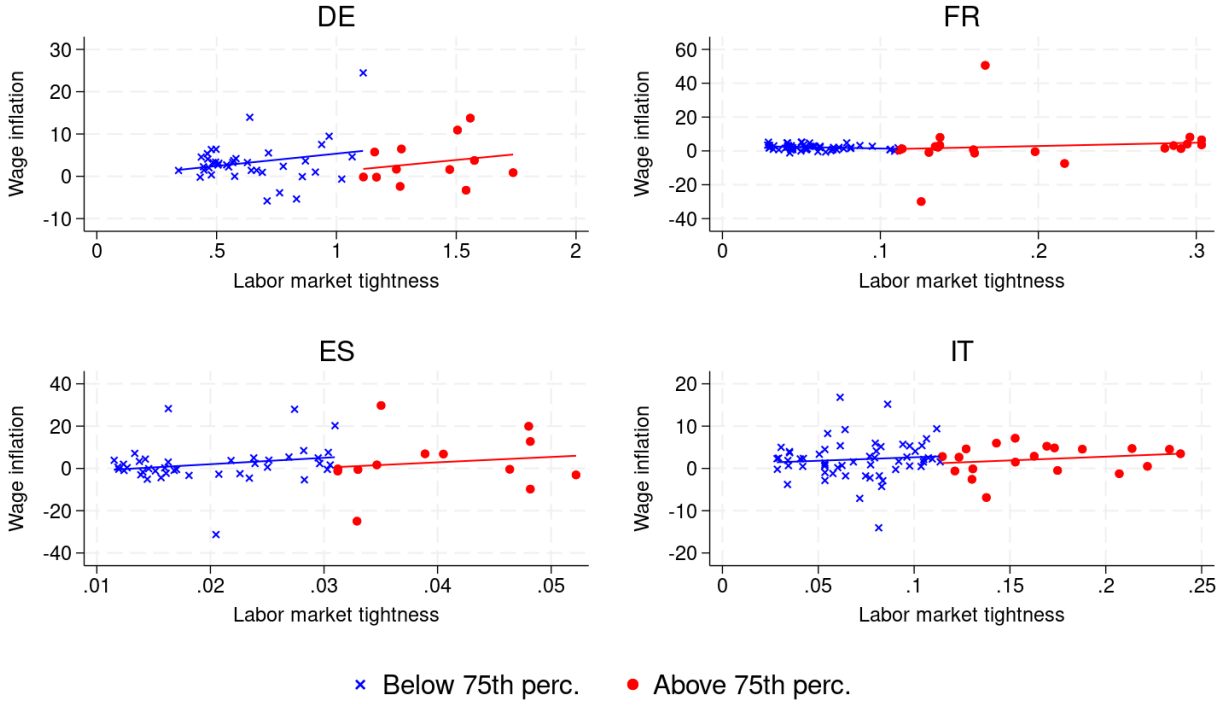
Source: Eurostat, Consensus (for inflation expectations); own calculations. The wage Phillips curve is estimated using data until 2017Q4. Labor market tightness is defined as the ratio between the vacancies and the number of unemployed.

Figure 3. Relationship between wage inflation and tightness, euro area



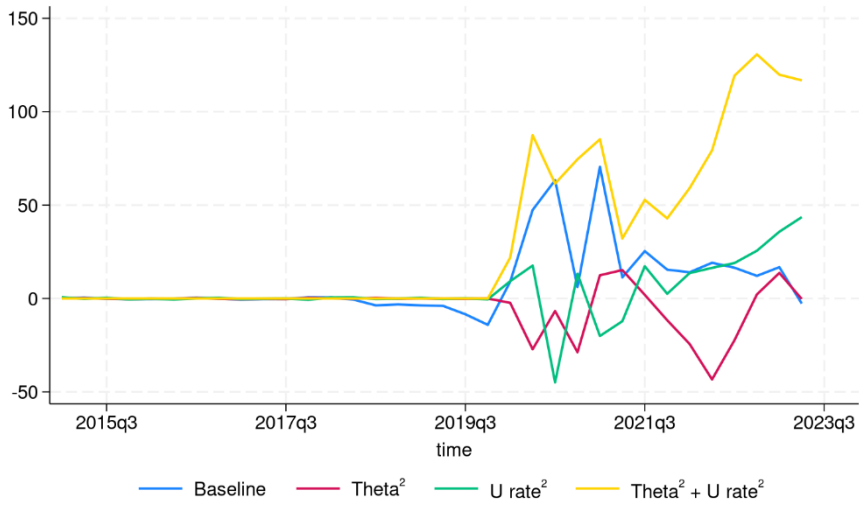
Source: Eurostat; own calculations. Wage inflation is the annualized quarterly growth rate of the hourly wage. Labor market tightness is defined as the ratio between the vacancies and the number of unemployed.

Figure 4. Relationship between wage inflation and tightness, EA main countries



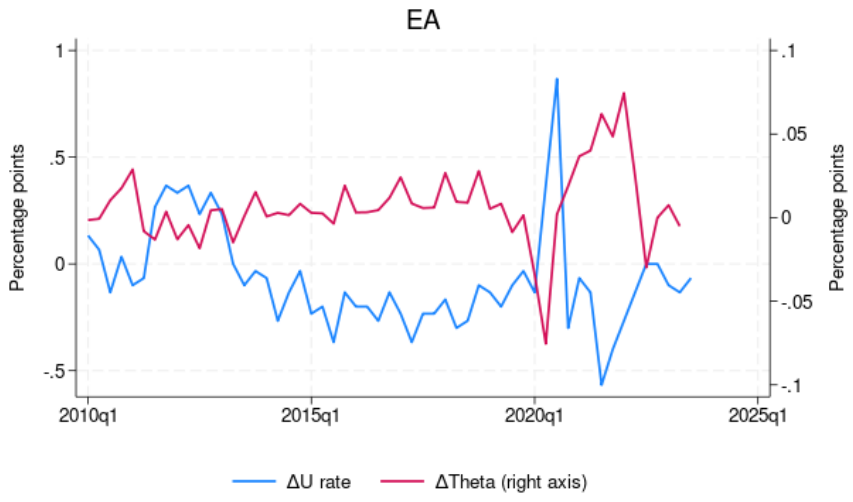
Source: Eurostat; own calculations. Wage inflation is the annualized quarterly growth rate of the hourly wage. Labor market tightness is defined as the ratio between the vacancies and the number of unemployed.

Figure 5. OLS Residuals of different wage Phillips curves, euro area



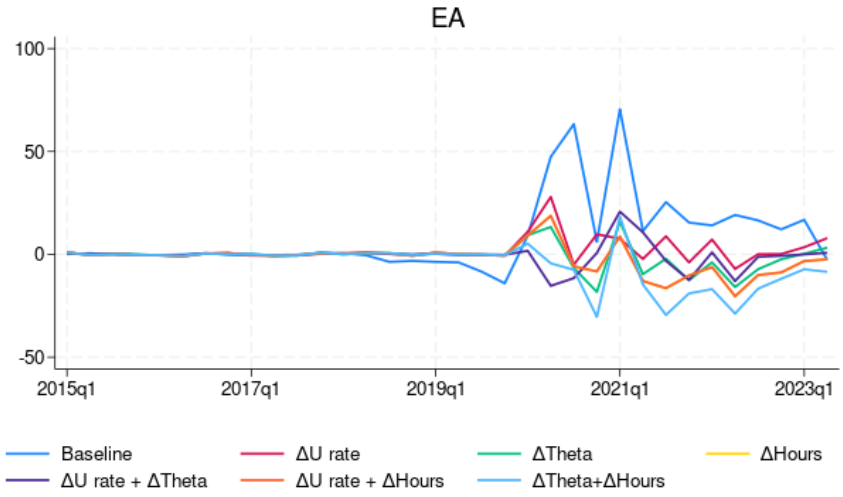
Source: Eurostat, Consensus (for inflation expectations); own calculations. The wage Phillips curve is estimated using data until 2019Q4.

Figure 6. Correlation between Δu_t and $\Delta \theta_t$, euro area



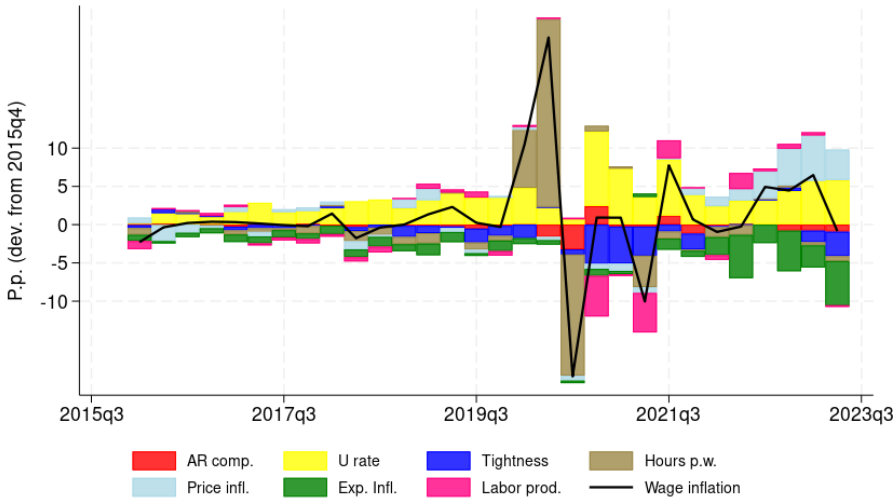
Source: Eurostat; own calculations.

Figure 7. OLS Residuals of different wage Phillips curves, euro area



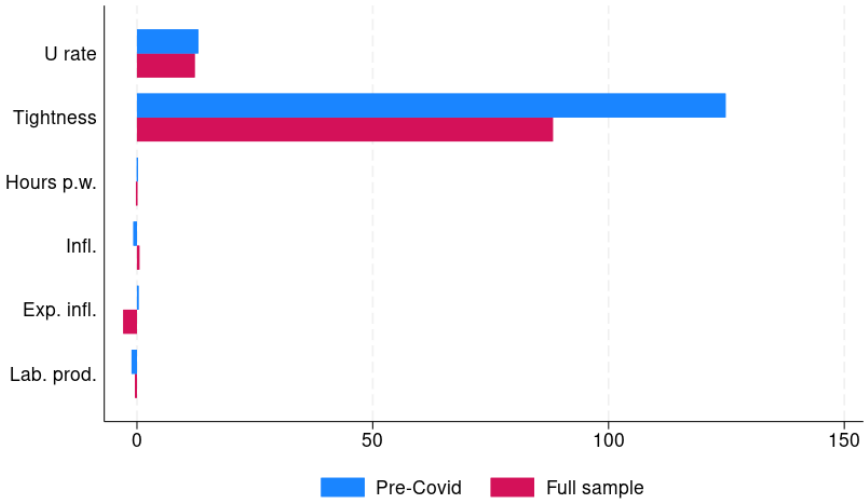
Source: Eurostat, Consensus (for inflation expectations); own calculations. The wage Phillips curve is estimated using data until 2019Q4.

Figure 8. Yellen decomposition of wage growth predictions (Phillips curve)



Source: Eurostat, Consensus (for inflation expectations); own calculations. The wage Phillips curve is estimated using data until 2023Q2.

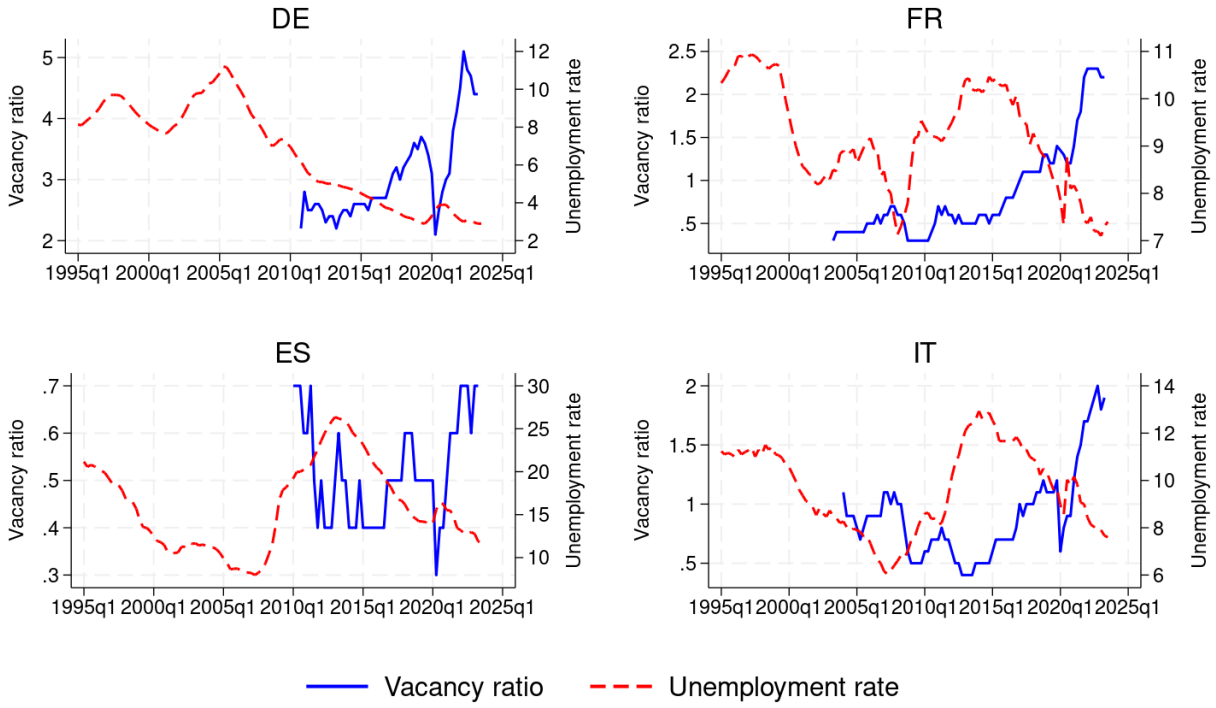
Figure 9. Estimated coefficients of the Phillips curve



Source: Eurostat, Consensus (for inflation expectations); own calculations. The 'pre-Covid' wage Phillips curve is estimated using data until 2019Q4. The 'full sample' wage Phillips curve is estimated using data until 2023Q2. For each variable we cumulate the coefficients of the lags and of the time change (current and lagged).

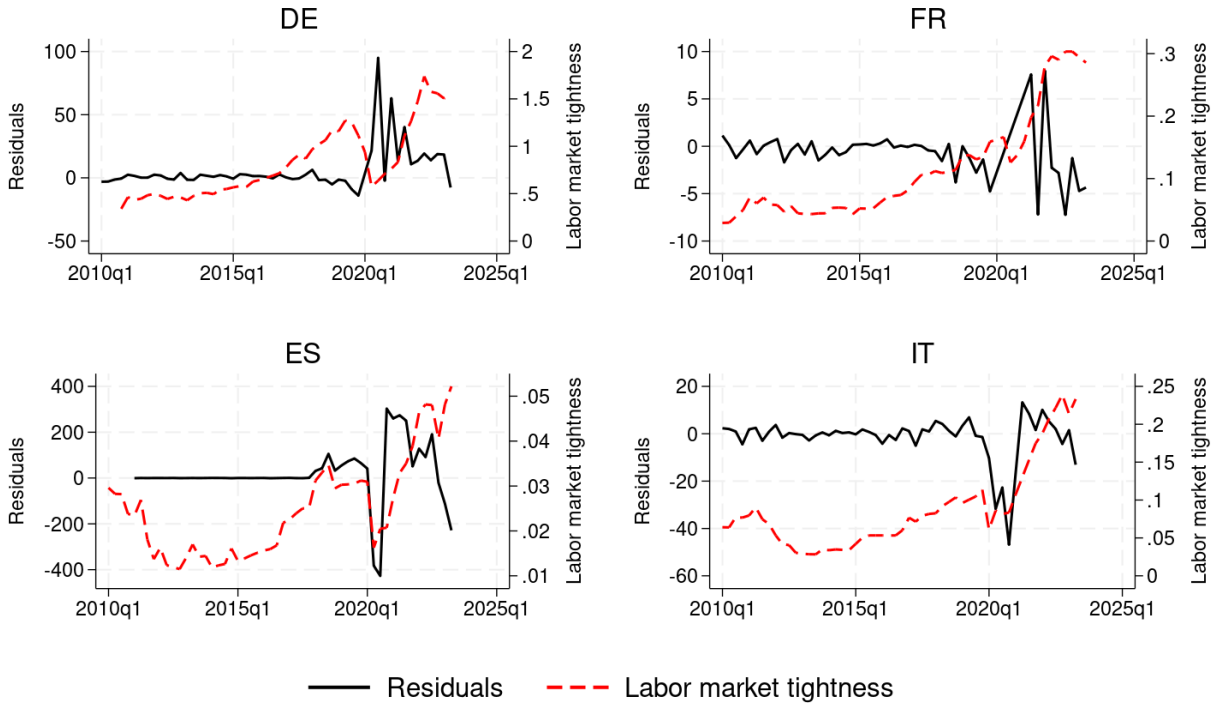
Appendix – Other Figures

Figure A1. Relationship between the vacancy ratio and the unemployment rate, EA main countries



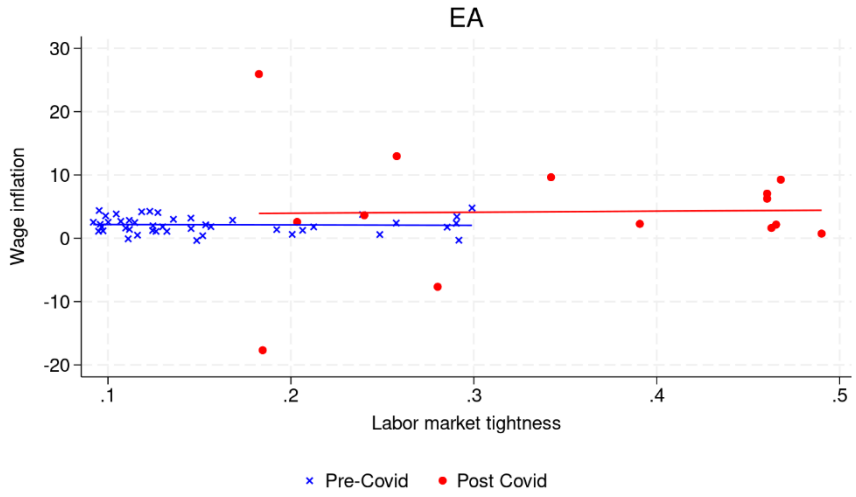
Source: Eurostat, Consensus (for inflation expectations); own calculations. The vacancy ratio is defined as the ratio between the number of vacancies and total jobs (occupied or vacant).

Figure A2. Residuals of the Phillips curve and labor market tightness in the euro area, main countries



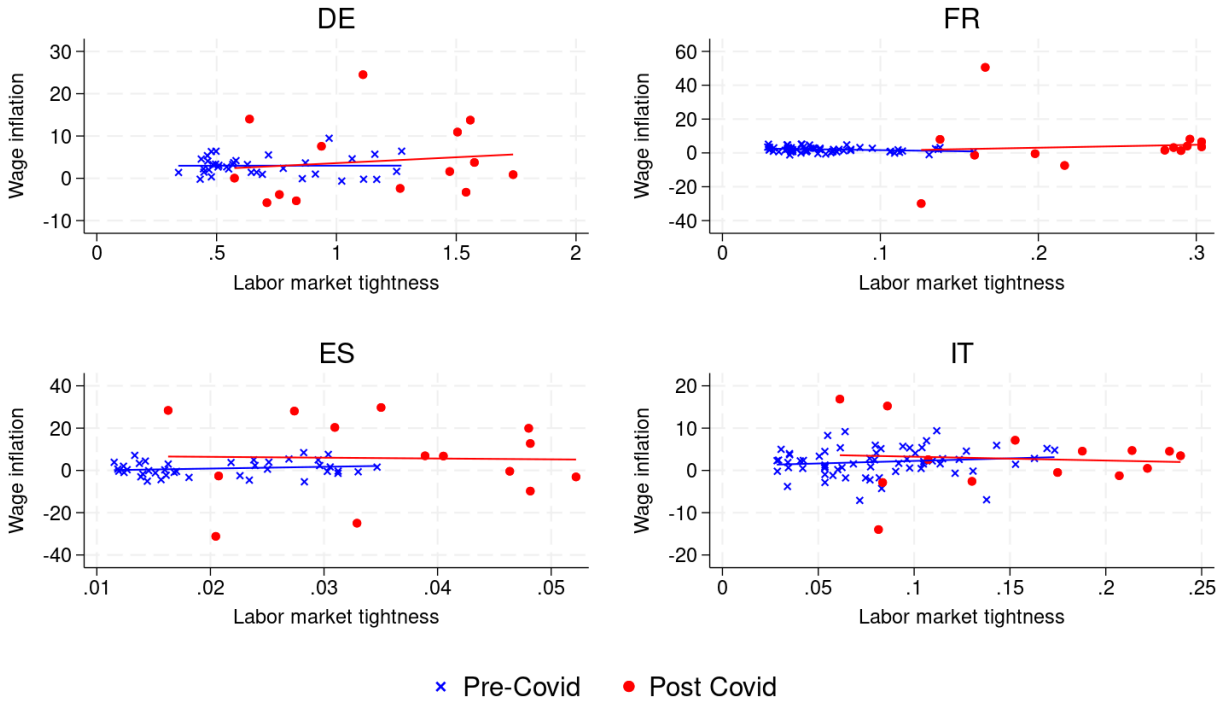
Source: Eurostat, Consensus (for inflation expectations); own calculations. The wage Phillips curve is estimated using data until 2017Q4. Labor market tightness is defined as the ratio between the vacancies and the number of unemployed.

Figure A3. Relationship between wage inflation and tightness, euro area



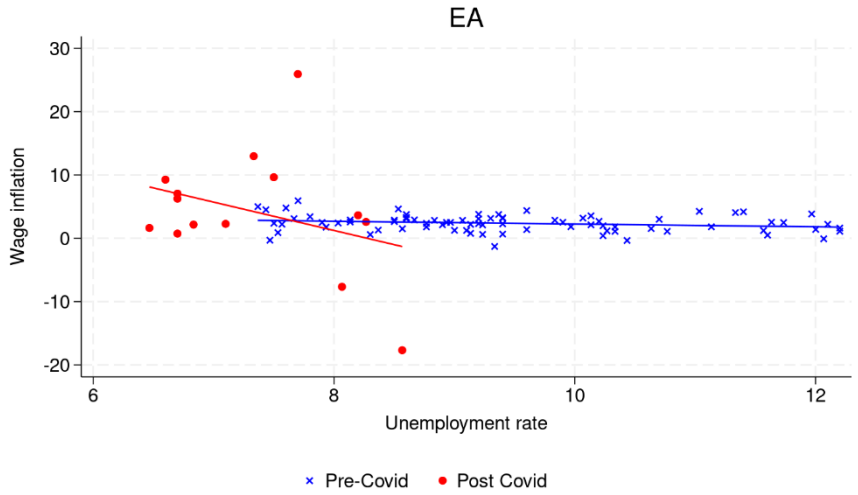
Source: Eurostat; own calculations. Wage inflation is the annualized quarterly growth rate of the hourly wage. Labor market tightness is defined as the ratio between the vacancies and the number of unemployed.

Figure A4. Relationship between wage inflation and tightness, EA main countries



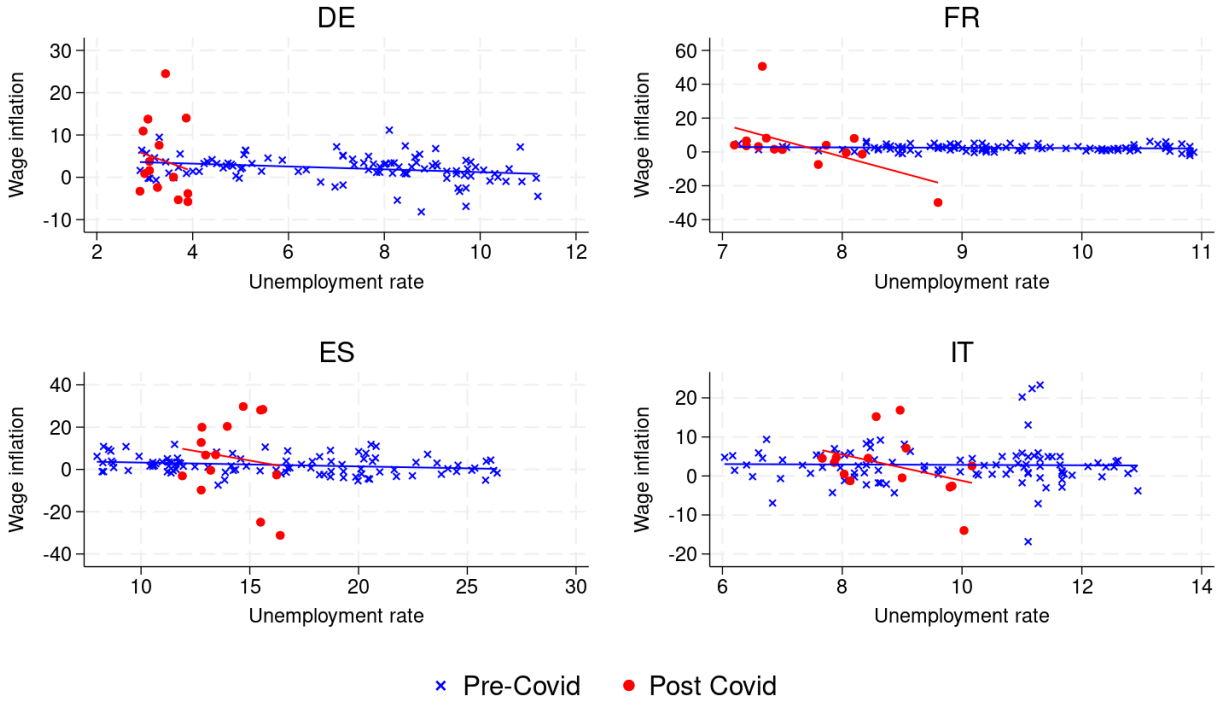
Source: Eurostat; own calculations. Wage inflation is the annualized quarterly growth rate of the hourly wage. Labor market tightness is defined as the ratio between the vacancies and the number of unemployed.

Figure A5. Relationship between wage inflation and unemployment rate, euro area



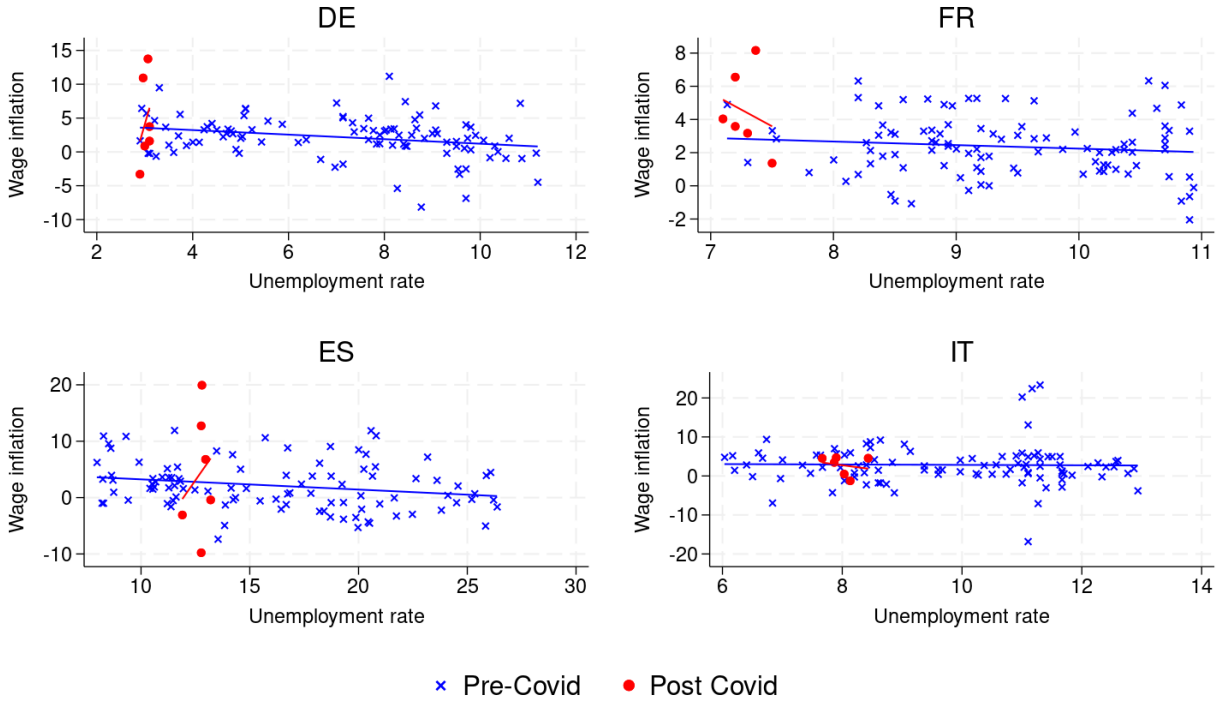
Source: Eurostat; own calculations. Wage inflation is the annualized quarterly growth rate of the hourly wage.

Figure A6. Relationship between wage inflation and unemployment rate, EA main countries



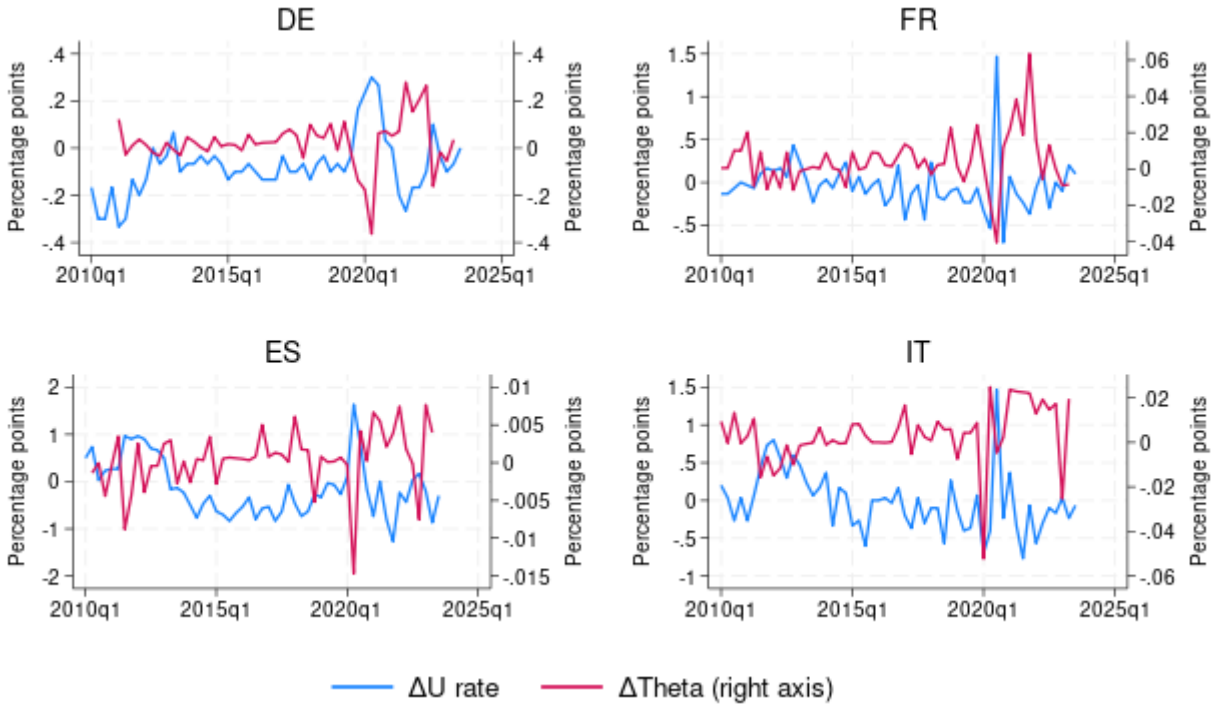
Source: Eurostat; own calculations. Wage inflation is the annualized quarterly growth rate of the hourly wage.

Figure A7. Relationship between wage inflation and unemployment rate, EA main countries, without Covid years



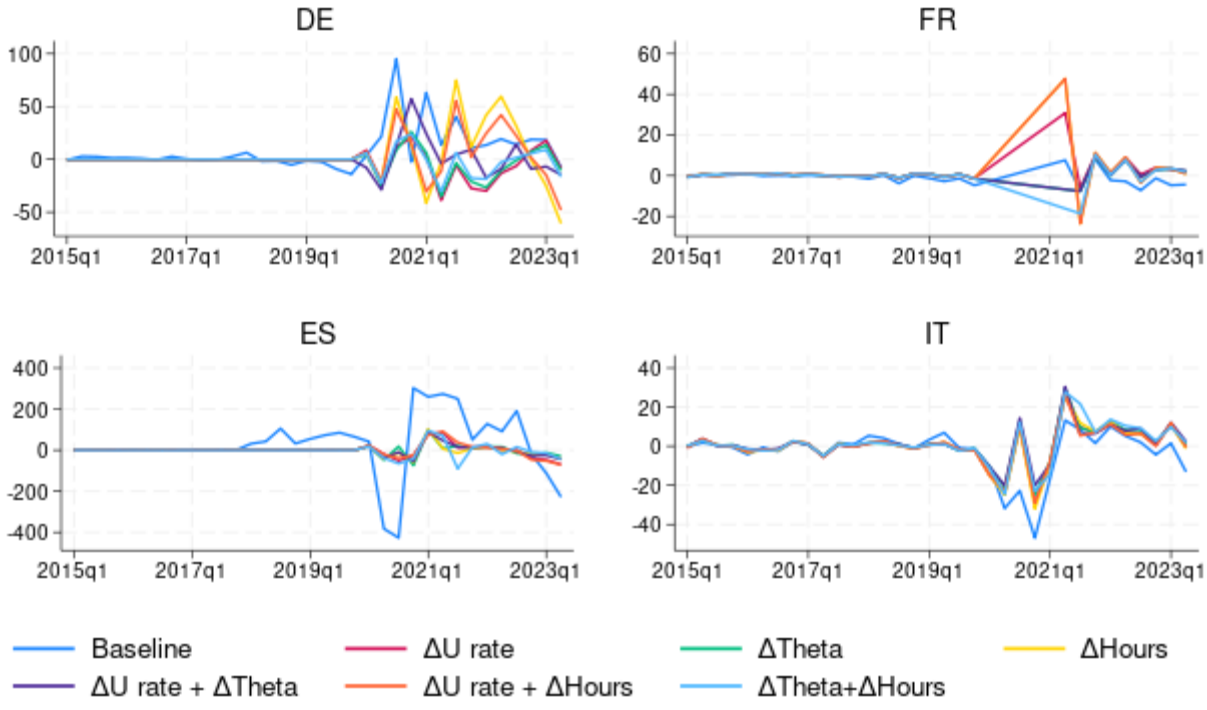
Source: Eurostat; own calculations. Wage inflation is the annualized quarterly growth rate of the hourly wage. The sample excludes observations of years 2020 and 2021.

Figure A8. Correlation between Δu_t and $\Delta \theta_t$, EA main countries



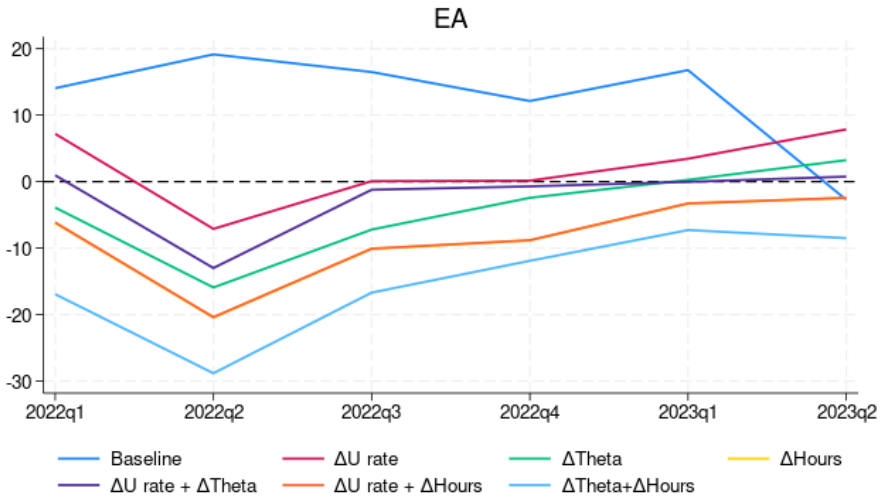
Source: Eurostat; own calculations.

Figure A9. OLS Residuals of different wage Phillips curves, EA main countries



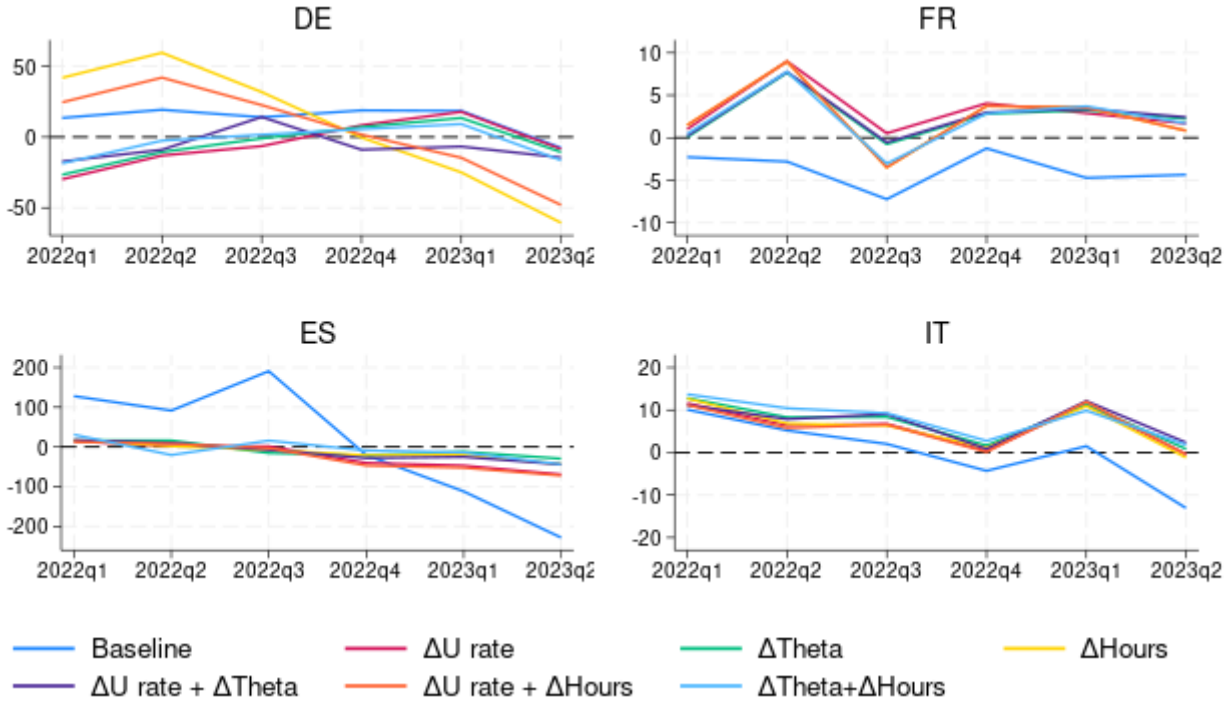
Source: Eurostat, Consensus (for inflation expectations); own calculations. The wage Phillips curve is estimated using data until 2019Q4.

Figure A10. OLS Residuals of different wage Phillips curves, euro area



Source: Eurostat, Consensus (for inflation expectations); own calculations. The wage Phillips curve is estimated using data until 2019Q4.

Figure A11. OLS Residuals of different wage Phillips curves, EA main countries



Source: Eurostat, Consensus (for inflation expectations); own calculations. The wage Phillips curve is estimated using data until 2019Q4.