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The Economic Impact of Yield Curve Compression:

Evidence from Euro Area Conventional and Unconventional Monetary Policy

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The Economic Impact of Yield Curve Compression: Evidence from Euro Area Conventional and Unconventional Monetary Policy

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This Economic Letter studies the effects of conventional and unconventional monetary policy on financial and macroeconomic variables using euro area data. I use market movements during meeting days of the ECB Governing Council as measures of policy surprises and then distinguish between conventional and unconventional surprises in a general way. Surprises that reduce rates and steepen the yield curve are understood to represent conventional policy, and surprises that reduce rates and flatten the yield curve as unconventional policy. I study the effects of these surprises in an empirical model of the euro area macroeconomy. I provide conditional and unconditional forecasts of key euro area aggregates under different policy actions by the ECB Governing Council. Unconventional monetary policy surprises are found to have strong effects on macroeconomic variables, though they have a somewhat delayed effect relative to conventional policy.

Introduction

During the period following the 2007-08 global financial crisis, many developed economy central banks turned to unconventional monetary policies to achieve their macroeconomic stabilisation goals. These central banks faced the problem of a lower bound on interest rates, meaning they could not cut their policy rates to low enough levels to respond effectively to negative developments in the economic cycle.[1] One key example of such an unconventional monetary policy is termed quantitative easing (QE), and occurs when central banks create reserves in order to purchase longer-maturity bonds and various other assets.[2] By doing so,

[*]Central Bank of Ireland, robert.goodhead@centralbank.ie. The views expressed in this paper are those of the author only and do not necessarily reflect the views of the Central Bank of Ireland, the European Central Bank or the Eurosystem. I thank Garo Garabedian, Sarah Holton, Gerard O'Reilly and Gillian Phelan for helpful comments, as well as an anonymous referee. I thank Conor Parle and Conor O'Reilly for excellent research assistance.

[1]Because of the substitutability of central bank reserves for vault cash, there is a limit to how negative one can make the policy rate before banks begin to avoid the use of reserves. The existence of a "reversal interest rate", below which further rate cuts are contractionary for lending, is discussed in the paper of Brunnermeier and Koby (2019). In their model, lower rates compress bank net interest margins in the case that they are unable to fully pass on these cuts to their deposit base, eventually incentivising banks to cut back lending.

[2]See Borio and Zabai (2016) and Bhattarai and Neely (2018) for review papers on the use of QE by central banks.

central banks aim to push up the prices of such bonds, lowering their yields and contributing to a general reduction of longer-term interest rates (achieved without further cuts in short-rates).[3] Therefore, in order to evaluate the usefulness of these policies it is necessary to understand the effects of a flattening of the yield curve on financial and macro-economic variables. This Economic Letter quantifies these effects in the euro area.

Decomposition of Conventional and Unconventional Monetary Policy

The approach broadly follows two steps: 1) separate conventional and unconventional monetary policy surprises using high-frequency (intra-daily) financial market movements around ECB monetary policy announcements; 2) model the impact of these policies on financial and macro-economic variables at monthly frequency.

The high-frequency data are from the Euro Area Monetary Policy Event-Study Database (EA-MPD) created by Altavilla et al. (2019). This dataset gathers intra-daily price movements for a selected group of financial contracts on meeting days of the ECB Governing Council. The authors use this dataset to create their own measures of monetary policy surprises, by looking at price shifts in a narrow window around the announcement itself. By using intra-daily surprises, we ensure that the financial market movements are responses to monetary policy news only, and do not reflect changes in underlying macroeconomic variables. This approach follows a literature studying such monetary policy surprises, which started with the work of Kuttner (2001). Gürkaynak et al. (2005) were the first to calculate intra-daily surprises, and to decompose them into a component relating to rate surprises, and a component relating to communication regarding the path of future policy.

This study posits a simple and general distinction between conventional and unconventional monetary policy. I decompose unconventional and conventional monetary policies by applying sign-restrictions to a vector of surprises in financial market variables. The key distinction is that expansionary conventional monetary policy steepens the yield curve, while expansionary unconventional monetary policy flattens it. Since the sample under investigation contains data from 2002 to present, the "unconventional" monetary policy surprise is clearly a summary measure of many forms of monetary surprise. Prior to the financial crisis (August 2007), the measure would include movements in long-term spreads that are prompted by ECB Governing Council statements.[4] During the financial crisis period (August 2007-2010), the shock series would incorporate movements in the yield curve induced by

[3] See the March 2015 speech of Benoît Cœuré for an example of a rationale given by a policy-maker for the use of quantitative easing, https://www.ecb.europa.eu/press/key/date/2015/html/sp150310_1.en.html.

[4] Baumeister and Benati (2013) summarise a list of factors that could affect the yield curve even in "normal" times: (1) shifts in liquidity preferences; (2) shifts in longer-term inflation expectations; (3) risk-appetite; (4) flight-to-quality considerations. To the extent that the ECB policy change and statement affects these factors, it is possible to back out some variation in the unconventional monetary policy shock even during the period prior to the financial crisis.

the various liquidity operations implemented by the ECB (i.e. it would begin to incorporate unconventional policy in the sense commonly understood). For the period of the European sovereign debt crisis (May 2010 - June 2013) the unconventional monetary policy shock would include movements in the yield curve induced by the effects of the Securities Market Programme (SMP). From the first announcements regarding APP (September 2014), the shock series will reflect the effect of expectations regarding quantitative easing. The decision to employ a summary measure of an unconventional monetary policy shock is partly pragmatic, in the sense that estimation of the macro-econometric model benefits from a longer time-series. However, the definition of the unconventional monetary shock employed has the benefit of permitting a general understanding of the effects of movements in the yield curve in response to ECB statements.

I take a vector of surprise movements comprised of changes in the two-year German sovereign yield, a measure of the yield curve (ten-year minus two-year German yield), and stock prices.[5] The sign-restrictions applied are detailed in Table 1. I assume that both conventional and unconventional (expansionary) monetary policy reduces the two-year German sovereign yield. This is a reasonable assumption, since changes to short-rates ought to transmit to the two-year rate, and measures to flatten the yield curve should also reduce this rate. The two-year rate is chosen, as opposed to a contract linked to the overnight rate, because of the lack of variation in the latter measure during the ELB period. The two-year German sovereign rate is also used as the measure of the shorter-term rate in the macro-econometric model, as discussed in the following Section. The use of the two-year rate implies that the conventional monetary policy surprise will include changes to expectations regarding the evolution of the policy rate of the ECB, as well as forward guidance policies, to the extent that they take effect within the two-year horizon.

I also assume that both conventional and unconventional expansionary monetary policies boost stock prices. This follows the argument of Andrade and Ferroni (2019) and Jarocínski and Karadi (2018), in the sense that the surprises may contain an "information effect" (or so-called "Delphic" forward guidance), whereby markets can receive positive or negative information regarding the macro-economy during the statements—restricting the behaviour of stock prices is a means to control for this.[6] While both papers also apply sign-restrictions to vectors of high-frequency surprises, neither identify unconventional monetary policy shock series designed to evaluate the impact of QE.

The key sign-restriction for the purpose of identification is to assume that an expansionary conventional monetary policy shock steepens the yield curve, while an expansionary unconventional monetary policy shock flattens it. A conventional monetary policy shock ought to affect short-term rates relatively more than long-term rates for two reasons: 1) the effects of a temporary shock should dissipate with the horizon; 2) long-term rates con-

[5] I use the entire event window, and do not differentiate between information from the window surrounding the press release and the window surrounding the press conference.

[6] Jarocínski and Karadi (2018) show that restricting the monetary policy surprises to push stock prices and interest-rates in opposing directions is a means to control for these effects, and Andrade and Ferroni (2019) follow a similar logic using market-implied inflation expectations.

Table 1 | Sign Restrictions

	Conventional Policy	Unconventional Policy
2Y DE Yield	$\downarrow$	$\downarrow$
10Y - 2Y DE Yield	$\uparrow$	$\downarrow$
Stocks	$\uparrow$	$\uparrow$

tain a term-premium component that is not strongly affected by transitory movements in short-rates. An unconventional monetary policy shock, on the other hand, represents surprise purchases of long-term assets. This ought to push term-premia down at the long-end of the yield curve via portfolio rebalancing.[7,8]

The sign-restrictions are implemented using the QR-decomposition, following the algorithm in Rubio-Ramírez et al. (2010).[9] As is well known, the application of sign restrictions can only partially identify the model, and the algorithm will yield many equally acceptable decompositions. I take the structural decomposition to be the median across 1,000 acceptable draws. I therefore do not consider the uncertainty over shock decompositions ("identification uncertainty") in the subsequent macro-econometric model, and treat the shocks as data. Properly accounting for identification uncertainty is left for future work.

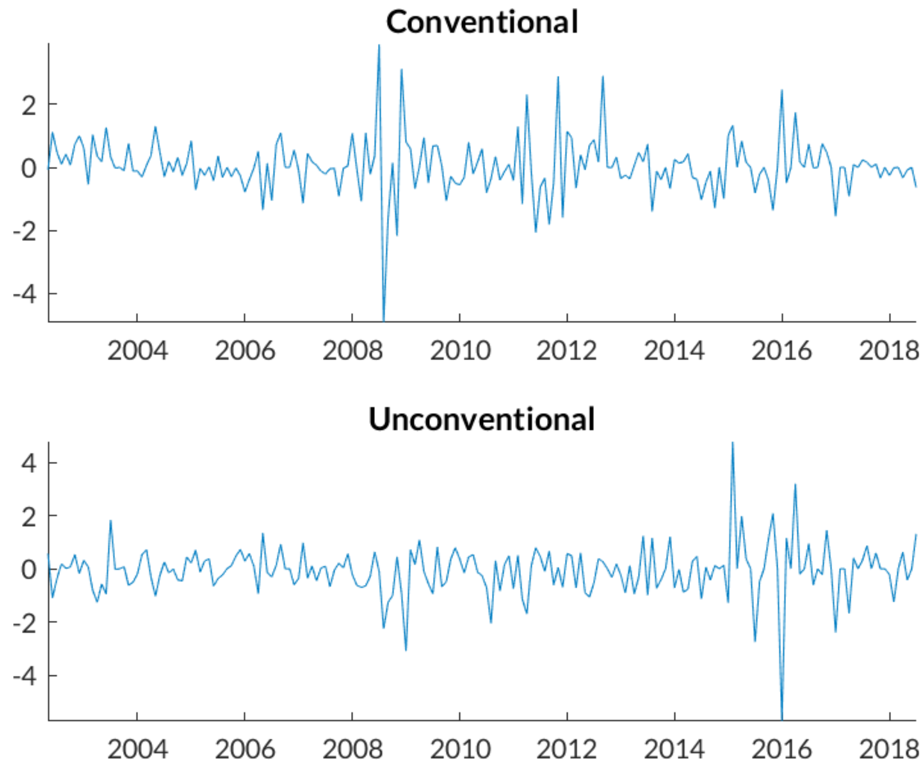
The structural shocks are plotted in Figure 1. Some heteroskedasticity is apparent in the series, with increased volatility of the conventional monetary policy shock during the "credit crunch" period of the financial crisis (2008), as well as the sovereign debt crisis (2010-2012) to some extent. There is likewise a clear increase in the volatility of the unconventional monetary policy shock during the APP period (post-2014). Since we can see variation in the unconventional shock series throughout the sample period, it is also clear that this shock summarises variation in asset prices in response to statements prior to the onset of the financial crisis, provided that the innovations lead to movements consistent with the sign-restrictions.

[7]For formal treatments of the portfolio rebalancing effect, see Vayanos and Vila (2009) and Hamilton and Wu (2012).

[8]In addition to the restrictions detailed in Table 1, I do impose some further criteria. The third structural shock in the vector is identified as a "growth shock", which is constrained to raise the 2Y DE yield, the 10Y - 2Y DE yield curve, and stocks. This is designed to reflect the transmission of macro-economic news from the Governing Council to markets. While the properties of this shock are not studied in this paper, these restrictions do affect the set of acceptable decomposition matrices. I additionally impose that an expansionary conventional monetary policy shock does not have a sufficiently strong steepening effect on the yield curve such that it *raises* the 10-year rate.

[9]Formerly, I define u_t to be the (3×1) vector of high-frequency movements in: (1) the two-year German Bund yield; (2) the movement in the ten-year minus the two-year German Bund yield (the yield curve); and, (3) movements in the Eurostoxx index. I compute the variance-covariance matrix of the chosen vector of variables over the set of meeting days, $V[u_t]$. I assume further that u_t is a linear combination of structural shocks, ϵ_t. One permissible decomposition is $u_t = P\tilde{\epsilon}_t$, where $V[u_t] = PP'$, and P is the lower triangular matrix from a Cholesky decomposition of $V[u_t]$. Here I refer to a decomposition as "permissible" in the sense that the variance-covariance matrix of these structural shocks is equal to that of u_t. I find many other permissible decompositions using repeated QR-decompositions of random orthonormal matrices. I then keep only those decompositions that satisfy the sign-restrictions in Table 1. Of this set, I choose the particular decomposition with elements closest to their median values within the set.

Figure 1 | Structural Shock Series



The shock should be understood as a *general* measure of unconventional monetary policy, as discussed previously.

This approach is very similar to that of Cieslak and Schrimpf (2019), who offer a categorisation of monetary policy events and separate unconventional monetary policy events from conventional ones by their overall effects on the yield curve by the same logic. However, they do not offer a continuous decomposition of surprise movements into conventional and unconventional monetary policy.[10] These authors also do not study the effects on macro-variables, as I do. The papers of Swanson (2018) and Altavilla et al. (2019) offer continuous decompositions of unconventional monetary policy shocks, but use the ability of the shock to explain variation in post-financial crisis data as their key criterion for identification.[11] These papers do not apply sign restriction schemes that control for information effects, as in my decomposition, and the approach taken in this study also has the virtue of avoiding potentially arbitrary division of the sample into pre-QE and post-QE periods. The Swanson (2018) approach has the advantage of parsimony, and gives plausible responses to the unconventional monetary shock. However, the shock is not identified via compression of the yield curve, and therefore it is possible it contains confounding movements in

[10] In the first part of their paper Cieslak and Schrimpf (2019) examine a sub-sample of meeting days where unconventional monetary policy shocks are the overall strongest shocks, and the sign-restrictions they employ in the latter part of the paper are designed to extract risk-premia surprises.

[11] Technically, Swanson (2018) imposes a criterion by which the unconventional monetary policy shock explains minimal variation in the pre-ZLB period; Altavilla et al. (2019) impose a similar criterion for the euro area case.

the responses of financial variables on announcement days. One example of such a confounding movement would be the "risk-premia" shocks discussed in Cieslak and Schrimpf (2019), which are non-monetary news shocks that flatten the yield curve (while simultaneously depressing equity prices). The approach taken in this paper is also related to that of Eberly et al. (2019), who also summarise unconventional monetary policies via their effects on the yield curve, in their case using a recursive scheme, and choose to term their measure "slope policy".[12] The idea that spread compression can be used to motivate a scheme of sign-restrictions is employed by Baumeister and Benati (2013), however these authors do not apply their restrictions to intra-daily surprise data.

The Macro-Econometric Model

The decomposed shocks are used as external instruments to estimate a Structural Vector Auto-Regression (SVAR), in order to study their effects on macro-economic variables. Such an approach, which can be termed a "Proxy-SVAR" approach, was pioneered in the papers of Stock and Watson (2012) and Mertens and Ravn (2013), who showed the usefulness of instrumental variables for identifying the effects of shocks within a VAR system. The approach was first applied in a monetary policy context by Gertler and Karadi (2015).

This study follows the specification of Paul (2019), who demonstrates that the Proxy-SVAR specification is identical to that of a standard VAR, when the surprise series is entered in as an exogenous variable (a VAR-X specification).[13] The VAR-X is therefore specified as follows, given observations over time for y_t, a vector of variables of interest:

$$y_t = B_0 + B_1 y_{t-1} + \ldots + B_k y_{t-k} + A z_t + e_t,$$

where the variance-covariance matrix of e_t is given by Σ_e, and z_t is an exogenous instrument series. The data are at monthly frequency, and the sample period is from April 2002 to July 2019. The variables are not differenced, and are entered into the system in levels. In order to assess the impulse responses of a broad range of macroeconomic and financial variables, the vector includes 10 variables and the VAR is thus of "medium" size. I include the following financial variables: the two-year German bond yield, a measure of the yield curve (the ten-year German bond yield minus the two-year yield), the nominal effective exchange rate, the Eurostoxx index (in logarithms), measures of corporate spreads, and Euro Area implied bond volatility. The included macroeconomic variables are: industrial production (in logarithms), unemployment, the stock of loans (in logarithms), and HICP (in logarithms).[14] The lag length is set equal to 12.

[12] See also Goodhead and Kolb (2018), Inoue and Rossi (2018). See Rossi (2018) for a recent survey paper discussing methods for identifying the effects of quantitative easing.

[13] The constant-parameter specification of Paul (2019) is estimated via frequentist methods, while my specification is Bayesian. A Bayesian approach is necessary since the VAR is medium-scale. The author gratefully acknowledges the use of replication codes provided by Paul (2019). Helpful codes were also used from the files that accompany the Handbook of Blake and Mumtaz (2017).

[14] All variables are seasonally adjusted where appropriate.

Given the relatively short-data series, and the fact the VAR is of medium scale, there is a clear issue regarding over-parameterisation (the "curse of dimensionality"). I follow the approach of Bańbura et al. (2010), who demonstrate that Bayesian shrinkage is appropriate in such cases, provided one strengthens the prior view on the relation between variables as the number of variables increases. I therefore estimate the model using Bayesian methods, and set a Normal-Inverse Wishart prior.[15] The coefficients $\{B_0, B_1, \ldots, B_k\}$ are assumed to be independent and normally distributed. The prior mean for each variable in the system is that it depends only on its own lag, meaning the prior for all of the coefficients is set to equal zero, with the exception of the first-order auto-correlation parameter $(B_1)_{ii}$ for each variable i. I vary the prior for the mean of the auto-correlation coefficient depending on whether the variable is stationary (when the prior mean is also set to zero), non-stationary (in which case the prior mean is set to equal one), or highly-persistent (the prior mean is set to 0.9).[16]

The variances of the prior are set according to the Minnesota scheme, therefore the coefficient for the effect of variable j on variable i, $(B_l)_{ij}$, has prior variance given by:

$$V\left[(B_l)_{ij}\right] = \begin{cases} \left(\frac{\lambda}{l}\right)^2, & \text{if } j = i, \\ \left(\frac{\lambda \sigma_i}{l \sigma_j}\right)^2, & \text{otherwise,} \end{cases}$$

for all lags l, and for all pairings of variables i and j.[17] Here σ_i is the standard deviation of the residual from OLS estimation of an auto-regressive process for variable i.[18] The key argument of Bańbura et al. (2010) is that the tightness of the priors, which is governed by λ, should increase as the number of variables in the system increases (i.e. λ should be lowered). I set λ to 0.108, which is the value used by Bańbura et al. (2010) for their medium-scale VAR. The prior on A_t has mean zero for all elements of the matrix, with a large variance, meaning the prior does not impose that the shock actually has an effect.[19] The prior for the VAR covariance matrix is an inverse Wishart distribution.[20]

I estimate two separate models, one with the conventional monetary policy shock series as an instrument, and the second with the unconventional shock series. In order to evaluate

[15] The VAR variance-covariance matrix, Σ_e is estimated simultaneously with the coefficient parameters within a Gibbs sampling loop. Computationally, a burn-in period of 10,000 iterations is specified, before a parameter distribution sampling-period of a further 10,000 iterations. Note that unstable coefficient matrix draws are discarded.

[16] In fact I set the prior for two variables to 0.9, deviating from Bańbura et al. (2010). I made this decision in response to the issue that for euro area data 2002-2019, German bond yields exhibit downward trends, and the behaviour of euro unemployment appears highly persistent. The assumption of white noise is not appropriate for such series. However, for neither variable is the assumption of a random-walk plausible: we have good reason to believe interest rates are broadly mean-reverting, and it is logically inconsistent for an unemployment rate to have a stochastic trend (since it is bounded between 0 and 1 by construction). Thus I set the prior to a highly-persistent value strictly below one.

[17] The prior mean for the intercept for variable i is zero, and the variance is set to $(\sigma_i * 10^5)^2$, i.e. the prior is uninformative.

[18] The auto-regressive process includes 12 lags, which is the same as that used for the VAR system.

[19] The prior variance is set to $(\sigma_Z * 10^5)^2$, where σ_Z is the unconditional standard deviation of the instrument.

[20] The inverse Wishart prior is specified with a scale matrix equal to the identity matrix, and degrees of freedom equal to the number of variables plus two.

the impulse-response functions to monetary policy shocks, the shocks must be normalised relative to the impulse-response of one of the variables within the system. This is because, as argued in Paul (2019), the VAR-X is only able to identify *relative* impulse response functions. The conventional monetary policy shock is normalised with respect to the two-year German Bund yield, and is scaled to reduce the rate by 10 basis points. The unconventional monetary policy shock is normalised to reduce the yield curve by 12 basis points. This value was chosen since it is the value of the average compression in the German sovereign yield curve on APP announcement days, as reported in Altavilla et al. (2015).[21,22]

Results

Impulse responses for the macro-economic variables are displayed in Figure 2, while the responses for financial variables are displayed in Figure 3.

With respect to the macro-economic variables, we can see that both conventional and unconventional monetary policy shocks raise the level of industrial production, reduce the unemployment rate, and raise the price level in ways consistent with theory (though the responses for the activity variables to conventional monetary policy are not significant). However, the effects of unconventional monetary policy shocks are much larger in magnitude for all three variables. We can also see that the conventional monetary policy shock affects the price level with a reduced lag, while the unconventional monetary policy shock has an effect with a greater delay, peaking at around two years after the shock.

The responses of financial variables to the respective shocks are suggestive of the mechanisms at play in delivering the macro-economic responses. We can see from inspection of the two-year rate that both conventional and unconventional monetary policy shocks reduce this rate at impact. This is essentially true by construction, given the sign-restrictions placed on this shock. However, only the conventional monetary policy shock leads to a persistent lowering of the shorter-term rate.

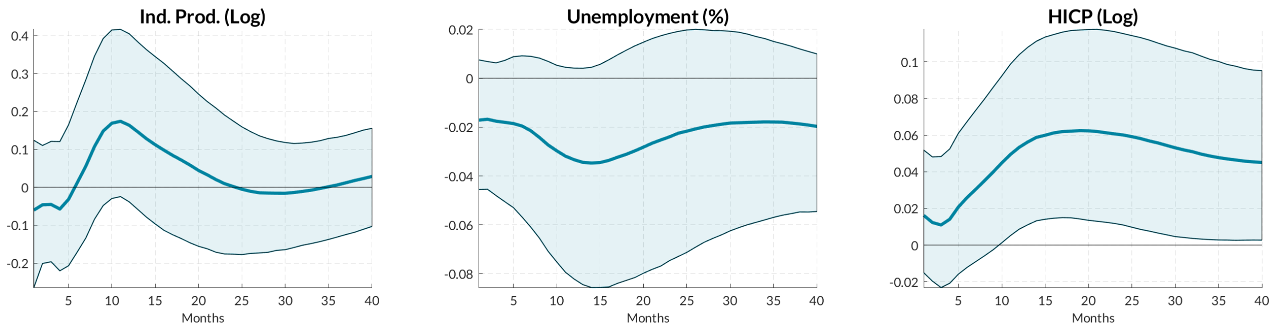
With respect to the behaviour of the yield curve, the conventional monetary policy shock steepens the curve, while the unconventional policy shock leads to a persistent flattening of the curve. This is again to be expected given the sign-restrictions in place. One feature of the results that appears puzzling is the response of the two-year rate to the unconventional monetary policy shock (though the path is not significant). The shorter-rate falls in response to the shock (which follows from the sign-restrictions), before rising and falling again to

[21] See Altavilla et al. (2015) Table 3, pp. 34. In fact, I use the reported one-day fall in the yield curve in terms of the ten-year subtract the *three-year rate* as the basis for normalisation, for the controlled-event study case, since the two-year rate was not reported. This should imply a slight over-estimate, given the estimated responses become stronger at the very short-end.

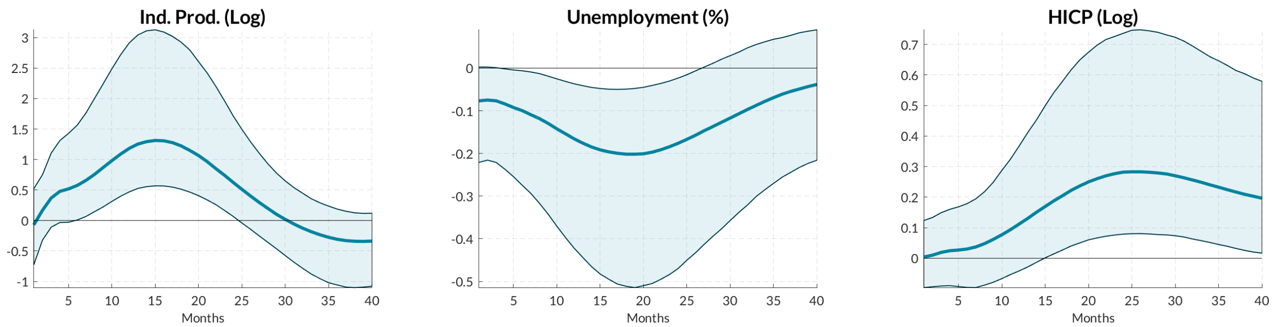
[22] One technical point is that the normalisation is conducted with respect to given parameter draws within the Gibbs sampling algorithm, which implies that the size of the impact of the surprise on the interest rate variable does not change with the variation in parameters. Another point is that I do not orthogonalise the shocks with respect to the variables in the system, which is a "safety procedure" conducted by Paul (2019) to ensure that the VAR-X estimates are identical to estimates from the alternative Proxy SVAR specification.

Figure 2 | The Effects of Monetary Policy Shocks on Macroeconomic Variables

(a) Conventional Monetary Policy



(b) Unconventional Monetary Policy



Notes: Figure shows impulse responses to expansionary conventional and unconventional policy shocks. The estimates are derived from two separately estimated VAR-X models. The variables in logarithms have been multiplied by 100. The conventional monetary policy shock is normalised to lower the two-year German Bund yield by 10bp. The unconventional monetary policy shock is normalised to reduce the yield curve (ten-year subtract two-year German Bund yields) by 12bp. Credible sets are at 68%.

some extent. One explanation for this finding is that the unconventional policy shock provides sufficient stimulus towards inflation and real variables that it induces a counteracting increase in the shorter-rate by the policymaker in the medium-run. In a sense, expansionary unconventional monetary policies could imply a faster path to "normalisation" of the level of the policy rate. However, it is possible that the path of the shorter-rate in the VAR system is influenced by the fact that we are using a two-year rate in place of the actual policy rates of the ECB. Therefore, one must be cautious when interpreting the two-year rate equation in the VAR as a "typical" monetary policy reaction function, since its dependent variable is influenced by unconventional policy to some extent.[23] For example, it is possible that the estimated path of the two-year rate could be influenced by (un-modelled) changes in the *composition* of the portfolio of the ECB over time across short-term and long-term bonds, or equally by the composition of the "free-float" of available public sector debt.

Part of the reason for the effectiveness of the unconventional monetary policy shock seems to be the strong depreciation in the NEER.[24] The unconventional monetary policy shock also stimulates a larger response in the stock of loans relative to the conventional shock. Both shocks boost stock prices at impact, as we would expect from the sign-restrictions that were applied. The unconventional monetary policy shock reduces corporate spreads in the short-term, but increases them in the longer-run for a period. The response of spreads to the conventional monetary policy shock shows an oscillatory pattern in the short-run. Conventional monetary policy seems to have a greater effect on implied volatility, which falls in response to the expansionary shock at the one-year horizon.

I also compute unconditional and conditional forecasts, which are displayed in Figure 4. It is important to stress that the unconditional forecasts already embed market expectations regarding ECB policy, as reflected in model-predictions for the two-year rate and the yield curve. The unconditional forecasts are therefore not forecasts for the case of ECB inaction, but forecasts for the case that the ECB acts as can reasonably be anticipated by market participants. The algorithm to compute the conditional forecasts is very simple, since I merely perturb the system by a single expansionary shock next period (with the shock normalised as for the impulse response functions discussed previously, i.e. the conventional policy shock is a -10bp surprise to the two-year rate, and the unconventional policy shock is a -12bp surprise to the yield curve). Results look broadly as we might anticipate, given the implications of the impulse response functions. One concern (from a policy perspective) is that the unconditional forecast for the level of inflation does not converge to the target of the ECB of below but close to 2% in the medium-term, though unconventional policy in particular is able to increase the forecast. Conventional monetary policy surprises have only moderate

[23] Forward guidance and expectations would also be important for movements in the two-year rate during the sample period. Results are also robust to the use of the two-year EONIA OIS rate in place of the two-year German sovereign yield in the VAR. This implies that results are not driven by the fact that this yield would be directly impacted by APP purchases (which included two-year bonds), nor by the issue that German yields are likely "special" in the sense that they are driven by safe asset premia.

[24] A number of studies have found substantial effects of unconventional monetary policy on exchange rates, and this channel is understood to be a dominant mechanism by which QE policies have real effects—see discussions in Bhattarai and Neely (2018) and Rossi (2018).

effects on the median inflation forecast, though they take effect slightly sooner than unconventional policy shocks. It must be acknowledged that the model attributes considerable uncertainty to the forecasts.

Conclusion

This Economic Letter has decomposed conventional and monetary policy shocks from the high-frequency surprise dataset for the euro area, created by Altavilla et al. (2019). The study used sign-restrictions to differentiate conventional and unconventional policies by their effects on the yield curve, respectively steepening and flattening it. The study used a macro-econometric Proxy SVAR model to study the effects of the two shocks, and found that the shocks that act to flatten the yield curve have stronger effects on macro-economic variables.

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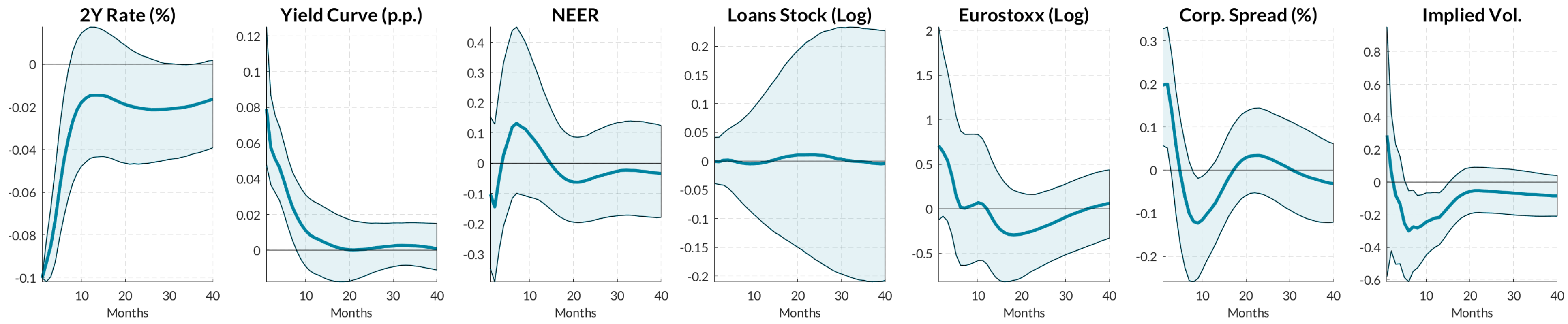
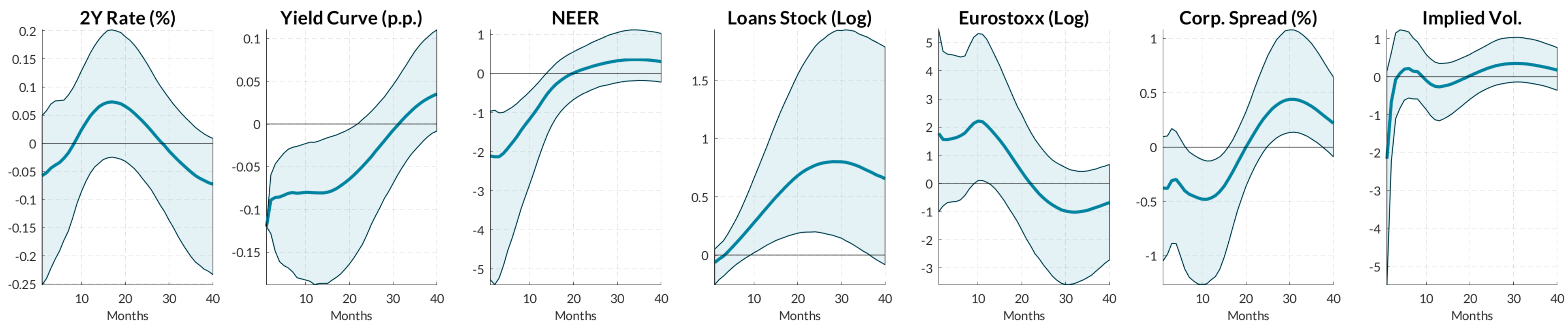
Figure 3 | The Effects of Monetary Policy Shocks on Financial Variables

(a) Conventional Monetary Policy



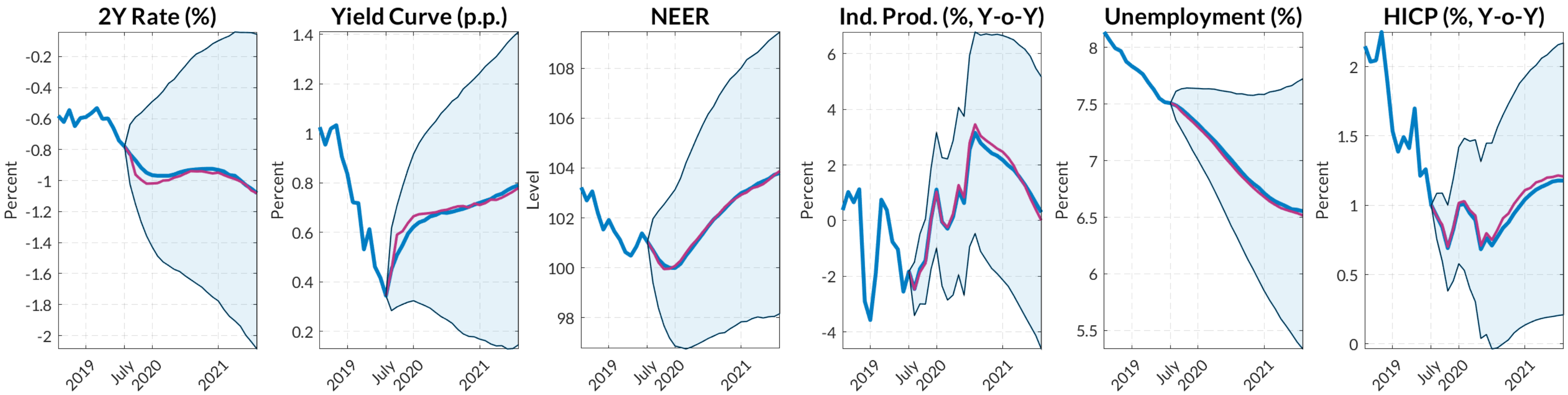
(b) Unconventional Monetary Policy



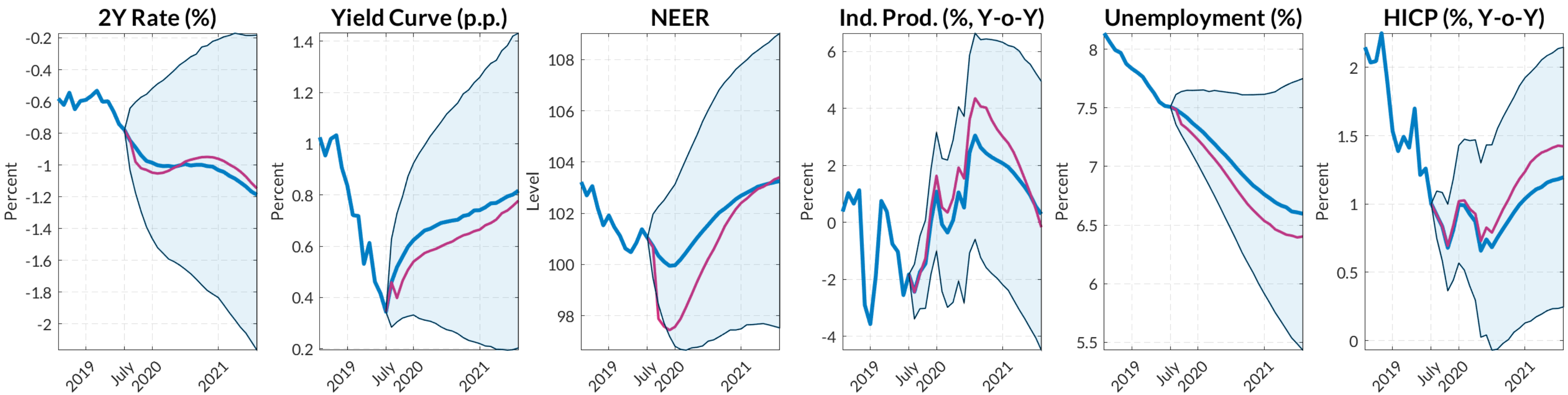
Notes: Figure shows impulse responses to expansionary conventional and unconventional policy shocks. The estimates are derived from two separately estimated VAR-X models. The conventional monetary policy shock is normalised to lower the two-year German Bund yield by 10bp. The unconventional monetary policy shock is normalised to reduce the yield curve (ten-year subtract two-year German Bund yields) by 12bp. Credible sets are at 68%.

Figure 4 | Conditional Forecasts for Selected Variables

(a) Conventional Monetary Policy



(b) Unconventional Monetary Policy



Notes: Figure shows unconditional and conditional forecasts for selected variables, which are the blue and pink bold lines respectively. The estimates are derived from two separately estimated VAR-X models. The conventional monetary policy shock is normalised to lower the two-year German Bund yield by 10bp. The unconventional monetary policy shock is normalised to reduce the yield curve (ten-year subtract two-year German Bund yields) by 12bp. Credible sets are at 68%.

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