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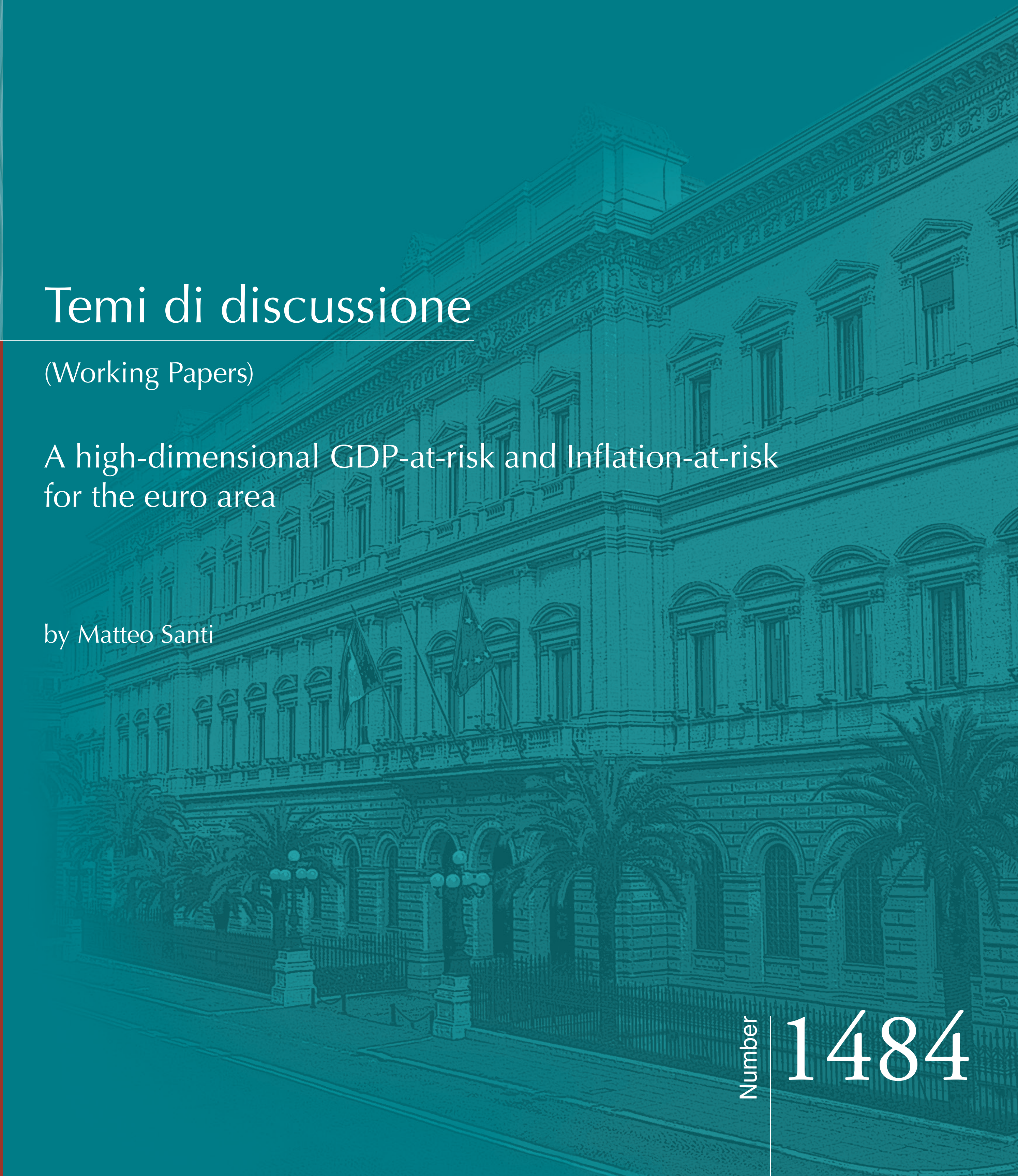

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(Working Papers)

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March 2025

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A HIGH-DIMENSIONAL GDP-AT-RISK AND INFLATION-AT-RISK FOR THE EURO AREA

by Matteo Santi*

Abstract

GDP-at-risk and Inflation-at-risk are standard measures of tail risk in modern macroeconometrics, adapted from tools originally developed in the financial risk management literature. In this paper, these indicators are estimated for the euro area and its Member States by leveraging a high-dimensional dataset in the construction of time-varying conditional distributions of GDP growth and inflation. The distributions obtained at country level are used to assess how the synchrony of euro-area countries' business cycles has evolved since the introduction of the euro. The results indicate significant asymmetries in the balance between upside and downside risks for both GDP and inflation, and a persistently weak synchrony for the left tails of GDP growth distributions during episodes of crisis.

JEL Classification: E23, E27, E37, C58.

Keywords: GDP-at-risk, Inflation-at-risk, high-dimensional macroeconometrics.

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1 Introduction[1]

Expectations on the future state of the economy carry with them a sizeable degree of uncertainty, stemming from the variety of factors driving economic variables and the complexity of their interactions. A common approach to deal with this uncertainty is to complement point estimates of future realizations of economic outcomes with probability distributions of the variables of interest. Forecasts of GDP growth and inflation are often presented in the form of probability distributions, conditional on a series of financial and economic indicators. The tails of these distributions, capturing outcomes in worst-case scenarios, can be especially informative and under scrutiny in turning points of the business cycle. A vast literature (Cecchetti (2006), Adrian, Boyarchenko, and Giannone (2019), Aikman et al. (2019) among others) and the recurrence of periods of macroeconomic stress have drawn policymakers' attention on these rare but harmful events, adapting modelling approaches borrowed from the financial risk management literature as the value-at-risk. In this paper, I obtain conditional distributions of GDP growth and inflation and construct measures of their tail risks for the Euro Area and its member countries. Such distributions are based on factors extracted from a high-dimensional dataset through a partial quantile regression approach (PQR, Giglio et al. (2016)). The advantage of this approach lies in the possibility to exploit a large information set, while avoiding at the same time making strong assumptions on the choice of the indicators for the conditioning set of the distribution. Once the conditional distributions for the EA member countries are estimated, I study the evolution of their synchrony since the introduction of the single currency, focusing on the tails. The synchrony of business cycles is a relevant feature in the optimal currency areas theory (OCAs, Mundell (1961), Krugman (2013)), particularly for the reduction of losses incurring from one-size-fits-all policies. In fact, the infrequency of asymmetric shocks, together with a uniform and ordered transmission to the real economy throughout the whole currency area is conducive to synchronized business cycles and, ultimately, to an easier conduct of monetary policy. Although the original OCAs theory assigns equal importance to the synchronization of growth and crisis periods, the history of the Economic and Monetary Union has shown that the main progress in the integration process was made during the latter. Given the relevance of

[1]The views expressed in this paper are those of the author and do not necessarily reflect the views of the Bank of Italy. I am grateful to Matteo Barigozzi, Martina Cecioni, Antonio M. Conti, Stefano Neri, Fabrizio Venditti and two anonymous referees for their useful comments and suggestions. All remaining errors are mine.

these episodes for policy advancements, this paper studies explicitly their synchrony in the EA by considering tail risk indicators across its member states.

Results hint at significant asymmetries in the variance of the tails of the GDP distribution both in the EA and in its member states: while the left tail - measuring downside risks to growth - varies significantly in the analysed sample, the right tail remains quite stable over time. Consistently with the literature, the resulting distribution is skewed to the left, as the probability of episodes of severe recessions are higher than those of strong expansions. Moreover, the left tails of the GDP distributions of EA countries tend to become more dispersed during crises, indicating that downside risks are often accompanied by risks of divergence among countries. An opposite - but smaller in extent - asymmetry is obtained when considering the inflation distribution, which displays a more volatile right tail, in contrast with a quite stable left part. In contrast to growth downside risks, upside risks to inflation appear more coincident across countries, indicating a good level of synchrony of price increases also during the periods of stress in the analysed sample. In principle, this synchrony might be a positive factor for the effectiveness of a common monetary policy: coordinated (in time and size) shocks to inflation might facilitate a broader consensus in the definition of monetary policies at the EA level. Finally, as a by-product of this analysis, I study the relationship between GDP growth and inflation at different quantiles of their distribution: this relation is estimated to be quite flat in low-growth/low-inflation scenarios, and with a gradually increasing slope moving towards the right tail of the GDP conditional distribution.

The paper is structured as follows: Section 2 presents the contributions to the literature on the estimation of measures of GDP- and inflation-at-risk. The dataset and the empirical methodology applied in this work are introduced in Section 3. Results for the Euro area as a whole are in Section 4, while those for the single countries are in 5. Section 6 concludes.

2 Literature Review

This paper is closely related to the literature on macroeconomic tail risk. The notion of growth-at-risk (GaR) dates back to the seminal paper of Cecchetti (2006). This approach consists in modelling macroeconomic tail risks by adapting tools developed in asset pricing and financial econometrics with the original objective of quantifying the uncertain losses caused by the randomness of the price of assets in a portfolio. Given the distribution of GDP growth rates, the $\alpha\%$ growth-at-risk is defined - along the lines of the value-at-risk - as the worst possible outcome (*i.e.* the lowest growth rate) over a specific time horizon, once excluded the worst $\alpha\%$ occurrences. Similarly, the $\alpha\%$ inflation-at-risk represents the highest inflation rate, once the $\alpha\%$ realizations on its right in the distribution are excluded. The paper notably pointed at the non-Gaussianity of GDP growth realizations in a panel of seventeen advanced economies: fat tails and a negative skewness highlight the relevance of rare events, whose probability would be underestimated assuming Normal distributions for historical GDP growth rates. In subsequent work (Cecchetti (2008)), the modelling framework is extended by means of a QVAR model and applied to study the non-linear relation between equity booms and macroeconomic variables. The non-linear relationship between financial conditions and GDP growth - theorized also in the literature on intermediary sector's capital and leverage cycles (Adrian and Boyarchenko (2012), Brunnermeier and Sannikov (2014) among others) - is elaborated upon in the analysis of Adrian, Boyarchenko, and Giannone (2019). In this paper, the conditional distribution of growth-at-risk is modelled semi-parametrically, combining quantile regressions (QR) with parametric interpolations. They find for the US a strong relationship between the left tail of the growth rate distribution and the NFCI and highlight a strong asymmetry between the behaviour of conditional right tail, that remains quite stable across time, and the left tail, whose level varies significantly. A series of papers (Aikman et al. (2019) using QR for the UK, Busetti et al. (2021) by expectile regressions for Italy) extend this methodology to obtain distributions conditioning on multiple variables. Other works (Hartwig et al. (2021), Giglio et al. (2016)) introduce optimized selection methodologies for the selection of stress indicators to be employed in the analysis of downside risks. The present paper is closely related to a work in this strand of research (Giglio et al. (2016)), with which it shares the methodology for the extraction of latent factors on the quantiles (PQR). Among alternative approaches to the modelling of non-linear relationships between financial vulnerabilities and macroeconomic outcomes topic, Galvão and Owyang (2018) propose factor-augmented models with regime transitions. Growth quantiles are modelled as GARCH processes in Brownlees and Souza (2021), or in a stochastic volatility framework in Gächter et al. (2023). These approaches sometimes allow to gain predictive power, but at the cost of losing some significant insights of the linkages between financial conditions and macroeconomic outcomes. Alternative strategies to gauge this macro-financial nexus include the use of copula methods (Coe and Vahey (2020), on US data), conjectures on data generating processes that can match the observed non-linearity, as in Loria et al. (2022), who propose a threshold model with state-dependent elasticities of real outcomes to financial conditions, or score driven models for the conditional GDP growth distributions (Delle Monache et al. (2023))

A line of research that is closely related to this work is represented by the studies on downside risks in the Euro area. Trying to close the gap in the advancement of research on this topic between the US and Europe, Figueres and Jarociński (2020) apply the framework of Adrian, Boyarchenko, and Giannone (2019) to European data, taking the region as a whole. Their findings support the hypothesis of a non-linear linkage between GDP growth and financial stress indicators, and select the CISS (Hollo et al. (2012)) as the most informative on the GDP growth left tail. The results are reviewed to a limited extent by an extension with specific focus on the choice of regressors for European GaR (Szendrei and Varga (2023)), carried out by LASSO methodologies. In a similar vein, Alessandri et al. (2019) apply a quantile regression approach to study the interactions between real variables and financial indicators to Italian data, finding quite volatile predictive abilities for downside risks to growth. Other works (Chavleishvili and Manganelli (2019), Chavleishvili and Kremer (2023)) employ QVAR models, or extend the framework to a mixed data sampling setting (Ferrara et al. (2022)). Finally, the paper by Lang et al. (2023) find that spreads and volatility indicators seem as relevant as financial vulnerability when evaluated on the short term, while only the latter seem to display some potential over the medium term. This paper contributes to this literature by estimating measures of tail risk to growth and inflation based on a high-dimensional dataset for the EA, and extending the estimation to member states considered separately, thus allowing for the analysis of business cycle synchrony based on the whole distribution of the variables of interest.

The paper is also connected to the literature on the assessment of OCAs requirements in the Euro Area, with a particular focus on the synchrony of business cycles: as stated by the original theory, the conduct of a common monetary policy for a group of countries is easier in the presence of shocks affecting member states in a symmetric fashion (Mundell (1961)). The concerns raised on the existence of a core-periphery gap in the Euro Area in a set of seminal papers (Bayoumi and Eichengreen (1992), Bayoumi and Eichengreen (1997)) were brought back in the midst of the Sovereign Debt Crisis (SDC) by Krugman (2013), who pointed at the potentially disruptive effects of sudden stops of capital flows to peripheral countries in the absence of both a Europe-wide backing of banks and of a system of fiscal transfers, paired with unfeasible macroeconomic adjustments through currency devaluation. However, a series of more recent papers (Campos and Macchiarelli (2016), Campos and Macchiarelli (2021) among others) updated the original estimates of Bayoumi and Eichengreen (1997), finding evidence of an increased synchrony of business cycles, driven by the adoption of the common currency and the higher competition induced by lower trade barriers in the Euro Area. Other works cast doubts on this convergence: estimating a SVAR identified with a combination of zero and sign restrictions, Kunovac et al. (2022) find a very slow progress in OCAs conditions since the introduction of the Euro, especially on account of periods of asymmetric stress as the SDC. Similarly, de Haan et al. (2024) find some evidence of improved synchrony among member states' output gaps, but with a non-monotonic process, susceptible to sudden stops during financial crises. The contribution of the paper to this literature consists in the empirical assessment of the convergence of economic cycles considered at different conditional quantiles, with a particular focus on tail outcomes. The synchrony of risk drivers and crisis episodes is particularly relevant both for monetary policy and for the possibility to build consensus on institutional reforms at common level, a feature that is connected to another OCAs criterion, namely the perception of a "common destiny" shared by member states (Baldwin and Wyplosz (2019)).

3 Data and Empirical Methodology

The approach followed in this paper involves a two-step estimation of the GDP growth and inflation distributions, conditional on the information extracted from the large dataset of Barigozzi et al. (2024). The dataset is described in 3.1; Section 3.2 presents the estimation procedure.

3.1 Data

The data source employed for the extraction of the quantile factors is the EA-MD-QD (Barigozzi et al. (2024)), a comprehensive dataset on a large list of economic and financial variables for the

Euro Area. The dataset contains a total of 118 series, providing information on national account variables (GDP and its subcomponents), labour market indicators (employment and unemployment in different economic sectors and alternative age groups), financial and credit aggregates (assets and liabilities of public and private entities), labour costs, real exchange rates, interest rates on different maturities, production indices, price indices (PPI and HICP on different categories of goods and services), as well as monetary aggregates and business confidence indicators[2]. In this application, both the dataset at the Euro area level and the national sub-datasets are employed (for Austria, Belgium, Germany, France, Greece, Italy, Netherlands, Spain and Portugal[3]). The extraction of the factors is conducted on observations at quarterly frequency on the 2001Q1-2023Q4 sample, and the construction of conditional distributions is carried out on a four quarters ahead horizon ($h = 4$).

The series included in the dataset are transformed in order to obtain stationarity, and an additional processing is performed on outliers and for real variables during the Covid period, that are treated as missing data and imputed using a EM algorithm as in McCracken and Ng (2016)[4]. Figures A1 and A2 report the yearly GDP growth rates for the EA and for the countries analysed in this paper, comparing the imputed series with the original ones. Using this approach, the intensity of the Covid recession - and of the following recovery - is dampened, allowing for a more robust estimation of the conditional distributions of GDP growth.

3.2 Principal Quantile Regression (PQR)

In the PQR model (Dodge and Whittaker (2009), Giglio et al. (2016)), the quantiles of the target variable - GDP growth or inflation h-quarter ahead - are assumed to be linear combinations of a series of unobserved factors $f_t(\tau)$. Such factors, which condense the most relevant information for the behaviour of the target variable at each quantile τ, are in turn linear combinations of the series contained in the large dataset X_t, whose weights measure the co-variation between the single series

[2] A complete list of the series in the dataset is reported in the Appendix.

[3] Country-specific datasets are do not include all the series available at aggregate level, but are equally quite large, as each of them contains around one hundred series.

[4] Outliers are defined according to two criteria: a first group of observations is considered as an outlier on a statistical basis (namely, a data point is treated as missing if its difference from the sample median is larger than ten times the interquartile range), and a second group is treated as such in order to handle the Covid period: real variables - GDP and its sub-components, employment indicators, industrial production indices - are treated as missing values in the 2020-2021 period and replaced by their EM-counterparts, obtained using loadings estimated on pre-Covid data and factors extracted from financial variables in the considered period.

x_{it} and the quantiles of the target variable y_{t+h}.

$$X_t = \lambda_i'(\tau) f_t(\tau) + u_{it}(\tau) \tag{1}$$

In this non-linear factor model, the loadings $\lambda_t(\tau)$, the factors $f_t(\tau)$ and the errors $u_{it}(\tau)$ are all quantile-dependent. The specification allows to combine the possibility - provided by factor models - to summarize the relevant information into a small-dimensional matrix $f_t(\tau)$ with the advantage of capturing the information which is relevant at different quantiles for the target variable $y_{\tau,t+h}$, as in the quantile regression literature (Koenker and Bassett Jr (1978)). The extraction of the factors takes place in two steps: in the first one, the target series $y_{\tau,t+h}$ is regressed on each series x_{it} contained in the original dataset through a sequence of univariate quantile regressions which also include a constant term, as in Equation 2. The outcome of this step is a vector of quantile-specific weights $\phi_i(\tau)$, whose elements measure the relevance of each series for the quantiles of $y_{\tau,t+h}$.

$$y_{\tau,t+h} = c_\tau + \phi_i(\tau) x_{it} + \varepsilon_{\tau,it} \tag{2}$$

Subsequently, given the weights $\hat{\phi}_i$, the realized factors $f_t(\tau)$ are estimated by computing the cross-sectional covariance of $\hat{\phi}_i$ and x_{it}. As their respective weights, also these estimated factors are quantile-specific, and are used in the following stage to model the distribution of the target variable. Factors are therefore weighted averages of the variables in X_t, where weights are given by the slope coefficients $\hat{\phi}_i$. This model differs from the similar Quantile Factor Model (QFM) specification (Chen et al. (2021)) in the choice of the target for the extraction of quantile factors. While factors, in the QFM case, condense the information at the quantiles of the independent variables set, here they are estimated in order to extract the most relevant information for an external target variable y_{t+h} on each quantile[5].

In the second step of the algorithm, the quantiles of the target variable $y_{\tau,t+h}$ are modelled as linear combinations of the factors estimated in the previous phase, as in Equation 3. The constant $\alpha(\tau)$ and the $\gamma'(\tau)$ parameters - which capture the relationship between the factors and the target

[5]The employed PQR specification and estimation procedure allows for the estimation of single-factor models (with one factor for each quantile). However, applying to X_t a rank minimization approach to select the number of factors in a QFM framework indicates the presence of a single factor on tail quantiles.

at the different quantiles - are estimated through a time series quantile regression.

$$\mathrm{Q}_\tau(y_{t+h}) = \alpha(\tau) + \gamma(\tau)\hat{f}_t(\tau) + \eta_t(\tau) \tag{3}$$

Once estimated both the factors and the parameters, it is possible to construct a distribution for y_{t+h},, conditional on the information extracted from X_t . Conditional quantiles are therefore defined as[6]:

$$\hat{\mathrm{Q}}_\tau(y_{t+h}|X_t) = \hat{\alpha}(\tau) + \hat{\gamma}(\tau)\hat{f}_t(\tau) \tag{4}$$

A parametric extension based on the skewed-t distribution The quantiles of Equation 4 implicitly characterize a distribution function, as the quantile function corresponds to the inverse cumulative distribution function. This distribution has the advantage of being free of parametric assumptions, but it is defined only for a discrete set of percentiles. However, it is possible to obtain a full conditional distribution by fitting a skewed-t distribution (Azzalini and Capitanio (2003)) on the known quantiles: this flexible specification allows for location and scale shifts (controlled by the parameters μ and σ), as well as for asymmetries and fat tails through the fatness and shape parameters ν and α. The probability density function of the distribution is:

$$f(y;\mu,\sigma,\alpha,\nu) = \frac{2}{\sigma}t\left(\frac{y-\mu}{\sigma};\nu\right)T\left(\alpha\frac{y-\mu}{\sigma}\sqrt{\frac{\nu+1}{\nu+\left(\frac{y-\mu}{\sigma}\right)^2}};\nu+1\right) \tag{5}$$

Where $t(\cdot)$ and $T(\cdot)$ are respectively the PDF and the CDF of a Student t-distribution. As this distribution is fit for each quarter in the sample, it is possible to obtain time series of its conditional parameters and of its moments[7]. In addition, the parametric distribution allows to estimate as well as additional measures of tail risk based on the expected value-at-risk conditional on the outcome variable falling in the set of the $q\%$ most extreme scenarios. For what concerns GDP, these quantities

[6] In this specification, the conditional quantiles of the h-quarter ahead target variable are functions of factors at time t. However, the inclusion of lagged factors does not impact significantly the results of the analysis.

[7] As in Adrian, Boyarchenko, and Giannone (2019), the parameters of the distribution are estimated for each time period by minimizing the squared distance between a series of selected empirical quantiles (the 5^{th}, 25^{th}, 75^{th} and 95^{th} percentiles) of the non-parametric distribution and the corresponding quantiles of the skewed-t distribution.

$$\{\hat{\mu}_{t+h},\hat{\sigma}_{t+h},\hat{\alpha}_{t+h},\hat{\nu}_{t+h}\} = \underset{\mu,\sigma,\alpha,\nu}{\arg\min}\sum_{\tau}\left(\hat{Q}_{y_{t+h}|X_t}(\tau|X_t) - F^{-1}(\tau;\mu,\sigma,\alpha,\nu)\right)^2$$

Parameters measuring the first (μ) and the third (α) moment are left free to assume any value in $\mathbb{R}$, while the dispersion parameter σ is constrained to lie in the $\mathbb{R}^+$ set and the shape parameter capturing the degrees of freedom ν is a positive real number in $\mathbb{Z}^+$

are denoted as Expected Shortfall (for the left tail) and Expected Longrise (for the right one):

$$ES_{t+h} = \frac{1}{q}\int_0^q \hat{F}^{-1}_{y_{t+h}|X_t}(\tau|X_t)d\tau \tag{6}$$

$$EL_{t+h} = \frac{1}{q}\int_{1-q}^1 \hat{F}^{-1}_{y_{t+h}|X_t}(\tau|X_t)d\tau \tag{7}$$

Analogous objects are constructed for the conditional distribution of inflation. In this second case, the left tail represents a measure of expected deflation risks, conditional on price growth lying in the lowest $q\%$ scenarios, while the right one analogously measures risks of high inflation.

4 Conditional distributions for the EA

This section presents the results obtained by constructing conditional distributions at the Euro area level: the findings for GDP are in 4.1, while those on inflation follow in 4.2. Finally, some considerations on the relationship between these distributions are presented in 4.3.

4.1 GDP-at-risk

Figure 1 reports the time-varying conditional distribution of the four-quarter-ahead Euro area GDP growth in the analysed sample. The dark blue line is the median of the distribution, while the lighter blue shaded areas represent a set of relevant percentiles (corresponding to a α set to 5, 10 and 25 percent on both tails of the distribution), and the black line is the actual GDP growth four quarters ahead. The lowest blue line representing the 5$^{\text{th}}$ percentile, therefore, is a measure of the GDP-at-risk. The actual growth rate follows quite closely the (lagged) median during before the Great Financial Crisis and in the period between 2014 and 2020, when the yearly growth rate settles around 1-2 percent. On the contrary, the gap between the median and the actual growth rate becomes quite large during episodes of crisis, when the contraction of the distribution median is far less pronounced than the fall of the actual growth rate: this indicates how considering and modelling specifically tail risks is particularly relevant during recessions, when point estimates of future outcomes are particularly unreliable given the increased conditional variance. The last four quarters displayed in the graph are an out-of-sample exercise for future realizations of GDP based on the latest observations available in the sample. The median of the distribution hovers around 0, suggesting a stagnating baseline scenario, but it is surrounded by a large degree of uncertainty, as the conditional variance of the distribution is quite large especially in the left tail, hinting at the presence of significant downside risks to GDP growth.

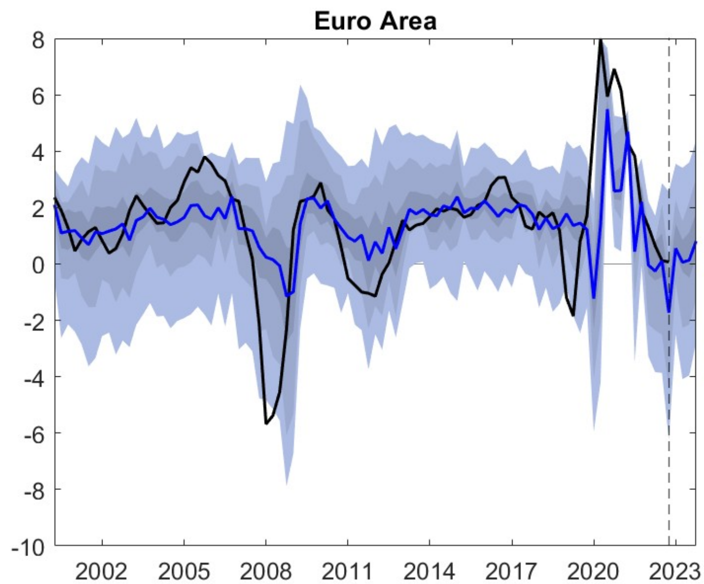


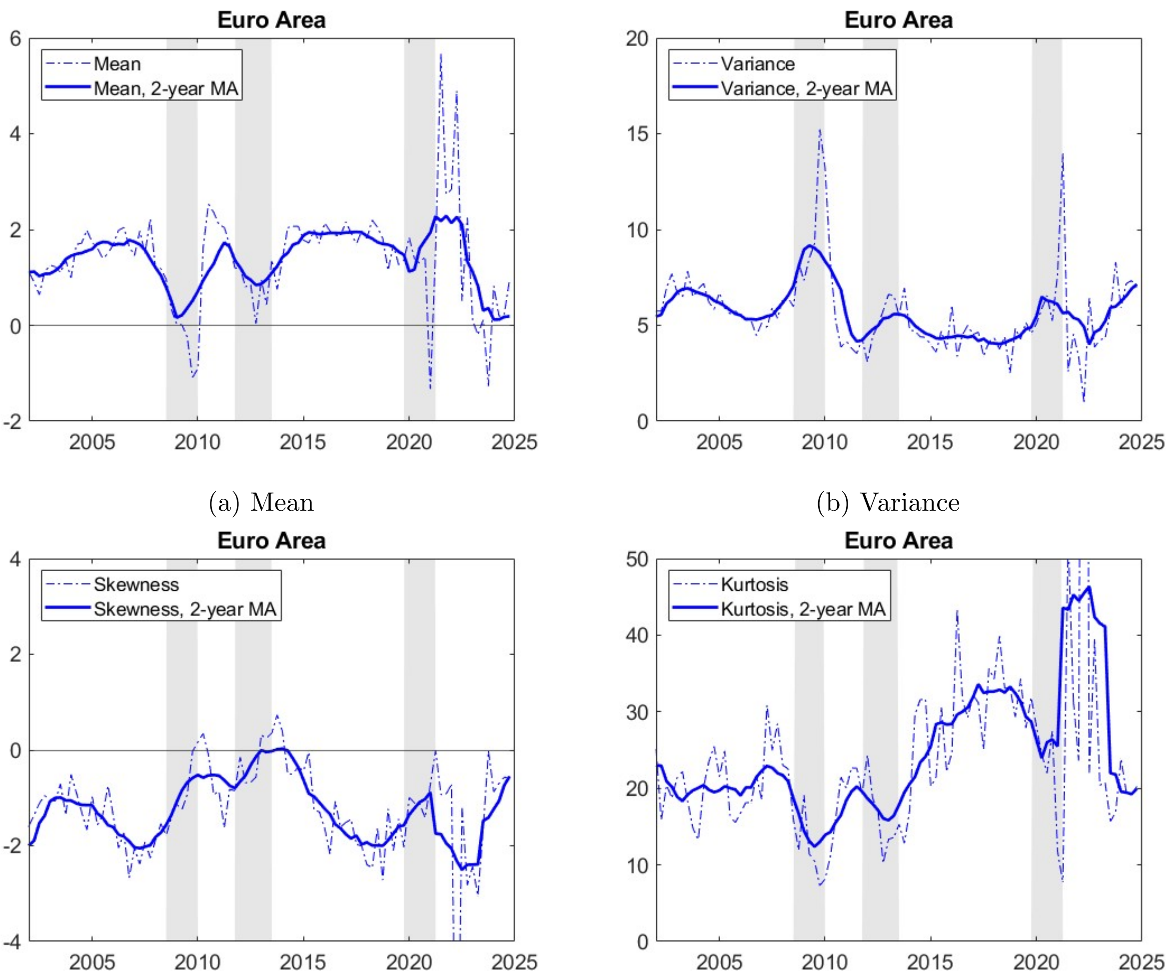
Figure 1: EA GDP growth conditional distribution (percentage points)
Black line: actual four-quarter-ahead GDP growth rate; Blue line: median; Shaded areas: 5^{th}, 10^{th}, 25^{th}, 75^{th}, 90^{th} and 95^{th} percentiles of the estimated conditional distribution.

An interesting feature of the obtained distribution is the asymmetric time-series variance on the two tails, a quite common result in the GaR literature: while the right tail of the distribution - representing unexpected economic booms - displays very little variation in the data sample, remaining around 3-4 percent, the converse applies to the left tail - measuring downside risks -, that varies much more significantly, with large drops during crisis. The variance of the 5^{th} and the 10^{th} percentiles is around four times higher than that of the median or of the right tail of the distribution (Figure A3). Moreover, the dispersion of the distribution tends to increase when the median shrinks, suggesting the presence of a negative relationship between the first and the second moment. For what concerns the main drivers of GDP-at-risk in the high-dimensional dataset, the four-quarter-ahead left tail of the distribution co-moves strongly both with indicators of real activity, such as the industrial production index for non-durable goods and for manifacturing firms. These variables are closely related also to the median of the distribution, confirming their leading properties for future economic activity. Other variables appear to be more specific to the left tail: the investment share of non-financial corporations, differently from production indices, does not appear among the most relevant series for the median of the distribution; price indices as the overall HICP and the services HICP, which hint at a relationship between the tails of the distributions of GDP growth and inflation; the residential property prices, a common indicator in the literature on GDP-at-risk and macroprudential policy (Aikman et al. (2019)) as a measure of financial imbalances. The relevance of GDP growth for both the left tail and the median is expected, given the strong time dependence of macroeconomic outcomes[8][9].

Given the obtained conditional quantiles, it is possible to fit a parametric skewed-t distribution and to estimate its time-varying conditional moments, reported in Figure 2 with their moving average on a eight quarters window. The conditional mean of the GDP growth rate hovers between one and two percent in ordinary times, but displays quite significant downturns during periods of crisis. Moreover, during recessions, conditional variance tends to increase, so that a fall is the expected GDP growth is accompanied by an increase in the uncertainty around the conditional point estimates, of particular strength during the GFC. For what concerns higher moments, in most of the sample the conditional distribution is negatively skewed: this result is consistent with the asymmetry between tails observed in the conditional distribution, as the probability mass of the recessions episodes is larger than that representing unexpected periods of strong growth. As far as kurtosis is concerned, it is noticeable that the drop in the probability of extreme data points caused by the reduction of variance in ordinary times is partially offset by the fatness of tails, as there is a moderate negative relationship between the second and the fourth moment.

[8] The normalized loadings are reported by bar chart A4 in the Appendix.

[9] Figure A5 reports the conditional distribution for the Euro Area GDP growth obtained without the adjustment for the Covid period. The inclusion of the Covid outlier affects the results by blurring the relation between the macro-financial indicators in the X_t matrix and future GDP realizations. The effect is visible especially on the left tail of the distribution immediately before the Covid crisis, as the model tries to fit the future collapse in economic activity by interpreting it as a fall in conditional skewness. However, the asymmetry of the two tails is maintained, so that the main conclusions of the analysis remain valid to the robustness check.



(a) Mean

(b) Variance

(c) Skewness

(d) Kurtosis

Figure 2: EA GDP growth conditional moments (percentage points)
Dashed lines: conditional moments; Solid lines: 2-year moving average of moments; Shaded areas: recessions.

Figure 3 reports the Expected Longrise (EL) and Expected Shortfall (ES) obtained from the parametric distribution. The information provided by these indicators partly overlaps with that provided by the non-parametric GDP-at-risk at the corresponding percentiles, but with in addition the incorporation of the most extreme values of the distribution. Specifically, these indicators measure the expected change in GDP, conditional on GDP growth falling in the tails of its distribution. The asymmetry between the tails observed on the quantiles is confirmed also by these measures, as the time series variance of the EL is smaller than that of the ES. In particular, while the 95%-EL lingers around 5 percent throughout the whole sample, the 5-%ES displays major descents during crisis episodes. The potential for an unexpected growth leap of the EA economy, conditional on GDP lying in the right tail on its distribution, appears therefore to be quite steady, while conditional downside risks are much larger, with possibly catastrophic realizations during crisis episodes.

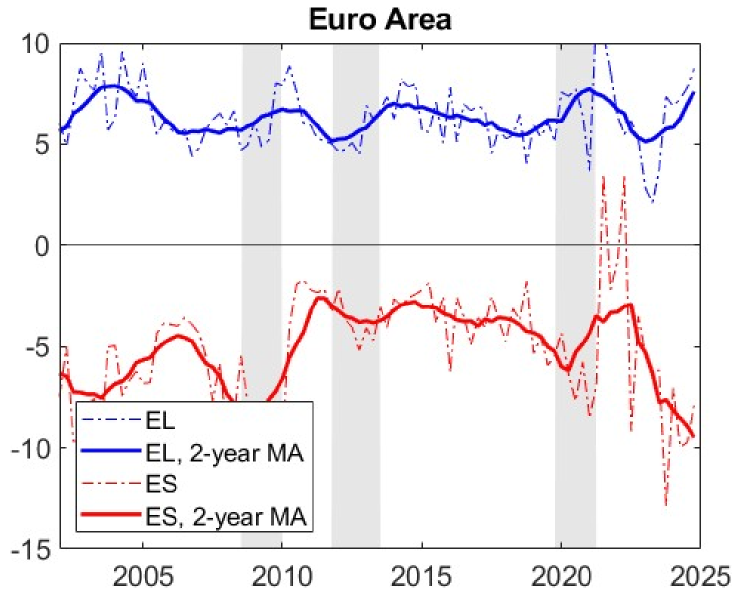


Figure 3: Expected Shortfall and Longrise, EA GDP growth (percentage points)
Dashed lines: ES and EL; Solid lines: 2-year moving average of EL/ES; Shaded areas: recessions.

4.2 Inflation-at-risk

The conditional distribution of four-quarter-ahead inflation for the EA is shown in Figure 4. Differently from GDP growth, the actual inflation level is quite aligned to the distribution median along the whole sample, on a level between 0 and 2 percent. The only exception is the large price increase of 2022-2023, during which actual inflation outpaced the conditional median by almost five percentage points, close to the right tail of the distribution. Notably, the asymmetry in tail variance observed for GDP growth is reversed for prices: lowest percentiles are stable throughout the sample around 0 percent - with the exception of the deflation risk observed during the GFC, the SDC and in the Covid period -, while the right tail of the distribution - a measure of inflation-at-risk - seems more volatile, with a jump around 2023. However, most of the right tail variance seems to be driven by the very extreme percentiles while the 90% percentile remain quite constant across time, suggesting a lower volatility if compared to the GDP-at-risk. The out-of-sample projections are compatible with a fast decline of inflation to the two percent target of the ECB, with a relatively low dispersion of the distribution if compared with its historical levels. Figure A6 reports the time variance of the conditional quantiles, confirming the asymmetric behaviour of the two tails, even if imbalances are smaller than in the GDP growth distribution. In particular, only the most extreme percentiles display exceptionally volatile (or stable) trends, while those closer to the median are more similar to each other. Among the series that co-move more strongly with the right tail of the inflation conditional distribution, there are the monetary aggregates M1 and M2, which on the contrary do not seem to be much related to the median of the distribution. This result implies a link between monetary aggregates and future prices which seems relevant only when considering risks of very high inflation, while these indicators do not seem to be much informative of future baseline inflation trends. Upside risks for prices stemming from credit are hinted at by the relevance of households' long-term liabilities for the right tail: these liabilities do not seem to be predictive of inflation in ordinary times, but become relevant for upside risks, given their ability to measure the build-up of financial imbalances. The correlation of such liabilities with confidence indicators in the construction sector explains the relevance of this latter for the right tail of the inflation distribution. On the other hand, producers' price indices for non-durable goods and the HICP for consumer goods are certainly relevant for both the right tail and the median of the distribution.

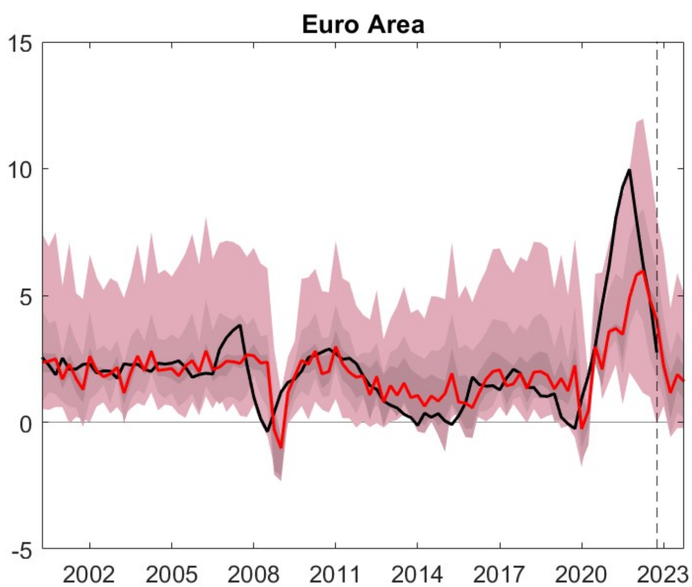
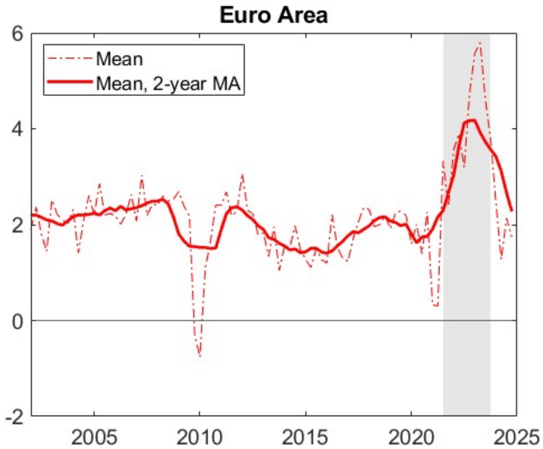
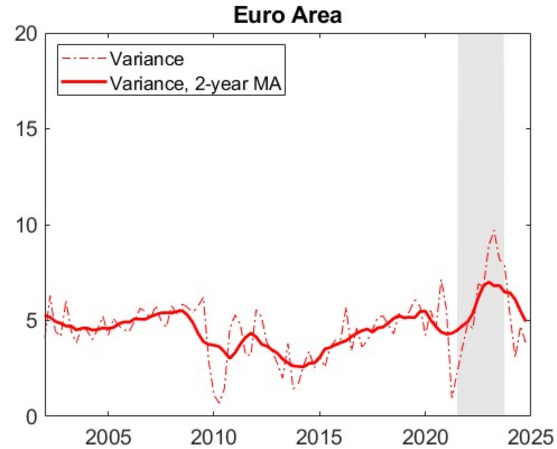


Figure 4: EA inflation conditional distribution (percentage points)
Black line: actual four-quarter-ahead inflation rate; Red line: median; Shaded areas: 5^{th}, 10^{th}, 25^{th}, 75^{th}, 90^{th} and 95^{th} percentiles of the estimated conditional distribution.

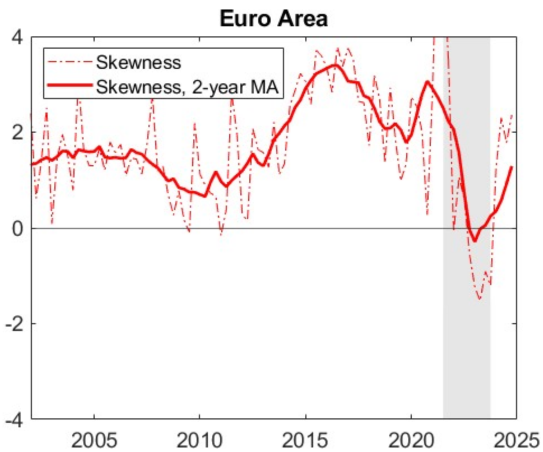
Figure 5 reports the conditional moments of the parametric inflation distribution. The conditional mean stays around 2 percent, the ECB medium-term target, in most of the sample, with the only exceptions of the GFC and the latest inflation spike. The conditional variance of the distribution is lower than that of GDP, and displays limited variations across time, with the only exception of the 2021-2022 period. The first and the second moment display a moderately positive correlation, suggesting that in periods of high inflation, also inflation uncertainty tends to increase. Conditional skewness is positive in most of the sample, as the tail right is fatter, especially in the 2014-2021 period; the distribution becomes more symmetric as its mean increases during the high inflation period. Finally, the kurtosis parameters remains quite constant in the sample, with a weak negative correlation with conditional variance: changes in the probability of observing outliers caused by increases in conditional variance are partially offset by opposite movements in the fourth moment.



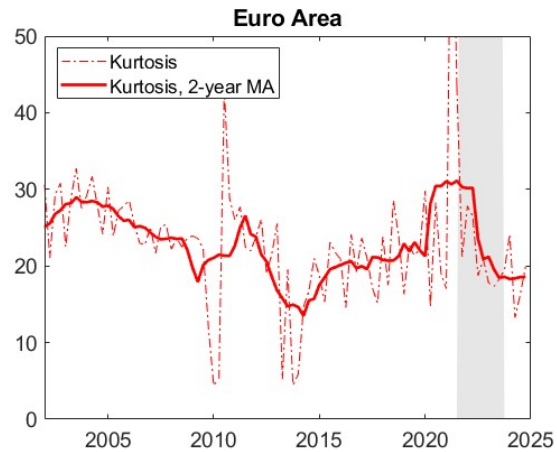
(a) Mean



(b) Variance



(c) Skewness



(d) Kurtosis

Figure 5: EA inflation conditional moments (percentage points)
Dashed lines: conditional moments; Solid lines: 2-year moving average of moments;
Shaded areas: quarters of high inflation (yearly HICP growth above 4 percent).

Figure 6 reports the counterparts of the EL and the ES for the inflation distribution, denoted here, respectively, as "Expected High Inflation" (EHI) and "Expected Deflation" (ED). The outcome is the opposite of what observed on the GDP distribution: as the expected outcome in the 95% percentile varies quite significantly across time, displaying a large fall around the GFC - when the recession mitigated significantly upside risks to inflation - and a sudden increase in 2022, the expected deflation is quite steady, suggesting that the possible reduction of prices does not exceed -1 or -2 percent even during crises. As this measure is a conditional (on inflation lying in the lowest 5% scenario) VaR, this result does not indicate a stable probability of deflation, but rather a quite steady rate of expected price drops in the left tail scenarios. The only exception is the recent surge in inflation and the subsequent monetary policy response, which induced an increase in conditional variance and temporarily stretched the tails of the distribution.

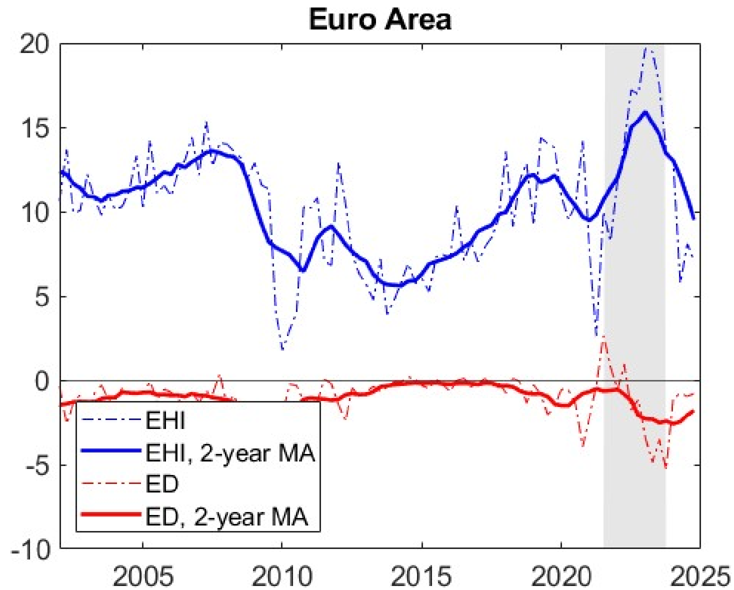


Figure 6: Expected High Inflation and Deflation, EA (percentage points)
Dashed lines: EHI and ED; Solid lines: 2-year moving average of EHI/ED;
Shaded areas: quarters of high inflation (yearly HICP growth above 4 percent).

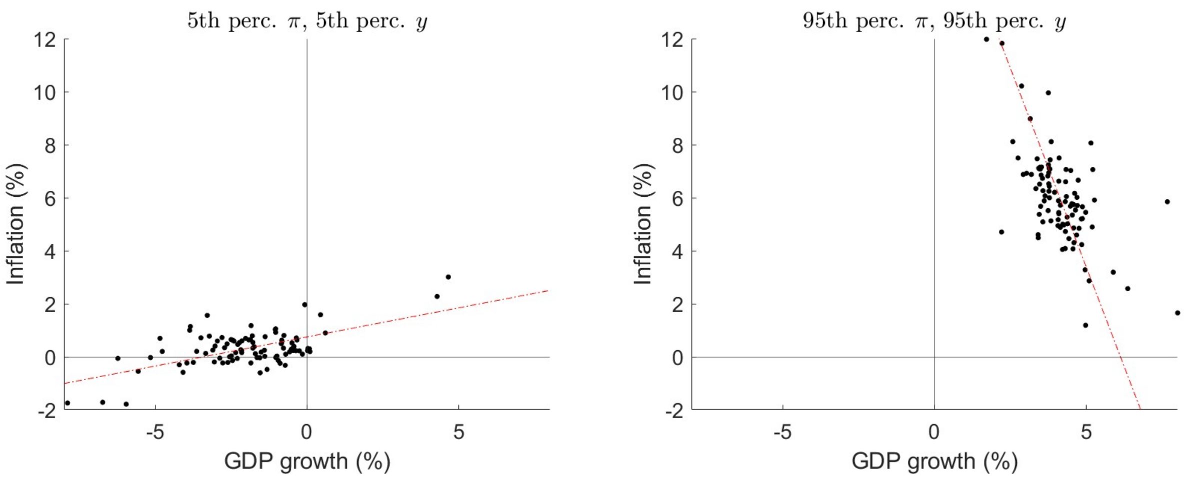
4.3 By-products: quantile AS curves and probabilities of recession/high π

The conditional distributions of GDP growth and inflation constructed separately are now considered jointly, so to evaluate their relationship in different parts of their density functions. In the scatter plots of Figure 7, each observation represents a pair of (y, π) conditional quantiles in a given quarter, with the panel on the left representing y and π quantiles on the left tail (5^{th} percentile), and the right panel those on the 95^{th} percentile. [10][11]. The two plots report pairs of GDP growth and inflation considered at the same tail, and can therefore be interpreted as a conditional aggregate supply (AS) curve seen at different points of the distributions. In fact, considering conditional GDP growth and inflation at the same quantile implies evaluating the two variables in a context of a shock that affects them in the same direction (*e.g.* a demand shock). For this reason, the obtained (y, π) pairs on the main diagonal delineate a supply curve at different quantiles. The

[10] The conditional medians of the two variables are positively correlated, similarly to their unconditional counterparts, as reported by Figure A8 in the Appendix.

[11] The results of a similar exercise, carried out considering the distributions of the single member states, are presented in the Appendix.

curve outlined by conditional quantiles appears to be flat when this relationship is evaluated on the left tail, suggesting that positive demand shocks are unlikely to affect prices during times of weak economic activity. Conversely, the curve becomes steeper on the right tail: when output growth is close to its potential, or in periods of high inflation, expansionary demand shocks would translate into price increases, with very limited effects on economic activity[12].



(a) Left tail

(b) Right tail

Figure 7: Conditional AS curve at different quantiles of y and π, EA

Probabilities of recession and high inflation four quarters ahead based on the information provided by the high-dimensional dataset can be obtained as a by-product of the parametric distributions[13]. These are reported in Figure 8, where high inflation is defined as a yearly HICP increase of more than four percent. The model assigns the highest probabilities of a recession prior to the GFC, around the SDC, during the Covid crisis and after the inflation surge of 2022. High inflation risks remain very limited (around 10 percent) throughout the whole sample, and show a moderately negative relationship with recession risks until 2021. On the contrary, the sudden jump in inflation risk estimated in 2022 is accompanied by a just smaller rise of recession risks. This positive correlation, not present in the previous episodes of crisis, can be attributed to the supply-side origin of the shock, which exogenously pushed up prices and slowed down economic activity[14]-

[12]The slightly negative slope of the fitted line in the right panel is driven by a small set of outliers on the right (corresponding to the post-pandemic recovery). By and large, the fitted line would be vertical when excluding these data points.

[13]A time series of approximate probabilities of recession and high inflation can be obtained also non-parametrically by directly reversing the stepwise conditional quantile function. The obtained results - not reported for the sake of brevity - are broadly in line with the probabilities obtained from the parametric distribution.

[14]Figure A17 reports the conditional probabilities of recessions and high inflation at country level. The timing of

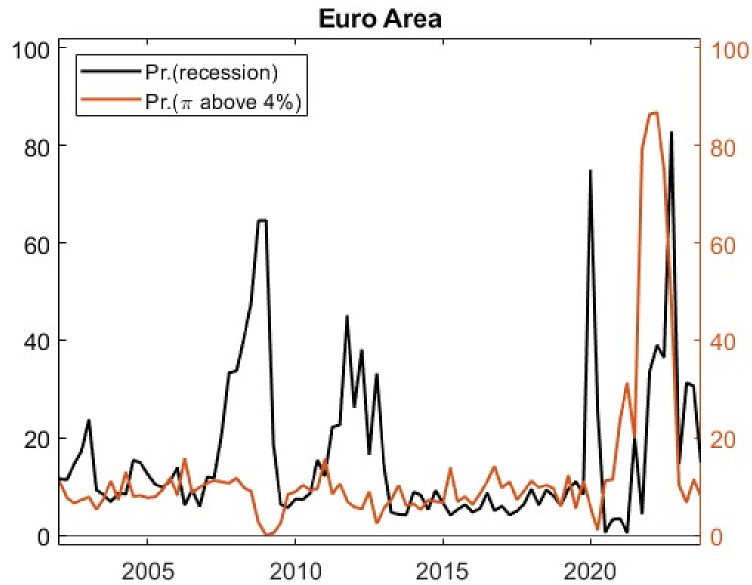


Figure 8: Conditional probabilities of recession and high inflation, EA (percentage points)

5 Assessing macroeconomic synchrony at the quantiles

This Section considers the main results obtained from conditional distributions at country level: the GDP growth conditional distributions for single member states are reported in 5.1, while the results on inflation distributions and their synchrony are in 5.2.

5.1 GDP-at-risk

Figure 9 displays the GDP growth conditional distribution of the four main EA countries. In this exercise, factors are extracted from the large dataset at EA level using the single countries' GDP growth four quarters ahead as target: the time-varying distributions reported here are therefore conditional on macroeconomic and financial factors at EA level. The asymmetry between stable right tails (around 3 percent) and varying left tails is present in all the analysed countries[15]. In-

the increases in their probabilities show a good degree of synchrony among countries. However, while the sensitivity to price upside risks is very similar during the whole period, this conclusion does not apply to recessions. The estimated probability of a recession during the GFC ranged from 30-50 percent in France and Belgium to over 80 percent in Greece, Italy, Portugal and Spain; similar asymmetries arise during the SDC, hinting at a higher exposure of peripheral countries to downside risks.

[15] An exception to this asymmetry is represented by Greece - reported in Figure A9 -, where the dispersion of the distribution is quite high on both sides of the median point, in most of the sample. The time series variance of GDP growth conditional quantiles for the EA countries distribution - not reported for the sake of brevity - confirms the higher volatility of left tails in all the analysed countries.

terestingly, while the timing of GDP-at-risk drops is quite coincident across countries, the value reached by the conditional 5^{th} percentile varies quite significantly during periods of stress. The left tail of the distribution of Germany and Spain appears to be particularly far from the median of the distribution, indicating a sizeable degree of downside risks, which look less pronounced in France. The whole conditional distribution of Italian GDP growth is shifted downwards with respect to that of the other countries, suggesting a persistently weaker growth potential also in baseline scenarios. Finally, the future perspectives outlined by the out-of-sample observations are consistent with weak growth prospects in all the considered countries[16].

The distributions obtained by conditioning on factors extracted from the EA dataset and from datasets at country level are compared in Figure A11. The subplots report the 5^{th}, the 50^{th} and the 95^{th} percentiles of the distribution conditioning on EA factors in blue, and their country-level counterparts in red. The median and the right tail are virtually overlapping in most of the sample and in all countries, suggesting that the information contained in the dataset at EA level - if treated by targeting GDP growth at national level when extracting quantile factors - differs only slightly from that provided by datasets at country level. On the other hand, also the left tails of the distributions are quite aligned, suggesting that also downside risks at country level are captured quite well by risk determinants extracted at EA level. However, there are some episodes of misalignment that suggest an additional degree of caution when dealing with low percentiles: common factors suggested quite high downside risks in Germany in the pre-GFC period, while the left tail of the distribution conditioned on country-level factors was very close to the conditional median, implying an additional degree of downside risks of external source that could not have been captured using only the German dataset. An opposite example is provided by the Italian and Spanish GDP-at-risk during the SDC, higher - in absolute terms - if conditioned on factors extracted at country level rather than from the EA dataset: this suggests the presence of country-specific downside risks - possibly related to interest rates paid on sovereign bonds and on debt imbalances, in this case - that were not observed through common factors.

[16] Figure A10 reports the distributions obtained without treating the original data to account for the Covid period. As for the distribution at EA level, the outlier obfuscates the relation between left tails and macro-financial factors to quite a limited extent, especially in the period before the pandemic. Nevertheless, the main result of this section, that is the asymmetry between the two tails is confirmed.

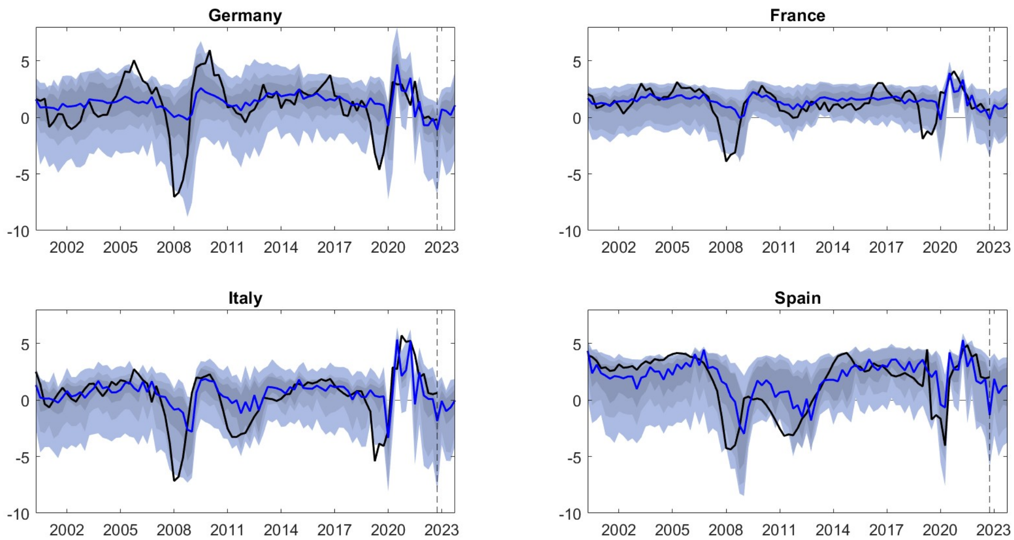


Figure 9: EA countries' GDP growth conditional distributions, common factors (percentage points)

Figure 10 reports the cross-sectional standard deviation of the conditional distributions in the nine countries, considered at different quantiles: this dispersion index can be used as an (inverse) measure of synchrony between GDP cycles, with the advantage - if compared to indices based on actual realizations - of capturing coordination on the whole distribution in each period. A first result is the low dispersion of median GDP growth rates across the whole sample, with small exceptions during episodes of crisis; the dispersion of actual growth rates follows quite closely the median dispersion during periods of growth. Similarly, the right tails of the distributions are quite synchronized throughout the period. On the contrary, the synchrony of left tails varies significantly across time, with very large spikes in periods of distress, when also the actual growth rates are very disperse. Moreover, differently from other portions of the distribution, the standard deviation of GDP-at-risk tends to revert quite slowly to the lower levels observed before crises. Looking at the standard deviations from a medium-term perspective, the left tail is not only found to be systematically more disperse than the rest of the distribution, but there are also little to no signs of a long-run reduction in its cross-sectional dispersion, suggesting very little improvements in the synchronization of economic cycles in bad times across EA countries in the last twenty years[17].

[17] These results hold true when considering GDP growth distributions constructing by either conditioning the distributions on factors extracted from datasets at national level, or by skipping the adjustment for the Covid period.

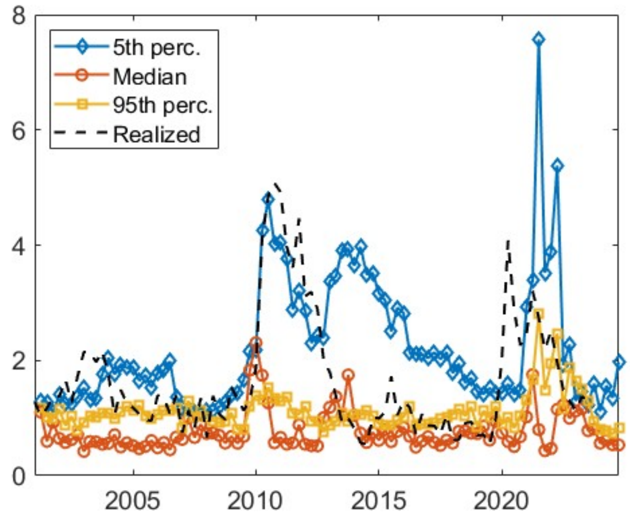


Figure 10: Conditional cross-sectional standard deviation for alternative τ, GDP growth

Figure 11 displays the conditional means of the GDP growth distributions of EA countries. Means tend to follow very similar trends, with coincident periods of growth and crisis in all countries; mean GDP growth lies around 2 percent in ordinary times for most countries, with the exception of Italy, where the central tendency of the distribution is close to 0 in most of the sample. The size of the impact of GFC is quite similar in all countries, with the exception of France and Belgium, while the conditional means of peripheral countries were more affected by the SDC. The trend of conditional variances, reported in Figure 12, is quite similar to that of the EA distribution; the negative relationship between the first and the second moment can be observed both on the time series dimension (as variance tends to increase in periods of low conditional mean, for all countries) and on the cross section (as variance increases more during crises in the countries where the fall of the first moment is stronger). The long-run level of variance is quite similar in most countries, and slightly lower only in Belgium and France; the high parameter of the Greece distribution reflects the high dispersion already observed in the non-parametric distribution.

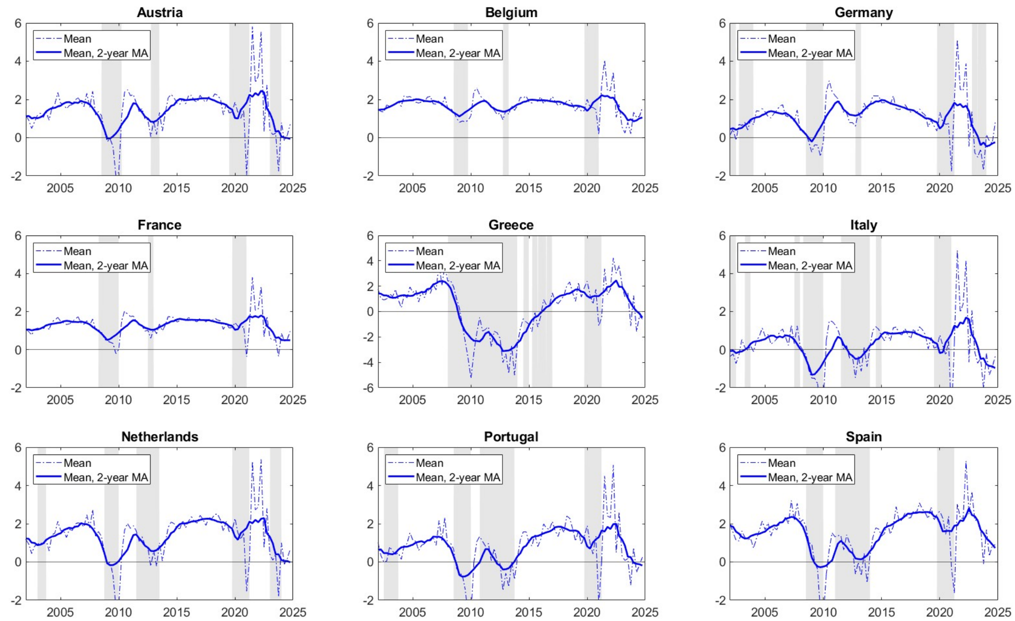


Figure 11: Conditional mean, EA countries GDP growth (percentage points)
Dashed lines: conditional mean; Solid lines: 2-year moving average of mean; Shaded areas: recessions.

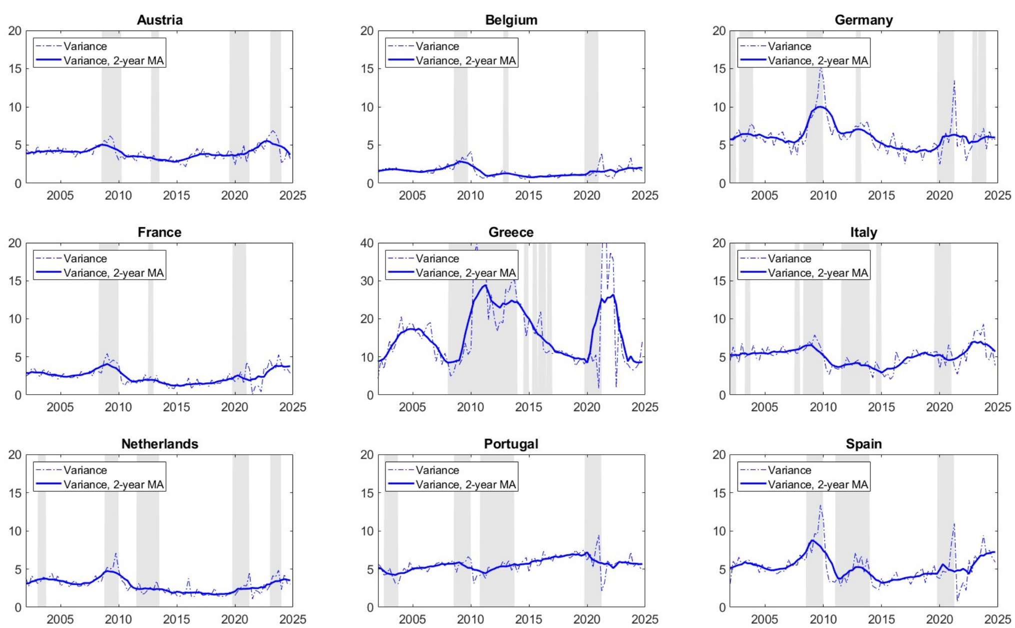


Figure 12: Conditional variance, EA countries GDP growth (percentage points)
Dashed lines: conditional variance; Solid lines: 2-year moving average of variance; Shaded areas: recessions.

5.2 Inflation-at-risk

The conditional distributions of inflation in the four main member states, obtained from factors extracted from the common dataset are reported in Figure 13. As for the EA, the only exception to the stability of the left tail of the distributions - that hovers around 0 percent during the whole sample - is the increase of deflation risk during crisis episodes. On the contrary, the percentiles on the right part of the distribution are quite volatile in all countries, and reach their highest point during the high inflation observed after 2022. During this episode of crisis, actual inflation rates do not follow the conditional median, as they do in most of the sample[18].

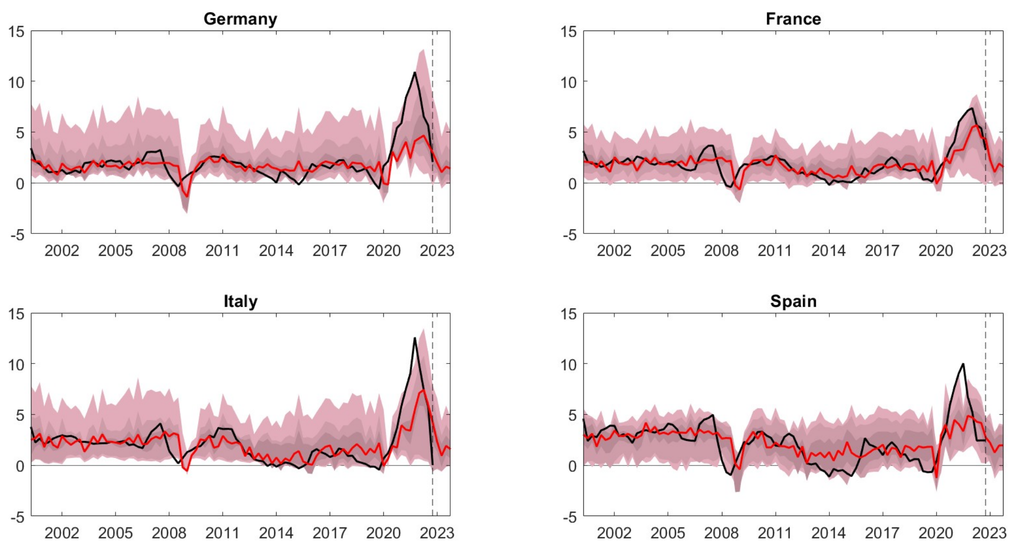


Figure 13: EA countries' inflation conditional distributions, common factors (percentage points)

Figure A13 compares the inflation distributions obtained conditioning on common (blue) and country-specific (red) factors. The dynamics of the left tails and of the conditional median are nearly equivalent in the whole sample, and also the right tails of the conditional distributions appear quite synchronous. These results indicate that the risks to price stability - both in periods of downward and upward pressures - are quite aligned throughout the Euro Area, to a wider extent than observed for GDP growth. The few episodes of departing right tails are observed during the pre-GFC period (in Germany, France and Italy), when upside risks to inflation were driven by common factors not fully captured by country-level indicators; moreover, these latter slightly

[18]The exposure of price leves to upside risks seems stronger in small open countries as Belgium, Greece and the Netherlands, whose distribution is more skewed to the right. Full results are reported by Figure A12 in the Appendix.

underestimate the right tail during the Covid crisis in Italy and Portugal, suggesting that a relevant part of inflation risks was driven by international supply-side determinants, not entirely captured by internal factors.

The cross-sectional standard deviation of the conditional inflation distributions, evaluated at different quantiles, is displayed in Figure 14. In contrast with GDP growth, here the average dispersion of the 95^{th} percentile is higher in comparison to the median and the lower percentiles. The dispersion of the actual inflation rates tends to follow that of the median, with the exception of the high inflation period of 2022, when it was closer to the right tail. However, there are two departures from the GDP results: first, for what concerns stress periods, the dispersion of the right tail of the inflation distribution varies in time much less than the indicator computed on the left tails of GDP growth, and tends to return quite quickly to previous levels, suggesting that the degree of divergence during times of upside risks to prices increases significantly less than what occurs in the case of downwards risks to economic activity; second, taking a longer term perspective, the dispersion of the distributions is more limited for inflation on all the percentiles, indicating a quite high and stable level of synchronization of price dynamics in the EA, reached already before the introduction of the common currency.

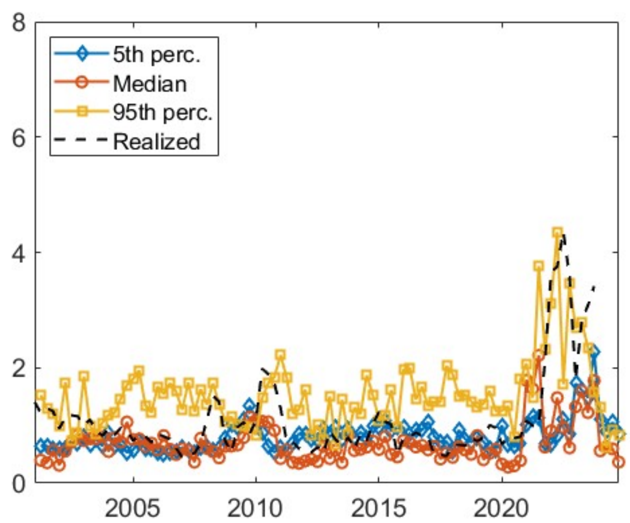


Figure 14: Conditional cross-sectional standard deviation for alternative τ, inflation

The conditional moments estimated from the inflation parametric distributions of inflation provide further evidence supporting the synchrony of inflation dynamics in the EA. Figure 15 reports the conditional means in the analysed EA countries: the most relevant result is the almost perfect co-movement of the time series, that decrease by similar proportions reflecting downward risks during the GFC and increase together in the high inflation period. Conditional means appear quite anchored to the ECB target of 2 percent in most of the sample and in all countries, with short-lived deviations during periods of crisis. The conditional variances of the inflation distributions at country level are reported in Figure 16. The second moment of the distributions is quite stable across time, displaying as observed on the EA moments a moderately positive correlation with the conditional mean on the time series dimension and a particularly strong increase during the period of high inflation. On the cross section, is is interesting to notice the higher variance of inflation in small open economies as Belgium, Greece and the Netherlands, more exposed to exogenous price shocks than other larger economies.

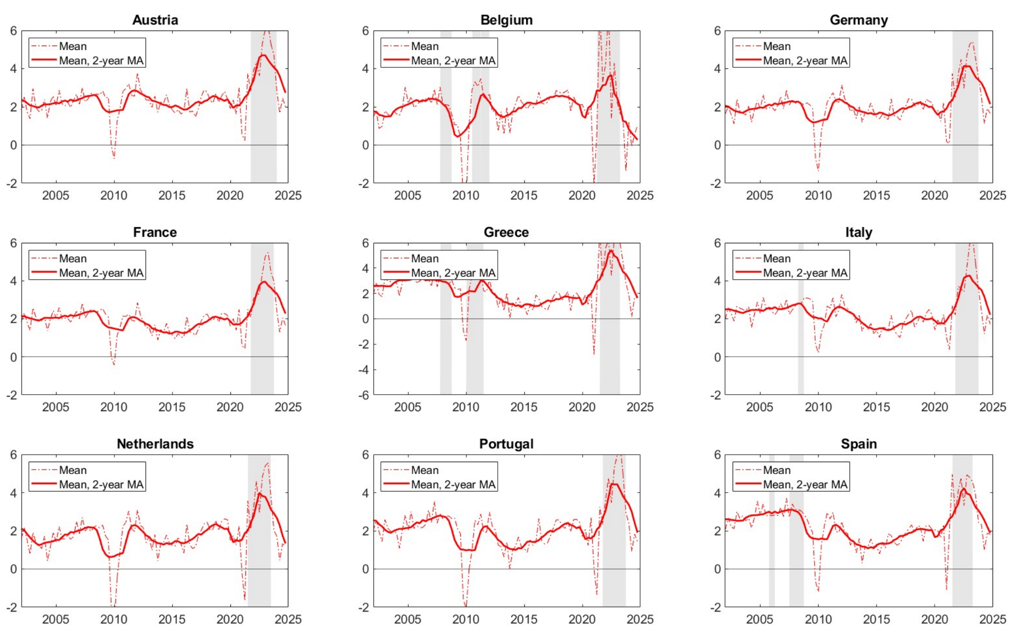


Figure 15: Conditional mean, EA countries inflation (percentage points)
Dashed lines: conditional mean; Solid lines: 2-year moving average of mean;
Shaded areas: quarters of high inflation (yearly HICP growth above 4 percent)

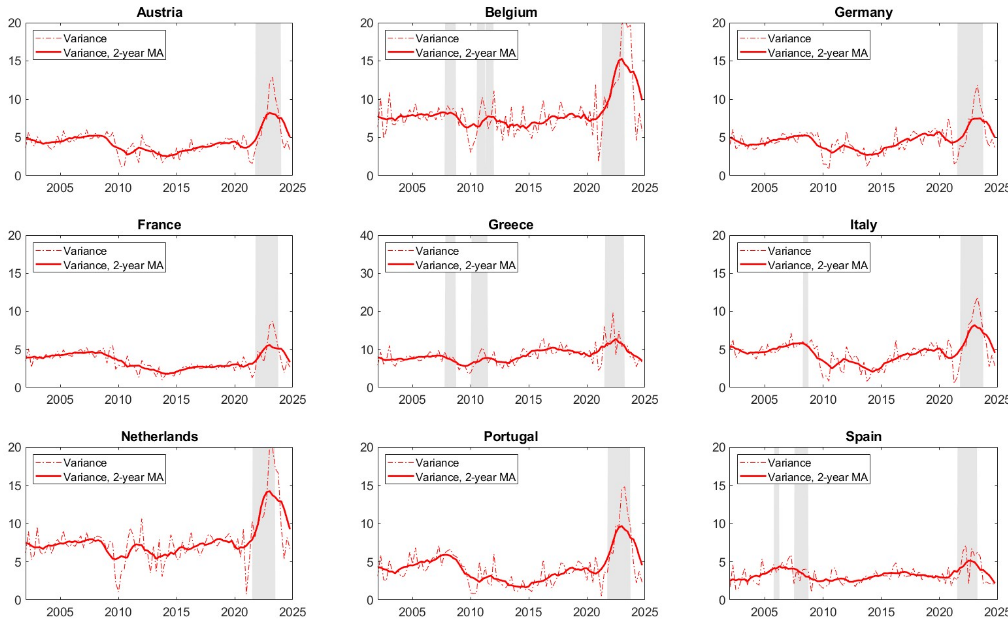


Figure 16: Conditional variance, EA countries inflation (percentage points)
Dashed lines: conditional variance; Solid lines: 2-year moving average of variance;
Shaded areas: quarters of high inflation (yearly HICP growth above 4 percent)

6 Conclusions

In this paper, the GDP-at-Risk and Inflation-at-risk for the Euro Area and its member states are estimated using the information provided by a large number of explanatory variables. For this purpose, a set of quantile-specific latent factors are extracted from a high-dimensional dataset, each one summarizing the relevant information at different points of the target variable distribution, and used them as independent variables in the construction of a conditional piecewise quantile function. In a subsequent step, a parametric distribution was fit on the interpolated quantiles, allowing for the estimation of time-varying conditional moments and measures of tail risk as the Expected Shortfall. Results indicate strong asymmetries in the GDP growth distribution, which displays fatter and volatile left tails in contrast with steadier right tails. Conditional mean and variance appear negatively related, suggesting that the uncertainty around outcomes is higher during recessions. Opposite - but minor in extent - asymmetries are found also in the inflation distribution, that displays fatter and more volatile right tails, while remaining fairly stable on its lower quantiles in the whole sample; the first moment of the inflation distribution remains substantially stable around the ECB target of two percent in most of the sample. Leveraging on the distributions of GDP growth and inflation at country level, the analysis evaluated the synchrony of business cycles across EA member states, inversely measured by the cross-sectional dispersion of conditional quantiles of the distributions. The objective is therefore to complement the study of the synchrony between economic cycles by considering the whole conditional distributions of growth and inflation. Results hint at an imbalance between the synchrony between countries' inflation distributions - on the whole distribution, even if slightly lower on the right tail - and the dispersal observed between the left tails of the GDP distributions during crisis, as measured by the cross-sectional standard deviations between low percentiles and by the conditional probabilities of recession implied by the parametric distributions. On the other hand, the short deviations of the conditional distribution from the target levels of inflation indicate a good level of synchrony of upside risks to inflation across countries in the euro area, at least in the analysed sample, characterized by positive shocks to the price level that hit the member states' economies in quite a symmetric manner.

A Other Figures and Tables

Table 1: List of series in the EA-MD-QD dataset at EA level (Barigozzi et al. (2024))

Name	Source	Class	Name	Source	Class
Real GDP	EUR	R	HHs - Assets: ST Loans	EUR	F
Real Exports	EUR	R	HHs - Assets: LT Loans	EUR	F
Real Imports	EUR	R	HHs: Total Financial Liabilities	EUR	F
Real Gov. Final consumption	EUR	R	HHs - Liabilities: ST Loans	EUR	F
Real HHs consumption expenditure	EUR	R	HHs - Liabilities: LT Loans	EUR	F
Real HHs cons. expenditure: Durable Goods	EUR	R	NULCs: Industry	EUR	N
Real HHs cons. expenditure: ND Goods and Serv.	EUR	R	NULCs: Mining and Quarrying	EUR	N
Real Gross capital formation	EUR	R	NULCs: Manufacturing	EUR	N
Real GFCF	EUR	R	NULCs: Construction	EUR	N
Real GFCF: Construction	EUR	R	NULCs: Trade, Transport, Food, IT	EUR	N
Real GFCF: Machin. and Eq.	EUR	R	NULCs: Financial Activities	EUR	N
Adjusted HHs Real Disposable Income	EUR	R	NULCs: Real Estate	EUR	N
Actual Final Consumption Expenditure of HHs	EUR	R	NULCs: Prof., Scientific, Tech activities	EUR	N
Gross Profit Share of NFCs	EUR	R	Real Exchange Rate	EUR	F
Gross Investment Share of NFCs	EUR	R	Exchange Rate (US dollar)	EUR	F
Gross Investment Rate of HHs	EUR	R	3-Months Interest Rates	EUR	F
Gross HHs Savings Rate	EUR	R	6-Months Interest Rates	EUR	F
Total Employment (domestic concept)	EUR	R	LT Interest Rates	EUR	F
Employees (domestic concept)	EUR	R	IPI: Manufacturing	EUR	R
Self Employment (domestic concept)	EUR	R	IPI: Capital Goods	EUR	R
Hours Worked: Total	EUR	R	IPI: Consumer Goods	EUR	R
Employment: Agriculture, Forestry, Fishing	EUR	R	IPI: Durable Consumer Goods	EUR	R
Employment: Industry	EUR	R	IPI: Non Durable Consumer Goods	EUR	R
Employment: Manufacturing	EUR	R	IPI: Intermediate Goods	EUR	R
Employment: Construction	EUR	R	IPI: Energy	EUR	R
Employment: Trade, transport, food	EUR	R	TI: Manufacturing	EUR	R
Employment: Information and Communication	EUR	R	TI: Capital Goods	EUR	R
Employment: Financial and Insurance activities	EUR	R	TI: Consumer Goods	EUR	R
Employment: Real Estate	EUR	R	TI: Durable Consumer Goods	EUR	R
Employment: Prof., Scientific, Tech activities	EUR	R	TI: Non Durable Consumer	EUR	R
Employment: PA, education, health/social services	EUR	R	TI: Intermediate Goods	EUR	R
Employment: Arts and recreational activities	EUR	R	TI: Energy	EUR	R
Unemployment: Total	EUR	R	PPI: Capital Goods	EUR	N
Unemployment: Over 25 years	EUR	R	PPI: Consumer Goods	EUR	N
Unemployment: Under 25 years	EUR	R	PPI: Durable Consumer Goods	EUR	N
Real Labour Productivity	EUR	R	PPI: Non Durable Consumer Goods	EUR	N
Wages and salaries	EUR	N	PPI: Intermediate Goods	EUR	N
Employers' Social Contributions	EUR	N	PPI: Energy	EUR	N
Tot.Ec. - Assets: ST Debt Securities	EUR	F	HICP: Overall Index	ECB	N
Tot.Ec. - Assets: LT Debt Securities	EUR	F	HICP: All Items: no Energy & Food	ECB	N
Tot.Ec. - Assets: ST Loans	EUR	F	HICP: Goods	ECB	N
Tot.Ec. - Assets: LT Loans	EUR	F	HICP: Industrial Goods	ECB	N
Tot.Ec. - Liabilities: ST Debt Securities	EUR	F	HICP: Services	ECB	N
Tot.Ec. - Liabilities: LT Debt Securities	EUR	F	HICP: Energy	EUR	N
Tot.Ec. - Liabilities: ST Loans	EUR	F	Real GDP Deflator	EUR	N
Tot.Ec. - Liabilities: LT Loans	EUR	F	Residential Property Prices	FRED	N
NFCs: Total Financial Assets	EUR	F	Industrial Confidence Indicator	EUR	C
NFCs - Assets: ST Loans	EUR	F	Consumer Confidence Index	EUR	C
NFCs - Assets: LT Loans	EUR	F	Economic Sentiment Indicator	EUR	C
NFCs: Total Financial Liabilities	EUR	F	Construction Confidence Indicator	EUR	C
NFCs - Liabilities - ST Loans	EUR	F	Retail Confidence Indicator	EUR	C
NFCs - Liabilities - LT Loans	EUR	F	Services Confidence Indicator	EUR	C
GG: Total Financial Assets	EUR	F	Business Confidence Index	OECD	C
GG - Assets: ST Loans	EUR	F	Consumer Confidence Index	OECD	C
GG - Assets: ST Loans	EUR	F	Money Stock: Currency	ECB	F
GG: Total Financial Liabilities	EUR	F	Money Stock: M1	ECB	F
GG - Liabilities: ST Loans	EUR	F	Money Stock: M2	ECB	F
GG - Liabilities: LT Loans	EUR	F	Share Prices	OECD	F
HHs: Total Financial Assets	EUR	F	Passenger's Cars Registrations	ECB	R

HHs: Households; GFCF: Gross Fixed Capital Formation; NFCs: Non-Financial Corporations; ST/LT: Short/Long-Term; GG: General Government; NULCs: Nominal Unit Labour Costs; IPI: Industrial Price Index; PPI: Producer Price Index; TI: Turnover Index; HICP: Harmonized Index of Consumer Prices

A.1 Imputation of GDP during the Covid period

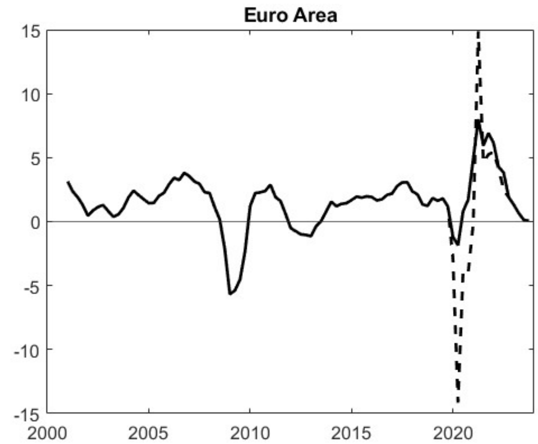


Figure A1: EA GDP growth, actual and imputed values (percentage points)

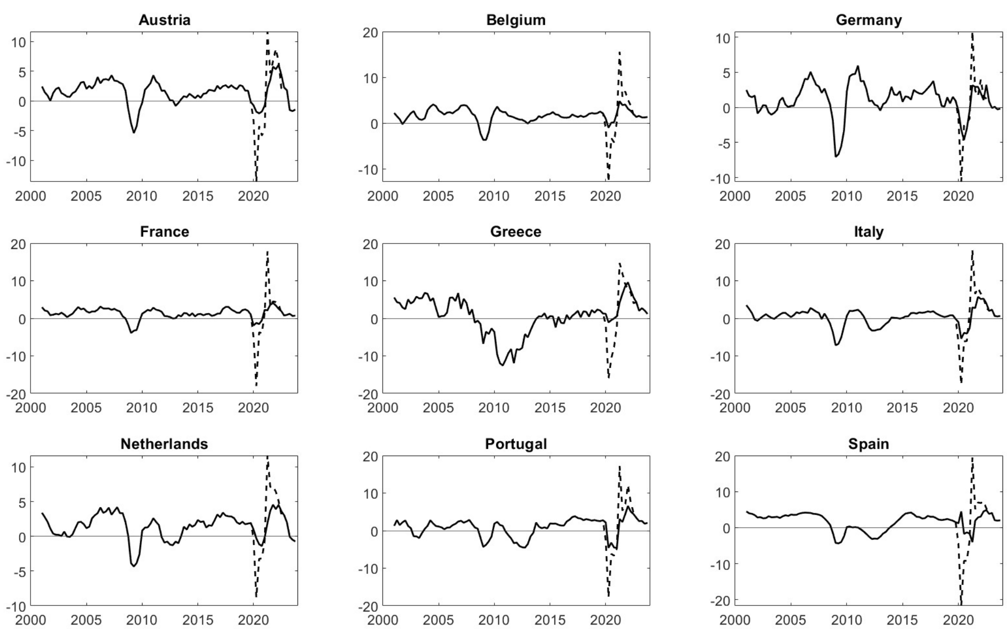


Figure A2: EA countries GDP growth, actual and imputed values (percentage points)

A.2 Other results for the Euro Area

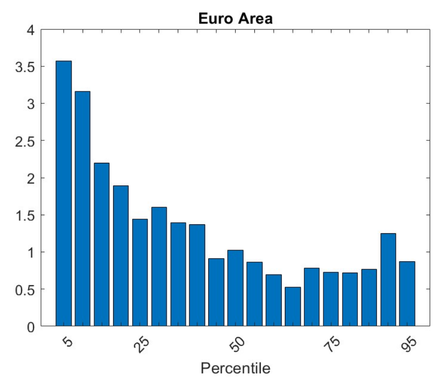
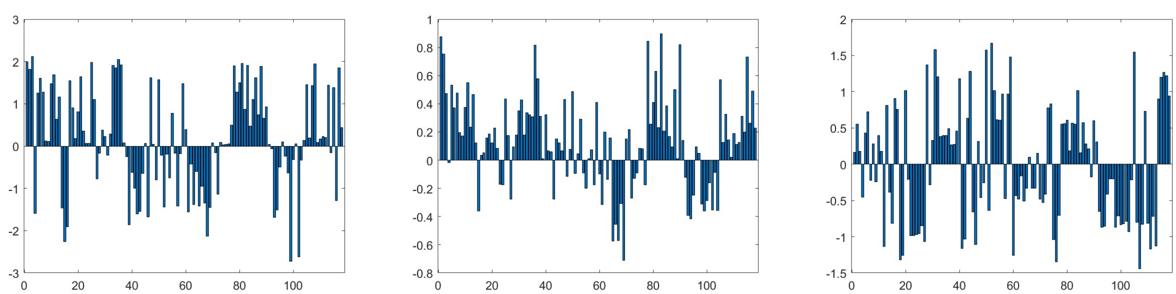


Figure A3: Variance of EA GDP conditional quantiles



(a) 5$^{\text{th}}$ percentile (b) Median (c) 95$^{\text{th}}$ percentile

Figure A4: Normalized loadings, EA GDP growth

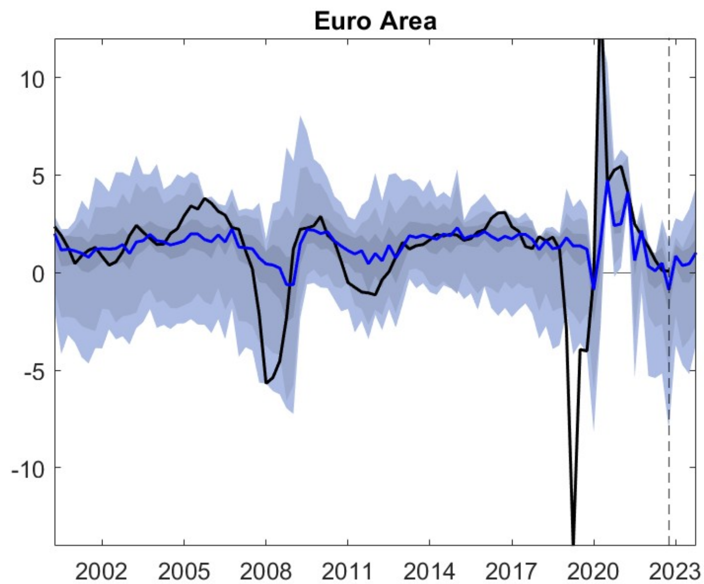


Figure A5: EA GDP growth conditional distribution, without Covid adjustment

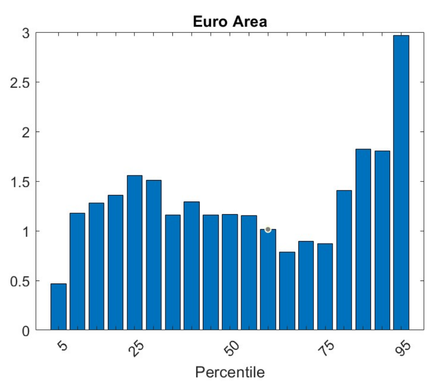
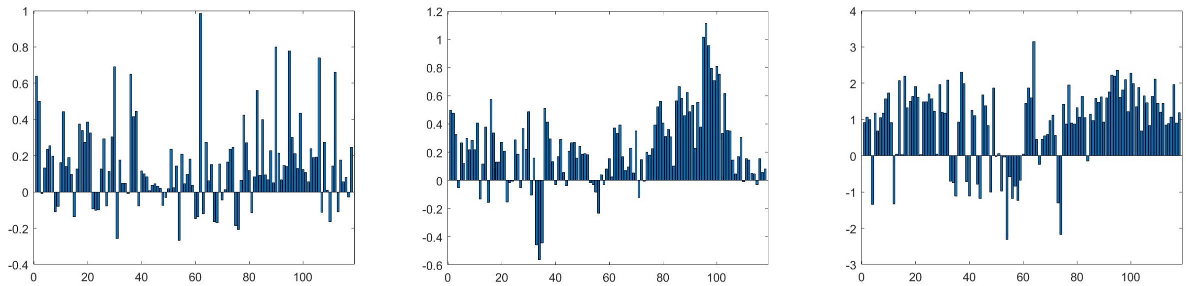


Figure A6: Variance of EA inflation conditional quantiles

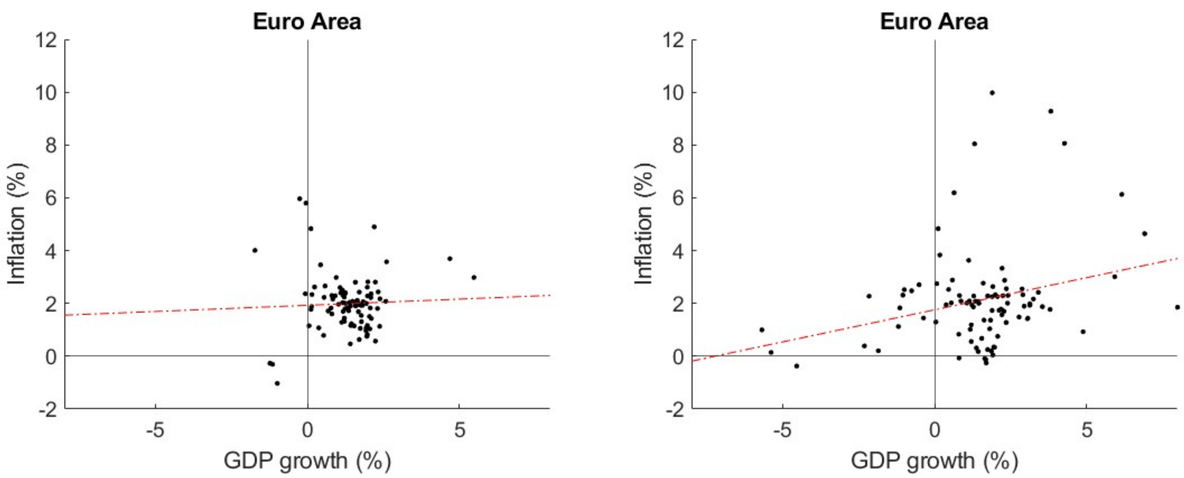


(a) 5$^{\text{th}}$ percentile

(b) Median

(c) 95$^{\text{th}}$ percentile

Figure A7: Normalized loadings, EA inflation



(a) Conditional medians

(b) Unconditional values

Figure A8: GDP growth and inflation, EA

A.3 Other results for the EA countries

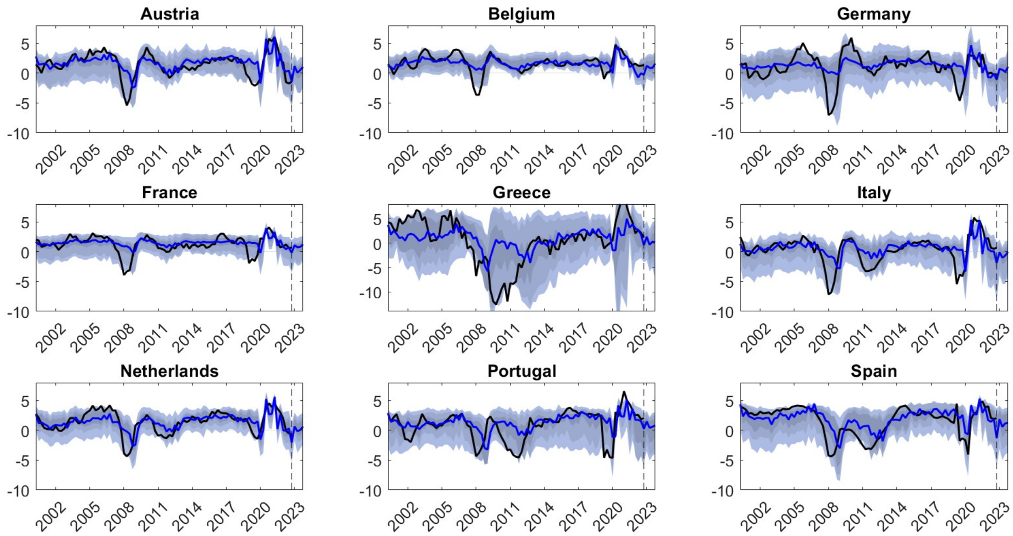


Figure A9: GDP growth conditional distributions, common factors (percentage points)

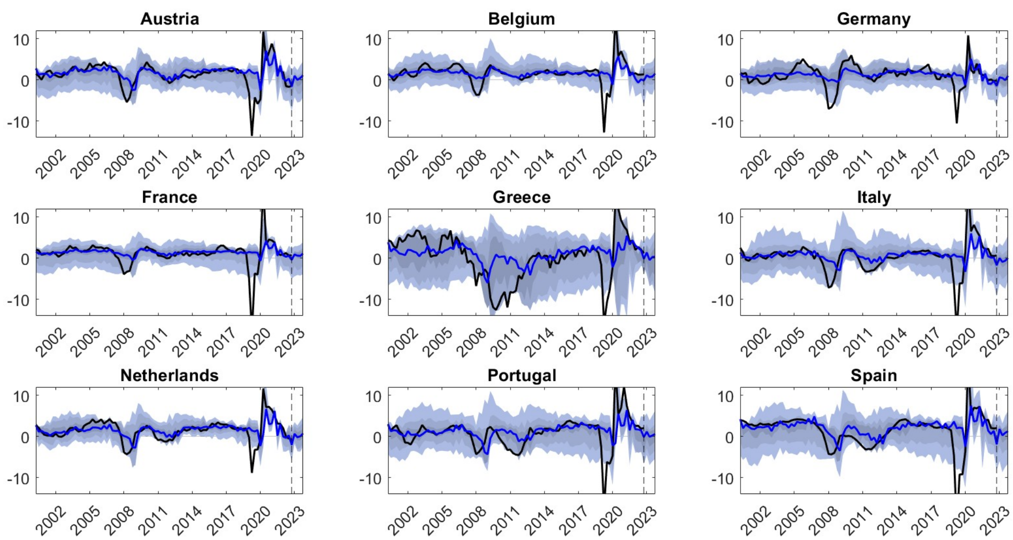


Figure A10: GDP growth conditional distributions, common factors (without Covid adjustment)

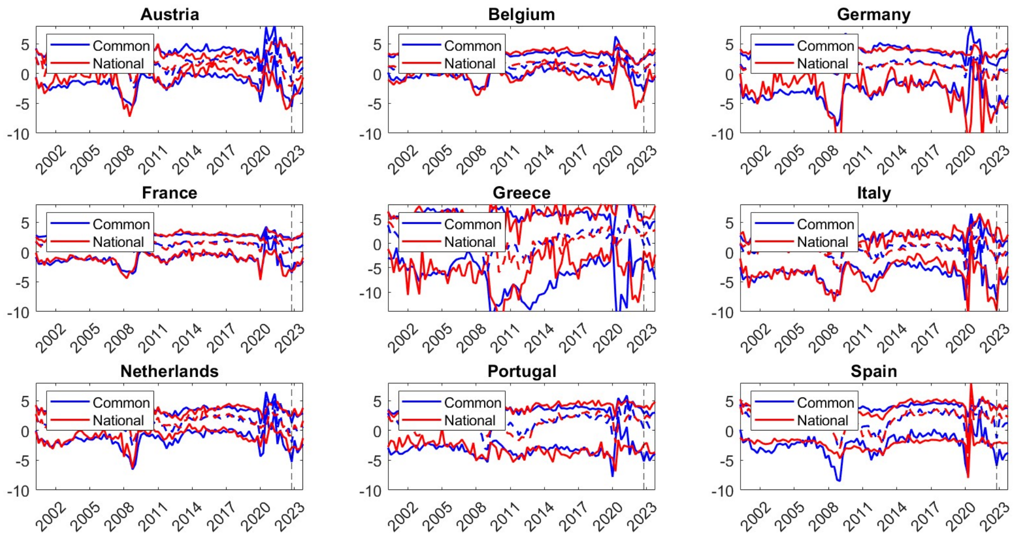


Figure A11: GDP growth conditional distributions, common and country-specific factors (percent)
Red lines: 5^{th}, 50^{th} and 95^{th} percentiles of the distributions conditional on EA factors (median in dashed lines).
Blue lines: 5^{th}, 50^{th} and 95^{th} percentiles of the distributions conditional on country-specific factors.

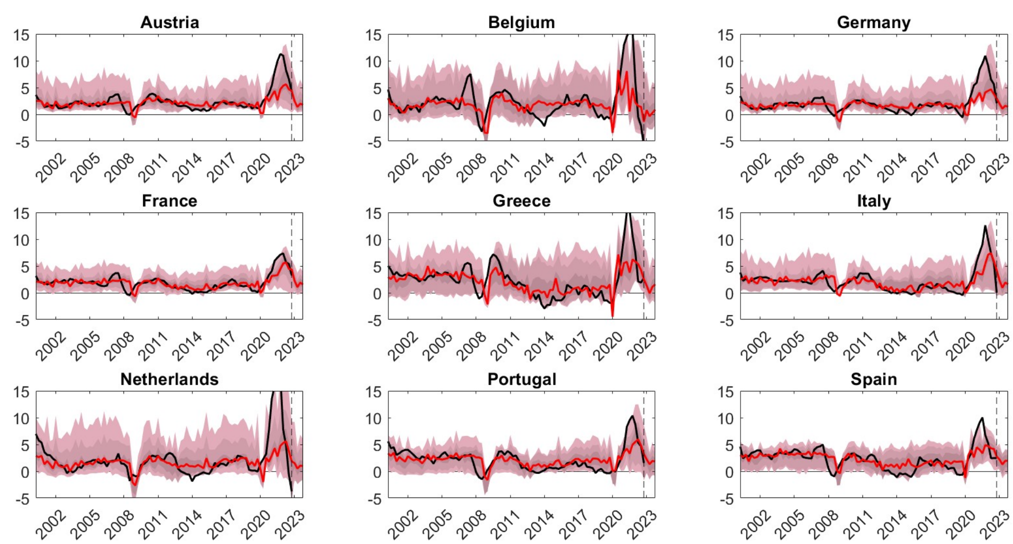


Figure A12: EA countries' inflation conditional distributions, common factors (percentage points)

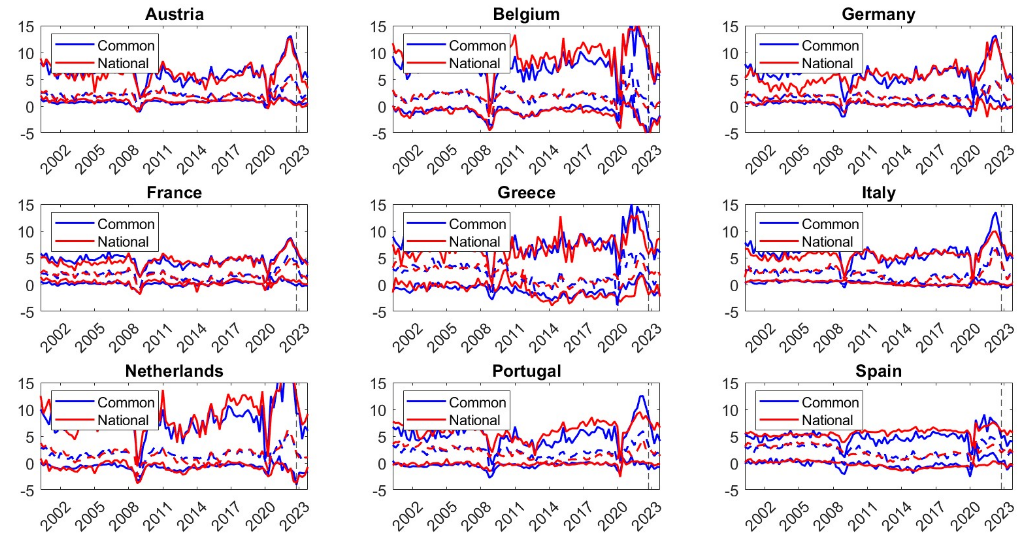


Figure A13: Inflation conditional distributions, common and country-specific factors (percent)
Red lines: 5^{th}, 50^{th} and 95^{th} percentiles of the distributions conditional on EA factors (median in dashed lines).
Blue lines: 5^{th}, 50^{th} and 95^{th} percentiles of the distributions conditional on country-specific factors.

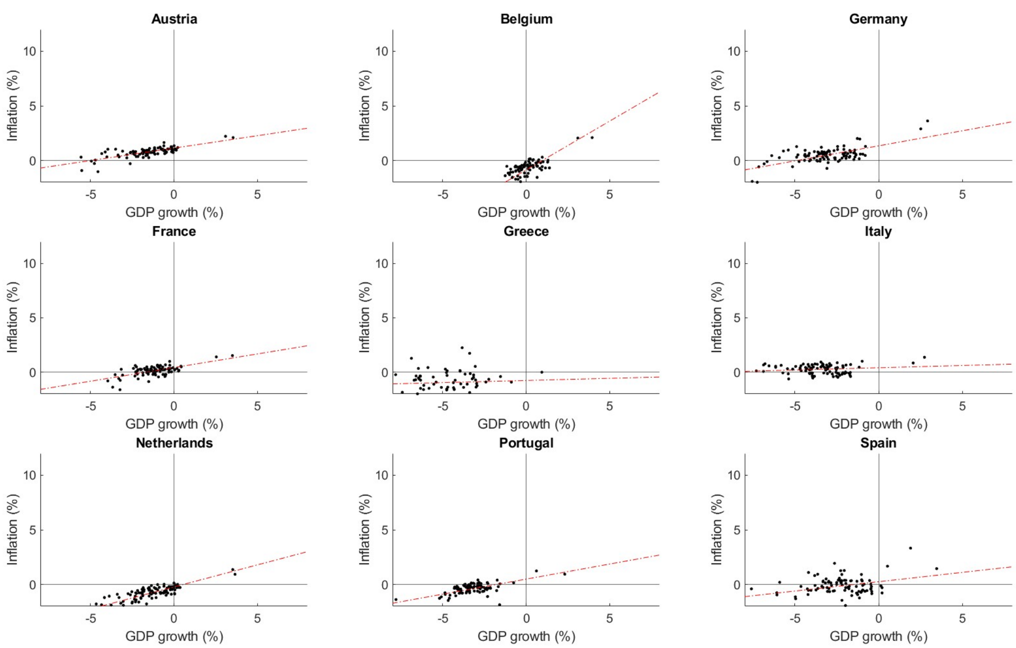


Figure A14: Conditional AS curves on the left tail, EA countries

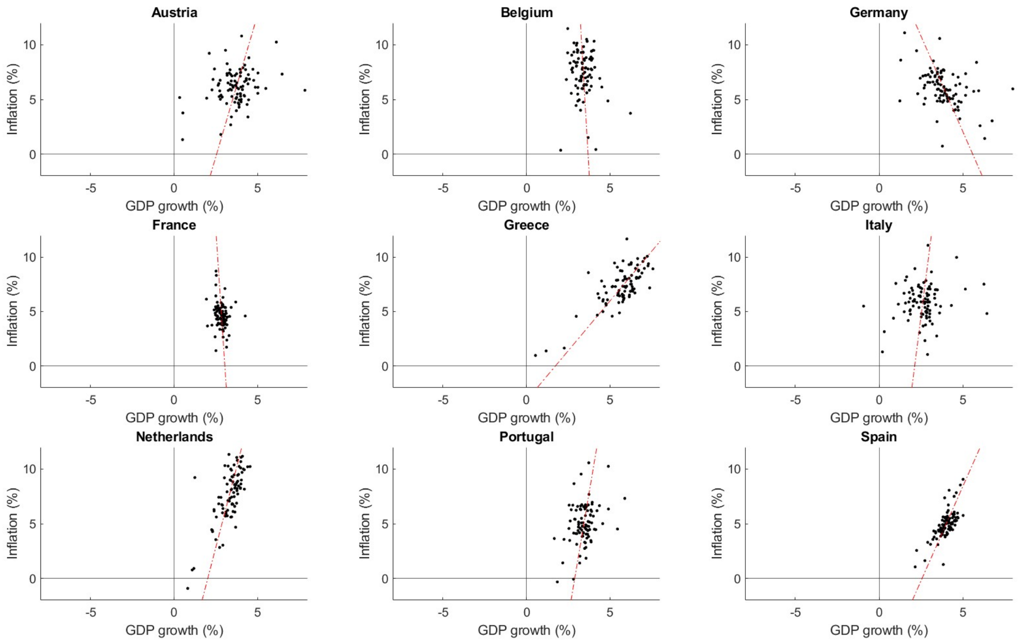


Figure A15: Conditional AS curves on the right tail, EA countries

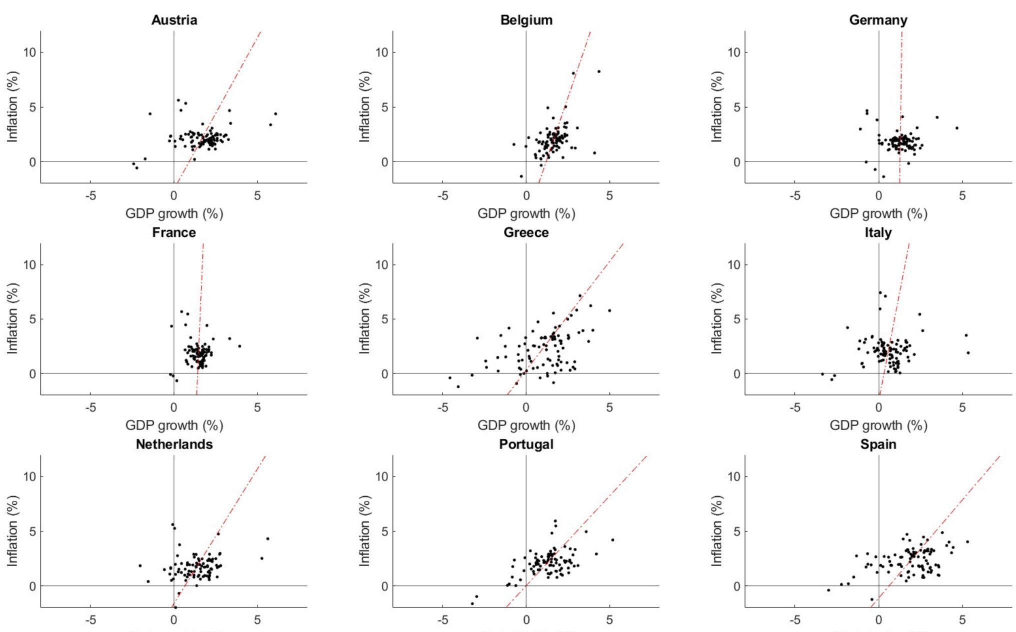


Figure A16: Conditional median of π and y, EA countries

Figure A17: Conditional probabilities of recessions and high inflation, EA countries (percent)

References

Adrian, T., & Boyarchenko, N. (2012). Intermediary leverage cycles and financial stability. *Becker Friedman Institute for Research in Economics Working Paper*, (2012-010).

Adrian, T., Boyarchenko, N., & Giannone, D. (2019). Vulnerable growth. *American Economic Review*, *109*(4), 1263–89.

Aikman, D., Bridges, J., Hacioglu Hoke, S., O'Neill, C., & Raja, A. (2019). Credit, capital and crises: A gdp-at-risk approach.

Alessandri, P., Del Vecchio, L., Miglietta, A., et al. (2019). *Financial conditions and growth at risk in italy*. Banca d'Italia.

Azzalini, A., & Capitanio, A. (2003). Distributions generated by perturbation of symmetry with emphasis on a multivariate skew t-distribution. *Journal of the Royal Statistical Society Series B: Statistical Methodology*, *65*(2), 367–389.

Baldwin, R., & Wyplosz, C. (2019). *The economics of european integration*. McGraw Hill.

Barigozzi, M., Lissona, C., & Tonni, L. (2024). Ea-md-qd: Large euro area and euro member countries datasets for macroeconomic research. *Zenodo*.

Bayoumi, T., & Eichengreen, B. (1992). Shocking aspects of european monetary unification.

Bayoumi, T., & Eichengreen, B. (1997). Ever closer to heaven? an optimum-currency-area index for european countries. *European economic review*, *41*(3-5), 761–770.

Brownlees, C., & Souza, A. B. (2021). Backtesting global growth-at-risk. *Journal of Monetary Economics*, *118*, 312–330.

Brunnermeier, M. K., & Sannikov, Y. (2014). A macroeconomic model with a financial sector. *American Economic Review*, *104*(2), 379–421.

Busetti, F., Caivano, M., Delle Monache, D., & Pacella, C. (2021). The time-varying risk of italian gdp. *Economic Modelling*, *101*, 105522.

Campos, N. F., & Macchiarelli, C. (2016). Core and periphery in the european monetary union: Bayoumi and eichengreen 25 years later. *Economics Letters*, *147*, 127–130.

Campos, N. F., & Macchiarelli, C. (2021). The dynamics of core and periphery in the european monetary union: A new approach. *Journal of International Money and Finance*, *112*, 102325.

Cecchetti, S. G. (2006). Gdp at risk: A framework for monetary policy responses to asset price movements. *NBER Working Paper*, (C0012).

Cecchetti, S. G. (2008). Measuring the macroeconomic risks posed by asset price booms. In *Asset prices and monetary policy* (pp. 9–43). University of Chicago Press.

Chavleishvili, S., & Kremer, M. (2023). Measuring systemic financial stress and its risks for growth.

Chavleishvili, S., & Manganelli, S. (2019). Forecasting and stress testing with quantile vector autoregression. *Available at SSRN 3489065.*

Chen, L., Dolado, J. J., & Gonzalo, J. (2021). Quantile factor models. *Econometrica*, *89*(2), 875–910.

Coe, P. J., & Vahey, S. P. (2020). Financial conditions and the risks to economic growth in the united states since 1875.

de Haan, J., Jacobs, J. P., & Zijm, R. (2024). Coherence of output gaps in the euro area: The impact of the covid-19 shock. *European Journal of Political Economy*, *84*, 102369.

Delle Monache, D., De Polis, A., & Petrella, I. (2023). Modeling and forecasting macroeconomic downside risk. *Journal of Business & Economic Statistics*, 1–27.

Dodge, Y., & Whittaker, J. (2009). Partial quantile regression. *Metrika*, *70*, 35–57.

Ferrara, L., Mogliani, M., & Sahuc, J.-G. (2022). High-frequency monitoring of growth at risk. *International Journal of Forecasting*, *38*(2), 582–595.

Figueres, J. M., & Jarociński, M. (2020). Vulnerable growth in the euro area: Measuring the financial conditions. *Economics Letters*, *191*, 109126.

Gächter, M., Hasler, E., & Huber, F. (2023). A tale of two tails: 130 years of growth-at-risk. *arXiv preprint arXiv:2302.08920.*

Galvão, A. B., & Owyang, M. T. (2018). Financial stress regimes and the macroeconomy. *Journal of Money, Credit and Banking*, *50*(7), 1479–1505.

Giglio, S., Kelly, B., & Pruitt, S. (2016). Systemic risk and the macroeconomy: An empirical evaluation. *Journal of Financial Economics*, *119*(3), 457–471.

Hartwig, B., Meinerding, C., & Schüler, Y. S. (2021). Identifying indicators of systemic risk. *Journal of International Economics*, *132*, 103512.

Hollo, D., Kremer, M., & Lo Duca, M. (2012). Ciss-a composite indicator of systemic stress in the financial system.

Koenker, R., & Bassett Jr, G. (1978). Regression quantiles. *Econometrica: journal of the Econometric Society*, 33–50.

Krugman, P. (2013). Revenge of the optimum currency area. *NBER macroeconomics annual*, *27*(1), 439–448.

Kunovac, D., Palenzuela, D. R., & Sun, Y. (2022). A new optimum currency area index for the euro area.

Lang, J. H., Rusnák, M., & Greiwe, M. (2023). Medium-term growth-at-risk in the euro area.

Loria, F., Matthes, C., & Zhang, D. (2022). Assessing macroeconomic tail risk. *Available at SSRN 4002665*.

McCracken, M. W., & Ng, S. (2016). Fred-md: A monthly database for macroeconomic research. *Journal of Business & Economic Statistics*, *34*(4), 574–589.

Mundell, R. A. (1961). A theory of optimum currency areas. *The American economic review*, *51*(4), 657–665.

Szendrei, T., & Varga, K. (2023). Revisiting vulnerable growth in the euro area: Identifying the role of financial conditions in the distribution. *Economics Letters*, 110990.

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