Macroeconomic Uncertainty Indices for the Euro Area and its Individual Member Countries

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Abstract

This paper introduces the Rossi and Sekhposyan (2015) uncertainty index for the Euro Area and its member countries. The index captures how unexpected a forecast error associated with a realization of a macroeconomic variable is relative to the unconditional forecast error distribution. Furthermore, it can differentiate between upside and downside uncertainty, which could be relevant for addressing a variety of economic questions. The index is particularly useful since it can be constructed for any economy for which point forecasts and realizations are available. We show the usefulness of the index in studying the heterogeneity of uncertainty across Euro Area countries as well as the spillover effects via a network approach.

Keywords: Uncertainty, Uncertainty Index, Survey of Professional Forecasters, Euro Area Macroeconomy, Spillovers

J.E.L. Codes: C18, E01, E30

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1 Introduction

This paper introduces macroeconomic uncertainty indices for both the Euro Area (EA) as well as individual EA-member countries. The methodology we use to construct the uncertainty index is based on Rossi and Sekhposyan (2015) and relies on the likelihood of the observed forecast error. The index is based on the quantile associated with the actual realized value of the forecast error in the unconditional distribution of observed forecast errors. For example, if according to the distribution of realized forecast errors, the probability of observing a forecast error of $x\%$ is very unlikely (e.g., a forecast error of $x\%$ is in the 99-th quantile, say, of the historical distribution of forecast errors), and the realized forecast error is indeed $x\%$, then the index determines that there is substantial uncertainty. The novelty of this paper is the application of the methodology in Rossi and Sekhposyan (2015) to construct uncertainty indices for the Euro Area as well as several of its member economies for which uncertainty indices are not currently available.[1]

The index we propose is appealing since aggregate uncertainty (or uncertainty common to a set of variables, such as policy variables) can be described with probabilistic statements. Further, our measure also has the advantage of providing information on whether the uncertainty is an upside (positive) or a downside (negative) one, while the measures commonly used in the literature, for instance dispersion-based measures, do not have this feature. This is potentially important, since being surprised about positive outcomes may have different macroeconomic effects than being surprised about negative outcomes.[2] Lastly, our measure of uncertainty is easy to construct and use. It requires no parametric models, which would be hard to implement for a variety of countries for which the data sample is relatively small (such as the Euro Area).

While there are a variety of uncertainty measures available and studied for the US (see Bloom, 2014), the available measures of uncertainty for the Euro Area are only a few. The VSTOXX index is a market implied volatility measure for the Euro Area, similar to the

[1] Our measure is easy to construct, and it can be applied to any country for which forecasts and realizations are available. In fact, using GDP growth and CPI inflation forecasts provided by Consensus Economics we can obtain uncertainty indices for all European individual countries. The time series of the uncertainty indices (in Excel format) are publicly available on our webpages at http://www.tateviksekhposyan.org/ and http://www.barbararossi.eu/.

[2] In fact, as Rossi and Sekhposyan (2015) show, for the US, upside uncertainty is expansionary, while downside uncertainty is recessionary. Thus, whether uncertainty is an upside or a downside one is relevant for understanding its macroeconomic impact.

VIX/VXO in the US, which has been used for measuring uncertainty and its macroeconomic impact (see Bloom, 2009). Baker, Bloom and Davis (2016) propose a news-based measure, the European Economic Policy Uncertainty (EPU) index by searching for keywords associated with uncertainty across a variety of relevant newspaper articles. Regarding uncertainty indices for individual EA-member countries, Baker, Bloom and Davis (2016) build economic policy uncertainty indices for only a few of them (Italy, France, Spain, and the Netherlands), and, in addition, their index is very time-consuming to calculate. On the other hand, our proposed index can be calculated for any country as long as there is a sequence of forecasts and corresponding realizations, and we provide such indices for Euro Area member countries. Our index is also different from theirs since it builds on forecast errors.

There are a few forecast-based uncertainty measures for the Euro Area as well. Both Kenny (2016) and Abel et al. (2016) focus on the Survey of Professional Forecasters conducted by the European Central Bank (which we will denote by ECB-SPF). Kenny (2016) uses an uncertainty index based on probability density forecasts. Abel et al. (2016) compare three measures that are typically used as uncertainty proxies: (i) ex-ante measures (i.e. the average dispersion across forecasters' density forecasts or the median inter-quartile range from individual predictive densities); (ii) disagreement measures (i.e. dispersion in point forecasts or the inter-quartile range of point forecasts across individuals at each point in time); and (iii) forecast error variances.[3] Note that the indices in Kenny (2016) and Abel et al. (2016) are obtained by using the whole cross section of forecasters' predictions or their predictive densities, and hence can only be constructed for the Euro Area as a whole since no such data are available at the individual country level. Our index, instead, is available for most European countries and several others around the world.

In terms of empirical results, Abel et al. (2016) find that the ex-ante uncertainty measures are counter-cyclical, and that output growth and inflation uncertainty increased since 2007. In addition, they find no meaningful relationship between ex-ante and ex-post uncertainty. Furthermore, they conclude that the relationship between disagreement and ex-ante uncertainty is positive, yet mild, with disagreement explaining very little of ex-ante uncertainty fluctuations. The latter finding is consistent with the fact that the empirical evidence on the relationship between disagreement and uncertainty has been mixed in the literature. As discussed in Zarnowitz and Lambros (1987) and Lahiri and Sheng (2010), researchers who use disagreement as a measure of uncertainty implicitly assume that the dispersion

[3] Jurado, Ludvigson and Ng (2015), Scotti (2016) and Jo and Sekkel (2016) are other important examples where the variance of forecast errors is used as an uncertainty measure, but in US data.

among forecasters mimics the dispersion that each forecaster expects across the outcomes. This assumption may not hold, and hence disagreement may not reflect uncertainty. Regardless, Zarnowitz and Lambros (1987) find mild evidence for it in the US data. Lahiri and Sheng (2010), on the other hand, establish conditions under which disagreement and uncertainty are the same. They find that forecast uncertainty is the same as disagreement plus the variance of future aggregate shocks cumulated over the forecast horizon, and hence depends on how the latter varies across time and horizons. Consequently, they find that disagreement is a reliable measure of uncertainty only in stable periods. In a related paper, Rich and Tracy (2010) also find little empirical evidence that disagreement is a useful proxy for uncertainty in the US. Our measure, instead, is not based on disagreement, but on the average of the point forecasts across the cross section of forecasters. See Rossi, Sekhposyan and Soupre (2016) for a comprehensive study of the relationship between ex-ante and ex-post uncertainty measures, as well as disagreement over time in the US.

More broadly, the uncertainty indices used in this paper are complementary to those proposed in the literature. Among the measures used in the literature, a common one is the ex-ante volatility (or the variance of the forecast errors, or any measure of dispersion), which implies that positive and negative outcomes are "symmetric" and of the same importance; our measure, instead, allows for asymmetry. Moreover, our measure is different than some of the alternatives in the literature that propose to differentiate between "good" and "bad" uncertainty in an asset pricing framework (see Bekaert and Engstrom, 2015, or Segal et al., 2014) since it measures the surprises in terms of probabilities as opposed to being a distance measure. Our index can also quantify how unexpected forecasters' predictions turned out to be relative to what was expected ex-ante; hence, in that sense, our approach is distantly related to the Value at Risk (VaR) literature (Engle and Manganelli, 2004). VaR measures the maximum loss that one can incur with a given probability and, hence, quantifies the risk of loss in a portfolio of financial assets.

Our analysis uncovers several interesting empirical findings. First, uncertainty, as measured by the Rossi and Sekhposyan (2015) index, was uncommonly high in the Euro Area during the financial crisis as well as during the European sovereign debt crisis. Though the crises were accompanied with downside uncertainty, the period after the crises was predominantly characterized as a prolonged period of upside uncertainty (at least in terms of inflation and the unemployment rate). In addition, we find that most European countries share a similar uncertainty cycle, although there is some evidence of divergence and heterogeneity after the last recession, starting in 2013:II. Finally, spillover effects for both output growth-and inflation-based uncertainty are rather large, especially when concentrating on the current composition of the Euro Area. When looking at the original set of Euro Area member economies, the degree of inflation-based uncertainty spillovers decreases somewhat, yet they still show considerable time variation: the spillover effects appear to be counter-cyclical, increasing during the financial and European sovereign debt crises, which also happen to lead/coincide with periods of recessions.

The paper is organized as follows. Section 2 provides an overview of the macroeconomic uncertainty indices we use. Section 3 discusses the proposed uncertainty indices for the Euro Area, while Section 4 discusses country-specific uncertainty indices. Section 5 analyzes the dynamics of the uncertainty across the Euro Area and assesses its spillover effects. Section 6 reports sensitivity analyses, and Section 7 concludes.

2 The Uncertainty Indices

The uncertainty index we use is proposed in Rossi and Sekhposyan (2015). The index is based on comparing the realized forecast error with the unconditional distribution of forecast errors for that variable. If the realized forecast error is in the tail of the distribution, we conclude that the realization was very difficult to predict, thus the macroeconomic environment is very uncertain.

More specifically, the index is based on the cumulative density of the forecast errors evaluated at the actual realized forecast error. Let the forecast error at time $t+h$ be denoted by $e_{t+h} = y_{t+h} - E_t(y_{t+h})$, $t = 1, ..., T-h$ (T being the overall sample size); i.e. it is the forecast error associated with the h-step-ahead forecast made using all the available information at time t. Throughout the paper we will refer to time t as a forecast origin date. Let $f(e)$ denote the probability distribution function (PDF) of the forecast errors, e_{t+h}. In our empirical implementation we use the full sample of forecast errors to proxy the unconditional distribution.[4] Given e_{t+h} and $f(e)$, the Rossi and Sekhposyan (2015) uncertainty index at time $t+h$ is based on:

[4]In principle, one could rely on the conditional distribution, where the density of forecast errors $f(e)$ is constructed based on all the forecast errors realized up to time t. Rossi and Sekhposyan (2015) implement both versions when constructing the uncertainty indices for the US. In the context of the Euro Area (or countries other than the US), using the conditional distribution rather than the unconditional one is more challenging since the overall sample size available for constructing the forecast errors is rather small, and it would result in a very short time series of uncertainy indices, which would not be useful for empirical analysis.

$$U_{t+h} = \int_{-\infty}^{e_{t+h}} f(e)\, de. \tag{1}$$

Note that, by construction, U_{t+h} is between zero and one. When U_{t+h} is close to the extreme values, either one or zero, the realized forecast error is very different from the expected value based on the unconditional distribution, and, hence, we conclude that uncertainty is high. U_{t+h} in eq. (1) is the quantile associated with the actual realized value of the forecast error in the unconditional distribution of observed forecast errors.

The measure proposed in eq. (1) allows us to differentiate between upside (positive) and downside (negative) uncertainty. When U_{t+h} is close to one, i.e. when the realization is much higher than its expected value relative to the historical average, we label the shock, i.e. the forecast error, as a positive uncertainty "shock." Conversely, a value of U_{t+h} close to zero indicates that the realized value is much smaller than the expected value, and we label it a negative unexpected "shock." To convey information about the asymmetry, Rossi and Sekhposyan (2015) propose two indices:[5]

$$U_{t+h}^{+} = \frac{1}{2} + \max\left\{U_{t+h} - \frac{1}{2}, 0\right\}, \tag{2}$$

$$U_{t+h}^{-} = \frac{1}{2} + \max\left\{\frac{1}{2} - U_{t+h}, 0\right\}. \tag{3}$$

Thus, U_{t+h}^{+} measures upside uncertainty, that is, uncertainty arising from news or outcomes that are unexpectedly positive (e.g. realized output growth turned out to be higher than expected). On the other hand, U_{t+h}^{-} measures downside uncertainty, that is uncertainty associated with unexpectedly negative events (e.g. lower output growth than expected).

In order to be able to compare instances of upside and downside uncertainty to each other, we, similarly to Rossi and Sekhposyan (2015), consider the normalized version of U_{t+h} and define the overall uncertainty index as:

$$U_{t+h}^{*} = \frac{1}{2} + \left|U_{t+h} - \frac{1}{2}\right|. \tag{4}$$

It should be noted that given the normalization, the uncertainty indices U_{t+h}^{*}, U_{t+h}^{+} and U_{t+h}^{-} fluctuate between 0.5 and 1. Furthermore, the definitions of upside and downside uncertainty depend on the variable at hand. For example, it is uncontroversial that positive surprises in GDP growth are instances of upside uncertainty, while positive surprises in the unemployment rate proxy for negative uncertainty.

[5] Since U_{t+h} is a Uniform variable defined over the (0,1) support, the mean value of U_{t+h} is 1/2, and the formulas that follow construct positive and negative uncertainty indices relative to the mean.

INSERT FIGURE 1 HERE

Figure 1 shows how the Rossi and Sekhposyan (2015) index works. We first focus on Panel A, which reports an example based on inflation forecasts. The figure on the left in Panel A plots the unconditional distribution of one-year ahead forecast errors of inflation (dotted line with circles), where the forecast errors are defined as the difference between the realized value of inflation and the average point forecasts of the Survey of Professional Forecasters administered by the European Central Bank (ECB-SPF).[6] The figure also plots two realizations of forecast errors in predicting inflation: the value realized in 2011:III, at the peak prior to the last recession in the Euro Area (dark vertical line on the right), and the value realized in 2013:II, one quarter after the trough (lighter vertical line on the left). While the realized value in 2011:III is positive and at the mode of the distribution, the one realized in 2013:II is in the left tail of the distribution. Thus, the latter captures a higher uncertainty episode in the economy relative to the former.

We quantify how much higher the uncertainty was in 2013:II than in 2011:III by calculating the value of the cumulative distribution function (CDF) of the forecast errors in the middle figure in Panel A, which is our measure U_{t+h}. The figure on the right in Panel A calculates the upward and downward uncertainty indices, U^+_{t+h} and U^-_{t+h}, respectively. When calculating the indices, we maintain the common underlying assumption that positive inflation is inherently undesirable and, thus, uncertainty associated with positive forecast errors (such as the episode in 2011:III) is considered downside uncertainty. On the other hand, the realized value in 2013:II corresponds to a high upside uncertainty episode. Moreover, the realization associated with upside uncertainty is about 27 percent less likely to occur than the realization associated with downside uncertainty.

Panels B and C depict the uncertainty indices calculated from output growth and unemployment forecasts during the same period of time. The pattern for the real variables is somewhat different than that of inflation. It appears that the pre-recession peak of 2011:III is associated with a higher level of uncertainty in terms of output growth, while the post-trough forecast error observation of 2013:II is not much different from its historical mean. As Panel C shows, uncertainty based on unemployment rate behaves similarly: it is higher in 2011:III relative to 2013:II. The case for unemployment is different than that of GDP growth: although the pre-recession uncertainty is of comparable magnitude in both cases, the post-recession one is higher in the case of unemployment, as the forecast error associated

[6] We elaborate on the construction of the distribution in the next section.

with the forecast made in 2013:II is about 1/4-th less likely than that of GDP growth.

3 The Euro Area Uncertainty Indices

We construct the overall as well as the upside and downside uncertainty indices for the Euro Area based on the point forecasts from the Survey of Professional Forecasters administered by the European Central Bank. The ECB Survey of Professional Forecasters (ECB-SPF) is a quarterly survey of expectations for several target variables and for a variety of short, medium and long term horizons. It collects professional forecasters' expectations of inflation (year on year percentage change of the Harmonised Index of Consumer Prices), real GDP growth (year on year percentage change of real GDP) and unemployment rates (defined as the number of unemployed between 15 – in some countries 16 – and 74 years of age as a percentage of the labor force) in the Euro Area. The ECB-SPF adapts to the changing composition of the Euro Area, i.e. accounting for the new member countries as they join the currency union.

Our uncertainty index relies on the average point forecasts across the cross section of individual forecasters. In order to construct the unconditional densities of forecast errors, we use forecasts from 1999:I to 2015:II for inflation and unemployment rate and 1999:I to 2015:III for output growth.[7] Further, in the benchmark specification, we use the final release of the data as the realization when calculating the forecast errors. However, we also investigate the behavior of our indices when the first release of the data is used instead.

It should be noted that the ECB-SPF dataset provides both fixed and moving horizon forecasts. In other words, each quarter the forecasters are asked to provide forecasts for specific calendar years (moving horizon forecasts) as well as for one, two and five year ahead (fixed horizon forecasts). The difference between the fixed and moving horizon forecasts is as follows.

A moving horizon forecast is a forecast where, in January of 2013 (i.e. the first quarter), the forecasters are asked to provide their expectations for calendar years 2013, 2014 and 2015. Then, they are asked the same information in April of 2013 (i.e. the second quarter). If we were to use the current year forecasts they provide in the first two quarters of 2013, we would compare forecasts whose horizons are changing: the forecasts made in April would have one quarter of uncertainty that has already been resolved relative to the January forecasts.

[7] The data publication calendar and the target forecast horizons enable us to use one more observation for output growth forecasts.

A fixed horizon forecast, instead, is one where, for example, in January 2013 forecasters are requested projections for December 2013 and, subsequently, in April 2013 they are asked their projections for March 2014. We choose to work with the fixed horizon forecasts since they are not affected by the resolution of uncertainty over time. The available fixed horizon ECB-SPF forecasts measure expectations for one-, two- and five-years ahead of the period for which the most up-to-date official data releases are available; we focus on forecasts of all the macroeconomic variables at the one-year-ahead fixed horizon, since it makes our results more comparable with those in Rossi and Sekhposyan (2015).

There are a few intricacies associated with the ECB-SPF. First, the survey also provides conditional density forecasts where the respondents provide their probability assessments about particular economic outcomes. This could be a natural choice for measuring uncertainty in the Euro Area (as some of the literature discussion in the introduction does).[8] Instead, we focus on the unconditional densities based on average point forecasts across the forecasters. Our choice is done for consistency, as our ultimate goal is to provide country-specific uncertainty indices for a wide variety of countries (discussed in Section 4): for the majority of the countries we consider, neither densities nor individual forecasts are available. Hence, it would be impossible to calculate measures of uncertainty based on predictive densities or other measures of central tendencies extracted from the cross-section of forecasts. Our measure of uncertainty based on the point forecast, on the other hand, can be easily obtained. Moreover, Clements (2016) points out that unconditional densities of point forecasts appear to be more informative than conditional predictive densities, at least in the context of the US Survey of Professional Forecasters.

In the ECB-SPF, the forecast horizon also has variable-specific peculiarities. Namely, the one-year-ahead forecasts refer to a one-year-ahead time period from the date of the last realization in the information set of both the researchers and the public. As such, though the forecasts of output growth, inflation as well as the unemployment rate are one-year-ahead, they pertain to different time periods in the year. As discussed in Genre et al. (2013), the "one-year ahead forecast is actually around six-to-eight months ahead for GDP growth, eleven months ahead for the unemployment rate and twelve months ahead for HICP inflation." In order to match the forecast horizons accurately, we go through the ECB SPF's individual forecast dataset to elicit the specific one-year-ahead horizon for which the

[8] For a careful treatment of the ECB-SPF predictive densities in the context of understanding forecasters' learning mechanisms see Manzan (2016).

forecasters are asked to provide predictions.[9]

As mentioned earlier, in the benchmark specification the forecasts are evaluated against the final release of the data. This is done in order to be consistent with the country-specific indices, for most of which no real-time data vintages of realizations are available. For the Euro Area, the last vintage of the data used as a final release data belongs to June 1, 2016. The last observations in the series for output growth, inflation and unemployment rate respectively are 2016Q1, May 2016 and April 2016. When considering the robustness of the results to real-time data, we use the first available realization from the real time database for the Euro Area (as discussed in Giannone et al., 2012).[10]

3.1 Variable-specific Uncertainty Indices for the Euro Area

Figure 2 plots Rossi and Sekhposyan's (2015, hereafter labeled RS) overall uncertainty index U^*_{t+h}, as well as the downside uncertainty ("Downside UC", U^-_{t+h}) and upside uncertainty ("Upside UC", U^+_{t+h}) indices extracted from the distribution of the forecasts errors of inflation, output growth and the unemployment rate. The figure also plots the CEPR recession dates, determined by the Euro Area Business Cycle Dating Committee (shaded areas).[11] Common wisdom associates the few years after 2007 with high uncertainty, due to the financial crisis in 2007-2009 and the European sovereign debt crisis in 2010-2012. It is reassuring that our uncertainty index captures such episodes (as shown in the left panels in Figure 2). In fact, the left figures in Panels B and C show that the downside uncertainty in the real side of the economy, namely output growth and the unemployment rate, spikes during recessions; however, there is also an episode of downside uncertainty in the early 2000s. It is worth noting that, after the last recession in the Euro Area, both inflation and the unemployment

[9] The European SPF dataset for the individual as well as aggregate forecasts are available at: http://www.ecb.europa.eu/stats/prices/indic/forecast/html/index.en.html

To appreciate the importance of this point, consider again the January 2013 survey. In the first quarter of 2013, the one-year-ahead forecast of inflation is for December 2013, while that of the unemployment rate is for November 2013, and the GDP growth prediction for 2013:III. In order to properly evaluate the forecasts, we use year-over-year growth rates of inflation and GDP growth matched to the specific forecast target date. For instance, the GDP growth rate forecast from January 2013 (quarter I) is matched to the realization corresponding to real GDP growth from 2012:III to 2013:III. Since the unemployment rate is forecasted in levels, we use the realization associated with the target date.

[10] The real-time database as well as the instructions on how to download the data are available at: https://sdw.ecb.europa.eu/browseExplanation.do?node=9689716.

[11] The dates are provided at: http://cepr.org/content/euro-area-business-cycle-dating-committee.

rate have shown considerable upside uncertainty relative to their historical dynamics. On the other hand, the uncertainty associated with output growth has been relatively low.

INSERT FIGURE 2 HERE

The right plots in Figure 2, Panels A-C, investigate the sensitivity of our uncertainty index to using the final realization versus the first release as the realization. The solid line corresponds to the benchmark index calculated based on the final realization, while the dashed-dotted line calculates the same index using the first release of the data for the forecast target horizon from the real-time database of the Euro Area. As can be seen from Panel A, right figure, the inflation-based uncertainty is essentially identical in the second part of the sample regardless of the choice made for the realization, while there are some minor differences in the beginning of the sample. Similarly, Panel B, right figure, suggests that using the first realization can potentially alter our index, though not considerably. On the other hand, as the right figure in Panel C shows, the choice of the realization is important for the unemployment-based uncertainty index, since uncertainty would be considerably larger in 2005-2007 if calculated based on first release data.

3.2 A Macroeconomic Uncertainty Index for the Euro Area

The variable-specific uncertainty indices are constructed from forecast errors in specific macroeconomic variables; hence, they provide valuable information about uncertainty measured in terms of these specific variables. However, sometimes, it is useful to have a broader uncertainty index that summarizes the information contained in variable-specific uncertainty indices.

This uncertainty index, which we label as the "Euro Area macroeconomic uncertainty index", is the first principal component extracted from the three variable-specific uncertainty series.

INSERT FIGURE 3 HERE

Figure 3 compares our proposed indices with those used in the literature. Panel A juxtaposes the dynamics of our variable-specific uncertainty indices; Panel B, instead, compares our summary macroeconomic uncertainty indices (both the first principal component and the average of the indices in Panel A) with the Baker, Bloom and Davis (2016) EPU index and the implied volatility index for Europe, VSTOXX. Both the EPU and VSTOXX are reported at the quarterly frequency, obtained by averaging (over the quarter) the monthly series in the case of the EPU and the daily series in the case of VSTOXX. All series are standardized, i.e. demeaned and divided by their respective standard deviations, to facilitate comparisons.

As the top plot in Figure 3 shows, around the time of the financial and sovereign debt crises (between late 2000s and early 2010s) the variable-specific uncertainty indices are highly correlated, while these correlations are lower in the rest of the sample. Moreover, output growth uncertainty diverged from the inflation- and unemployment-based ones towards the end of the sample period; the rest of the time, unemployment and output growth uncertainty move closely together, except during 2005-2007. This is due to the nature of the data: as we have shown earlier (Figure 2, Panel C), when using real-time data, uncertainty indices based on unemployment rate and output growth move closely together even in the 2005-2007 period.

An alternative way to obtain a measure of macroeconomic uncertainty from variable-specific uncertainty indices is to average them. This would be similar to the approach undertaken in Jurado, Ludvigson and Ng (2015). We, instead, prefer the principal component analysis to mitigate the fact that the forecasts of output growth, inflation and the unemployment rate, though all being one-year-ahead forecasts, potentially refer to different time periods/target dates (as discussed previously). In fact, principal component analysis helps us distinguish between variable-specific uncertainty associated with different forecast horizons, which is captured by the idiosyncratic component, and the common source of uncertainty, which is the one we are interested in estimating. We focus on the first principal component: overall, it explains 48% of the total variation in the observed series. The factor loadings are higher for output growth and the unemployment rate (1.10 and 1.27, respectively) than inflation (0.41). However, we also construct the average across the series for robustness.

The plot at the bottom of Figure 3 shows that aggregation of the variable-specific uncertainty indices based on principle component analysis (labeled "1st PC" in the figure) results in a very similar series to simple averaging (labeled "Average"). Relative to both the EPU as well as VSTOXX, our macroeconomic index describes the early 2000s as being less uncertain, while the second half of 2000s is associated with a higher degree of uncertainty. At the end of the sample, our aggregate macroeconomic uncertainty measure is in between the EPU and VSTOXX. Needless to say this measure, being smoothed, is less volatile than both EPU and VSTOXX.

INSERT TABLE 1 HERE

Table 1 reports correlations between the various variable-specific indices, the macroeconomic uncertainty index, the EPU and VSTOXX. As the table indicates, uncertainty indices based on real variables (output growth and employment) are highly correlated with each other, as well as with the principal component summary measure (which loads heavily on them). The correlation of the real uncertainty measures with that of inflation uncertainty is somewhat smaller. Moreover, it appears that our macroeconomic index is more correlated with VSTOXX than the EPU, though in absolute value these correlations are small.

4 Individual Euro Area Member Country-Specific Uncertainty Indices

One of the contributions of this paper is to provide individual Euro Area country-specific uncertainty indices based on our measure. Baker, Bloom and Davis (2016) build economic policy uncertainty indices for several Euro Area countries, such as Germany, Italy, France, Spain and the Netherlands. However, their index is very time-consuming to calculate, and it is not available for a wide variety of countries. On the other hand, our proposed index can be calculated for any country as long as there is a sequence of forecasts and corresponding realizations. The Euro Area countries for which we have constructed the indices, with the respective periods for which time series of uncertainty indices are available, are listed in Table 2. The time series are available on our webpages. It is also noteworthy that Table 2 lists the current composition of the Euro Area, which changed over time. For instance, Greece joined in 2001, Slovenia in 2007, Slovakia in 2009, Estonia in 2011, Latvia in 2014 and Lithuania in 2015. We provide the indices for seventeen out of the current nineteen Euro Area member countries. We have no available data for Malta and Luxemburg.

INSERT TABLE 2 HERE

The uncertainty indices for the individual countries are based on Consensus Economics forecast errors. The forecasts generally start on 1990:M1, although for some countries they start later. Moreover, the frequency of the forecasts change over time. For instance, for Eastern Europe, the survey was conducted every two months between May 1998 and April 2007 and monthly thereafter. For the remaining countries, the survey provides monthly point forecasts (which are the average across forecasters). The realizations are from Haver

Analytics and correspond to final release values. The data sources we used were chosen to collect the largest possible sample of countries and time periods.

By construction, Consensus Economics forecasts are fixed-event forecasts: data are collected monthly, but forecasts refer to the average rate of growth of GDP and CPI inflation over either the current year or the next calendar year. Being fixed-event forecasts, their horizon changes over the year (as discussed in Section 3). We construct monthly fixed-horizon forecast using the method proposed by Dovern et al. (2012). Dovern et al. (2012) propose taking weighted averages of the current-year and next-year forecasts. For example, in the case of GDP data, for each month the survey contains a pair of "fixed-event" forecasts for the current-year, which we label $\widehat{f}^{FE}_{t+k|t}$, and for the following year, which we label $\widehat{f}^{FE}_{t+k+12|t}$. The twelve–month-ahead (fixed-horizon) forecast at time t is the average of the two fixed-event forecasts using weights that are proportional to their share of overlap with the forecast horizon. Let k denote the number of months from time t until the end of the year, $k = 1, 2, 3, 4, ..., 12$; then the fixed horizon forecast is $\frac{k}{12}\widehat{f}^{FE}_{t+k|t} + \frac{12-k}{12}\widehat{f}^{FE}_{t+k+12|t}$.[12] We use a similar procedure for inflation.[13]

As mentioned, the realizations are the seasonally adjusted inflation and output growth values taken from Haver Analytics. The GDP growth data is available at the quarterly frequency, while inflation is monthly. In order to construct the forecast errors, we first aggregate the fixed-horizon monthly output growth forecasts into quarterly series, and then compare them to the quarterly realization of output growth. For inflation, we construct both monthly and quarterly uncertainty indices. To make the indices comparable to the ECB-SPF Euro Area uncertainty indices, in this section we only report the quarterly indices; a discussion of the monthly inflation-based indices is provided in our robustness section. We use the quarterly averages of the monthly realizations and the fixed-horizon-forecasts to obtain the quarterly forecast errors.[14]

[12] E.g.: in month one, $k = 12$, while in month twelve, $k = 1$. An alternative procedure to construct fixed-horizon forecasts from fixed-event ones is developed by Knueppel and Vladu (2016). Their procedure gives optimal weights that minimize the mean squared forecast error loss function of the fixed-horizon forecast. For the purposes of our index, which is based on the unconditional distribution of the forecast errors, this alternative weighting results in very similar uncertainty indices. However, if one were to construct uncertainty indices based on the conditional distributions, the difference could be non-negligible.

[13] In the sample periods where forecasts are available only every two months, the current year and next year forecasts are weighted based on the adjusted formula: $\frac{k}{6}\widehat{f}^{FE}_{t+k|t} + \frac{6-k}{6}\widehat{f}^{FE}_{t+k+6|t}$, where $k = 1, 2, ..., 6$.

[14] The survey forecasts as well as the realizations for the countries start potentially at different points in time. If we miss some observations for the three months of the quarter for either the forecasts or the realizations, we construct the quarterly average based on the available observations. This situation occurs

The timing of the surveys relative to the realizations is worth a separate discussion. When the survey takes place, typically only the past value of the realization is available. Thus, in the first month of the year, when the forecasts are obtained, the realizations for the current year have not been published yet. Following the procedure that is typically used for the ECB-SPF, which faces a similar problem, we calculate the realizations as one-year-ahead growth rates from the last data release that was available to the forecasters at the time they made their forecasts. For instance, the realization we associate to the quarterly one-year-ahead forecast in the first quarter of the year captures GDP growth between the fourth quarter of the current year relative to the fourth quarter of the previous year.

INSERT FIGURES 4 AND 5 HERE

Figures 4 and 5 depict the upside and downside uncertainty indices for the individual Euro Area countries in our dataset. Figure 4 shows the overall macroeconomic uncertainty index based on GDP growth forecast errors, while Figure 5 focuses on the inflation uncertainty index. The shaded areas highlight Euro Area-wide recessions identified by the CEPR business cycle dating committee, rather than country-specific recession dates which are not available.

Figure 4 shows that most European countries share a similar overall macroeconomic uncertainty cycle, as the downside uncertainty index tracks closely the recession dates. However, the timing and magnitude differ somewhat across countries. Comparing Figure 4 with Figure 2, Panel B, the behavior of the individual Euro Area countries is also similar to the behavior of the uncertainty indices in the Euro Area. There is evidence of divergence towards the end of the sample, though, as some countries experienced upside uncertainty (e.g. Ireland, Slovenia, Slovakia, Spain, etc.), while others experienced downside uncertainty (Austria, Greece, Latvia, Lithuania, etc.).

Figure 5 shows that inflation uncertainty is more homogeneous across countries relative to output growth uncertainty. There is evidence of upside uncertainty in most countries during the 1990s, which disappears in the 2000s. The latest part of the sample can still be described by upside uncertainty across the board. Considering the overlapping period where the Euro Area (reported in Figure 2, Panel A) and the individual member country uncertainty indices are both available, their behavior is very similar.

only in the case of Eastern European forecasts during the sample period where the forecasts are every two months rather than monthly.

5 Spillover Effects of Uncertainty in the Euro Area

The previous section described country-specific uncertainty indices based on inflation and output growth forecast errors and analyzed their relationship to the broader Euro Area index by visual inspection. Here we delve in more details. First, we compare the common component of the country-specific indices to the ECB-SPF Euro Area one. Second, we investigate the heterogeneity across the Euro Area countries by looking at correlations over the business cycle. Third, we formally investigate the spillovers of uncertainty across the countries and over time via a network analysis.

5.1 The ECB-SPF Euro Area Uncertainty Index versus Individual Countries' Uncertainty Index Aggregates

In this sub-section, we compare the Euro Area uncertainty indices constructed based on the ECB-SPF forecasts to aggregate country-specific indices extracted from the Consensus Economics survey-based country-specific indices. The aggregate uncertainty indices constructed form the individual countries' indices are the principal component and the cross country average. Note that the latter are based on the current Euro Area composition, while the ECB-SPF Euro Area uncertainty indices are based on the changing composition of the Euro Area instead. We focus our analysis on the sub-sample where all the indices overlap.

INSERT FIGURE 6

The left panel in Figure 6 depicts the indices for output growth, and the right panel depicts the indices for inflation. The panels show that the average of country-specific uncertainty indices behaves similarly to the first principal component; thus, it does not matter how we aggregate the individual countries' uncertainty indices to obtain an aggregate index. However, it matters whether we consider the aggregate index based on individual countries' indices or the ECB-SPF Euro Area aggregate index, as they turn out to be quite different. In fact, in the case of GDP growth, the ECB-SPF-based measure oscillates roughly around the cross-country average; on the other hand, in the case of inflation, the cross-country average identifies a higher level of uncertainty prior to 2007. It is worth noting that the two measures have diverged in the recent period: the ECB-SPF Euro Area aggregate suggests a lower output growth uncertainty than the cross-country average, while it is the opposite for inflation.[15] The correlation coefficient between the ECB-SPF Euro Area aggregate and the cross-country averages is 0.62 for output growth and 0.68 for inflation.

5.2 Heterogeneity in Euro-Area Uncertainty

Figure 7 shows the average uncertainty in the Euro Area and its member economies from 1999:I till 2013:I (Panel A) and 2013:II-2015:II (Panel B). The pictures in Panel A show that the average uncertainty has been more or less homogeneous in the Euro Area up to the end of the last recession. However, as Panel B suggests, after the trough of the last recession the heterogeneity has increased. As shown in the left figure, GDP growth-based uncertainty in Belgium, France, Germany and Slovakia appears to be lower than that based on the ECB-SPF Euro Area, while it is higher in other countries, especially Ireland, Slovenia and Spain. On the other hand, inflation uncertainty in general appears to be higher relative to the GDP-based uncertainty. As discussed previously, the ECB-SPF Euro Area aggregate inflation uncertainty is higher than the cross-section average; as evident from Figure 7, it is also higher than that of any of its members. This emphasizes the divergence between the Euro Area and its members in terms of inflation expectations and outcomes after the crises. This might be indicative of the fact that though the forecasters are more certain about country-specific outcomes, they are more uncertain about the Euro Area wide policy, which is reflected in an increased area-wide uncertainty. Moreover, countries with high GDP growth-based uncertainty do not necessarily have high inflation-based uncertainty.

INSERT FIGURE 7

[15] Besides the fixed country-composition of the aggregate index that is imposed when constructing the aggregate index using individual countries' indices versus the changing composition embedded in the ECB-SPF, other potential reasons for the divergence between the two measures could be the fact that they come from different surveys, with potentially different participants. Moreover, it is possible that the ECB-SPF participants weigh the country-specific data differently than our averaging or principal component extraction imply. In addition, though the two sets of forecasts are compared to each other as of the forecast origin dates, their target dates vary. As discussed earlier, the target date for the weighted Consensus forecasts in the first quarter would be the year-over-year growth from the fourth quarter of the last year to the fourth quarter of the current year. On the other hand, that of GDP growth-based uncertainty from the ECB-SPF is based on the growth from quarter 3 of the previous year to quarter 3 of the current year. This, if anything, would put a lower bound on the leading properties of country-specific uncertainty indices relative to the Euro Area aggregate. For inflation, the target periods are the same, so the differential in the target dates should be irrelevant.

Tables 3 and 4 display correlations of the country-specific output growth (Table 3) and inflation (Table 4) uncertainty indices with that of the corresponding ECB-SPF Euro Area aggregate.[16] When $k = 0$, the table reports contemporaneous correlations. For each country, we highlight in bold the contemporaneous correlation as well as any correlation higher (in absolute value) than the corresponding contemporaneous correlation. According to Table 3, GDP growth-based uncertainty leads that of the Euro Area for economies such as Austria, Belgium, Finland, France, Germany, Italy, the Netherlands and, to a lesser degree, Slovakia. The largest contemporaneous correlations are reported for Germany and Italy. This finding is not surprising, as Germany, France and Italy are among the largest countries in the Euro Area in terms of GDP. The picture is less clear in the case of inflation: it appears that, for most countries, inflation uncertainty is coincidental with the ECB-SPF Euro Area aggregate; the largest contemporaneous correlations are those of Belgium and Spain.

INSERT TABLES 3 AND 4 HERE

5.3 Uncertainty Spillovers in the Euro Area: a Network Approach

Lastly, we study the spillover of uncertainty in the Euro Area. In order to do so we rely on the methodology proposed by Diebold and Yilmaz (2009) and implement it in the robust framework of Klößner and Wagner (2013).[17] More specifically, we study the spillovers in a Vector Autoregression (VAR) framework and propose an uncertainty spillover index. The spillover index accounts for the total share of uncertainty shocks of non-domestic origin across all the countries. The analysis is not intended to give a causal interpretation of the spillovers of uncertainty in the Euro Area, but rather provides a measure of pairwise directional and total inter-connectedness.

Borrowing some of the notation from Klößner and Wagner (2013), let Y_t be an N dimensional vector of uncertainty indices for the N countries in the sample and consider the standard VAR(p): $Y_t = \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + ... + \Phi_p Y_{t-p} + \varepsilon_t$, where ε_t is a white noise with a variance-covariance matrix of Ω_ε, while $\{\Phi_i\}_{i=1}^p$ are $N \times N$ coefficients summarizing the dynamic behavior of the system. Given the maintained assumption of stationarity of the VAR, the MA(∞) representation is: $Y_t = \varepsilon_t + A_1\varepsilon_{t-2} + A_2\varepsilon_{t-2} + ...$ The spillover effects are derived from the forecast error decomposition. The h-step-ahead forecast error is

[16] Note that we do not report the correlations for Cyprus as it does not have enough available observations to precisely estimate correlations for leads and lags up to order four.

[17] The algorithm is implemented with the fastsSOM package in R, see Klößner and Wagner (2016).

$e_{t+h} = Y_{t+h} - Y_{t+h|t} = \varepsilon_{t+h} + A_1\varepsilon_{t+h-1} + A_2\varepsilon_{t+h-2} + ...A_{h-1}\varepsilon_{t+1}$. The forecast error covariance matrix, consequently, can be written as $\Omega_{e,h} = \Sigma_{i=0}^{h-1} A_i \Omega_\varepsilon A_i^{'}$, where A_0 is the identity matrix. Diebold and Yilmaz (2009) choose to work with the Cholesky factorization of Ω_ε. If L is the Cholesky factor of Ω_ε, such that $LL^{'} = \Omega_\varepsilon$, then country k's contribution to country j's forecast error variance can be written as $\left(\Sigma_{i=0}^{h-1}\left(\Sigma_{k=1}^{N}(A_iL)_{jk}(A_iL)_{jk}^{'}\right)\right)^{-1}\Sigma_{i=0}^{h-1}(A_iL)_{jk}(A_iL)_{jk}^{'}$, and the uncertainty spillover index (USOI) is defined as:

$$USOI = 100\Sigma_{j=1}^{N}\frac{\Sigma_{i=0}^{h-1}\left(\Sigma_{k=1,k\neq j}^{N}(A_iL)_{jk}(A_iL)_{jk}^{'}\right)}{\Sigma_{i=0}^{h-1}\left(\Sigma_{k=1}^{N}(A_iL)_{jk}(A_iL)_{jk}^{'}\right)} \quad (5)$$

The Cholesky decomposition is not order invariant and the analysis is not structural, that is, there is no preferred Cholesky rotation over the others based on economic theory; thus, one would have to take into account multiple Cholesky rotations (precisely $N!$) in a robustness analysis. We implement Klößner and Wagner's (2013) algorithm to perform forecast error variance decomposition analysis for all possible Cholesky rotations and report the average over all of them. Diebold and Yilmaz (2009), on the other hand, only verified the robustness of their analysis to a few set of alternative Cholesky rotations.

Our exercise is similar to that in Klößner and Sekkel (2014), although we focus on the Euro Area and use the indices proposed in Rossi and Sekhposyan (2015). Klößner and Sekkel (2014), instead, study spillovers of the Baker et al. (2016) index for countries such as Canada, France, Germany, Italy, US and the UK. They find that between January 1997 and September 2013 the spillover index among the set of these six developed countries was approximately 27%. Moreover, they find time-variation in the spillover effects; the spillovers are countercyclical: they were relatively high until 2006, they then decreased and then spiked again around 2008 due to the financial crisis and associated high policy uncertainty. They also find evidence that the spillovers have been declining since then: at the end of their sample, their level was roughly the same as before 2008. Furthermore, they find that some countries (such as the US, the UK and France) have been net "exporters" of uncertainty, while the rest have on average been net "importers" – although, for some countries, the role has reversed over time.

We perform a similar type of analysis, with the objective of understanding the spillover effects in the Euro Area. We report the results for output growth-based uncertainty in Table 5 and those for inflation-based uncertainty in Table 6. Our empirical results are based on estimating VARs with two lags for sixteen Euro Area countries (excluding Cyprus, Luxemburg and Malta from the current list of members) and performing the variance decomposition at the two-year-ahead forecast horizon ($h = 8$). We also include the Euro Area aggregate in our analysis, which could capture some of the spillovers from the current Euro Area countries that are not accounted for in the Euro Area aggregate due to the changing nature of its membership.

As Table 5 shows, the spillover effects for output-growth-based uncertainty in the Euro Area are high, about 74%. Moreover, some of the countries, namely Austria, Belgium, France, Latvia, Portugal, Slovakia, Slovenia, Spain and the Netherlands have been on average uncertainty "exporters," as the net contribution ("To" - "From") of the uncertainty in these countries is positive (marked in bold in the row labeled "Net"). The three countries with the highest spillover effects are Austria, Belgium and Slovakia: this is certainly surprising given that these countries are relatively small members of the Euro Area. It is interesting to note that the "importers" of uncertainty are Finland and Ireland, while the Euro Area as an aggregate also turns out to be a net importer of uncertainty.

The case of inflation-based uncertainty, shown in Table 6, is somewhat different. In this case, the Euro Area, as well as Austria, Belgium, Estonia, France, Italy, Portugal and Spain, turn out to be uncertainty "exporters." The overall spillover effects are also fairly high, amounting to about 78%: in particular, it is interesting to note that they are much higher (2.5-2.7 times) than those detected by Klößner and Sekkel (2014). According to our spillover index, only about one quarter of the uncertainty in the Euro Area is of idiosyncratic country-specific nature, while the rest derives from the inter-connectedness, which transmits the uncertainty.

INSERT TABLES 5 AND 6 HERE

When we condition on the type of uncertainty, the picture changes somewhat. Table 7 shows the per country net contribution of uncertainty, together with the spillover index for both upside and downside uncertainty. When the upside and downside uncertainties are considered separately, the overall spillover index jumps by about 10 percentage points: in the case of output growth, upside and downside uncertainty rise to 84% and 85%, respectively; in the case of inflation, it increases to 87% (relative to 78%, the value we estimated when we did not distinguish between the sources of the uncertainty).

INSERT TABLE 7 HERE

Moreover, which countries are exporters or importers of uncertainty also changes. Exporter countries are marked in bold in Table 7. When we look at output growth-based uncertainty (columns 2 and 3), now Austria, Belgium, Germany, Lithuania, Portugal and the Netherlands are "exporters" of upside uncertainty, while Belgium, Estonia, Finland, France, Germany, Ireland and Portugal "export" downside uncertainty. It should be noted that, Germany, which was a net "importer" of uncertainty, becomes an "exporter" when we take into account the conditional source of the uncertainty. Belgium, Germany and Portugal appear to be "exporters" for both kinds of output-growth based uncertainties. For the inflation-based uncertainty (columns 4 and 5), the Euro Area, France, Germany and Spain turn out to be both "exporters" and "importers" of uncertainty; Austria, Estonia, Greece and Italy turn out to be "exporters" of downside uncertainty, while Ireland, Portugal, Slovakia and Slovenia turn out to be "exporters" of upside uncertainty.

Our results are surprising, since, during the period of the sovereign debt crises, one would have expected Greece, Ireland, Italy, Portugal and Spain to be exporters of uncertainty, as these countries are the ones whose yields increased to compensate for the risk associated with either budgetary and/or banking problems. However, in our analysis Greece, for instance, does not come out as a main source of uncertainty across the Euro Area. In fact, it becomes an "exporter" only of downside inflation-based uncertainty. This is the because our index is different from those considered in the literature: we measure uncertainty as the likelihood of unexpected outcomes (that is, we control for conditional expectations), while the measures such as the EPU or VSTOXX are unconditional. This is crucial since unconditionally (or ex-ante) the uncertainty associated with the performance of the Greek government debt (and thus the Greek economy) might have been high; however, after controlling for expectations, the surprises and their associated uncertainty might not have been so high, and thus their spillover effects not as large.

6 Sensitivity Analysis

In this section, we first investigate the robustness of our results to monthly inflation-based uncertainty indices. Namely, we show monthly indices for the eleven countries in the Euro Area (the ten original members and Greece). In fact, while output growth-based uncertainty indices are, by construction, quarterly, since real GDP is only provided quarterly for the majority of the countries, country-specific inflation-based uncertainty indices can be constructed at the monthly frequency.[18] Second, we consider spillovers of uncertainty across the

[18] In fact, we previously constructed monthly indices, and then aggregated them to the quarterly frequency to make them comparable to the output growth-based indices as well as the aggregate ECB-SPF Euro Area

European countries. Lastly, since monthly indices are available with a much larger number of time series observations, they enable us to study the evolution of spillovers over time, which we were unable to do in quarterly data given their small sample size.

Figure 8 shows monthly inflation-based uncertainty indices for a set of European countries which includes the ten original members of the Euro Area (minus Luxemburg, for which we have no data) and Greece. We do not consider Eastern European countries such as Estonia, Latvia, Lithuania, Slovakia and Slovenia since forecasts are only available every two months in the beginning of the sample for these countries and thus the sample is too short to study the evolution of spillovers over time. As the figure shows, monthly indices are broadly similar to the quarterly ones reported in Figure 5. The only noticeable difference is the volatility of the indices: monthly indices are more volatile than quarterly ones, although our conclusions regarding upside and downside uncertainty and the identification of periods of high uncertainty are the same regardless of the frequency.

INSERT FIGURE 8 HERE

Table 8 reports the analysis of spillover effects for the monthly inflation-based uncertainty index in the eleven Euro Area countries.[19] As before, the VAR includes 2 lags and the forecast horizon equals 24 month in order to facilitate comparison with previous results. The spillover index decreases to 45%; thus, in this different set of countries, slightly more than half of uncertainty volatility can be explained by idiosyncratic uncertainty, while about 45% is due to spillovers from other countries. Moreover, Belgium, Germany, Greece and Spain turn out to be, on average, uncertainty "exporters," while the rest of the countries are, on average, uncertainty "importers." This is in contrast to the results reported in Table 6: from the set of the countries classified as "exporters", only Belgium and Spain remain classified as such. Our sensitivity results show that not only the overall spillover index, but also the classification of countries as uncertainty "exporters" and "importers" clearly depends on the network: a larger network decreases the role of idiosyncratic shocks and increases the importance of spillovers.

INSERT TABLE 8 HERE

inflation-based ones.

[19]Recall that the network is smaller in this analysis than that considered in the main empirical exercise, as here we only consider eleven countries instead of the nineteen in our main empirical analysis with quarterly data.

Lastly, Figure 9 shows the spillover effects over time, as well as the net contribution of each country to the overall uncertainty. The statistics are calculated on a 60 month rolling window. Panel A shows the $USOI$ over time. The $USOI$ index increased dramatically during the financial crisis and the European sovereign debt period (between 2007-2012). It has then decreased quickly in August 2014, perhaps because of the uncertainty regarding the collapse of the Chinese stock market that dominated the news around that time.[20] Note that the $USOI$ hovers around 75%, which is much higher than the 45% average reported in Table 8.[21]

INSERT FIGURE 9 HERE

Panel B in Figure 9 shows the net contribution for each country over time. Negative values indicate that a country is a net "importer" of uncertainty, while positive ones indicate that a country is a net "exporter" of uncertainty. Again, the figures show a great deal of time variation in the status of the countries. For instance, Austria and Belgium were net "exporters" of uncertainty early in the sample period, while they became net "importers" in most of the second part of the sample. Belgium became a net "exporter" towards the end of the sample period. Finland was a net "importer" of uncertainty for most of the sample. France and Ireland switched their positions frequently over the sample period, while Germany and Greece were net "exporters" of uncertainty in most of the sample period. The uncertainty associated with Italy spiked during the sovereign debt crisis. The same happened to a lesser extent for Spain; Portugal, instead, is a net "exporter" of uncertainty in that period. The Netherlands was an uncertainty "importer" for most of the sample, except at the very end.

7 Conclusions

This paper proposes the Rossi and Sekhposyan (2015) uncertainty index for the Euro Area and its member economies. One of the main advantages of the index is that it is easy to construct and use: the only inputs it requires are forecasts and realizations, and hence is available for a large number of countries. Moreover, it has the additional benefit that it characterizes uncertainty in terms of probabilistic statements, thus making it possible to

[20] Note that the dates on the plot refer to the end of the rolling window.

[21] The fact that the rolling window analysis results in higher spillover indices over time relative to the average level of spillovers is consistent with the evidence in Diebold and Yilmaz (2009) and Klößner and Sekkel (2014).

disentangle upside and downside uncertainty. We show that our proposed uncertainty index captures perceived episodes of high uncertainty associated with the financial and European sovereign debt crises both at the Euro Area level, as well as at the level of individual countries. The analysis shows similarity in the uncertainty cycles across the Euro Area, with some evidence of divergence after the last recession. Our spillover analysis attributes a large portion of the variation in uncertainty to spillover effects from other countries. In fact, only about a quarter of the spillovers can be attributed to idiosyncratic country-specific shocks. Whether a country is an uncertainty "importer" or "exporter" depends on the source of uncertainty, i.e. whether it is the overall uncertainty, upside or downside uncertainty. Moreover, the level of spillovers, as well as the countries that mostly contribute to it, depends heavily on the network size. When looking at the original Euro Area members (plus Greece), the spillover index decreases by 3/5th, though it remains at a considerably higher level than those documented in the literature for advanced economies using the EPU index.

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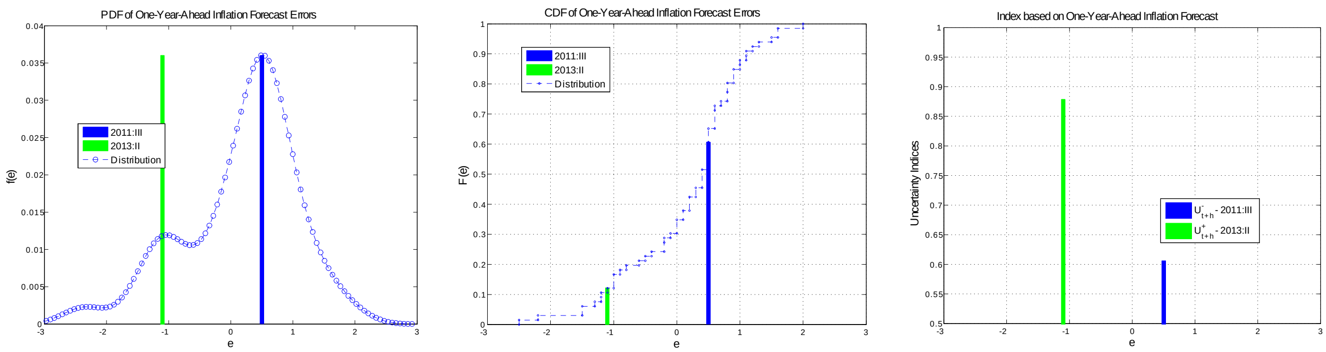
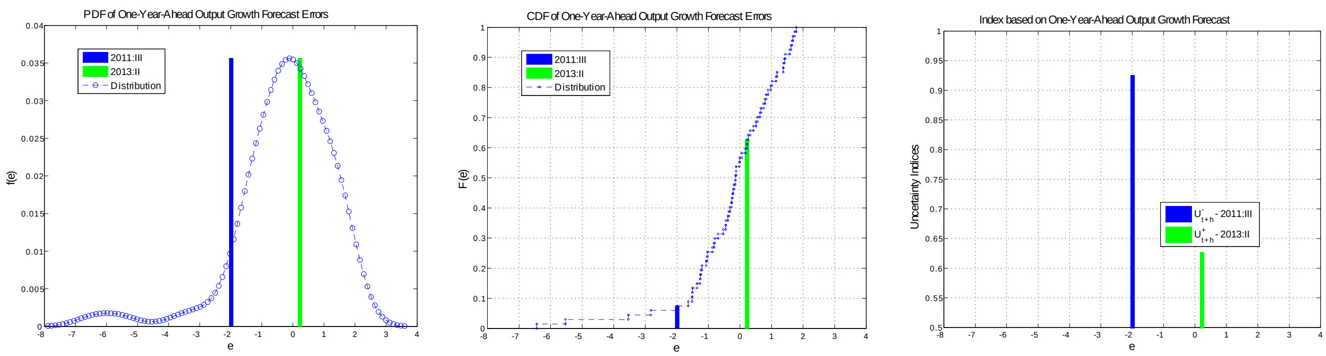
8 Figures and Tables

Figure 1. Empirical Distribution of the ECB-SPF Forecast Errors

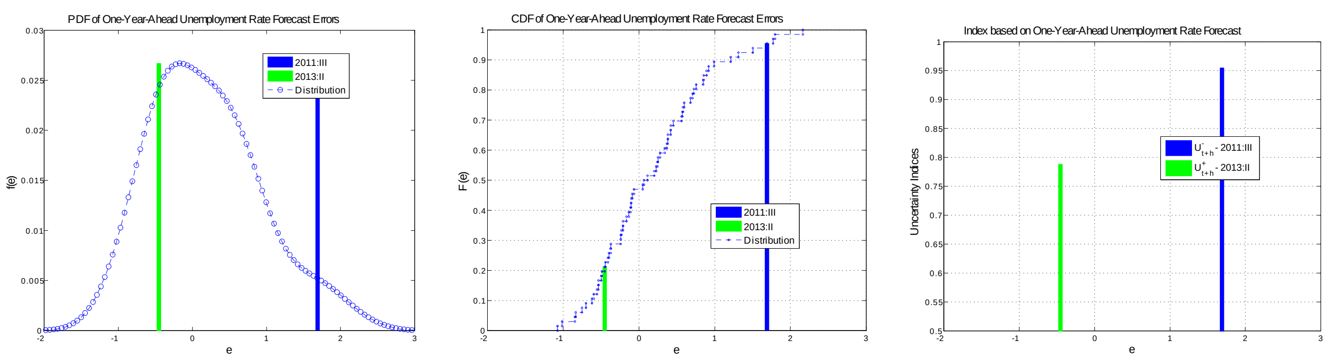
Panel A: Inflation Rate



Panel B: Output Growth



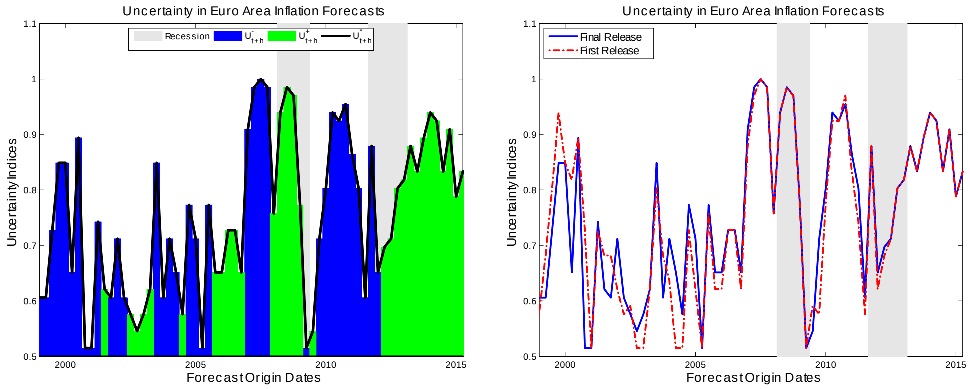
Panel C: Unemployment Rate



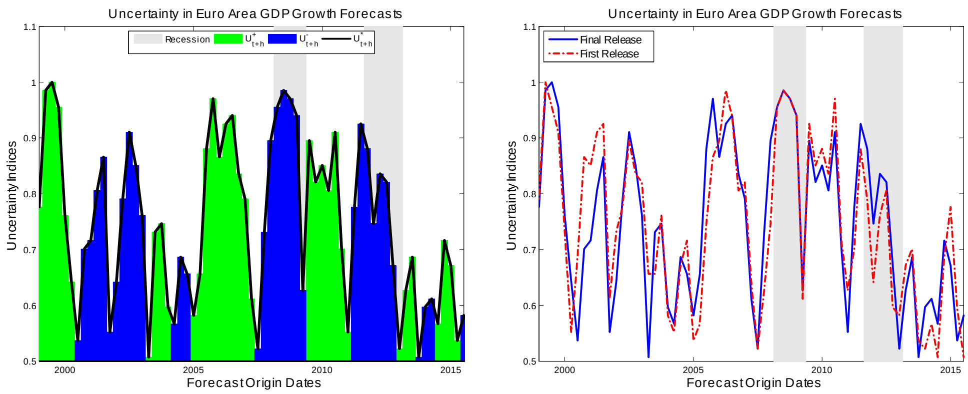
Note: The figures depict the empirical PDFs and CDFs of forecast errors of HICP inflation rate (Panel A), real GDP growth (Panel B) and unemployment rate (Panel C) in the ECB-SPF, together with two realizations of forecast errors. The first realization, 2011:III, corresponds to the peak of the latest business cycle, while the second realization, 2013:II, is one-quarter after its trough. The forecast error realizations are computed based on final release values.

Figure 2. Euro Area Variable-Specific Uncertainty Indices

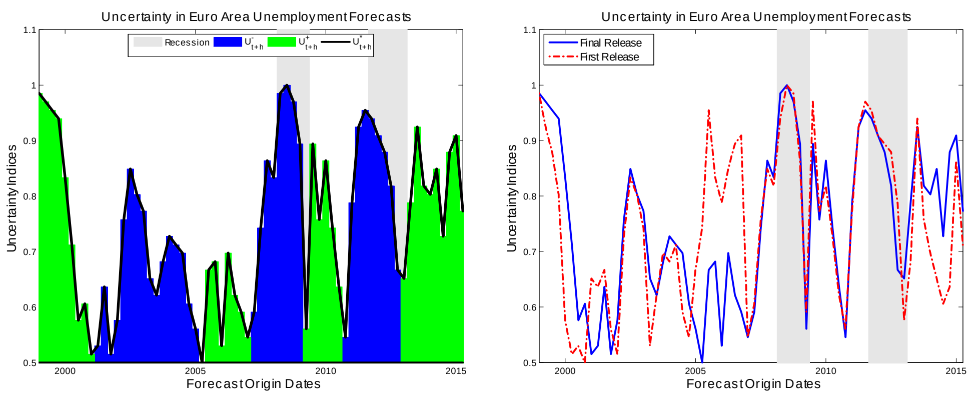
Panel A: Inflation Rate



Panel B: Output Growth

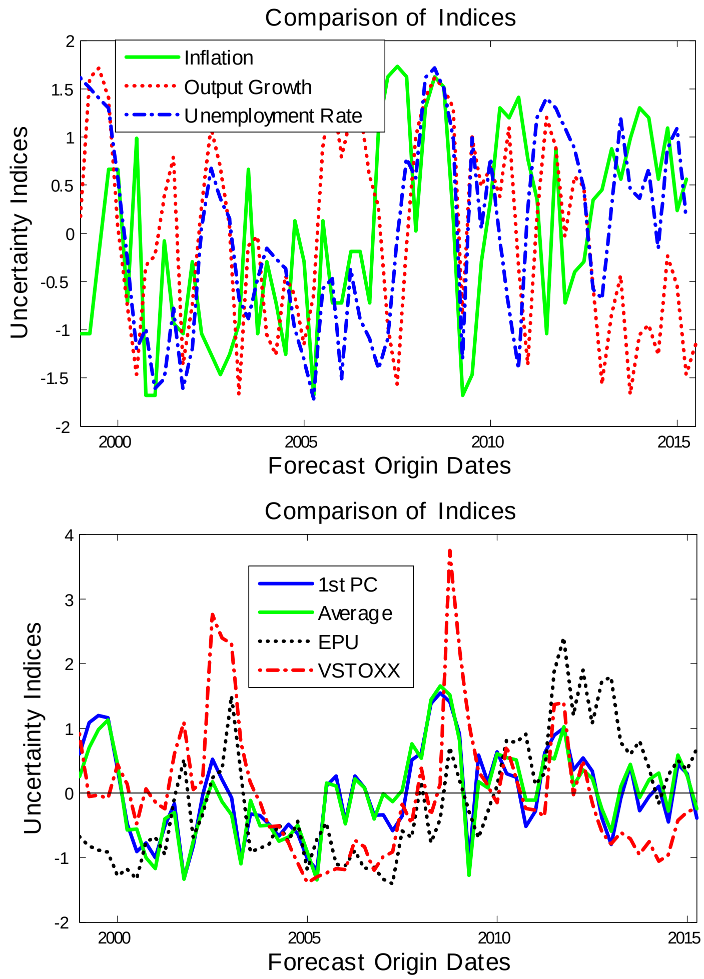


Panel C: Unemployment Rate



Note: This figure depicts the uncertainty indices obtained from the forecast error distributions implied by the ECB-SPF's inflation rate (Panel A), output growth (Panel B) and unemployment rate (Panel C) forecasts. The left column in each panel shows the upside (U^{+}_{t+h}), downside (U^{-}_{t+h}) and overall uncertainty (U^{*}_{t+h}) indices, while the right panel shows the sensitivity of the overall uncertainty index (U^{*}_{t+h}) to using real-time data.

Figure 3. Comparing Uncertainty Indices



Note: The top panel in the figure compares Euro Area variable-specific uncertainty indices. The bottom panel, on the other hand, compares the overall Euro Area macroeconomic indices to the EPU and VSTOXX.

Figure 4. Euro Area Country-Specific Output Growth Uncertainty Indices

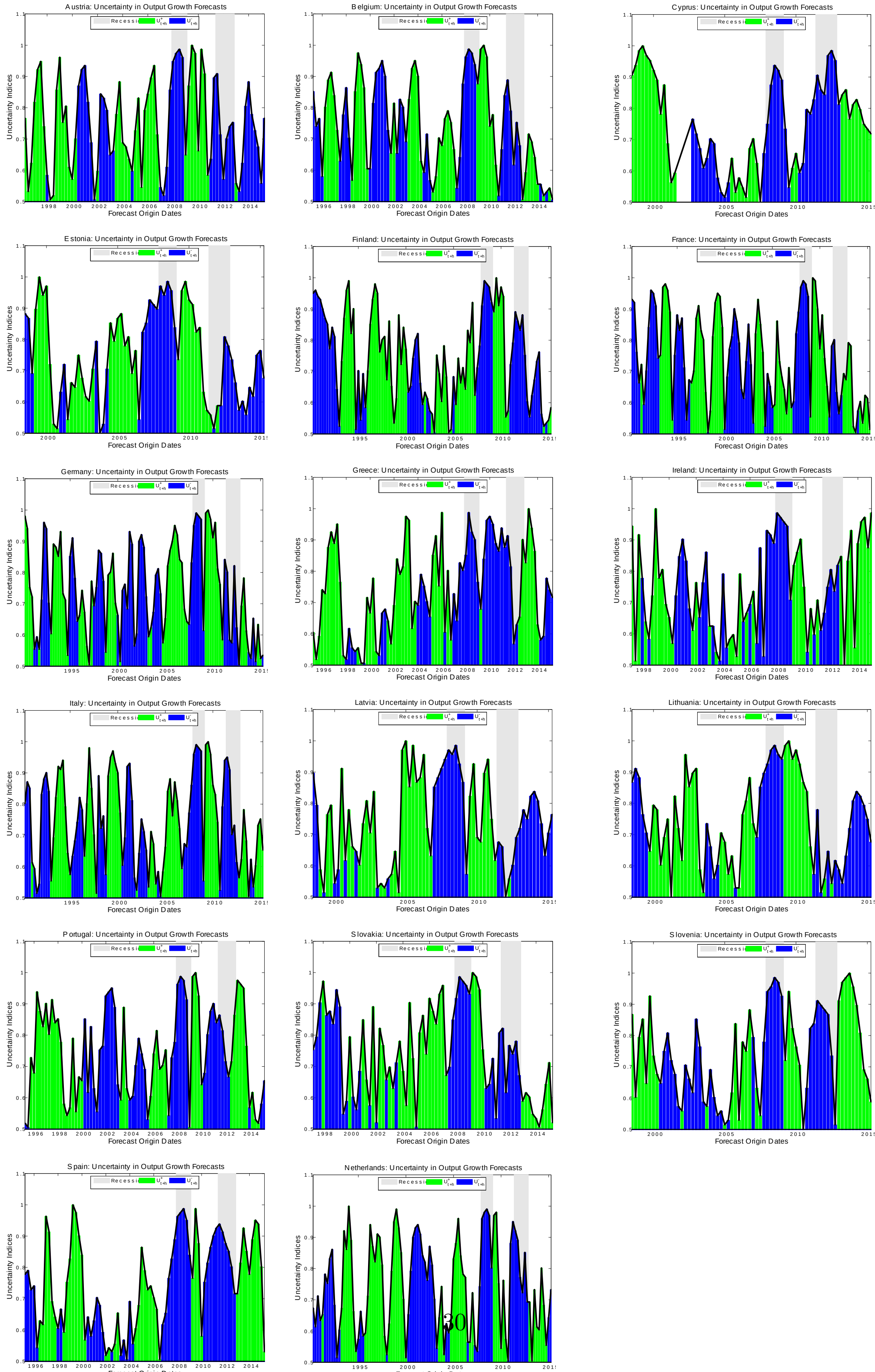


Figure 5. Euro Area Country-Specific Inflation Uncertainty Indices

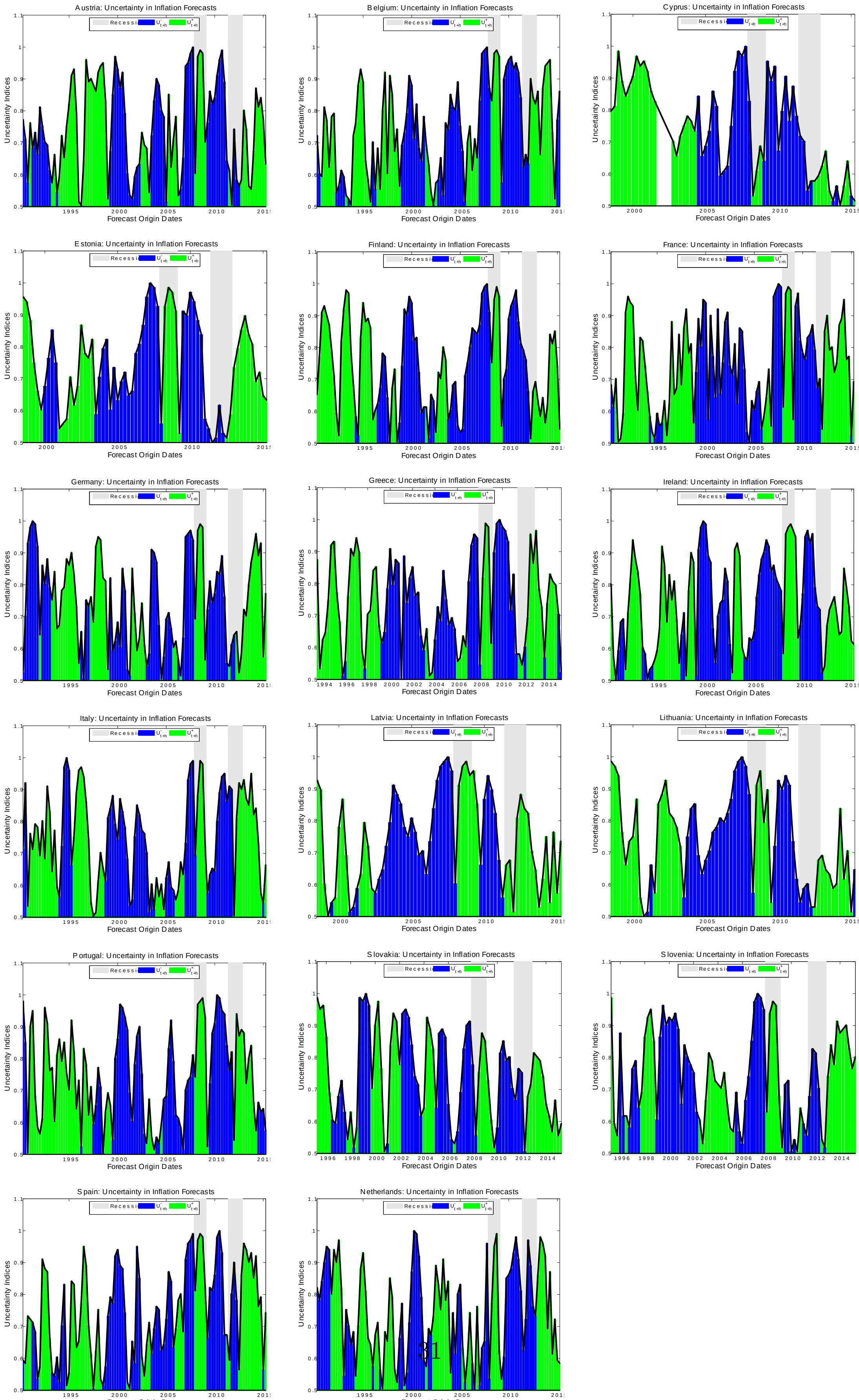
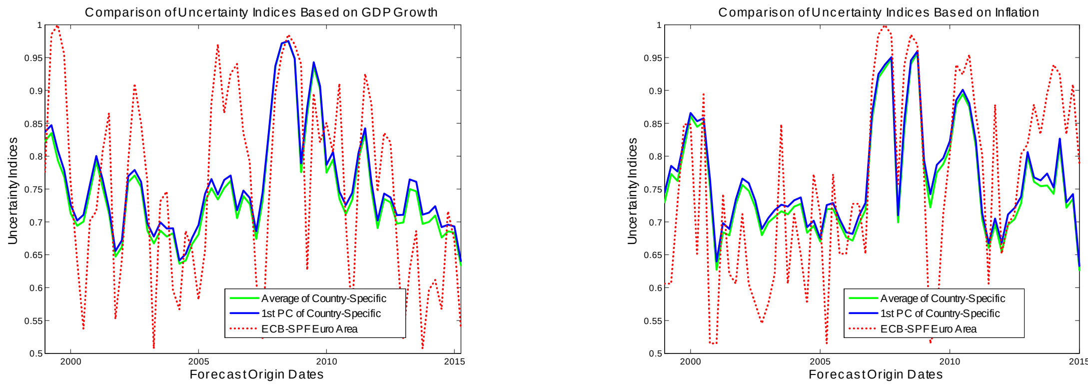


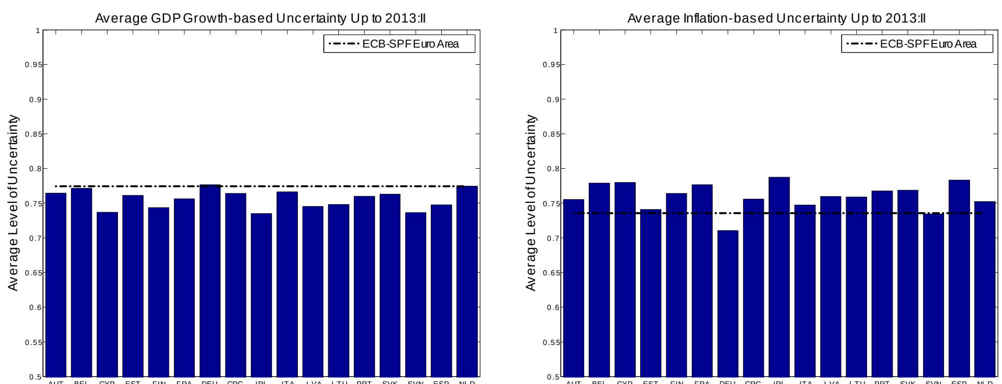
Figure 6. ECB-SPF Euro Area vs. the Aggregate of Country-Specific Indices



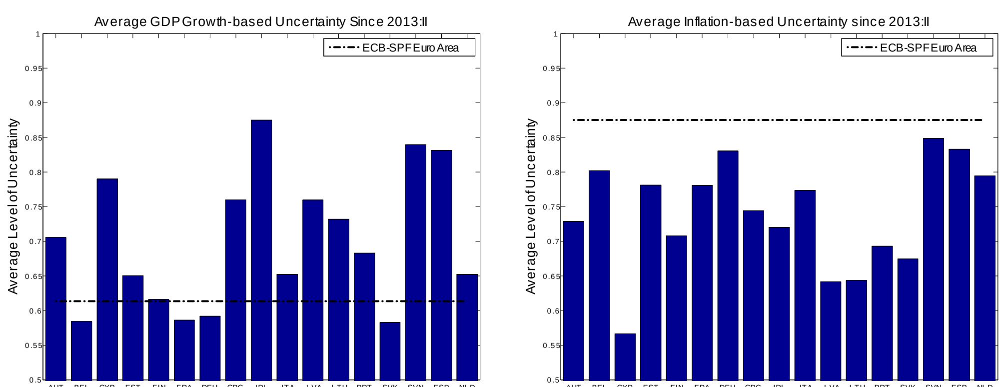
Note: The figure compares the cross-country average of the country-specific indices (labeled "Average of Country-Specific"), as well as its first principal component (labeled "1st PC of Country-Specific"), to uncertainty indices obtained from ECB-SPF directly (labeled ECB-SPF Euro Area). The left panel compares uncertainty in output growth, while the right panel compares uncertainty in inflation.

Figure 7. Average Uncertainty across Euro Area

Panel A: Average Uncertainty from 1999:I-2013:I

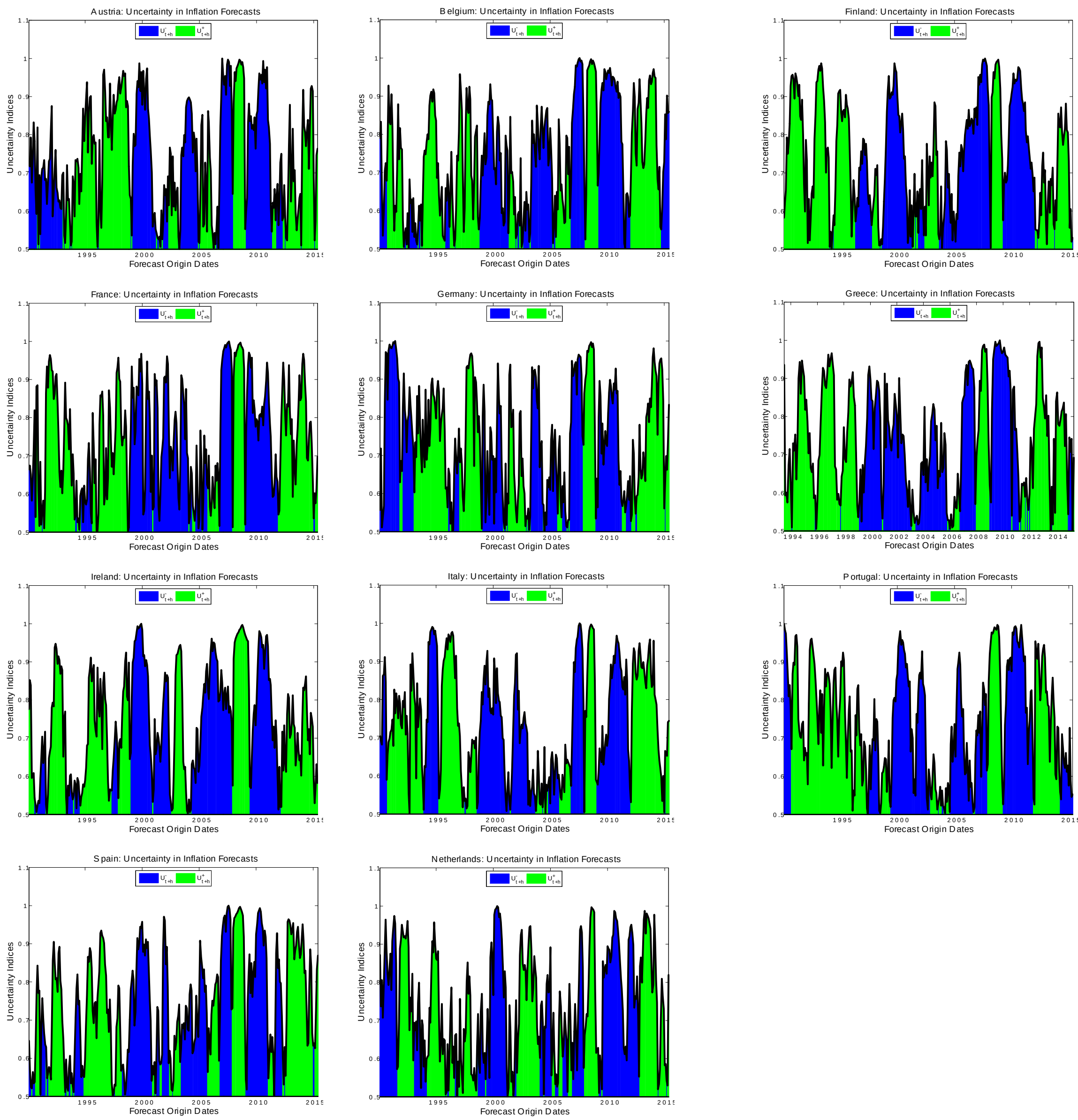


Panel B: Average Uncertainty from 2013:II-2015:I



Note: The figures show the average level of country-specific and Euro Area uncertainty. Table 2 reports the full names of the countries associated with the mnemonics reported on the horizontal axis.

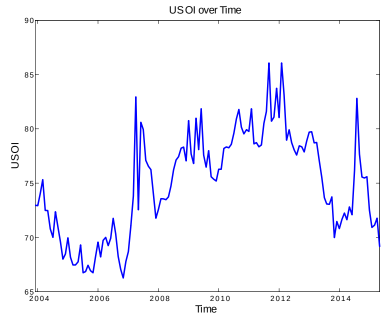
Figure 8. Euro Area Country-Specific Monthly Inflation Uncertainty Indices



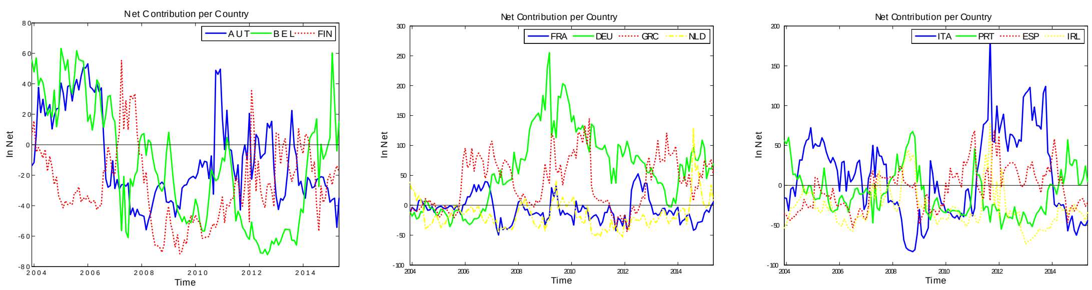
Note to Figures 4,5 and 8: The figures depict the uncertainty indices obtained from the forecast error distributions implied by the weighted annual forecasts from Consensus Economics.

Figure 9. Spillovers over Time

Panel A: The $USOI$ Over Time



Panel B: Net "Exporter" Status Over Time



Note: The results in the figure are based on a rolling window of 60 observations. The VAR includes two lags and the forecast horizon equals two years (24 months). The dates on the x-axis correspond to the forecast origin dates associated with the end of the rolling window.

Table 1. Correlations of Variable-Specific and Macroeconomic Uncertainty Indices

	Inflation	Output Growth	Unemployment	Euro Area Macroec. Uncertainty Index	EPU	VSTOXX
Inflation	1.00	-0.10	0.23	0.29	0.12	-0.19
Output Growth		1.00	0.41	0.76	-0.06	0.33
Unemployment			1.00	0.88	0.33	0.36
Euro Area Macroec. Uncertainty Index				1.00	0.19	0.36
EPU					1.00	0.38
VSTOXX						1.00

Note: The correlations are based on the sample period 1999:I-2015:II, which is the common period across the series.

Table 2. Euro Area Member Country Data			
Country Name	Country Code	Output Growth Uncertainty	Inflation Uncertainty
Austria	AUT	1996:Q2-2015:Q2	1990:M2-2015:M5
Belgium	BEL	1995:Q2-2015:Q2	1990:M2-2015:M6
Cyprus	CYP	1998:Q3-2015:Q2	1998:M7-2015:M6
Estonia	EST	1998:Q3-2015:Q2	1998:M7-2015:M5
Finland	FIN	1990:Q2-2015:Q2	1990:M2-2015:M5
France	FRA	1990:Q2-2015:Q2	1990:M2-2015:M5
Germany	DEU	1990:Q2-2015:Q2	1990:M2-2015:M6
Greece	GRC	1995:Q2-2015:Q2	1993:M7-2015:M5
Ireland	IRL	1997:Q2-2015:Q1	1990:M2-2015:M5
Italy	ITA	1990:Q2-2015:Q2	1990:M2-2015:M6
Latvia	LVA	1998:Q3-2015:Q2	1998:M7-2015:M5
Lithuania	LTU	1998:Q3-2015:Q2	1998:M7–2015:M5
Portugal	PRT	1995:Q2-2015:Q2	1990:M2-2015:M5
Slovakia	SVK	1997:Q2-2015:Q2	1995:M3-2015:M5
Slovenia	SVN	1998:Q3-2015:Q2	1995:M3-2015:M6
Spain	ESP	1995:Q2-2015:Q2	1990:M2-2015:M6
The Netherlands	NLD	1990:Q2-2015:Q2	1990:M2-2015:M5

Note: The table reports the Euro Area member countries for which we have constructed uncertainty indices based on GDP growth and inflation forecast errors. The dates refer to the forecast origin dates.

Table 3. Correlation of GDP Uncertainty Indices over the Cycle									
	$Corr\left(U^*_{i,t-k}, U^*_{EA,t}\right)$								
Country	$k=4$	$k=3$	$k=2$	$k=1$	$k=0$	$k=-1$	$k=-2$	$k=-3$	$k=-4$
AUT	-0.01	0.09	0.26	**0.55**	**0.41**	0.07	-0.14	0.01	0.05
BEL	-0.05	0.07	0.28	**0.49**	**0.39**	0.16	0.06	0.16	0.34
EST	0.34	0.21	0.21	0.31	**0.33**	0.28	0.24	0.21	0.11
FIN	-0.03	0.01	0.26	**0.49**	**0.47**	0.36	0.34	0.20	0.19
FRA	0.12	0.10	0.26	**0.59**	**0.40**	0.10	-0.07	0.07	0.25
DEU	0.12	0.12	0.29	**0.68**	**0.61**	0.29	0.08	0.08	-0.01
GRC	0.04	0.06	0.11	0.08	**0.10**	0.08	0.01	-0.03	-0.01
IRL	0.01	0.22	0.23	0.27	**0.12**	-0.01	-0.16	-0.22	-0.04
ITA	0.13	0.22	0.38	**0.70**	**0.60**	0.28	0.10	0.03	0.02
LVA	0.47	0.47	0.27	0.17	**0.15**	0.05	-0.12	-0.14	-0.08
LTU	0.16	0.23	0.21	0.19	**0.30**	0.28	0.12	0.15	0.14
PRT	0.01	0.10	0.10	0.17	**0.12**	0.02	0.08	0.17	0.25
SVK	0.21	0.27	0.35	**0.51**	**0.50**	0.36	0.16	0.25	0.21
SVN	-0.24	-0.19	0.06	0.17	**0.26**	0.13	0.07	0.01	-0.01
ESP	0.22	0.27	0.25	0.25	**0.24**	0.10	-0.04	-0.11	-0.13
NLD	0.18	0.32	0.47	**0.58**	**0.42**	0.12	-0.10	-0.13	-0.13

Note: The table shows the correlations of country-specific output-growth based uncertainty indices, lagged k periods, $U^*_{i,t-k}$, with that of the Euro Area aggregate, $U^*_{i,t}$. Refer to Table 2 for a list of country names associated to the mnemonics. The sample period is 1999:I-2015:II. Boldface highlight contemporaneous correlations as well as lead-lag correlations exceeding the contemporaneous correlations.

Table 4. Correlation of Inflation Uncertainty Indices over the Cycle									
$Corr\left(U^{*}_{i,t-k}, U^{*}_{EA,t}\right)$									
Country	$k=4$	$k=3$	$k=2$	$k=1$	$\mathbf{k=0}$	$k=-1$	$k=-2$	$k=-3$	$k=-4$
AUT	-0.07	-0.03	0.11	0.36	**0.45**	0.38	0.27	0.09	0.03
BEL	0.16	0.28	0.41	0.45	**0.64**	0.46	0.28	0.16	0.18
EST	0.23	0.27	0.28	0.36	**0.41**	0.23	0.09	0.00	-0.11
FIN	0.07	0.16	0.26	0.39	**0.55**	0.45	0.24	0.20	0.10
FRA	-0.02	0.13	0.23	0.23	**0.48**	0.14	0.18	0.19	0.10
DEU	-0.02	0.11	0.29	0.40	**0.58**	0.44	0.33	0.13	0.13
GRC	0.01	0.14	0.14	0.25	**0.39**	0.21	0.00	0.14	0.06
IRL	-0.12	-0.12	0.05	0.21	**0.38**	0.19	0.09	-0.02	-0.09
ITA	0.10	0.07	0.22	0.40	**0.52**	0.42	0.43	0.25	0.13
LVA	0.20	0.11	0.16	0.27	**0.35**	0.24	0.17	-0.05	-0.18
LTU	0.14	0.07	0.08	0.19	**0.21**	**0.25**	0.04	-0.19	-0.32
PRT	-0.15	-0.11	-0.05	0.21	**0.35**	0.23	0.28	0.14	0.09
SVK	-0.23	**-0.29**	**-0.26**	**-0.15**	**-0.03**	0.02	-0.09	-0.17	-0.34
SVN	-0.07	-0.04	0.12	0.31	**0.43**	0.22	0.13	0.18	0.16
ESP	0.17	0.21	0.36	0.48	**0.64**	0.46	0.27	0.08	0.03
NLD	-0.06	-0.13	-0.01	0.10	**0.27**	**0.30**	0.10	-0.06	-0.06

Note: The table shows the correlations of country-specific output-growth based uncertainty indices, lagged k periods, $U^{*}_{i,t-k}$, with that of the Euro Area aggregate, $U^{*}_{i,t}$. Refer to Table 2 for a list of country names associated to the mnemonics. The sample period is 1999:I-2015:I. Boldface highlight contemporaneous correlations as well as lead-lag correlations exceeding the contemporaneous correlations.

Table 5. Spillover in Output Growth Uncertainty Index

	EA	AUT	BEL	EST	FIN	FRA	DEU	GRC	IRL	ITA	LVA	LTU	PRT	SVK	SVN	ESP	NLD	*From*
EA	15.19	8.72	6.58	2.94	3.60	6.04	8.89	5.92	2.19	4.77	5.89	2.03	3.35	4.08	5.98	7.23	6.59	84.81
AUT	2.11	31.78	11.11	3.40	4.26	4.23	5.85	3.25	2.02	4.31	3.75	1.62	3.27	9.48	3.56	3.16	2.83	68.22
BEL	2.63	7.44	29.48	4.26	1.30	8.04	5.87	5.01	2.14	2.91	7.65	1.21	4.36	11.67	1.79	2.37	1.87	70.52
EST	4.46	2.30	7.36	19.48	3.15	3.20	3.03	5.16	1.33	4.12	5.44	1.60	3.75	19.34	6.30	3.80	6.18	80.52
FIN	1.61	6.31	18.38	4.41	10.61	7.59	2.47	1.97	2.95	3.42	2.80	1.08	4.56	14.04	4.19	10.20	3.41	89.39
FRA	3.53	6.89	12.32	4.09	2.30	17.42	7.51	4.43	3.07	4.96	5.41	2.79	5.08	7.21	6.31	3.33	3.34	82.58
DEU	5.62	11.10	5.55	4.21	1.47	3.94	26.62	4.28	1.54	5.20	5.04	1.01	2.48	11.49	4.66	3.15	2.63	73.38
GRC	2.30	6.22	8.91	3.11	3.86	5.50	3.31	25.76	2.71	8.41	2.94	2.32	4.11	6.01	7.65	2.28	4.61	74.24
IRL	1.89	2.36	3.09	2.84	5.48	8.11	3.31	7.95	18.27	3.91	7.69	5.25	5.24	1.88	16.55	2.78	3.41	81.73
ITA	1.41	5.17	7.33	4.98	3.79	6.74	5.54	3.78	1.67	22.92	3.66	1.59	3.62	5.58	4.16	11.20	6.87	77.08
LVA	1.34	4.56	6.16	7.12	2.64	5.53	3.81	1.75	2.07	4.57	27.26	1.45	7.57	12.28	2.93	3.46	5.51	72.74
LTU	3.85	4.20	2.41	4.99	1.69	2.90	2.11	4.23	3.22	1.60	9.54	23.71	8.69	9.50	9.43	2.76	5.19	76.29
PRT	0.88	7.73	5.92	2.70	1.71	8.37	2.70	2.24	1.79	6.75	1.61	3.69	40.41	3.80	4.47	1.29	3.95	59.59
SVK	3.07	6.98	9.09	4.83	2.94	2.59	2.79	3.16	1.45	3.12	7.49	1.71	4.95	38.00	3.17	2.07	2.59	62.00
SVN	2.39	5.10	7.97	2.43	3.51	11.38	3.05	2.53	4.14	3.84	1.88	1.64	13.28	1.02	24.88	7.81	3.15	75.12
ESP	6.45	1.70	2.26	3.89	3.43	4.44	2.57	4.90	0.76	5.41	2.09	2.58	1.63	2.64	6.90	40.00	8.36	60.00
NLD	2.35	7.09	7.86	3.49	1.18	2.88	4.76	7.10	1.23	2.47	4.02	4.80	4.16	2.89	4.69	5.82	33.20	66.80
To	45.87	93.88	122.30	63.68	46.30	91.49	67.56	67.65	34.27	69.76	76.92	36.36	80.10	122.91	92.74	72.72	70.49	*SOI =*
Total	61.06	125.66	151.78	83.16	56.91	108.91	94.19	93.41	52.55	92.68	104.19	60.06	120.50	160.91	117.62	112.72	103.70	*74%*
Net	-38.94	**25.66**	**51.78**	-16.84	-43.09	**8.91**	-5.81	-6.59	-47.45	-7.32	**4.19**	-39.94	**20.50**	**60.91**	**17.62**	**12.72**	**3.70**	

Note. The table shows the average spillovers of output growth-based uncertainty across the Euro Area during 1999:I - 2015:I. The reported results are the average of all 17! permutations of Cholesky rotation matrices in the variance decomposition exercise. Each column reports the contribution of the shocks from the column country to the country in the row. The row labeled as "To" summarizes the contribution from the column country to all others (except itself). The row "Total" captures the total variation of uncertainty in each country (including itself). The column "From" summarizes the total contribution of the country in a row to the rest of the countries, while the row "Net" shows the difference between how much uncertainty a country exports "To" other countries and how much it receives "From" other countries. Please refer to Table 2 to obtain the names of countries associated with the labeled mnemonics.

Table 6. Spillover in Inflation Uncertainty Index

	EA	AUT	BEL	EST	FIN	FRA	DEU	GRC	IRL	ITA	LVA	LTU	PRT	SVK	SVN	ESP	NLD	*From*
EA	22.02	8.13	12.82	5.96	4.62	5.97	5.52	2.75	2.98	4.12	2.08	1.41	6.86	2.53	6.23	4.38	1.62	77.98
AUT	5.35	25.06	5.89	12.60	3.21	4.30	7.21	4.93	3.56	2.40	3.78	2.48	3.31	2.68	3.26	7.28	2.69	74.94
BEL	8.86	4.29	23.20	9.79	4.89	3.88	5.55	2.67	3.38	3.32	5.30	3.83	4.66	1.73	4.11	8.84	1.70	76.80
EST	4.83	8.36	3.37	26.67	3.12	3.99	6.94	2.39	4.97	3.07	4.49	4.01	4.31	4.14	4.21	7.24	3.90	73.33
FIN	5.59	6.93	6.43	11.77	19.91	3.27	2.98	2.64	6.26	4.35	4.80	4.02	3.09	2.82	3.95	7.73	3.47	80.09
FRA	7.63	7.44	6.09	5.33	2.09	19.99	8.02	9.19	4.21	9.13	3.96	2.98	3.80	1.27	2.75	4.52	1.61	80.01
DEU	11.12	8.28	4.44	10.29	1.44	6.61	21.12	3.56	2.86	2.91	3.62	1.20	7.09	3.62	5.50	4.04	2.31	78.88
GRC	5.60	8.10	7.26	5.58	3.86	11.23	5.60	22.16	3.10	3.94	6.82	2.16	2.41	1.36	3.11	4.39	3.30	77.84
IRL	4.12	1.37	7.64	7.35	9.97	3.18	4.11	1.47	22.39	3.16	9.99	4.08	6.48	1.37	3.77	6.91	2.62	77.61
ITA	7.31	3.68	12.00	1.99	4.41	8.79	3.52	4.08	4.38	23.02	3.09	4.47	6.41	1.82	4.39	5.57	1.07	76.98
LVA	3.16	3.48	3.43	12.11	4.78	3.88	3.29	3.22	6.15	8.12	23.63	4.26	7.22	6.97	2.03	2.13	2.14	76.37
LTU	3.99	5.87	4.44	9.95	1.88	4.73	2.30	3.08	7.47	8.00	3.88	18.88	6.09	6.45	5.06	4.83	3.10	81.12
PRT	4.74	2.41	9.40	3.55	8.42	4.06	2.61	7.12	3.65	5.53	3.64	2.49	23.87	3.94	2.30	10.09	2.19	76.13
SVK	2.51	6.35	3.37	2.93	5.85	4.20	3.20	3.22	4.63	9.35	5.07	8.65	10.62	22.37	3.46	2.99	1.22	77.63
SVN	5.40	4.67	4.90	5.85	1.95	4.08	6.39	6.52	3.92	11.01	5.10	2.79	4.35	1.96	23.08	3.21	4.83	76.92
ESP	7.42	7.55	13.33	7.35	5.06	4.42	5.62	3.03	3.43	4.50	2.48	4.25	3.85	1.34	3.82	19.97	2.58	80.03
NLD	4.08	6.68	6.68	6.23	4.20	4.38	4.48	6.05	3.38	4.70	2.88	2.76	2.64	3.25	7.49	6.17	23.96	76.04
To	91.71	93.57	111.51	118.64	69.76	80.95	77.34	65.93	68.34	87.61	70.98	55.85	83.19	47.26	65.42	90.30	40.35	*SOI =*
Total	113.73	118.63	134.70	145.31	89.68	100.94	98.45	88.09	90.73	110.62	94.61	74.73	107.07	69.63	88.50	110.27	64.31	*78%*
Net	**13.73**	**18.63**	**34.70**	**45.31**	-10.32	**0.94**	-1.55	-11.91	-9.27	**10.62**	-5.39	-25.27	**7.07**	-30.37	-11.50	**10.27**	-35.69	

Note. The table shows the average spillovers of inflation-based uncertainty across the Euro Area during 1999:I - 2015:I. The reported results are the average of all 17! permutations of Cholesky rotation matrices in the variance decomposition exercise. Each column reports the contribution of the shocks from the column country to the country in the row. The row labeled as "To" summarizes the contribution from the column country to all others (except itself). The row "Total" captures the total variation of uncertainty in each country. The column "From" summarizes the total contribution of the country in a row to the rest of the countries, while the row "Net" shows the difference between how much uncertainty a country exports "To" other countries and how much it receives "From" other countries. Please refer to Table 2 to obtain the names of countries associated with the labeled mnemonics.

Table 7. Spillover Effects of Upside and Downside Uncertainty					
Country	Output Growth			Inflation	
	Upside	Downside		Upside	Downside
Euro Area	-59.10	-41.26		**67.53**	**99.36**
Austria	**47.58**	-34.43		-36.55	**44.51**
Belgium	**143.22**	**15.44**		-16.57	-10.22
Estonia	-21.67	**56.28**		-24.50	**10.34**
Finland	-2.83	**82.34**		-54.53	-43.05
France	-7.03	**3.61**		**1.62**	**36.78**
Germany	**3.07**	**16.12**		**44.25**	**18.05**
Greece	-6.25	-26.68		-39.92	**17.21**
Ireland	-23.78	**65.97**		**65.49**	-36.29
Italy	-1.48	-27.78		-24.92	**27.99**
Latvia	-40.51	-5.44		-23.04	-18.85
Lithuania	**9.88**	-31.88		-57.11	-31.55
Portugal	**5.27**	**28.53**		**86.91**	-18.53
Slovakia	-34.28	-65.33		**18.65**	-41.16
Slovenia	-12.13	-29.49		**27.20**	-35.08
Spain	-22.88	-3.69		**6.63**	**0.33**
The Netherlands	**22.91**	-2.33		-41.14	-19.85
USOI	*84%*	*85%*		*87%*	*87%*

Note: The table shows the net spillover effects of upside and downside uncertainty for GDP growth- and inflation- based uncertainty indices. A negative number indicates that a country is an uncertainty "importer", while a positive number indicates that it is an uncertainty "exporter."

Table 8. Spillover in Monthly Inflation Uncertainty Index

	AUT	BEL	FIN	FRA	DEU	GRC	IRL	ITA	PRT	ESP	NLD	*From*
AUT	40.09	7.48	6.54	5.62	15.53	5.23	5.19	0.94	3.90	5.93	3.55	59.91
BEL	2.86	63.69	1.67	5.52	6.29	6.43	1.08	1.96	1.45	7.96	1.07	36.31
FIN	2.15	4.81	49.76	2.15	4.61	4.02	18.84	5.84	0.67	4.19	2.97	50.24
FRA	2.65	6.60	1.50	50.40	11.03	8.50	4.11	5.02	4.97	4.49	0.72	49.60
DEU	2.54	5.95	2.08	6.64	64.14	4.62	2.65	1.21	0.89	7.39	1.87	35.86
GRC	2.40	8.10	1.57	11.47	2.17	58.45	1.30	1.04	5.63	2.10	5.76	41.55
IRL	1.46	1.91	20.12	2.45	1.84	1.69	55.07	3.69	5.01	4.80	1.95	44.93
ITA	1.05	4.87	0.75	3.83	3.54	11.83	0.95	56.82	7.73	6.86	1.78	43.18
PRT	3.41	4.42	0.53	2.78	0.85	18.53	2.07	2.47	55.99	6.10	2.85	44.01
ESP	1.68	8.16	1.07	2.97	3.78	9.14	4.98	5.76	2.77	54.68	5.01	45.32
NLD	7.03	2.65	1.47	1.31	2.49	4.93	0.98	7.29	3.85	10.11	57.89	42.11
To	27.25	54.94	37.30	44.74	52.14	74.91	42.16	35.24	36.87	59.95	27.53	*SOI =*
Total	67.34	118.63	87.06	95.13	116.28	133.36	97.23	92.06	92.87	114.62	85.42	*45%*
Net	-32.66	**18.63**	-12.94	-4.87	**16.28**	**33.36**	-2.77	-7.94	-7.13	**14.62**	-14.58	

Note. The table shows the average spillovers of monthly inflation-based uncertainty across the Euro Area during 1999:I - 2015:I. The reported results are the average of all 11! permutations of Cholesky rotation matrices in the variance decomposition exercise. Please refer to Table 6 notes for the interpretation of rows and columns and Table 2 to obtain the names of countries associated with the labeled mnemonics.