Characterising economic uncertainties in five European countries

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Growing uncertainty is frequently put forward to explain slowdowns in business activity, due to the wait-and-see attitudes it tends to generate. This is a vague concept, however, that is difficult to characterise and measure. This paper presents several uncertainty indicators suggested by the academic literature and puts them into perspective: the number of times uncertainty-related terms occur in the press; the volatility of economic measurements (such as the industrial production index or stock market index); errors in forecasts made using an economic model.

In the five leading European economies, France, Germany, the United Kingdom, Spain and Italy, all these indicators increase during periods of economic slowdown, as defined by the OECD. Furthermore, over the period 1999-2017, the citation impact indicator shows an upward trend in all the countries. This is not the case for the others, which have tended to fall over the past ten years.

Macroeconomic uncertainty and the uncertainty expressed in the press therefore seem to follow different rules. This is demonstrated mainly by looking at two events. In 2008, in the crisis period, macroeconomic indicators experienced their greatest fluctuations, while uncertainty expressed in the press was relatively inert, contrary to what was seen in 2016 during the Brexit referendum period.

Taking uncertainty indicators overall, the country-specific features appear less significant than their shared trends. In this sense, France is not particularly different from its European partners.

Questions relating to the economic consequences of uncertainty are a recurrent feature in the public debate, as in the economic literature. In the face of the different types of uncertainty (economic, policy-related or concerning households or enterprises), economic agents may change their behaviour. The economic literature, for example, has long identified precautionary savings behaviour among households, namely a tendency to slow consumption when the economic outlook is uncertain. The recent period may be subject to such effects, since uncertainty seems to have increased in varying dimensions: in addition to the global economic crisis (2008 financial crisis) and then the European crisis (sovereign debt in 2010), there have been political and geopolitical events that were as unpredictable as their consequences (a succession of terrorist attacks, the Brexit vote, results of the American elections, etc.). In a longer-term perspective, environmental issues raise questions about the sustainability of the current production model and consequently the future of our economies.

From a theoretical point of view, uncertainty is characterised by difficulty in predicting what will happen in the future. However, it is a notion that is particularly difficult to pin down, as it reflects a feeling, with all the degrees of subjectivity that this can imply, as much as it does objective and observable facts. This report therefore aims to present various ways of measuring

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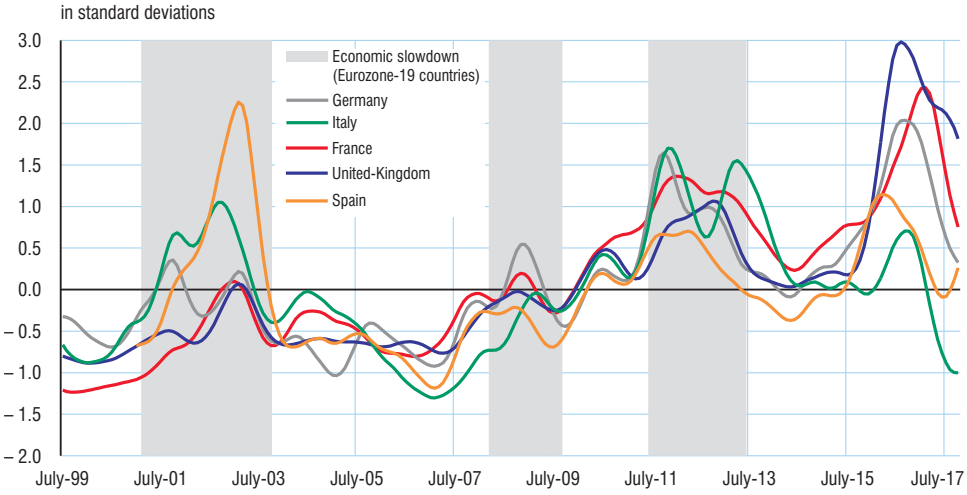
uncertainty, such as those put forward in the economic literature, and to apply them over the last 20 years to the five main European economies (Germany, Spain, France, Italy and the United Kingdom).

Uncertainty as expressed in the press

One first way of appreciating uncertainty, and probably the simplest from a practical point of view, is to look at how it is experienced by the economic agents. This can be done, as a first approximation, by quantifying the use of this term in the public debate. This is what Baker *et al* [2016] did by measuring, each month, in the press of a given country, the proportion of articles containing the words "uncertainty" or "uncertain", whenever these were used in association with a well-defined list of economic and political terms.[1] The indicator obtained – referred to as *News* in the rest of this report – was constructed for each country studied over the period 1999-2017 (*Figure 1*).[2]

1. News indicator for 5 european countries between 1999 and 2017



Note for the reader : in February 2003, the News indicator in Spain was 2,25 standard deviation above its mean over the period 1999-2017.
Note : the News indicator was constructed by Baker et al. [2016]. It is normalized and smoothed with an Hodrick-Prescott filter. Shaded areas correspond to period of economic slowdown identified from the turning points of the Composite Leading Indicators computed by OECD for the 19 countries Euro zone.
Source: Baker et al. [2016] database [http:/www.policyuncertainty.com/index.html]; OECD for shaded areas.

1. More precisely, the terms identified were trios of words such as "economy/uncertainty/deficit", economy/uncertainty/legislation" "economy/uncertainty/regulation", etc. The press taken into consideration consisted of two of the main newspapers in the countries in question (*Handelsblatt* and *Frankfurter Allgemeine Zeitung* for Germany, *El Mundo* and *El País* for Spain, *Le Monde* and *Le Figaro* for France, *Corriere Della Sera* and *La Repubblica* for Italy, *The Times of London* and the *Financial Times* for the United Kingdom).
2. The indicator obtained for each country is centred and reduced over the period studied, that is to say that its mean is extracted and divided by its standard deviation, with the aim of increasing comparability between countries. Indeed, it is considered that the mean and the variance are not commensurable between countries. In addition, once reduced and centred, the indicator is smoothed by Hodrick-Prescott (HP) filtering in order to eliminate low-amplitude or too high-frequency fluctuations and to improve overall readability. These different operations (centring, reduction, filtering) are applied to all the uncertainty indicators considered in the report. It should be noted that the application of moving average filters does not alter the conclusions.

The *News* indicators for the 5 countries studied globally show four relatively synchronous peaks. The first three are situated in periods of economic slowdown: a substantial peak in 2003 (slowdown of advanced economies at the beginning of the 2000s in the wake of the bursting of the internet bubble and the 11 September 2001 terrorist attacks), and two smaller peaks in 2009 (height of the financial crisis) and then in 2012-2013 (European sovereign debt crisis). The last peak, in 2016, does not seem to be linked to a depressed economic context and is probably linked to the outcome of the British referendum on the United Kingdom's withdrawal from the European Union ("Brexit").

Furthermore, although the magnitude of the changes differs from one country to another, the indicators were at their lowest in 2007, just before the financial crisis, and they tended to increase after that, reaching their highest point in 2016.[3] The crisis may therefore have altered the practices of the press, which would appear to be using words referring to uncertainty more often.

The scale of the 2016 peak, compared to the other peaks observed, raises questions about the nature of the *News* indicator. In fact, it measures how often uncertainty is mentioned and in this respect it may be subject to two limits. On the one hand, it is not insensitive to passing trends or media hype, which means that certain terms may be used very frequently at certain times without it corresponding to the actual magnitude of the phenomenon concerned.[4] On the other hand, the indicator reflects the fact that there is concern about uncertainty, which does not necessarily correspond to observable changes in the economic environment. In what follows, we will consider indicators that seek to measure economic uncertainty beyond its expression in the press. The notion of uncertainty refers to the difficulty of predicting the future: economic uncertainty therefore represents the component in economic measurements that is not foreseeable by agents, approached by forecast errors (*box 1*).

Box 1

Formalising the notion of uncertainty

The notion of uncertainty is intrinsically forward-looking in the sense that it refers to the quality that can be given to forecasts about the future. In economics, assuming thatagents base their decisions on an anticipation of subsequent developments based on a model, uncertainty can be characterised by the quality of this forecasting model. This quality can obviously vary over time, and good modelling for a given period can become irrelevant if there is a change of economic regime or if major events or unforeseeable facts occur.

More formally, a mathematical framework was defined to serve as a theoretical structure underlying the measurements of economic uncertainty presented in this report:

– namely a vector of economic variables Y_t (containing for example GDP and its growth, inflation, unemployment, the oil price, etc.) generally characterising the economic situation;

– in order to predict the future economic situation Y_{t+h} over a given period h (for example a quarter or a year), an agent, enterprise or household will use an implicit predictive model. The latter will be specific to each agent and depend on its particular considerations: ability to mobilise information, prejudices, potentially limited rationality, etc. This model will enable it to make a forecast in this form:

$$\hat{Y}_{t+h|t} = f_{t,h}(X_t, Y_t)$$

Variables X_t and Y_t sum up here all the information available on date t and relevant in the agent's eyes to forecast the future. This may depend on the current situation Y_t but also on a set of other factors

3. It should be noted that Italy contrasts sharply with the other countries studied, with a downward indicator profile over the end of the period.

4. In the case of the *News* indicator, as the words searched for belonged to a wide semantic field, the risk of them being "trendy" terms would seem to be limited.

Box 1 (cont.)

(including some relating to the past) collected together here as X_t. These may be economic or non-economic (geopolitical, historical, personal, etc.). In most cases, the predictive model may depend on both the forecast period h considered and the date of the forecast t;

– making this forecast, the agent makes an error, written $\varepsilon_{t,h}$ and given by the difference between the forecast and what actually happens Y_{t+h}:

$$Y_{t+h} = \hat{Y}_{t+h|t} + \varepsilon_{t,h} = f_{t,h}(X_t, Y_t) + \varepsilon_{t,h}$$

The notion of uncertainty then corresponds to the variance of the forecast error committed at a given date t and for a fixed forecast period h. In this study, if an agent anticipates that its forecast has a high chance of being highly erroneous, then the period will be considered as uncertain.

This definition is similar to the classic distinction made by Frank Knight in 1921 between the notion of uncertainty and that of risk. In Knight [1921], the notion of risk qualifies situations where the description of the forecast error can be attached to that of a law of probability: in other words, a risk is "probabilisable". Knight contrasts this to the notion of uncertainty, which he qualifies as "radically" different and uses to characterise situations where the future events are not probabilisable, meaning that they cannot even be predicted based on a potential underlying law of probability, since none exists. The uncertainty indicators dealt with in this report are closer to the notion of risk[1] defined by Knight insofar as we are seeking to describe the forecast error statistically, and the two terms - uncertainty and risk - will therefore be used interchangeably in what follows.

1. The term "risk" is also frequently used in financial circles. In that case it refers to situations where the occurrence of a loss or contingency is possible or likely

Uncertainty measured by volatility

Considering that an economic agent uses the empirical mean of a series to make a forecast about its future, the volatility[5] of an economic magnitude is an indicator of uncertainty (*box 1*).

To illustrate this, we present here two uncertainty indicators measured by observed volatility, each one corresponding to a different magnitude:

– the first, which concerns the real economy, corresponds to volatility in the growth rate of the industrial production index (IPI). The IPI is a series that correlates well to economic activity and is available monthly. Its volatility will therefore be able to reflect the short-term uncertainty relating to production in the countries in question;[6]

– the second relates to the financial sphere where the question of uncertainty is very specific: values on the markets include a risk premium that may reflect uncertainty. Volatility on the financial markets may then reflect the very difficulty investors have in qualifying that risk. The great sensitivity of the financial markets to new and unexpected information also induces particularly marked movements in asset prices. Volatility in the growth rate of the stock market index, through share price tracking, is therefore a magnitude reflecting the uncertainty relating to the financial activity.

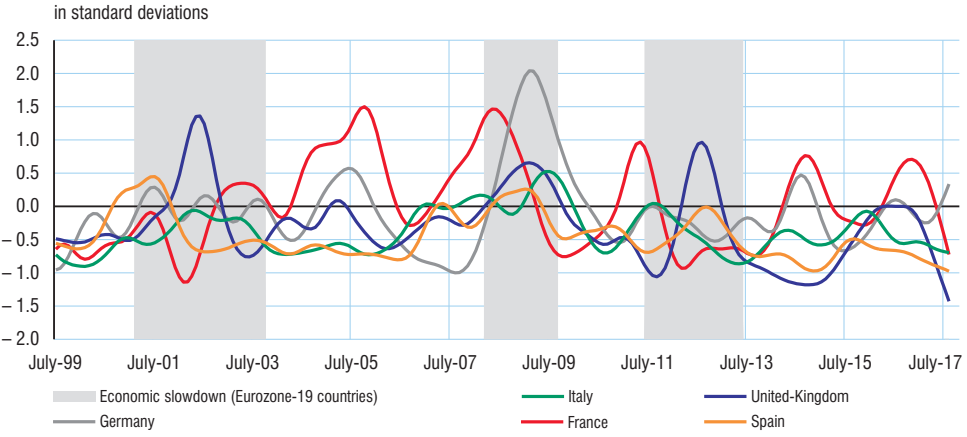
The volatility of the growth rate of the IPI shows a very variable profile in the different countries considered (*Figure 2*). France and Germany have thus seen more marked variations in this

5. Volatility is a term used more often in finance than variance. Nevertheless it refers to the same statistical measurement. In what follows, the words variance and volatility will be used interchangeably. Volatility is calculated using a moving (or rolling) variance with a centred window. This technique amounts to calculating an empirical variance not over all the elements in a time series, but only over a subset of points of fixed size and symmetrically placed around the date in question.
6. To assess the uncertainty of the overall economic activity of a country, the volatility of GDP could have been a good indicator. However, GDP data are not available monthly. This is why the IPI has been used here

indicator than their neighbours. France also seems to stand out, with a relatively more cyclical volatility, which is also found, but to a lesser degree, for the United Kingdom. Uncertainty measured by this indicator would tend to see its local peaks at the time of periods marked by strong fluctuations in economic activity, whether downward (periods of economic activity) or upward (in 2005 and at the end of the period).

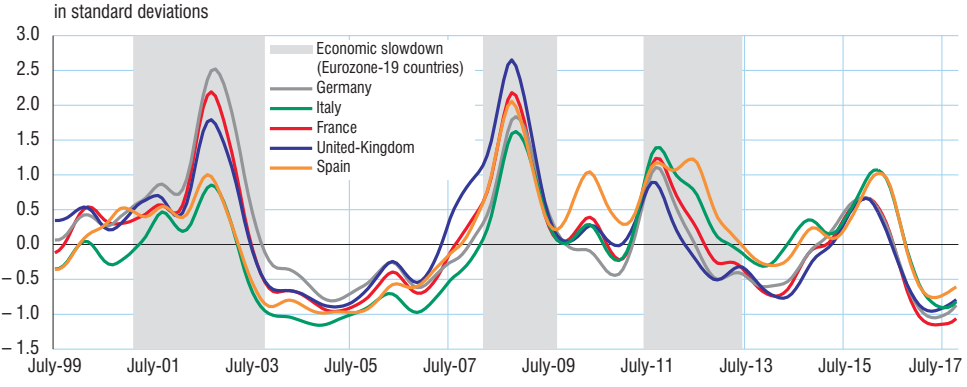
Stock market uncertainty, measured by the volatility of the growth rate of the stock market index (*Figure 3*), shows a high level of synchronisation between the countries studied. This may reflect the interdependence of the European financial markets, due to the financial integration facilitated by the introduction of the single currency and deepened by the banking union. Stock

2. Volatility of the IPI's growth rate for 5 european countries



Note for the reader: in February 2009, the volatility of the growth rate of the Industrial Production Index in Germany is 2 standard deviation above its long term mean.
Note: this indicator depicst the volatility of the IPI's growth rate, computed over a 6 months' rolling window. It is normalized and smoothed with an Hodrick-Prescott filter. Shaded areas correspond to period of economic slowdown identified from the turning points of the Composite Leading Indicators computed by OECD for the 19 countries Euro zone.
Source: OECD, author's calculations.

3. Volatility of the stock market index in 5 european countries between 1999 and 2017

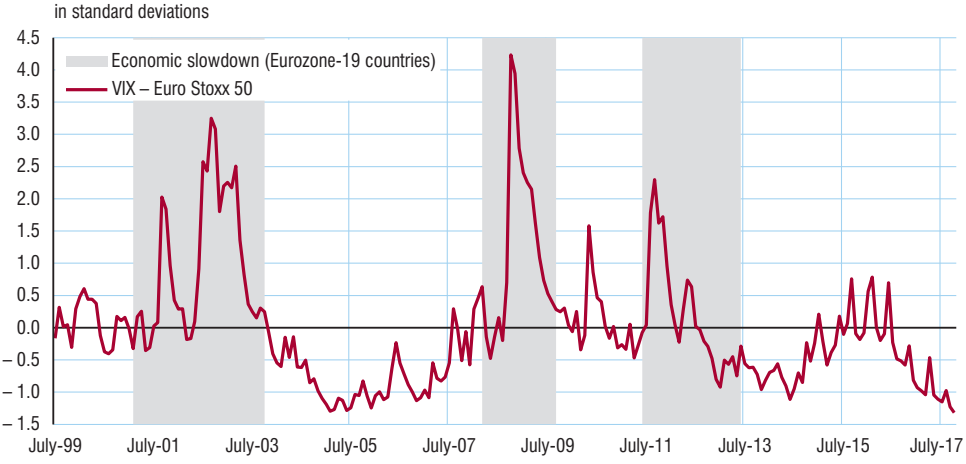


Note for the reader: in October 2008, the volatility of the stock market index in the UK was 2,7 standard deviation above its long term mean.
Note: this indicator depicts the volatility of the stock market index, computed over a 30 business days' rolling window. It is normalized and smoothed with an Hodrick-Prescott filter. The stock market indexes considered are CAC40 for France, DAX for Germany, FTSE 100 for the United-Kingdom, FTSE MiB for Italy and IBEX 35 for Spain. Shaded areas correspond to period of economic slowdown identified from the turning points of the Composite Leading Indicators computed by OECD for the 19 countries Euro zone.
Sources: DataInsight ; author's calculations; OECD for shaded areas.

market uncertainty presents a systematically upward trend in periods of economic slowdown, in particular after the Iraq War (2003) and then during the 2008-2009 financial crisis (collapse of the Lehman Brothers investment bank in September 2008), but also outside those periods, for example during the Greek public debt crisis of 2010-2011 and later probably in connection with the results of the Brexit referendum. In this respect, and perhaps paradoxically, the increase in stock market uncertainty following the Brexit vote seems to have been higher in Spain and Italy than in the other countries studied, including the United Kingdom. Furthermore, the period from 2004 to the 2008-2009 financial crisis was a period of low financial uncertainty. The global financial crisis that followed it, then the different stages of the sovereign debt crisis in Europe, were accompanied by a return to stock market uncertainty, as measured by this stock market index volatility indicator.

In terms of stock market uncertainty, another indicator widely used by the financial markets is the "*Volatility Index*" (VIX), also known as the "fear index" due to its reputation as a good indicator of the nervousness of the markets and their general state of mind with respect to future prospects. It is a daily index and is used in particular to build hedging or insurance financial products in the face of long-term changes in share prices. It does not strictly speaking represent the observed volatility in stock prices, but rather anticipations of their future volatility. Its mode of calculation aggregates a composite indicator of the prices of the call or put options[7] of the shares in a stock market index. The price of an option depends on the expected volatility of the price of the underlying asset. The VIX attempts to capture this prospective dimension, which is what distinguishes it from a simple statistical measurement of observed volatility. Accordingly, it is often used in the economic literature to approach the uncertainty felt by investors and, by extension, by the economy as a whole. By way of illustration, here we present the monthly changes in the VIX calculated for the Euro Stoxx 50 stock market index (*Figure 4*). Generally, the VIX shows a profile similar to that of the volatility of stock market indices. Between July 1999 and July 2017, its monthly average only exceeded the 2 standard deviations bar for any length of time on four occasions, namely when Enron and WorldCom scandals broke (autumn 2001 and from summer 2002 respectively), at the time of the collapse of Lehman Brothers

4. Euro Stoxx 50-VIX Index between 1999 and 2017



Note for the reader: this indicator depicts the Euro Stoxx 50-VIX. It is normalized. Shaded areas correspond to period of economic slowdown identified from the turning points of the Composite Leading Indicators computed by OECD for the 19 countries Euro zone.
Sources: DataInsight for Euro Stoxx 50-VIX; OECD for shaded areas.

7. A *call* option allows subscribers to acquire a financial instrument at a fixed price and on a date determined in advance. It is the opposite of a *put* option

(September 2008) and the outbreak of the financial crisis, then during the Greek crisis and finally the sovereign debt crisis.

Since the crisis, the VIX seems to have fallen over the long-term trend, perhaps reflecting the feeling of relative security brought by the accommodating monetary policies of the different central banks, through the provision of liquidities and the assertion of their role as last resort lenders. Over the period 2016-2017, there was nevertheless a substantial rise in the VIX, which has been corrected since then. This may be connected to a climate of normalisation of monetary policy in the United States, anticipated eventually in Europe too.

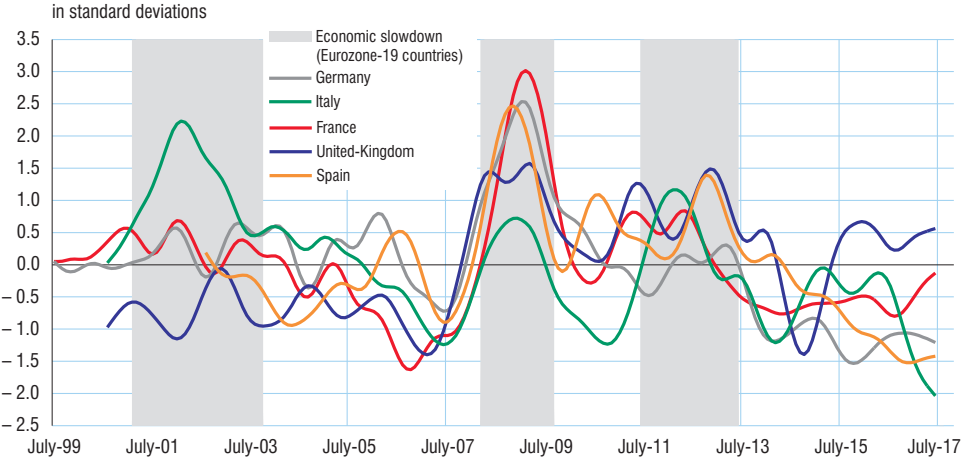
The indicators presented so far aim to measure uncertainty by the volatility of particular series, representative of trends in certain well-defined sectors of the European economies, and on the assumption that volatility is a relevant reflection of the forecasting errors of the economic agents. However, these indicators remain specific to a single dimension. In order to assess uncertainty in the economy overall, it is possible to calculate the volatility of a large number of economic and financial series and then aggregate them. We have chosen to apply this method to a set of 90 macroeconomic series produced by Eurostat and the OECD (*Figure 5*). The aggregation was done using a simple arithmetic mean of the volatilities calculated for each of the series, which made it possible to obtain a single indicator, which will be referred to in what follows as the aggregate volatility indicator (*Figure 6*).

5. Time series used in the construction of the Volatility Indicator

Variable type	Examples of series
Production and income	IPI, sectoral turnover, etc.
Labor market	Employment, hours worked, active population, unemployment rate, etc.
Housing	Building permits, Production Index (building), etc.
Interest rates, bonds	Interest rates, bond rates, sovereign rates, etc.
Prices	Consumer Price Index, exchange rates, etc.
Business Tendency Surveys	Business climate, balance of opinions, etc.

Sources: Eurostat; OECD.

6. Aggregate volatility for the 5 countries studied between 1999 and 2017



Note for the reader: in January 2009, in France, aggregate volatility was 3 standard deviations above its long term mean.
Note: this indicator depicts the mean of volatilities, computed over a 30 business day's rolling window. It is normalized and smoothed with an Hodrick-Prescott filter. Shaded areas correspond to period of economic slowdown identified from the turning points of the Composite Leading Indicators computed by OECD for the 19 countries Euro zone.
Sources: Eurostat and authors' calculations for volatilities; OECD for shaded areas.

We observe first of all, in all the countries, that aggregate volatility substantially increased from 2008 onwards to reach its highest level in the second quarter, at the moment when the financial crisis broke. Since 2013, the indicator has followed a general downward trend in all the countries in question, although with significant fluctuations around this trend. Aggregate volatility at the end of the period in the United Kingdom is the highest in relation to its average, probably because of Brexit. In France, the trend in aggregate volatility has been downward, reaching its lowest level in October 2006, but its saw the highest increase of all the countries considered between 2006 and 2009.

Uncertainty measured by the forecasting errors of a model

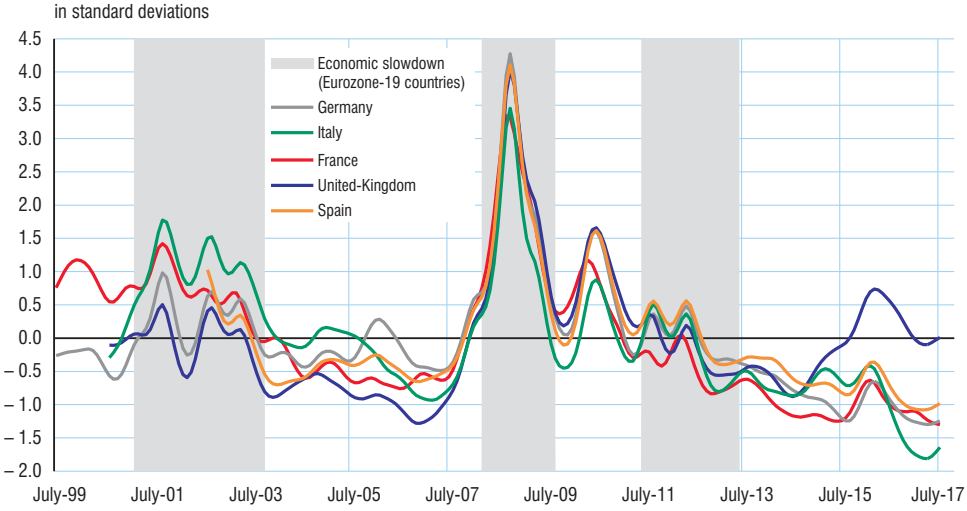
The aggregate volatility indicator appears conceptually better able to describe the general uncertainty affecting agents' economic behaviour than the volatility indicators specific to each series. As pointed out by Jurado, Ludvigson and Ng [2015] (JLN in the rest of this report), agents' economic forecasts are made in view of all the magnitudes observed in the economy, present and past, but also the supposed links between them. For example, if we consider the forecast that an employee is likely to make regarding their future compensation, this is not just based on past changes in their salary, but also on the chances of promotion and the economic context of the employer company. The uncertainty relating to their compensation therefore depends not only on how their salary may have deviated from its average trend in the past - which would be reflected by a volatility indicator – but also on the uncertainty affecting the other parameters that enter into consideration.

On the basis of this idea, and in order to assess the overall uncertainty to which the economic agents are subject, JLN propose to build a measurement aggregated from a wide spectrum of macroeconomic series. To do this, they propose a methodology (*Box 2*) consisting, first of all, using an econometric model, of extracting the macroeconomic information available on a given date from a large number of economic and financial series (survey data, series from national accounts, prices of assets, interest rates, etc.), then using this information to produce, for each series, the "best possible forecast"[8] for a given forecast period (for example 3 months). For each of these magnitudes, the difference with the forecast can then be interpreted as the unpredictable, and therefore uncertain component in the series in question (*Box 1*). By aggregating the uncertainties thus constructed for each series, a composite economic and financial indicator – referred to as the JLN indicator in what follows – is obtained. In this report, the JLN indicator has been calculated for a forecast period of 3 months[9] (*Figure 7*) using the same 90 macroeconomic series as for the volatility indicator (*Figure 5*) and 102 financial series.[10]

The JLN indicators calculated in the five European countries studied show quite similar trends. In particular, they saw a sharp rise at the time of the financial crisis in Europe towards the end of 2008: they then reached their maximum over the period, this standing out quite clearly from the previous peaks of 2003-2004 and later peaks in 2010-2012 (successive developments in the sovereign debt crisis). The maximum point in 2008 indicates that the financial crisis was accompanied by greater overall uncertainty than the other crises over the period, which the previous volatility indicators did not necessarily reflect, being more confined to a particular magnitude and not taking into account, in their calculation, the connections that this series

8. The "best forecast" is the one constructed on the basis of all the information available at the time of the forecast.
9. The choice of a forecast period of 3 months is intended to characterise the uncertainty relating to the short-term prospects of the economic agents. The profiles obtained for different forecast periods (1 to 9 months) are, however, quite close and do not qualitatively alter the conclusions that can be drawn.
10. These financial series are mainly the returns on portfolios of shares [French, 2018].

7. JLN indicator at a 3 months' forecast horizon between 1999 and 2017



Note for the reader: in October 2008, the JIN indicator in Germany was 4,3 standard deviations above its long term mean.
Note: this indicator depicts the JLN indicator at a 3 months' forecast horizon. It is normalized and smoothed with an Hodrick-Prescott filter. Shaded areas correspond to period of economic slowdown identified from the turning points of the Composite Leading Indicators computed by OECD for the 19 countries Euro zone.
Sources: Eurostat ; financial data from K. French; authors' calculation for the JLN indicator; OECD for shaded areas.

might have with the other economic magnitudes. After 2012, the JLN indicators fell, in part, until the recent period. Nevertheless, in the United Kingdom, there was a new peak in 2016, probably due to Brexit. In the other countries, at the end of the period studied, the levels of uncertainty measured were historically low.

Box 2

Construction of the Jurado, Ludvigson and Ng uncertainty indicator [2015]

The construction of the Jurado, Ludvigson and Ng [2015] (JLN below) uncertainty indicator rests on two hypotheses. Firstly, the uncertainty relating to the trend in a magnitude must not be approached by the forecast error variance conditioned only to the past observations of this particular magnitude but the error variance conditioned by all the economic information available at a given time. In JLN's approach, this information is summed up as a set of factors that are supposed to reflect the common changes in a sample of economic and financial magnitudes. Secondly, macroeconomic uncertainty cannot be limited to the uncertainty relating to a single magnitude, but must be measured by aggregating the uncertainties of a large set of magnitudes

Formally, JLN [2015] measure on date t the uncertainty of a magnitude y_j for a given period h as follows:

$$U_{jt}^{y}(h) = \sqrt{\mathrm{E}\left[\left(y_{jt+h} - \mathrm{E}\left[y_{jt+h} \mid \mathrm{I}_t\right]\right)^2 \mid \mathrm{I}_t\right]}$$

where I represents all the information available on date t. $\mathrm{E}[y_{jt+h} \mid \mathrm{I}_t]$ if the forecast of the magnitude y made on date t and for period h, conditioned to all the information available on t. $(y_{jt+h} - \mathrm{E}[y_{jt+h} \mid \mathrm{I}_t])$ is the difference between the effective realisation of this variable over given period and its forecast, that is to say the forecast error. The proposed measurement of uncertainty relating to yj therefore amounts to considering the expected

Box 2 (cont.)

variance of this forecast error. A high variance reflects the possibility of substantial differences and therefore a poor forecast, which means that there is greater uncertainty attached to the forecasting of this series

The JLN uncertainty indicator, $U_t^{\text{macro}}(h)$, is then obtained by aggregating these indicators for each of the series using a simple mean:

$$U_t^{\text{macro}}(h) = \sum_{j=1}^{N_y} \frac{1}{N_y} U_{jt}^h(h)$$

where N_y is the number of magnitudes used in the calculation of the JLN indicator. These may be of an economic and/or financial nature according to the type of overall uncertainty that one wishes to measure.

The procedure for calculating the uncertainty relating to each individual magnitude can be summed up in three steps:

– firstly, a dynamic factor model[1] is applied to a set of economic and financial series in order to estimate the latent factors. These factors are assumed to contain all the economic information available at a given moment;

– secondly, using a linear structure, the series is regressed over its own past, for estimated factors and additional variables of interest. This gives for each period h the forecast $E[y_{jt+h}|I_t]$ for the series conditioned to all the information I_t;

– thirdly, the series of forecast errors for the given period is calculated:

$U^y_{jt+h}(h) = y_{jt+h} - E[y_{jt+h}|I_t]$, for which, finally, the variance is estimated at each date.

1. The factor model rests on the hypothesis that the common dynamic of a large number of time series can be summed up by studying a small number of unobserved (or latent) factors which themselves change over time. For an analysis of the properties and estimation of factor models, see Stock and Watson [2016].

The forms of uncertainty are common to the five countries

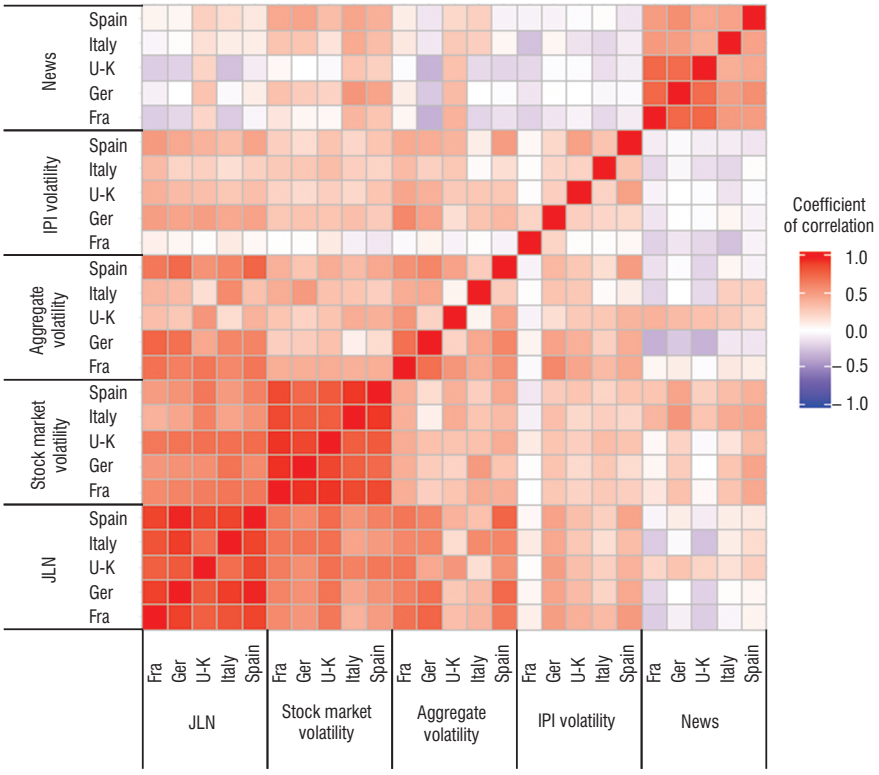
For the five European countries studied, we ultimately have five common uncertainty indicators: the *News* indicator, IPI growth rate volatility, the stock market index growth rate volatility, aggregate volatility and the 3-month JLN indicator. As we have seen, these indicators cannot be considered equivalent. They differ considerably in their construction, some are univariate, others are multivariate and one of them reflects media noise more than actual economic trends.

One way of going further in comparing them consists of carrying out an analysis of the correlations between these variables in order to identify the scale of the uncertainty they can be used to capture. As all five indicators are available for the five European countries studied (Germany, Spain, France, Italy and the United Kingdom), we have a set of twenty-five variables over the period 1997-2017 (*Figure 8*):

– as the block structure of the correlation matrix along its diagonal indicates, the indicators in the same family (for example the JLN indicators situated in the south-west quadrant of the matrix) are strongly positively correlated between countries. This confirms the intuitions presented in the earlier discussions which showed the good synchronicity of the cycles of uncertainty between European countries, whichever uncertainty indicator was considered;

– the JLN indicator is positively correlated both with stock market index growth rate volatility and with aggregate volatility (as shown by the study of the first five columns in the matrix). This confirms the ability of this indicator to capture an initial dimension of what we could call "macrofinancial" uncertainty. This ability to seize a rich dimension partly explains why this indicator is so popular in the economic literature for measuring uncertainty within a national economy. The volatility of the IPI growth rate seems to be positively correlated, but more weakly, with this macrofinancial uncertainty in all the countries studied (in the case of France, this correlation is virtually nil);

8. Correlations between uncertainty indicators in five europeen countries



Note for the reader: a square in the matrix depicts the correlation between the variables in column and in line. Red color represents a positive correlation; blue color represents a negative correlation; white color represents no correlation between variables.
Sources: Eurostat; OECD; News from Baker, Bloom et Davis, financial factors from K. French; authors' calculations.

– finally, whatever the country studied, the *News* indicator correlates very weakly (and even shows a negative correlation) with the other uncertainty indicators, with the partial exception of stock market index growth rate volatility. There is therefore a second dimension to uncertainty, specific to its expression in the press as reflected by the *News* indicator. Two robust conclusions come out of the analysis of these correlations. On the one hand, there are two separate dimensions to uncertainty in Europe, macrofinancial uncertainty and the uncertainty expressed in the press. The lack of correlation between these two dimensions is manifest when we look at two precise events: in 2008, at the beginning of the financial crisis, the economic and financial indicators saw their greatest fluctuations whereas the *News* indicator remained relatively inert; conversely, in 2016, following the result of the Brexit referendum, the *News* indicator fluctuated very significantly upward whereas the other indicators remained relatively stable or saw a downward trend.

On the other hand, in terms of uncertainty, there are no major differences between the five countries studied. The contrast between the two dimensions of uncertainty is valid in all the countries. Thus, when it comes to uncertainty, the specificities of the countries appear less significant than their points in common. In this sense, uncertainty in France is comparable to that of the European countries (*Box 3*).

Box 3

Focus on France

Here we take France to analyse more closely the statistical characteristics of the five indicators, to which we have added the VIX for the Euro Stoxx 50 (Figure 1). Between 2002 and 2017, all the indicators except the News indicator peaked at the time of the 2008-2009 financial crisis. Except for this common characteristic, the differentiated trends set apart a relatively homogeneous group of indicators: stock market index growth rate volatility, the Euro Stoxx 50 VIX and the JLN indicator are closely linked with each other throughout the economic cycle. They saw peaks during the periods of economic slowdown and a downward trend after 2012. Since 2008, aggregate volatility has been following a course that is more or less in line with the previous three indicators: upward at the beginning of 2009, a new peak after 2012 and a downward trend since then. However, before 2008, it was relatively disconnected from these indicators: in particular, there was no peak in 2003.

The News indicator has its own dynamics, in particular an upward trend since the 2008 crisis. Finally, IPI growth rate volatility, as well as increasing during the periods of economic slowdown, also saw local peaks in certain periods of sustained economic growth. This indicator has not shown any particular upward or downward trends over the last five years.

Furthermore, based on the calculation of various statistical measurements, it is possible to evaluate more precisely the characteristics of the profiles of these indicators in terms of persistence, skewness or degree of kurtosis (Figure 2). The following lessons can be drawn:

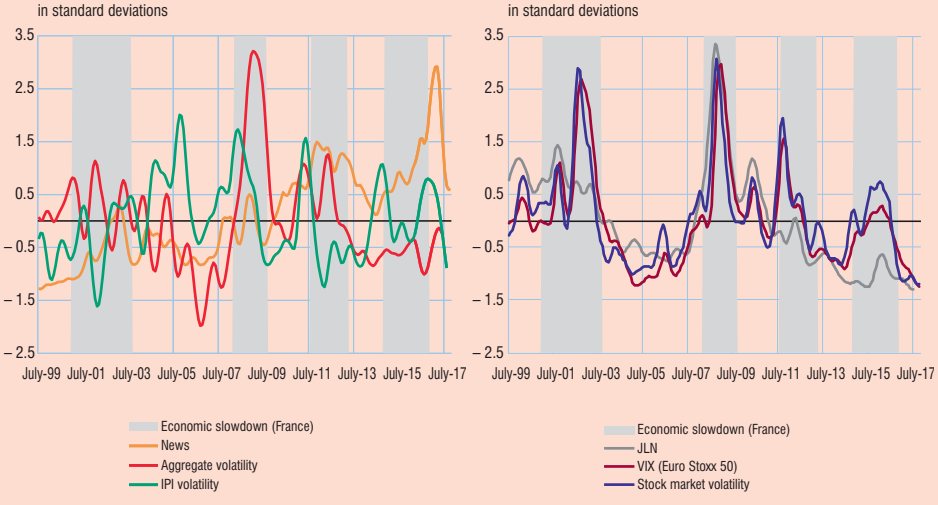
– the six indicators show a certain persistence, that is to say that once a period of uncertainty occurs, it has a tendency to last (autoregression coefficients between 0.58 and 0.87 inclusive, line AR(1) Figure 2);

– for all the indicators, there are more periods of low measured uncertainty than periods of high uncertainty (positive skewness, skewness line, Figure 2). However, that does not prevent the existence of very pronounced positive peaks;

– four indicators (stock market index growth rate volatility, aggregate volatility, Euro Stoxx 50 VIX, 3-month JLN indicator) show a distribution with thick tails (kurtosis higher than 3, kurtosis line, Figure 2). Their profiles do in fact show pronounced peaks more often than those of the News and IPI volatility indicators (kurtosis of 3 or less).

The six indicators are negatively correlated with the quarterly growth rate of GDP:1 the periods of high uncertainty correspond to the periods that see a drop in GDP. It should be noted that the

1. Six Uncertainty Indicators for France



Sources: Eurostat; OECD; News from Baker, Bloom et Davis, financial factors from K. French; authors' calculations.

Box 3 (cont.)

2. Descriptive statistics of the indicators for France

	Uncertainty indicator					
	Industrial Production Index volatility	Stock market volatility	Aggregate volatility	VIX	JLN (3 months' horizon)	News
First order auto-correlation coefficient (AR(1))	0.65	0.58	0.84	0.70	0.87	0.82
Skewness	0.43	1.12	1.22	1.53	1.13	0.65
Kurtosis	2.83	4.17	5.49	5.74	4.80	3.00
Correlation with quarterly GDP growth …						
…contemporaneous	– 0.17	– 0.39	– 0.51	– 0.49	– 0.29	– 0.25
…4 months forward	– 0.10	– 0.05	– 0.06	0.07	– 0.02	– 0.08
…4 months backward	0.24	0.00	0.10	– 0.09	0.03	– 0.21

Note for the reader : those statistics are computed on non filtered time series
Source: authors's calculations.

relationship is weaker (in absolute value terms) with News and with IPI volatility. Overall, the correlations disappear (or are substantially reduced) when the GDP growth rate delayed by 4 months (or advanced by 4 months) is considered.

The results presented above do not provide evidence of an unequivocal causal relationship between uncertainty and the economic outlook. It is in fact difficult to distinguish between "exogenous" uncertainty of geopolitical origin (elections, terrorist attacks, risk of international conflict, etc.) and "endogenous" uncertainty which can result from the functioning of the markets or economic policies.

1. GDP being measured annually or quarterly, it is not possible to use monthly correlation. The five indicators have therefore been calculated quarterly (by averaging their value over the months of each quarter) in order to deduce their correlation with the quarterly GDP growth rate.

For more information

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