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Uncertainty, Risk-Taking and the Business Cycle

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# Uncertainty, risk-taking and the business cycle

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## **Abstract**

This paper investigates the business cycle behaviour of measures of perceived uncertainty and financial risk premia in Germany over the past two decades. Both the perceived uncertainty and the financial risk premia are highly countercyclical and may therefore amplify and propagate the transmission of business cycle shocks. We find that exogenous uncertainty shocks have a significant small but temporary effect on output and financial risk premia and their overall contribution to output developments is limited. Positive financial risk aversion shocks, on the contrary, have a protracted but large negative impact on the economy and are more important in driving business cycles than uncertainty shocks.

# 1 Introduction

The question of what drives business cycle fluctuations has been the topic of a vibrant research agenda ever since Kydland and Prescott (1982) posited that the propagation of productivity shocks could explain most of the dynamics in business cycles. Most of the recent debate has focused on the relative role of productivity shocks in driving business cycles. For example, Galí (1999) argued that productivity shocks could not be a major source of business cycles because they lead to a negative correlation between GDP and hours worked, an implication that is at odds with the data. Other sources that have received attention are labour supply shocks, investment-specific technology shocks and more recently news shocks<sup>1</sup>.

The current Great Recession has, however, put some doubt on the relevance of these sources of business cycle dynamics for the current downturn. Recently, two other sources have received renewed attention. Bloom (2009) and Bloom et al. (2008) argue that on average measures of uncertainty go up by about 50% in a US recession. They show that a shock to uncertainty can have first-order negative effects on output and productivity in a model with partially irreversible investment and hiring decisions. In such a model a rise in uncertainty leads firms to postpone their investment and hiring decisions. Moreover, as this postponement reduces the reallocation of resources in response to relative productivity shocks, also aggregate productivity falls. Using various measures of uncertainty in an otherwise standard VAR for the US economy, Bloom et al. (2008) show that also in the data uncertainty shocks lead to a significant, but temporary fall in output and productivity. In accordance with the model, they also find that following the significant contraction output overshoots on the positive side. As uncertainty dissipates, there is some recovery of the old investment and hiring plans. Following the collapse of Lehman Brothers, many measures of uncertainty, for example implied stock market volatility as captured by the VIX, went up dramatically. Bloom

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<sup>1</sup>For example, Hall (1999) argued that labour supply shocks are the main source of business cycle fluctuations. In an estimated DSGE model which allows for a variety of shocks, Smets and Wouters (2007) find indeed that those shocks are more important for business cycles than productivity shocks. Fisher (2006) argued that investment-specific technology shocks could explain more than half of the variations in GDP at business cycle frequencies. This possibility was confirmed by Justiniano et al. (2008) and Schmitt-Grohe and Uribe (200.) using an estimated DSGE model. Beaudry and Portier (2004) proposed news shocks as an important alternative source of business cycle. The results in Schmitt-Grohe and Uribe (200.) suggest that expected investment-specific productivity shocks are the most important.

and Floetotto (2009) have argued that this may explain the sudden collapse of output, investment and trade in the last quarter of 2008, but also a resumption of growth in the second half of 2009 as uncertainty has been reduced.

An alternative story is, of course, that the troubles in the financial intermediation sector have led to a rise in external finance premia and possibly a credit crunch, which had a negative effect on investment and activity. As a result, the role of financial factors in driving business cycle fluctuations has again received renewed attention. Using a sample that ends before the current financial crisis, Smets and Wouters (2007) estimate the contribution of variations in an external finance wedge to business cycles and find that they explain only about 20 percent of short-run fluctuations in US economic activity. More recently, Justiniano et al. (2008) use an extended sample to estimate the relative importance of investment-specific versus financial intermediation shocks. They conclude that shocks that create a wedge between the production of investment goods and their transformation into capital are the most important source of fluctuations and explain about 50% of output at business cycle frequencies. Those wedges are more related to financial intermediation shocks than to investment-specific technology shocks, as illustrated by the high correlation of those shocks with corporate bond spreads. In addition, they show that such shocks explain most of the current recession. Gilchrist et al. (2009) explicitly extend the Smets and Wouters model with a financial accelerator a la Bernanke et al. (1999) and use the measure of bond spreads proposed in Gilchrist et al. (2009) to capture the external finance premium. Also they find that credit supply shocks are important drivers of business cycles and explain a big part of the current recession. Finally, Christiano et al. (2008) find that financial factors are important in both the euro area and the United States. The precise nature of the financial shocks is still unclear and may, of course, differ depending on the structure of the financial system. However, Rajan (2005) and Borio and Zhu (2008) have argued that variations in risk taking may be important in driving variations in risk premia. When times are good and interest rates low, the appetite to take on risk may be high due to a number of behavioural and regulatory incentives. Similarly, when there is a negative shock to the economy, the appetite to take on risk may fall.

In this paper, we take a look at the German economy over the past two decades to explore the relative role of uncertainty versus risk aversion (or risk appetite) shocks. Clearly looking at various risk premia may not be able to distinguish between both

sources of variation as risk premia capture both variations in fundamental uncertainty and changes in the price of risk or risk aversion. As argued in Popescu (2009) one can generally decompose variations in risk premia in a part that is due to variation in the attitude towards risk as captured by a risk aversion parameter and a part that is due to variation in the perceived uncertainty of the returns to the asset. In standard asset pricing models, there will typically also be a covariance term. However, for our purposes we will assume this does not vary over the business cycle.

In order to capture the perceived uncertainty of the performance of the German economy, we use an average measure of disagreement in expectations about various macro economic variables, derived by Doern et al. (2009) on the basis of the survey forecasts collected by Consensus Economics. As we will show below, this measure is clearly countercyclical, i.e. the degree of perceived uncertainty typically rises in recessions. In order to capture the risk premia, we will use a variety of financial spreads. The most important categories are spreads between corporate and government bond yields and measures of implied volatility, in particular in the stock market. Clearly, the bond spreads also reflect other factors such as credit risk in the corporate sector. However, we will assume that changes in the aggregate economy will capture most of the changes in credit risk, so that what is left captures mostly changes in risk aversion. Bekaert et al. (2009) use a dynamic asset pricing model to decompose implied stock market volatility and credit spreads in the United States and Germany in factors due to risk aversion and due to uncertainty. They find that changes in risk aversion explain most of the variability in implied volatility, whereas both uncertainty and risk aversion determine credit spreads. In this paper, we will not do a formal decomposition using an asset pricing model. Instead, we use a simple VAR to better understand the effects of innovations in uncertainty and financial spreads on the economy.

It is important to be able to distinguish between the two shocks because they are likely to have different effects on the economy. As argued by Bloom et al. (2008), uncertainty shocks have a large, but temporary impact on the economy and typically lead to substantial overshooting. On the other hand, shocks that originate from the financial system are likely to have more protracted effects on the economy, as various historical episodes (such as the bursting of the Japan bubble for example) have shown.

The rest of this paper is structured as follows. In the next section, we present our measures of perceived uncertainty and risk premia and analyse the unconditional

cyclicality of both, as well as how they are correlated with each other. We find that both measures are highly countercyclical and positively correlated. Section 3 then investigates how both measures respond to innovations in economic activity in the context of a vector autoregression and compares the impulse responses of an uncertainty shock with a risk aversion shock. Our benchmark specification is based on a monthly VAR. We perform robustness analysis using various measure of uncertainty and risk premia and a quarterly specification, which by and large confirm the baseline results. Finally, Section 4 provides the conclusions.

## **2 Perceived uncertainty and financial risk-taking in Germany**

In this section, we present measures of perceived uncertainty and financial risk aversion for Germany and we analyse their comovement and cyclical behaviour. Given that both agents' uncertainty and risk attitudes are fundamentally unobservable, we rely on a number of proxies which we consider best suited to capture these concepts, given data availability. Our approach is to capture uncertainty shocks using information on forecaster disagreement about a broad range of macroeconomic variables. These forecasts reflect the dispersion of beliefs about the economic outlook among professional forecasters and, absent more representative measures, we assume that they proxy also for the perceived uncertainty of all economic agents.

In order to measure financial market risk-taking we rely on the fact that certain asset prices, in particular spreads and implied volatilities, are good proxies for the time variation in risk-aversion. However, as any of these measures are composites of remunerations for various asset-specific sources of risk, our strategy is to consider instruments of different types and from various markets, in order to be able to better capture the fundamental variation in risk attitudes and to eliminate the idiosyncratic components. In the following section we discuss in detail how the uncertainty and risk premium proxies are constructed, while the precise data sources can be found in Appendix.

## 2.1 Forecaster uncertainty

We use a measure of dispersion of individual expert forecasts for Germany from Consensus Economics based on Dovern et al. (2009)<sup>2</sup>. This paper analyzes forecaster disagreement proxies measured in two ways, on the basis of either the standard deviation or the interquartile range of individual forecasts, where an adjustment has been applied in order to transform the fixed event forecasts into fixed horizon forecasts<sup>3</sup>.

The Consensus projections are the most important professional survey available for G7 countries, in terms of both time-length and cross-sectional dimension (number of respondents). While the survey covers a range of key economic indicators, we focus on the most important variables, which are also those with the longest coverage: 5 real variables (GDP, consumption, investment, industrial production, unemployment) and 2 nominal variables (interest rate and inflation). These forecasts reflect the views of experts (from public and private economic institutions, mostly investment banks and economic research institutes, but excluding central banks and governments). The survey started in October 1989 and is available at monthly frequency. The polling takes place via electronic forms which forecasters submit in the first two weeks of each month, which are then published at the end of the second week of the month. Due to the way the survey is conducted, one can conjecture that the information set on which the forecasters base their predictions incorporates the data releases of the previous month, while they contain relatively little information on the macroeconomic indicators of the current period (the implications of the timing of the survey are further discussed in the context of the identification strategy).

In Table 2 we report the increase in forecaster uncertainty during recessions, as defined by the Economic Cycle Research Institute for Germany. It is apparent that, while uncertainty about unemployment approximately doubles during recessions, it ranges between 20 to 40 percent for the other macroeconomic variables, while being considerably lower for inflation<sup>4</sup>.

We aggregate these measures of uncertainty and derive several proxies for perceived

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<sup>2</sup>We would like to thank Jiri Slacacek for providing this data.

<sup>3</sup>This is due to the fact that the forecasting horizon of fixed event forecasts varies from month to month and consequently their volatility and cross-sectional dispersion is strongly seasonal.

<sup>4</sup>These exceptions may to be linked with specific features of the German economy, in particular persistent structural unemployment and the exceptionally high credibility of the Bundesbank.

uncertainty (see Figure 1). For robustness purposes, we have experimented with both simple averages and principal components, extracted from the dispersion across all variables and only across the real ones, using as dispersion measures both the standard deviations and interquartile ranges. All the uncertainty proxies we have computed are highly correlated and display similar cyclical properties. In particular, the uncertainty indices are strongly countercyclical, increasing by approximately 30% during recessions. They also correlate negatively with quarterly real output growth, with correlation coefficients in the range of close to 40-50 percent.

Overall, all the measures we employ consistently show that the distribution of agents' perceptions of the macroeconomic fundamentals shifts during recessions, in that both the mean outcome worsens and also the dispersion widens (there is higher disagreement, i.e. more agents believe in a higher likelihood of more extreme outcomes).

## 2.2 Financial market risk-taking

Financial market changes in risk-appetite can be measured by changes in the level and the dispersion of the market price of risk<sup>5</sup>. In order to capture these dimensions, we consider several measures of spreads and volatilities which are commonly used as risk-aversion proxies. Our exercise is constrained by the availability of German data, which leads us to focus on 2 measures of spreads (corporate to government bond spread and mortgage to government bond spread) and 5 measures of implied volatilities from the money market (Euribor futures), government bonds market (Schatz, Bobl and Bund futures ) and the stock market (VDAX).

Table 3 shows that financial risk premia and financial market volatility are also highly countercyclical. The VDAX volatility goes up by 24 percent during recessions, while the implied money market volatility increase is close to 60 percent. The implied volatility of government bond futures ranges between 14 and 42 percent across the various maturities. Corporate and mortgage bond spreads more than double during recessions.

Using various aggregating techniques, we derive a number of financial risk premium indices (RPIs), which are plotted together with the underlying series in Figures 3 and 2. We have experimented with simple averages (after standardization), as well as principal

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<sup>5</sup>See also Popescu (2009) for a discussion on the effects of monetary policy on financial market risk-taking.

components. As some of these series are available only for a shorter time-span, we have computed indicators based on both the longer and the shorter sample. The financial market risk premia indices, like the measures of perceived uncertainty, rise significantly during recessions. They are also countercyclical, as suggested by negative correlations with output growth in the range of minus 20-30 percent.

Uncertainty and financial market risk-premia are also positively correlated (with correlation coefficients between 32-50 percent), suggesting that the two measures are closely linked. This is hardly surprising, given that financial markets incorporate all available information and thus should react to increased uncertainty about macroeconomic outcomes. However, both uncertainty and financial market risk aversion are endogenous to the business cycle, so in order to investigate in more depth the interlinkages between them, we proceed in the following section to a VAR analysis.

### **3 Estimating the impact of perceived uncertainty and financial risk aversion shocks**

The purpose of this section is to estimate a range of VARs which would enable us to disentangle between the effects of (first-order) fundamental macro shocks and those of uncertainty and financial risk aversion shocks. Such an exercise is clearly fraught with difficulties in the absence of a clear theoretical framework that would provide sufficient identifying restrictions and also given the approximate nature of our computed indicators. However, even this simple approach is already capable of yielding some interesting conclusions.

#### **3.1 The benchmark VAR model**

Our baseline VAR comprises of the following variables: industrial production, unemployment rate, CPI and the interest rate (to which we refer as the macro block), the uncertainty index and the financial market risk premia index (both computed as the principal components extracted from all the available series, in order to capture the largest available information set<sup>6</sup>). The specification is estimated in the order men-

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<sup>6</sup>However, all the experiments discussed below have been replicated for the other uncertainty and financial risk proxies with consistently robust conclusions (results available upon request).

tioned before, at monthly frequency, with 6 lags (given by the standard information criteria), on the sample 1992:1-2008:12.

This recursive identification structure is justified on the following grounds. The macro block is placed first in the VAR, on the assumption that it is slow-moving, compared to agents' expectations and financial market variables. The order within the macro block is standard, with quantities coming first, prices next and the policy rate at the end. Perceived uncertainty is ordered second, which is based on the assumption that when forming expectations agents incorporate (contemporaneously) the macroeconomic information in their decisions. The plausibility of this assumption, however, hinges on the availability of the macroeconomic data (which may not often be the case, in particular at monthly frequency) and on the timeliness of the survey measures, which we discuss in more detail in the robustness checks we have conducted. The financial market risk index is placed last in the VAR, on the grounds that it incorporates both the macro news and agents' shift in perceptions regarding the overall uncertainty.

This ordering insures that when we look at the impact of uncertainty shocks, the effect of (first-order) fundamental macroeconomic shocks is controlled for. and financial risk aversion shocks

### **3.1.1 Response to output shocks**

We first evaluate the effects of a standard "first-moment" shock to economic activity. Figure 4 plots the impulse response functions to a shock to industrial production (with 2-standard error bands). The shock has a persistence of over 2 years and causes unemployment to fall significantly also for approximately 2 and a half years. Given our very basic VAR, it is difficult to identify this shocks very precisely, however, one may interpret it as a generic expansionary macroeconomic shock (as prices seem to rise, it has some features of a demand shock).

Interesting to notice is that an expansionary business cycle shock has as an immediate impact a significant reduction in both the perceptions of uncertainty and financial market risk-aversion. Thus, positive macroeconomic news (first-order shocks) seem to have second-order effects, by reducing perceptions of volatility and the market-price of risk. Both effects are significant for approximately one year, after which, in the medium-term, both seem to overshoot. As the boom peters out, uncertainty as captured by forecaster disagreement is at its maximum and also financial risk premia are

rising.

For robustness, we also estimated a similar VAR at the quarterly frequency, comprising of the same variables except for the replacement of industrial production by GDP<sup>7</sup>. The results of a shock to output, plotted in Figure 5, present a very consistent picture with the monthly VAR, although it appears more difficult to obtain significant results for the financial market risk premia (which may be due to the relatively short sample).

Moreover, these results are broadly confirmed by an alternative ordering in which it is assumed that uncertainty shocks affect the macroeconomy contemporaneously, but react with a lag to business cycle shocks (this concern can be justified by the unavailability of timely data, in particular at the monthly frequency). This can be seen from Figures 10 and 11, where the uncertainty shock has been ordered prior to the macro block, however, this has little bearing on the conclusions.

Overall, these results confirms the implication that real activity shocks have significant and non-monotonic effects on both perceived uncertainty and risk-aversion. As the economy expands in the first part of the cycle, both uncertainty and risk-aversion decline, as investment increases, unemployment falls and asset markets are going up. However, when the cycle approaches a turning point, both uncertainty and financial market risk aversion are high, as agents try to gauge when the recessionary phase will begin. In this period, when the agents anticipate a contraction but are unsure about the exact timing or intensity of the downturn, disagreement about the course of the economy is at its highest and asset markets start to exhibit signs of increased risk-aversion, by becoming more volatile and by demanding a higher premium for risky assets.

### **3.1.2 The impact of perceived uncertainty and risk aversion shocks**

We move on now to study the effects of a shock to perceived uncertainty is shown in Figure 6 for the monthly specification and Figure 7 for the quarterly VAR. For the monthly estimation, the uncertainty index is lead by 1 period, reflecting the feature of the survey that it incorporates mainly information and shocks from the previous month, as mentioned previously in the discussion of the methodology for collecting of this data. In an additional exercise in which the uncertainty index is used contemporaneously, we

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<sup>7</sup>For the monthly variables, we experiment with using the average or end of period value with no significant variations.

find that the effect on financial risk premia is much smaller, which may indicate the fact that such a specification would be capturing belated effects of the uncertainty shock, which the asset markets have already reacted to incorporated.

The increase in uncertainty is significant for approximately half a year, thus such shocks are not very persistent. Industrial production falls by approximately 0.20 percent in the first 6 months and may overshoot in the long-run, although this is not clearly significant. Unemployment increases more gradually, peaking after one year and a half and reverting to trend after approximately 3 years.

When we estimating the model at the quarterly frequency replacing industrial production with GDP, we find similar results. The contractionary effect of uncertainty shocks on output is confirmed to be significant only on impact, for about one quarter. The rise in unemployment is more significant and protracted.

In both specifications, the rise in uncertainty has a significant effect on prices, which rise persistently. This is difficult to interpret in a reduced form VAR as this one but we conjecture that it is possibly related to the reaction of monetary policy. Following an uncertainty shock, monetary policy is lax for an extended period of time (1-2 years), although the drop in output has been very brief. This may increase the upward pressure on inflation.

As expected if one believes that asset markets efficiently incorporate all available information, an increase in uncertainty also has an immediate effect on risk premia. Financial market risk aversion increases significantly for approximately the duration of the increase in uncertainty.

Overall, these results appear to be robust to alternative orderings. In particular, one may assume that information on the economic indicators is available with a lag (or people take time to process these news), while on the other hand a fundamental uncertainty shock may affect the economy contemporaneously. This may justify an ordering as presented in Figures 1 and 13, which report the results of an uncertainty shock when the uncertainty variable is ordered first.

We next turn to the risk aversion shock. Figures 8 and 9 plot the impulse response to such a shock in the monthly and quarterly VAR specification respectively. A few observations are worth noting. First, the persistence of the risk aversion shock is much larger. The risk premium remains significantly different from zero for about one to two years. It also has much more persistent and larger effects on economic activity.

Industrial production reaches a trough after two years at a close to -0.5 percent drop and it takes between 3 to 4 years for it to recover. In contrast to the uncertainty shock, the risk aversion shock does lead to a gradual drop in prices and a significant drop in the short-term interest rate. Similar results can be found in the quarterly VAR specification. Second, the rise in risk aversion does initially lead to a rise in perceived uncertainty, but the effect is relatively small and not very significant.

To examine the relative importance of uncertainty and risk aversion shocks for business cycle developments it is instructive to look at the forecast error decomposition. (see Tables 4 and 5). Focusing on the business cycle frequency (forecast horizons of 3 to 4 years) a few remarks can be made. First, the shocks to output that explain about 50 percent of the 3 to 4 year-ahead forecast errors in industrial production also explain a substantial fraction of the forecast errors in the uncertainty (about 40%) and risk premia (about 30 %) indices. As already indicated by the unconditional countercyclicality of both measures, uncertainty and risk premia are therefore highly endogenous to the business cycle and may contribute to the propagation and amplitude of business cycles. Second, the uncertainty shocks explain only a small fraction of the forecast errors in industrial production and financial risk premia at business cycle frequencies. In contrast, the financial risk aversion shock explains a significant fraction of industrial production (between 10 and 15 percent) and of the uncertainty index (4 to 8 percent). We therefore conclude that exogenous changes in financial risk aversion contribute more to business cycle movements than changes in perceived uncertainty. These results are broadly confirmed by the quarterly VAR analysis reported in Table 5.

These conclusion is also confirmed in the most recent episode, as illustrated by the contribution of the various shocks to the current recession (see Figure 14). The historical decomposition shows that both risk aversion and uncertainty shocks have contributed to the current recession. However, the financial shocks have had more significant negative contributions on activity since the onset of the crisis and particularly so during the episodes of extreme turbulence associated with the failure of Bear Stearns and Lehman Brothers. The increase in uncertainty seems to have had the largest impact on activity only in the last part of 2008, when the financial crisis lead to increasing concerns regarding the risk of a new Great Depression. In particular, in December 2008, the rise in uncertainty accounted for about 1 percent and the risk aversion shock approximately 3 percent of the fall in industrial production (compared to the baseline).

## 4 Conclusions

In this paper we have investigated the business cycle behaviour of measures of perceived uncertainty and financial risk premia in Germany over the past two decades. Some tentative conclusions are as follows. First, both the perceived uncertainty and the financial risk premia are highly countercyclical. They fall in good times and rise in recessions and may therefore amplify and propagate the transmission of business cycle shocks. Second, in response to positive output/demand shocks, both uncertainty and risk premia initially fall, but eventually increase as the output boom peters out. Third, exogenous positive uncertainty shocks have a small and temporary negative effect on output and a positive effect on financial risk premia. Their overall contribution to output developments is, however, limited. Fourth, positive financial risk aversion shocks on the contrary have a persistent and large negative impact on the economy and are more important in driving business cycles than uncertainty shocks. Overall, we can conclude that both measures are largely endogenous to the business cycle and contribute to amplifying fluctuation, but risk premia shocks also do have significant (contractionary) effects on their own.

The explorative analysis in this paper is only a first step. On the data side, it would be interesting to check the robustness of the results to the inclusion of additional measures of uncertainty and financial risk premia. One way of doing so would be to extend the analysis to the euro area. On the methodological side, the VAR methodology is useful to derive a number of stylised facts. However, without a clear structural framework, it does not allow to clearly identify the various structural shocks that may drive output, risk premia and uncertainty. Providing such a framework is an important area of future research, but lies beyond the scope of this paper.

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## 5 Data Appendix

The macro series (GDP, industrial production, unemployment rate, CPI and the short-term (3 month) interest rate) are from the OECD databases.

In the following, we discuss in detail the construction of the uncertainty and risk-proxies which are employed in the paper.

### 5.1 Measures of perceived uncertainty

We construct 8 uncertainty indices (UI) based on measures of dispersion of professional macroeconomic forecasts in the Consensus Economics survey (from Doornik et al. (2009)). These are computed as simple averages or as principal components (PC), aggregating over the real variables (consumption, GDP, investment, industrial production and unemployment) or over all the variables (additionally interest rate and inflation) and using as a base measure of dispersion the interquartile range (IQR) or the standard deviation (STD). All the measures are highly correlated (with a correlation coefficient of above 0.85) and the reported results are quite robust to the precise measure employed.

### 5.2 Measures of financial risk-taking

The financial data comes from two sources: Global Financial Data and Datastream (see Table 1 for complete references).

The corporate bond spread is defined as the difference in yield between the Corporate Bond Yield (which is an index of long-term investment-grade corporate bonds rated BBB or higher) and the 10-year government Bund.

The mortgage spread is calculated as the difference between the yield on an index of Mortgage Bonds (which is a composite of long-term bank mortgage-backed bank bonds) and the 10-year government Bund.

The data are aggregated into several risk-premium indices (RPI), after standardization (see 2 and 3). In particular, we have computed indices based on simple averages and principal components. As the corporate bond spread, the mortgage spread and the VDAX are available since 1992:2, we have a first range of indicators constructed on only these 3 measures. Additionally, we compute RPIs based on all the series (a total of 8), which includes the implied volatilities of the money market and government

bond market futures, available starting in 2000:1. We have also computed separately RPIs based only on measures of implied volatility (where we have abstracted from the two spreads), on the basis of the potentially different time-series properties of the two types of data.

While the RPIs are based on more heterogenous data than the uncertainty indices, they are nonetheless highly correlated (with a coefficient of correlation of over 0.79) and seem to describe a very similar pattern of responses over the studied VARs.

Table 1: Data sources for the financial series

<b>Name</b>	<b>Source</b>	<b>Symbol</b>
Corporate Bond Yield	GFD	INDEUD
Bank Mortgage Bond Yield	GFD	INDEUMD
VDAX Implied Volatility Index	Datastream	VDAXNEW(PI)
3M Euribor Future Continuous Call - Implied Vol.	Datastream	LEIC.SERIESC
EURO-BOBL Future Continuous Call - Implied Vol.	Datastream	GBEC.SERIESC
EURO-BUND Future Continuous Call - Implied Vol.	Datastream	GGEC.SERIESC
EURO-SCHATZ Future Continuous Call - Implied Vol.	Datastream	GEBC.SERIESC
USD/EUR Future Continuous Call - Implied Vol.	Datastream	DEXC.SERIESC
2-year Government Note Yield (Schatz)	GFD	IGDEU2D
5-year Government Note Yield (Bobl)	GFD	IGDEU5D
10-year Benchmark Bond Yield (Bund)	GFD	IGDEU10D

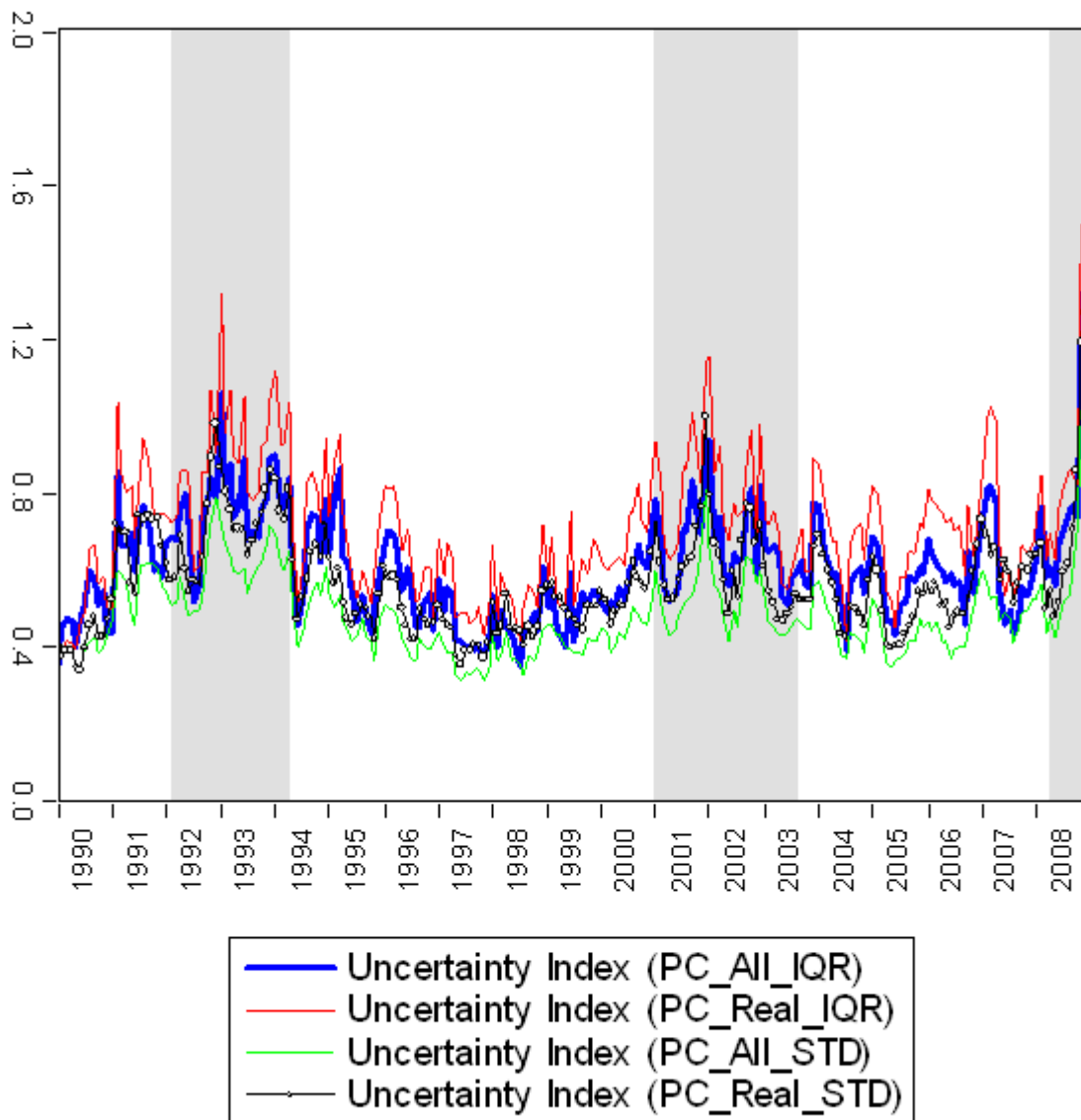


Figure 1: Perceived Uncertainty Index, based on principal components extracted from the dispersion of Consensus Economics individual forecasts (measured as IQR, STD) over real and nominal macroeconomic indicators

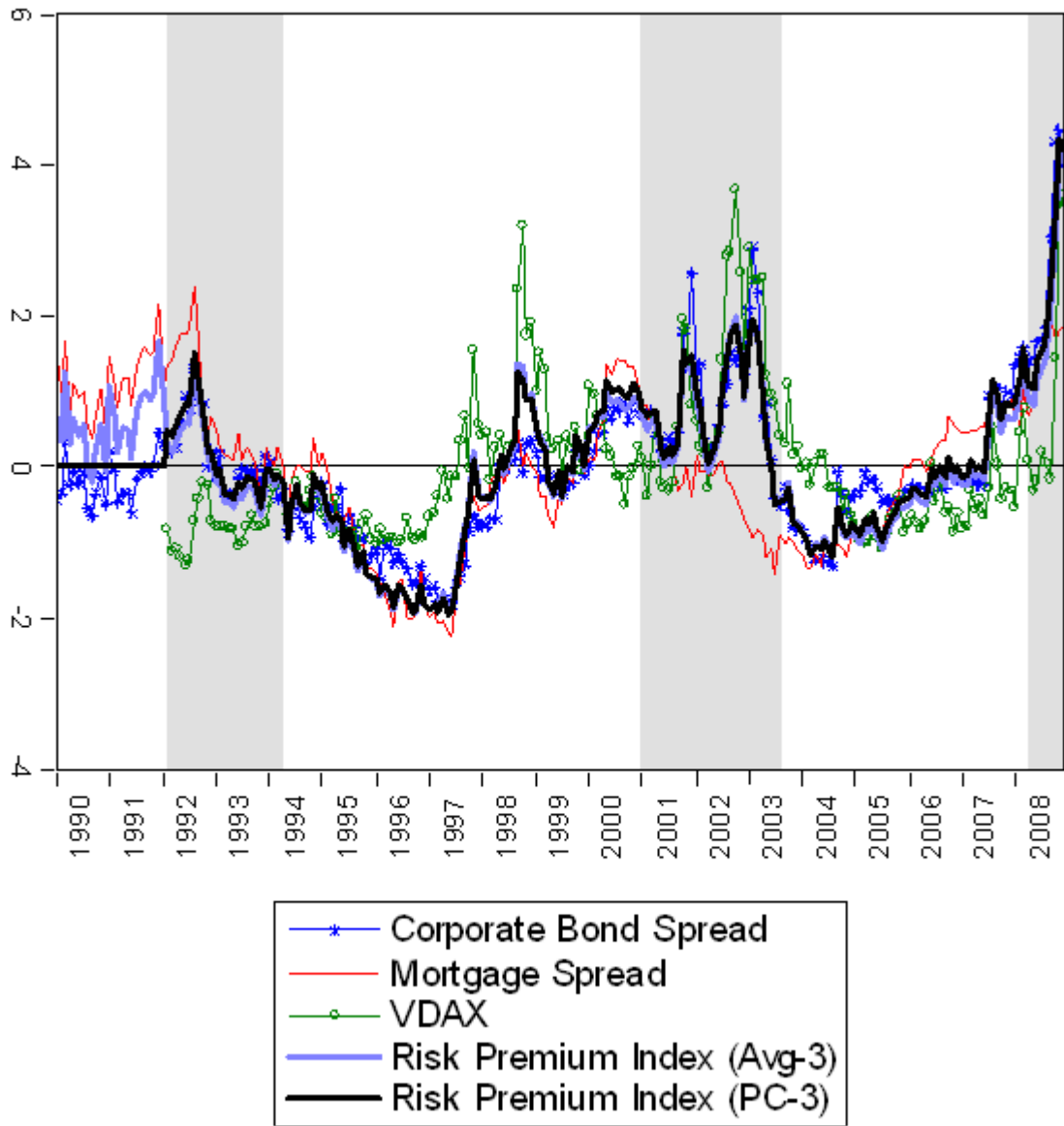


Figure 2: Financial market risk aversion proxies and the Risk Premia Indices based on them

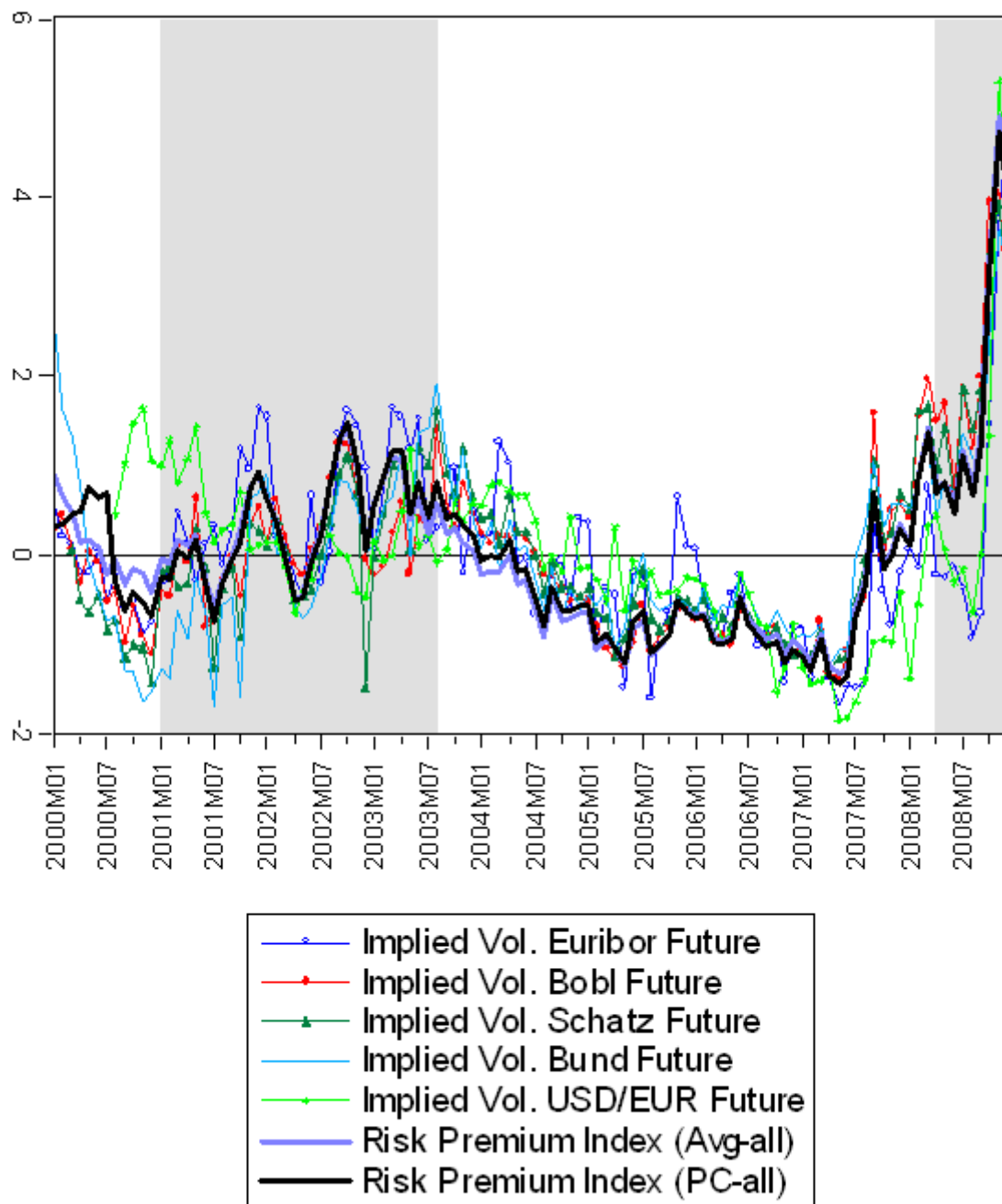


Figure 3: Financial market risk aversion proxies and the Risk Premia Indices based on them (cont'd)

Table 2: Increase in Perceived Uncertainty during Recessions

<i>Indicator</i>	<i>IQR</i>	<i>STD</i>
Consumption	19.27%	25.15%
GDP	36.51%	37.75%
Investment	21.69%	20.38%
Industrial Production	26.97%	32.80%
Unemployment	101.85%	95.06%
Interest rate	34.72%	31.71%
Inflation	10.95%	16.47%
UI <sup>1</sup> (Avg-real <sup>2</sup> )	31.35%	32.28%
UI (Avg-all <sup>3</sup> )	29.85%	31.27%
UI (PC <sup>4</sup> -real)	32.09%	34.15%
UI (PC-all)	29.37%	32.49%

<sup>1</sup> Uncertainty Index  
<sup>2</sup> Real (5) variables  
<sup>3</sup> All (7) variables  
<sup>4</sup> Principal Components  
Sample: 1990:1-2008:12

Table 3: Increase in Financial Market Risk Premia during Recessions

<i>Indicator</i>	<i>Increase</i>	<i>Sample</i>
Implied Volatility DAX (VDAX)	24.03%	1992:2 - 2008:12
Implied Volatility Euribor (3m)	59.64%	2000:1 - 2008:12
Implied Volatility Schatz	42.78%	2000:1 - 2008:12
Implied Volatility Bobl	32.08%	2000:3 - 2008:12
Implied Volatility Bund	14.78	2000:1 - 2008:12
Corporate Spread	282.43%	1990:1 - 2008:12
Mortgage Spread	182.47%	1990:1 - 2008:12
RPI <sup>1</sup> (Avg <sup>2</sup> -3 <sup>3</sup> )	49.94%	1992:2 - 2008:12
RPI(PC <sup>4</sup> -3)	54.20%	1992:2 - 2008:12
RPI(Avg-All <sup>5</sup> )	39.15%	2000:1 - 2008:12
RPI(PC-All)	30.09%	2000:3 - 2008:12

<sup>1</sup>Risk Premium Index  
<sup>2</sup>Average (after standardization)  
<sup>3</sup> Based on the Corp. Spread, Mort. Spread and VDAX  
<sup>4</sup> Principal Components  
<sup>5</sup> Based on all 7 series

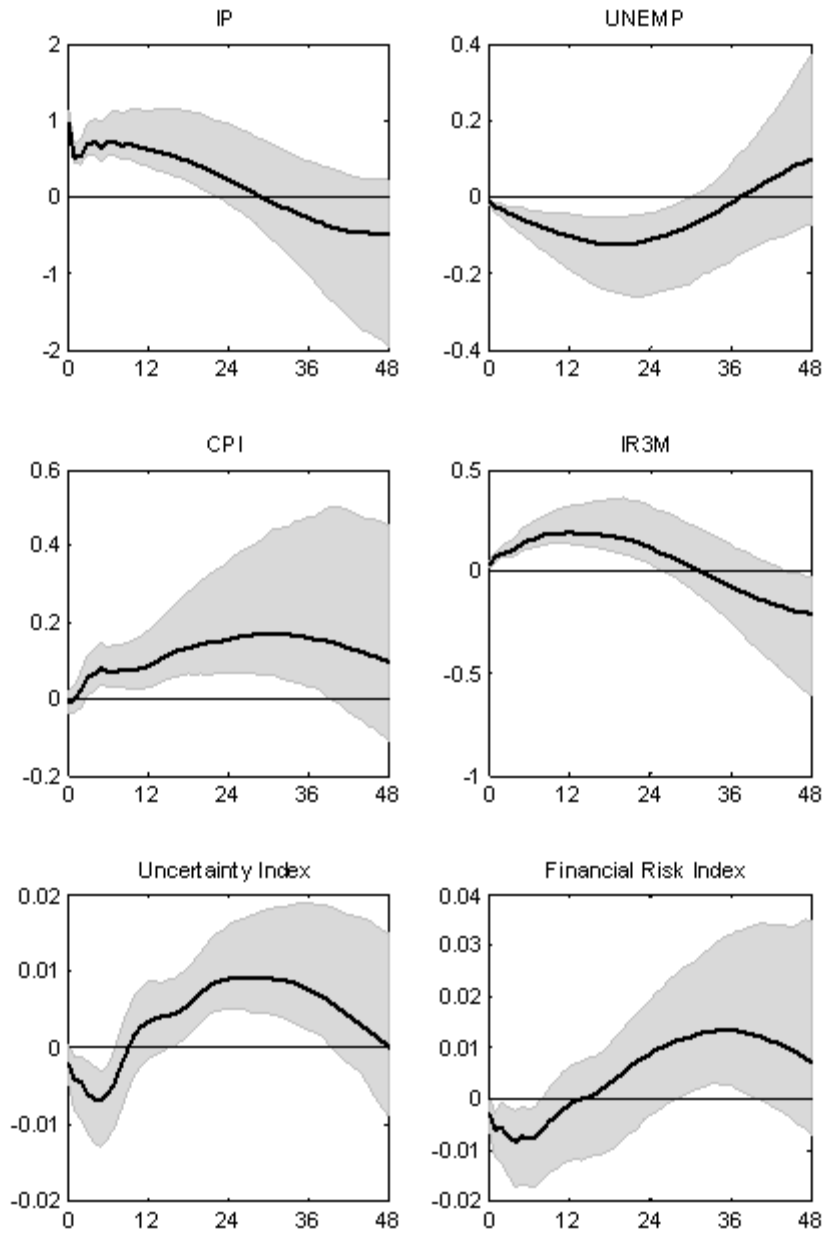


Figure 4: Effects of an industrial production shock in the baseline specification (monthly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

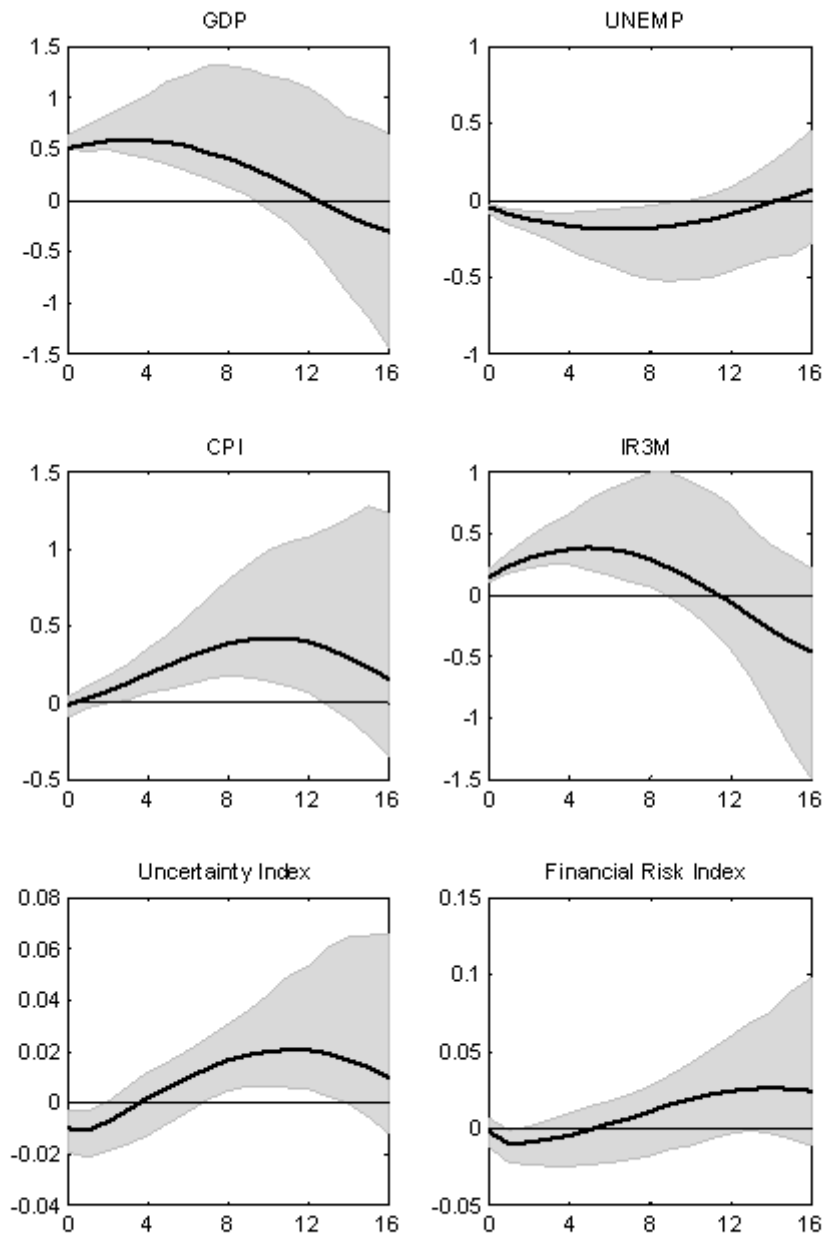


Figure 5: Effects of a perceived uncertainty shock in the baseline specification (quarterly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

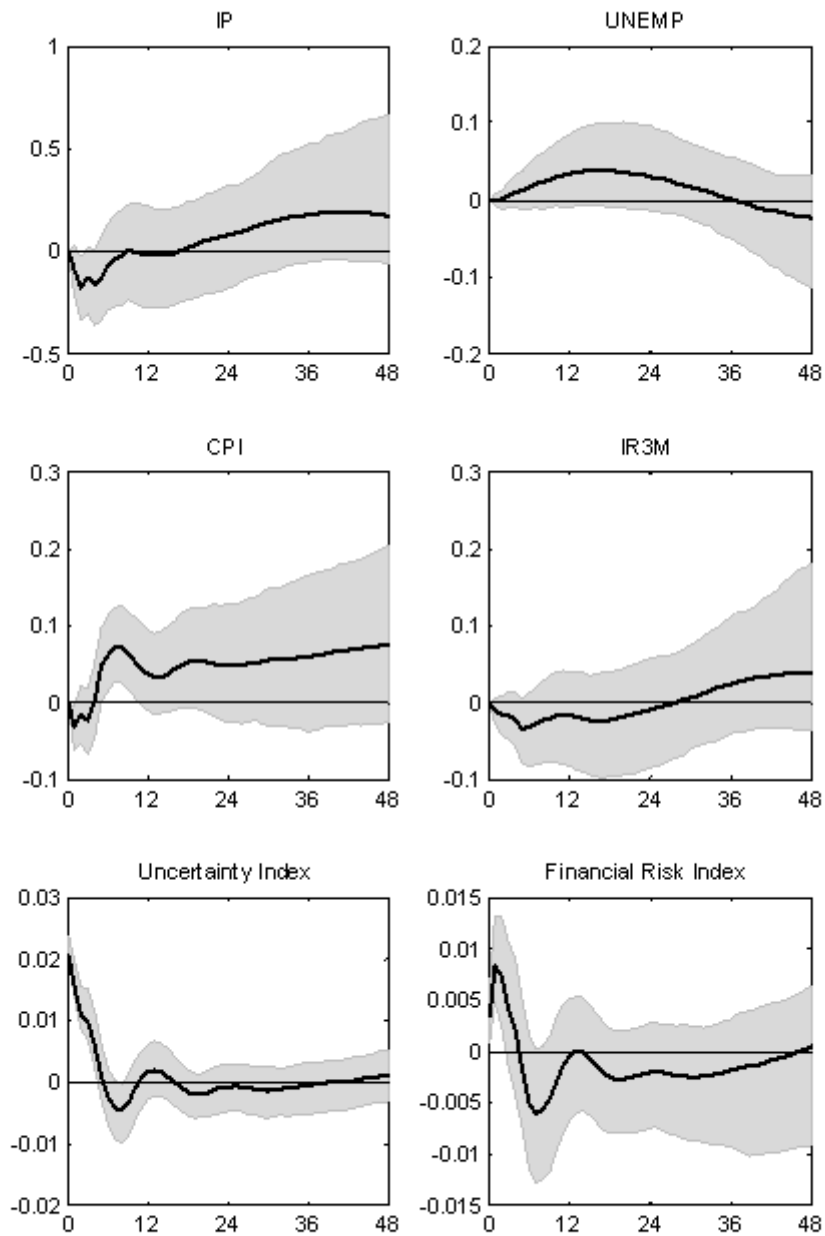


Figure 6: Effects of a perceived uncertainty shock in the baseline specification (monthly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

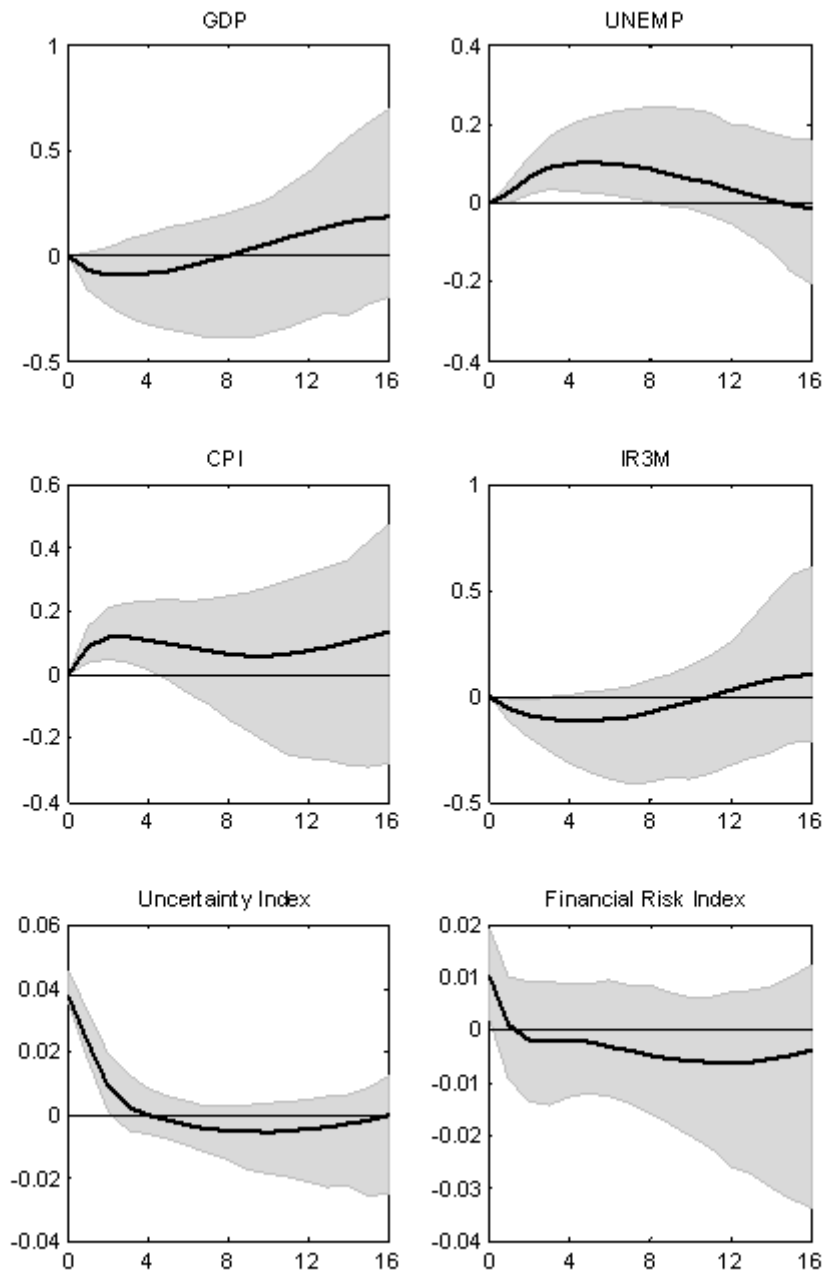


Figure 7: Effects of a perceived uncertainty shock in the baseline specification (quarterly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

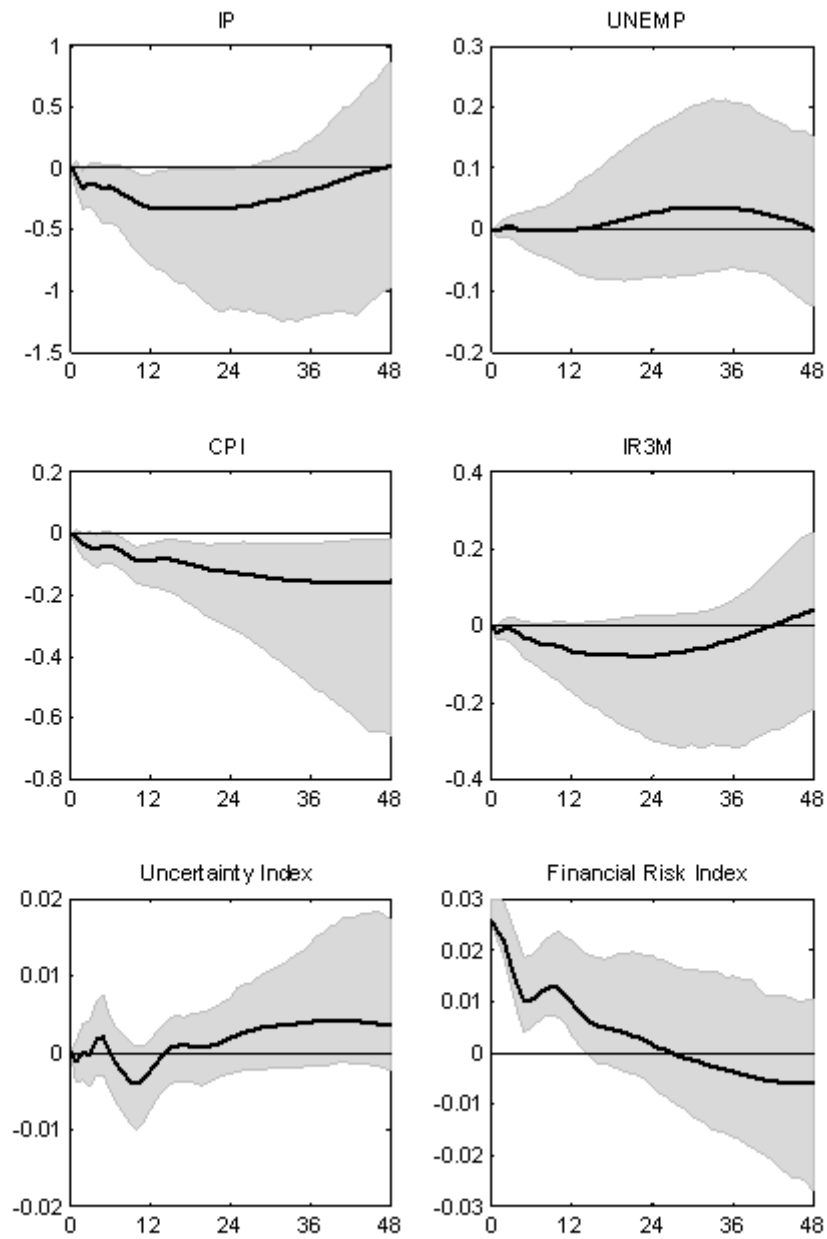


Figure 8: Effects of a financial risk aversion shock in the baseline specification (monthly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

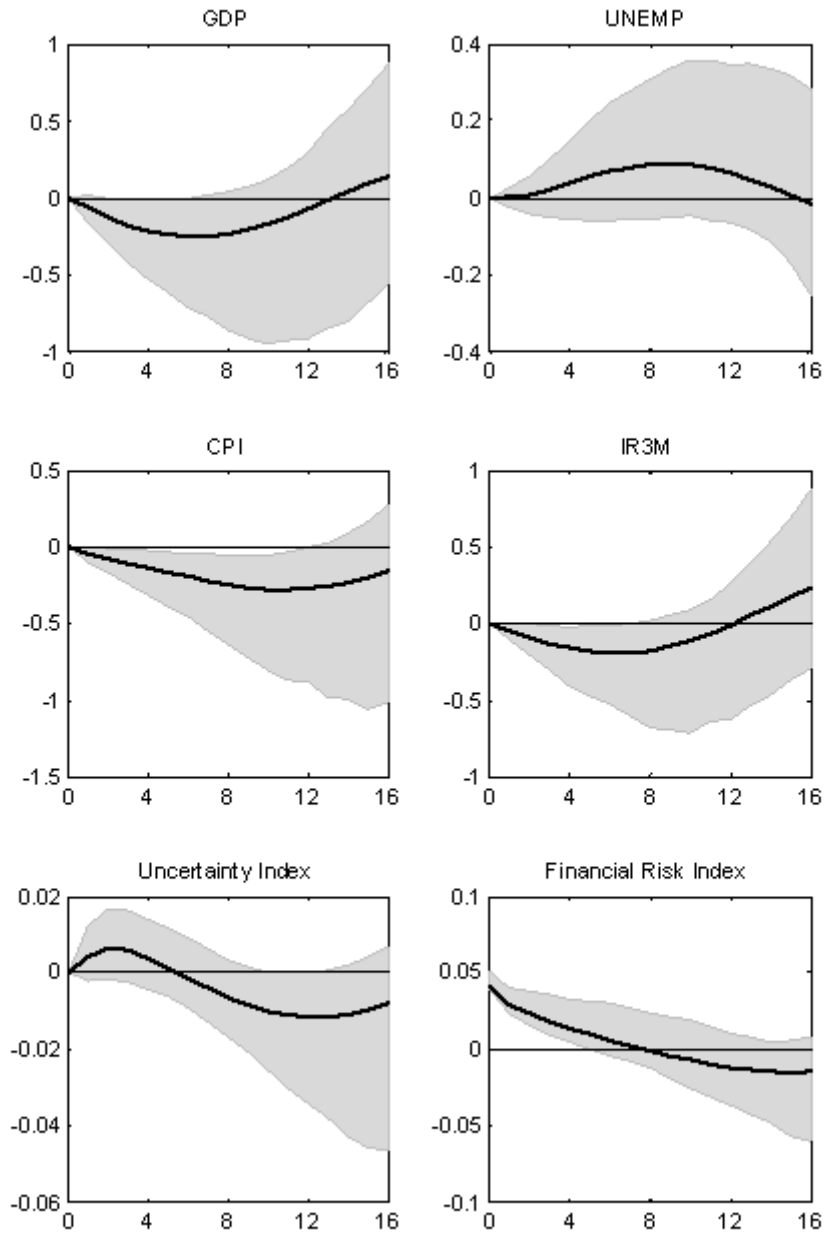


Figure 9: Effects of a financial risk aversion shock in the baseline specification (quarterly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

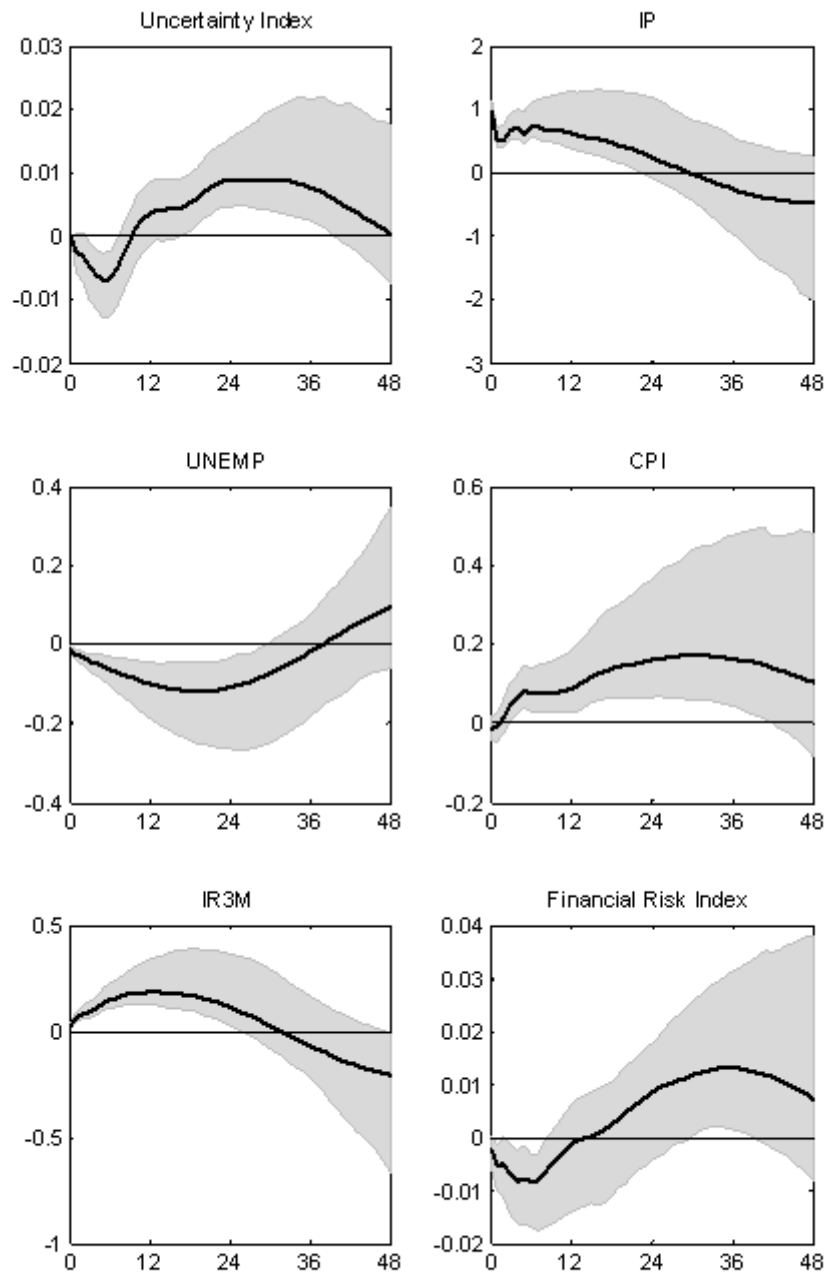


Figure 10: Robustness to ordering. Effects of an industrial production shock when uncertainty is ordered first (monthly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

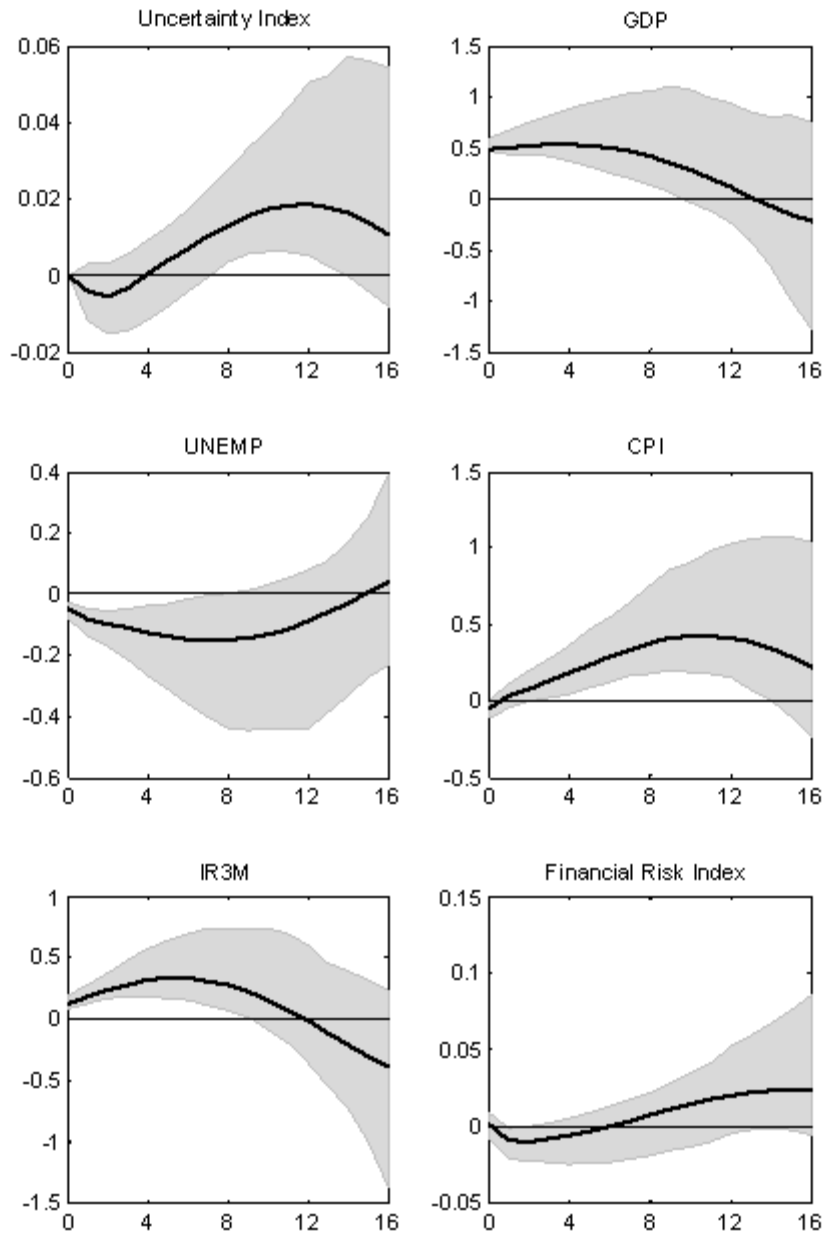


Figure 11: Robustness to ordering. Effects of an industrial production shock when uncertainty is ordered first (quarterly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

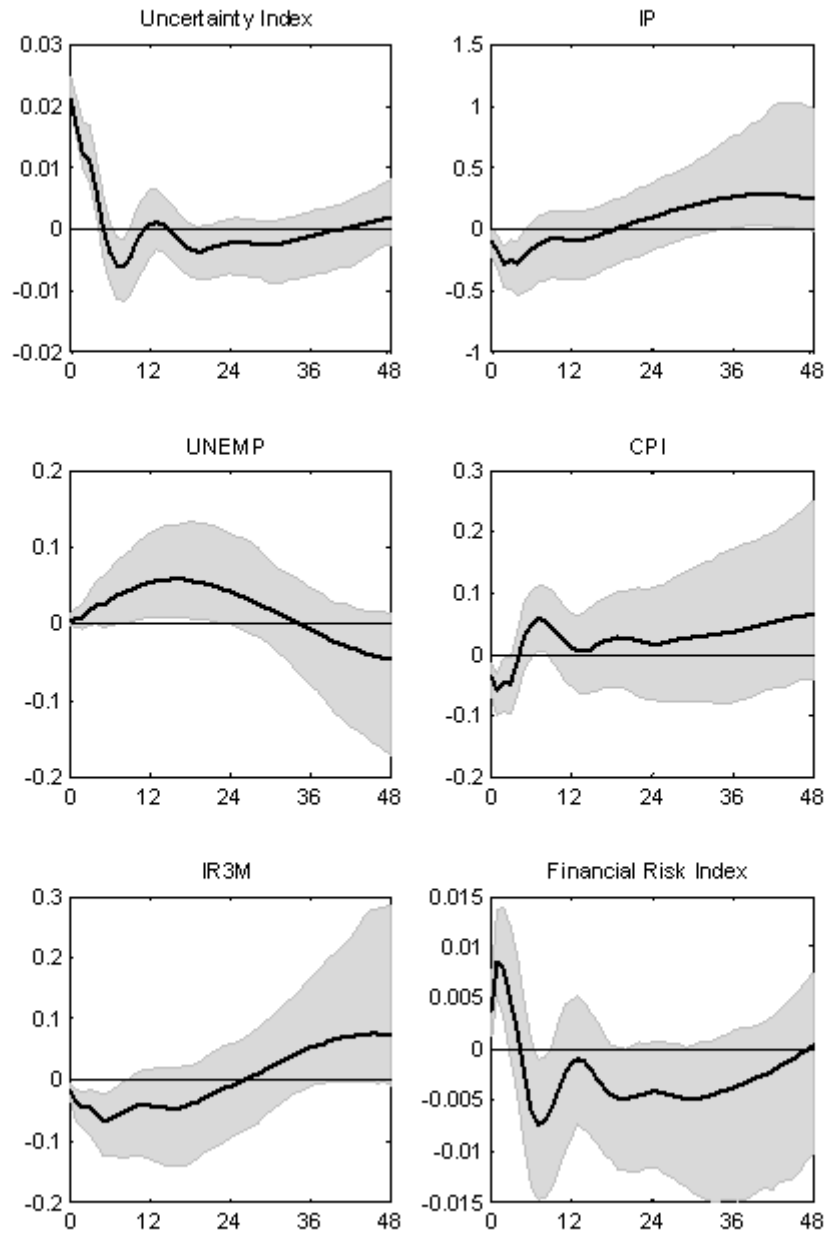


Figure 12: Robustness to ordering. Effects of a perceived uncertainty shock when uncertainty is ordered first (monthly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

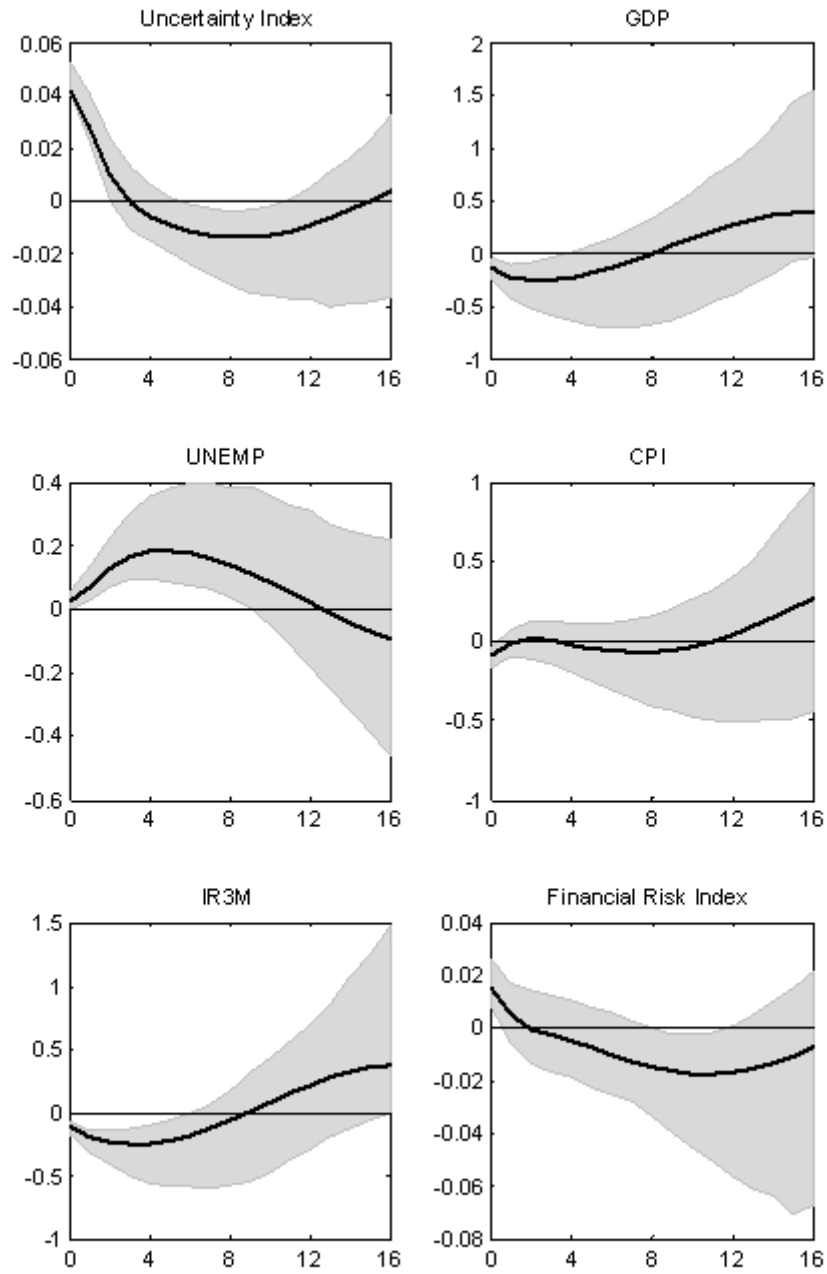


Figure 13: Robustness to ordering. Effects of a perceived uncertainty shock when uncertainty is ordered first (quarterly frequency). The figure reports the 2.5th, 50th and 97.5th percentiles of the IRFs distribution.

Table 4: FEVD - Monthly VAR

Variable	IP	UNEMP	CPI	IR3M	UI	RPI
Horizon	<b>Contribution of the Industrial Production Shock</b>					
1	100.00	3.35	0.93	4.78	0.55	1.85
12	86.70	24.58	14.98	63.63	11.21	11.90
24	74.69	43.25	29.31	72.03	24.09	11.51
36	53.21	47.82	33.54	58.27	42.64	27.15
48	49.05	43.33	28.84	55.64	42.24	36.88
	<b>Contribution of the Uncertainty Shock</b>					
1	0.00	0.00	0.00	0.00	95.09	1.48
12	1.79	2.47	10.13	1.29	49.87	6.15
24	1.19	4.29	7.21	1.07	37.38	5.26
36	2.29	4.18	5.73	0.95	26.09	4.53
48	3.64	3.70	5.71	1.42	21.62	3.77
	<b>Contribution of the Financial Risk Aversion Shock</b>					
1	0.00	0.00	0.00	0.00	0.00	95.07
12	5.18	0.11	13.50	3.93	3.32	66.55
24	13.32	0.41	20.30	9.54	2.97	54.19
36	14.60	2.48	23.70	11.72	4.85	39.38
48	11.34	2.79	25.39	8.23	7.96	34.69

Table 5: FEVD - Quarterly VAR

Variable	IP	UNEMP	CPI	IR3M	UI	RPI
Horizon	<b>Contribution of the Output Shock</b>					
1	100.00	14.37	0.48	19.22	5.14	0.35
4	91.34	26.44	5.56	37.05	8.57	4.52
8	79.16	37.02	24.30	43.72	12.22	4.22
12	59.64	41.16	31.61	33.59	25.03	13.17
16	45.19	36.15	26.13	28.23	28.18	23.97
	<b>Contribution of the Uncertainty Shock</b>					
1	0.00	0.00	0.00	0.00	81.48	5.02
4	2.07	6.88	11.33	4.15	71.06	2.59
8	1.65	11.84	7.04	5.40	48.85	2.39
12	1.46	12.22	3.79	4.06	32.83	3.05
16	2.95	10.63	3.17	3.12	24.72	3.17
	<b>Contribution of the Financial Risk Aversion Shock</b>					
1	0.00	0.00	0.00	0.00	0.00	80.31
4	5.12	0.48	6.04	4.51	3.36	77.27
8	12.16	4.40	14.43	11.06	3.14	58.95
12	11.80	8.18	17.74	10.24	7.34	42.59
16	8.96	7.72	15.83	8.21	10.47	36.37

Figure 14: Historical decomposition during the financial turmoil



Note: The line represents the deviation from the baseline of the respective variable to an industrial production shock (1st column), and uncertainty shock (2nd column) and a financial risk-aversion shock (3rd column). The bars in each panel denote the component of the series accounted for by each structural shock.