The impact of uncertainty shocks in Spain: SVAR approach with sign restrictions

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Abstract

The purpose of this research is to quantify the impact of economic uncertainty shocks in Spain by using an SVAR approach with sign restrictions with data from January 2001 to June 2018. Specifically, we analyze temporary and persistent economic uncertainty shocks. Furthermore, we isolate the uncertainty shocks whose origin is only politic to identify potential differences in the effects of the uncertainty according to its origin. Our results suggest that positive shocks to economic and political uncertainty lead to an increase in unemployment and a fall in consumer confidence, business confidence, IBEX 35 Index and industrial production. Moreover, these negative effects of uncertainty remain for a long-time horizon, especially for the case of industrial production and unemployment. According to these results, we can conclude that economic uncertainty shocks have a significant negative impact on the Spanish economy.

Keywords: Economic Uncertainty, SVAR, Sign Restrictions, Policy Uncertainty.

JEL Classification: D81, E21, E22

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1. INTRODUCTION

The warning of the economic literature on the impact of uncertainty in economies is not novel. However, with the global financial crisis of 2008 - the Great Recession - attention on uncertainty has increased considerably, becoming a serious concern for policy makers and an increasingly popular topic among academics.

The global financial crisis of 2008 caused serious economic damage and huge confusion for the population, as few or no one, including experts, really knew what the future had in store. The combination of events gave way to unexplored territory and uncertainty became a major concern, since people no longer had strong confidence in future results. Many economic leaders highlighted the importance of uncertainty. Famous in 2010 were the words of the economist Ben Bernanke, former chairman of the Federal Reserve: "Even as the Reserve continues prudent planning for the ultimate withdrawal of monetary policy accommodation, we also recognize that the economic outlook remains unusually uncertain. We will continue to carefully assess ongoing financial and economic developments, and we remain prepared to take further policy actions as needed"

At present, the European economy in general and the Spanish economy specifically are immersed in a period of high uncertainty for several reasons. Firstly, the victory for Brexit in UK, country closely linked with Spain among other reasons because of tourism and migratory flows, opens a new Pandora's Box and a new period of uncertainty that has been felt in European and Spanish stock markets and social concern. Secondly, Spain is experiencing a political earthquake because of the absence of a stable government due to parliamentary fragmentation. Additionally, and more recently, the Catalan "process" is putting in check not only the country's own unity, but also European integration, which can cause effects that are difficult to foresee. Therefore, Spain is an interesting country to study the impact of uncertainty and if these last events could have an important impact on some of the main macroeconomic variables.

The aim of this paper is to quantify the economic impact of the shocks of economic uncertainty in Spain with data from January 2001 to June 2018 and by using the i3e economic uncertainty index, which is explained in detail in section 3.1 of this paper. Additionally, we isolate the shocks whose origin is only politic by using the Economic Policy Uncertainty Index (EPU). Both indexes are explained in detail in the following sections of this paper. To evaluate the effects of shocks of uncertainty in separate variables, we make use of Vector Auto Regressive Structural Models (SVAR) and two varieties of identification schemes are pursued: recursive (Cholesky) and sign restrictions. However, due to its potential advantages thanks to allowing a more flexible identification than recursive methods, we consider appropriate and relevant to focus our research on the results obtained using sign restrictions. This approach has been little used so far in previous research on shocks of economic uncertainty (Redl, 2017; Caldara et al., 2016).

In relation to the previous literature, this research is relevant and a novel contribution by different noteworthy aspects: (1) the nonexistence of previous published studies quantifying this impact of economic uncertainty shocks for the Spanish case under a sign restrictions approach and with our measure of economic uncertainty; (2) the relevance of Spain as it is

country where the Great Recession has had a large impact on macroeconomic variables; and (3) as it is a country currently experiencing a convulsive political moment due to the previously mentioned Catalan "process" and because of a fragmented parliament with important difficulties to carry out political reforms.

The results of this research lead to conclude that uncertainty shocks have a significant negative impact on economic activity in Spain. An increase in the unemployment and a fall in consumer confidence, business confidence, IBEX 35 Index and industrial production, is observed because of economic and political uncertainty shocks. Moreover, these negative effects remain for a long-time horizon, especially for the case of industrial production and unemployment. On the other hand, we also find that our results are consistent with an imperfect information argument (Bloom, 2009), when we analyze the effect of persistent economic uncertainty shocks by imposing sign restrictions on the duration of a positive response of uncertainty to an uncertainty shock.

The paper is structured as follows. In section 2, a review of the existing literature on uncertainty is exposed to establish precedents and create a framework for guidance regarding the theory and empirical analysis. Then in section 3, a detailed description of the data used for quantification, focusing on the measure of uncertainty, is presented and subsequently the econometric methodology is described in detail. Section 4 presents the results of the various models, followed by a series of robustness tests. Finally, in section 5 the main conclusions of the research are enunciated.

2. LITERATURE REVIEW

Economic theory holds that the spread of uncertainty to economic activity is through several channels: investment, consumption, employment, or risk premium; the first two being the most notable. Likewise, the latest research urges the relevance of uncertainty not only itself but also of the variations in time of uncertainty and the effects of such fluctuations on economic activity.

As mentioned in the introduction, the theoretical concepts related to the impacts of uncertainty in the economy are not new. Bernanke (1983) points out that agents often must decide whether to engage early with irreversible investments or otherwise obtain benefits due to the wait and the acquisition of more information. In the case that waiting supposes greater benefits in the long term, given an uncertain environment, uncertainty directly affects investment cycles and as a result short but sharp recession can be derived. Dixit and Pindyck (1994) focus on the theoretical approach to capital investment companies. These authors conclude that companies have a beneficial interest in waiting in times of uncertainty since this leads to optimal results in the long term.

Regarding consumption, the literature shows two routes through which uncertainty can affect consumption. The first way is through precautionary saving (Carroll and Sanwick, 1997). Uncertainty increases the fear of agents to reduce their levels of income and consumption in the future. This motivates them to change their behavior today, saving more. The second way that uncertainty and consumption relate is especially true when spending is high and making the decision is reversible expensively; faced with uncertainty shocks consumers have incentives to postpone the purchase. This happens because the agent can get more information postponing the decision.

Based on previous works, Knotek and Khan (2011) provide a theoretical framework updated for uncertainty shocks including households. Its main premise is that the increase in uncertainty causes agents to decrease their spending as they enter into the mode of "wait and see". For households they explain that uncertainty shocks can take many forms that affect the total wealth. For example, a negative drop in the stock market can significantly affect the value of paper assets. Additionally, political decisions made by policy makers and economic stability are often an essential factor in determining employment opportunities. When uncertainty is high, the possibility of unexpected results is higher and therefore consumers are less likely to make large purchases (homes, cars or appliances) difficult to reverse. The same line of reasoning applies to businesses. Entrepreneurs often need to make large purchases of specific capital for industry. These purchases are quite often expensive to reverse so in the case of a reverse in their decision, companies lose a large sum of money. Therefore, when uncertainty is high and the economic result uncertain, companies have an incentive to wait for more information.

The recent interest in identifying the variations in time of uncertainty - uncertainty shocks - as cause of the economic cycle, takes relevance from the work already cited of Bloom (2009). Capturing and identifying the movements of uncertainty is often problematic, for this purpose Bloom uses stock market volatility. In times of uncertainty, the stock price tends to fluctuate wildly in reflection of investor confidence. Specifically, Bloom makes a structural VAR in which he measures the effects on the main macroeconomic variables through the VIX-index Chicago. The results of the analysis led him to conclude that uncertainty shocks caused a rapid and sharp decline in investment and employment for the US economy in the period between 1996 and 2010.

Alexopoulos and Cohen's work (2009) provides a richer approach to the empirical analysis of the work of Bloom for US. In it, the authors capture the uncertainty shocks through the monthly appearance of the words "uncertainty" or "uncertain" in articles in The New York Times. By proposing this form of measurement, they bring a qualitative leap into the field of research indicating that the media are the main channel through which households obtain information and can observe greater uncertainty in convulsive episodes. The results presented in the paper are consistent with the work of Bloom, in which production, employment, labor productivity, consumption and investment fall significantly in response to an unexpected increase in uncertainty.

Denis and Kannan (2013) in an analysis for UK using like uncertainty measures the volatility derived from options on the FTSE-100 index and the dispersion of one-year ahead forecasts of GDP in the UK, find that uncertainty shocks have a significant impact on economic activity in the UK, being this impact similar to that of the previous works cited for US except for the unemployment, which is less affected by uncertainty shocks in the case of UK. Haddow et al. (2013), Redl (2018) and Mumtaz (2016) found similar results for the UK, but the later author also points out that the responses of industrial production growth, CPI inflation, the short-term interest rate and stock market returns have declined over time. The main change in this response coincides with the adoption of inflation targeting in the UK. Similar outcomes are founded by Popescu and Smets (2010) when studying the German economy.

Regarding the Spanish case, there are not relevant and specific empirical works measuring the impact of economic uncertainty. However, in an analysis for the Eurozone Periphery and Germany, Petrakis et al. (2014) find that uncertainty shocks reduce industrial production, specifically manufacturing production in countries like Germany, Spain, Portugal, Italy and

Greece. On the other hand, Redl (2008) in an analysis for 11 advanced nations, among them Spain, using narrative restrictions and imposing that macro uncertainty shocks take place during close elections, finds that macro uncertainty shocks matter for all countries studied, with declines in GDP, investment and employment; even when there is no rise in credit spreads or financial uncertainty. Similar outcomes are founded by Carriere-Swallow and Cespedes (2013) and Fernandez-Villaverde et al. (2011) by using different methods when they explore emerging economies such that Argentina, Ecuador, Venezuela, and Brazil.

While the works previously mentioned are based on a partial equilibrium, Bloom et al. (2012), extend the literature with a stochastic dynamic general equilibrium model (DSGE). This model built with heterogeneous firms, uncertainty shocks and adjustment costs, indicates that a standard deviation of uncertainty reduces GDP by about 2%. Similarly, Basu and Bundick (2014) calibrate and solve a representative agent model, dynamic stochastic general equilibrium (DSGE) with capital accumulation and rigidity in nominal prices. In this way, they formalize a consistent model with the empirical evidence similar to that already indicated by Bloom. This is because uncertainty shocks can cause contractions in production and all its components when prices adjust slowly. Thus, they overcome the limitations of the models with perfect competition and flexible prices. They argue that a model that represents a closed and perfectly competitive economy is not able to reproduce the empirical joint movements in response to changes in uncertainty.

As mentioned in the introduction, the novelty of our research arises among other reasons because of the use of a sign restrictions approach. In this line, Caldara et al. (2016) study the impact of uncertainty shocks for the United States case by estimating an SVAR under sign restrictions. They find that uncertainty shocks are an important source of macroeconomic disturbances. Similarly, Redl (2017) evaluates the impact of uncertainty shocks for the United Kingdom and finds a strong negative impact response of GDP to macro uncertainty shocks.

Focusing on political uncertainty, this is uncertainty caused by political events (a more detailed explanation is given in section 3.2), Backer et al. (2016) develop a new index of Economic Policy Uncertainty (EPU) based on newspaper coverage frequency and they find that innovations in policy uncertainty decline investment, output, and employment in the United States and, in a panel vector autoregressive setting for 12 major economies. Other studies try to isolate the political uncertainty focusing on the movements of financial and economic variables during major political events, like national elections in a wide range of countries (Kelly et al. (2016); Julio and Yook (2012) or Canes-Wrone and Park (2014)). All of them find that political uncertainty declines investment and increases risk premium around general elections. For the specific case of Spain, as mentioned in the introduction, BBVA Research (2016) estimates an SVAR identified by sign restrictions to predict the effect of a persistent political uncertainty period because of the lack of a stable government between the years 2016 and 2017. The results indicate that economic activity would have increased by up to eight tenths of GDP in the accumulated of 2016 and 2017 in the absence of political uncertainty.

3. DATA AND METHODOLOGY

3. 1 Data: Economics uncertainty models

To estimate the different models of this work, we have collected monthly data from January 2001 to June 2018 for Spain. The variables used are the I3E [3]as a novel measure of uncertainty, the Unemployment Rate, the Industrial Production Index, the IBEX 35 Index, the Business Confidence Index and the Consumer Confidence Index. In addition, quarterly data are used from the first quarter of 2001 to the first quarter of 2018 to estimate models as a robustness test using the i3e Index, the Real GDP, Consumption, Investment, the IBEX 35 and the Unemployment rate.

The sources of these different variables' values for Spain are the IESE for the I3E, the Statistical Office of the European Union for the Unemployment Rate, the Organization for Economic Co-operation and Development for the Industrial Production Index, the Consumer Confidence Index and the Business Confidence Index, and the National Statistics Institute of Spain for the Real GDP, Consumption and Investment. It is important to note that the series appear seasonally corrected. As mentioned, all series are of monthly frequency except for the real GDP, Consumption and Investment, for which there is data only on a quarterly basis. Therefore, the model that uses these variables has been made by transforming the i3e Index, the Unemployment Rate and the IBEX 35 to quarterly frequency. Nonetheless, we find necessary to state that because of the short sample size, the quarterly VAR estimated may have problems establishing statistical significance.

Uncertainty itself is an abstract concept and therefore is not easily measurable. Bloom et al. (2012) set out in an adequate and concise way that "Unfortunately, there is not a barometer for uncertainty". However, in the literature different types of uncertainty measures have been developed: the dispersion in predictions, political uncertainty, uncertainty tax or monetary policy uncertainty, among others. This paper chooses to use as a measure of economic uncertainty the Economic Uncertainty I3e Index, an indicator developed jointly by the International Center for Decision Making (ICDM) and IESE. This index seeks to synthetically reflect the evolution of uncertainty of the economic situation and is published on a monthly basis on the website of the IESE Business School. Because of its novelty, we find it relevant to clarify this index and briefly state the process that is followed for processing it.

The index I3E is constructed using the daily variation rates of four economic and financial variables of great importance: IBEX 35, exchange rate $ / €, Crude Oil Brent traded on the Electronic Continental Exchange (ICE) and prices for the Spanish 10-year bond. From each of these individual variables four partial indices and the General Index I3E are constructed. It should be noted that the ICDM and IESE are currently developing an international index that works with the American bond and the S&P500 replacing the IBEX 35. However, given the high correlation between the Spanish stock market and the US stock market, it is not expected to obtain significant differences in the results. It is also important to mention that all the components of the I3e Index measure ex post volatility, not ex ante volatility.

[3] Detailed information about this index can be found in http://blog.iese.edu/icdm/i3e-2/

It can be observed therefore that the index has two global components and two local components that try to capture uncertainty affecting the Spanish economy from multiple origins, both international and national.

The first local component is the IBEX 35, which is the benchmark stock market index of the Bolsa de Madrid, Spain's principal stock exchange. Stock market indexes are commonly used in the literature as a proxy for uncertainty, among other reasons because they are available in real time and they are reasonably comparable across countries (Bloom, 2009; Caggiano et al., 2014). The other local component is the exchange rate $ / €. The use of this component is justified because exchange rate is a potential variable to be influenced by uncertainty. It is highly probable that differences in uncertainty among countries affect exchanges rates, since risk-averse investors will desire investing in the least uncertain country. Therefore, uncertainty will be included as an additional risk factor in the economy with higher uncertainty. For example, uncertainty about the situation in the Eurozone, the expected inflation or monetary policy, could be reflected in this component and cause uncertainty in the Spanish economy, having an important impact on the foreign sector of the country.

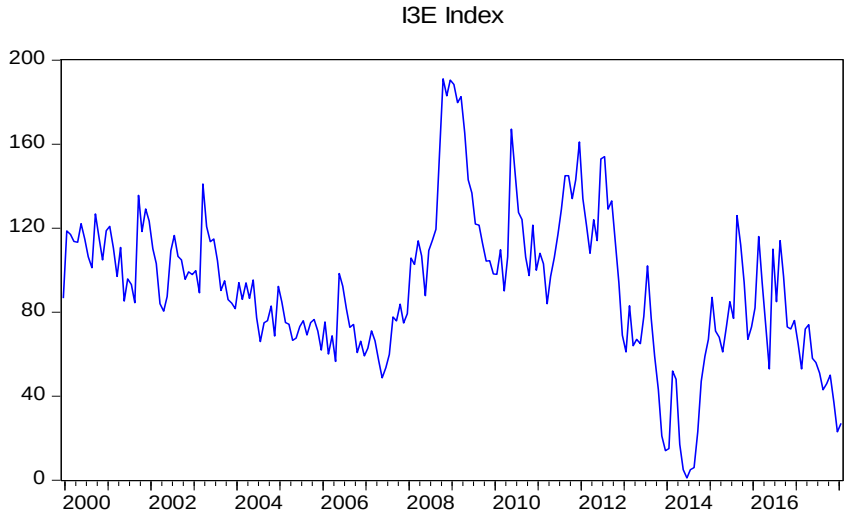
One of the global components the Crude Oil Brent Price. Oil is currently a noticeable factor used by households and firms in consumption and production. Consequently, alternations in the uncertainty about the evolution of the price of oil are expected to have a significant effect on economic fluctuations. This effect must be added to the direct effect generated as a consequence of the changes in oil price levels. This is, if oil price changes today, both the current price change and the expected variability of the future oil price – this is the uncertainty - have an impact on the relevant economy by affecting economic agents' decisions (Elder and Serletis, 2009 & Jo, 2012). In this sense, it is important to highlight that uncertainty about the Crude Oil Brent Price is expected to cause important effects in the Spanish economy, as it is an economy highly dependent on oil.

Finally, the other global component is the Spanish 10-year bond. This variable captures the uncertainty generated in Spain because of the country's own fiscal position or by other circumstances beyond the strictly local political decisions of the country, such as investor confidence in the euro or the Eurozone as a whole, or uncertainty about the monetary policy that the ECB carries out. Therefore, the price of the bond can capture very well the national and international uncertainty, as demonstrated during the sovereign debt crisis in the Eurozone in 2010 with great doubts about the solvency of the euro.

The economic uncertainty index I3E has an average value of 100 for the decade 2000-2009. In practice, the usual values typically range between 0 and 200. A value less than 100 is synonymous of a situation of economic uncertainty lower than the average in the previous decade, while values above 100 indicate a higher economic uncertainty.

Regarding the technical construction of the index, first volatility of the four series is calculated using an exponential smoothing. Once the series have been obtained, the logarithms of these series are taken to correct the bias to the right and proceed to normalize subtracting the mean of each and dividing by the standard deviation to further develop an arithmetic average of the four series. A series is thus obtained with mean zero and standard deviation σ. Then the series is multiplied by 30 / σ and 100 is added, thus obtaining finally the rate of economic uncertainty. Partial uncertainty indices for the IBEX 35, the exchange rate of $ / €, Brent oil price and the Spanish 10-year debt are calculated similarly.

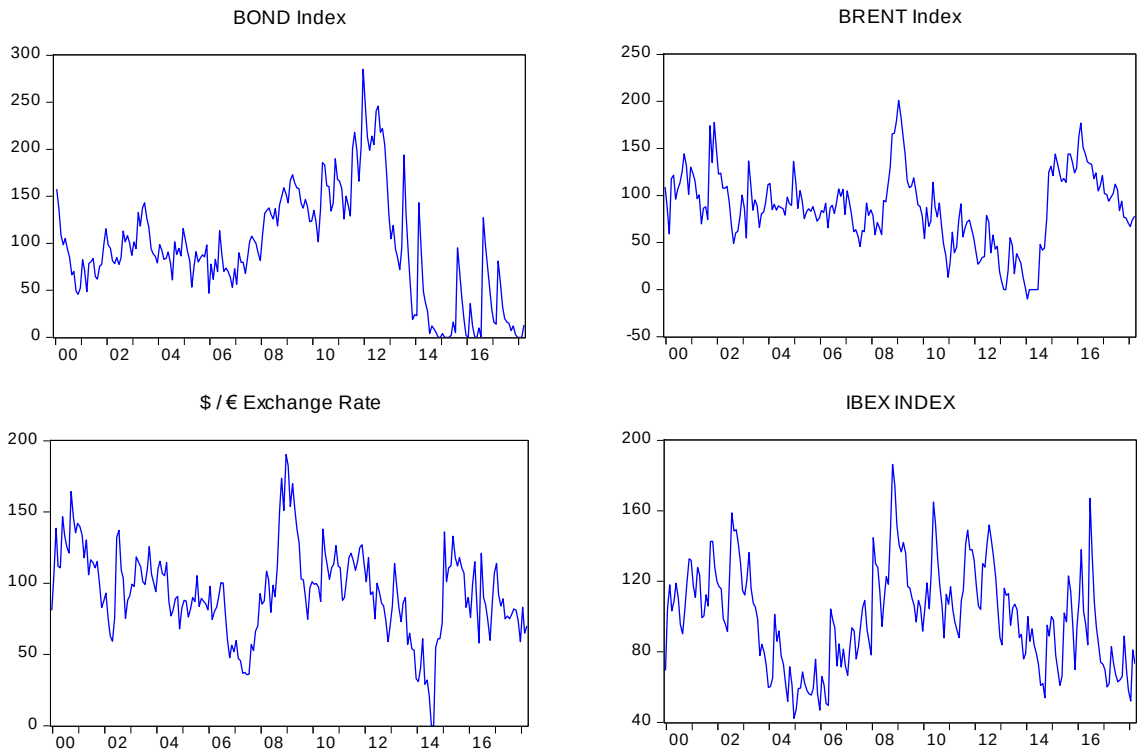
FIGURE 1: Evolution of the Economic Uncertainty Index (I3E) in Spain from December 1999 to June 2018.



Source: Own elaboration based on IESE data

Figure 1 shows the evolution of the General Index I3E from December 1999 until June 2018. In the early years, values between 100 and 150 are observed reflecting a high level of economic uncertainty resulting from various high impact events such as dot-com bubble burst, Enron scandals and the terrorist attacks of September 11. The index decreased and stabilized over time to levels between 50 and 100. This stabilization was truncated in the second half of 2007, when the crisis of subprime mortgages led to an increase in uncertainty and placed the index values close to 100. Later, in the summer of 2008, with the collapse of Lehman Brothers on the 15th of September, the index reached what is so far its highest value of close to 200 because of the US and the rest of the world's financial crisis. Gradually, the index decreased but in April 2010 the Greek debt crisis led to an increase in the index to near 150 because of the doubts raised about the solvency of many EU states. In November 2010, the index increased again this time by the debt crisis in Ireland and Portugal. During the following years, the index remained high, coinciding with the Spanish banking rescue of 2012 and the risk of bankruptcy in the common currency area. At the end of that same year the index began to fall, reaching the minimum of the period analyzed in June 2014, coinciding with the expansive policies of the ECB and the famous “Whatever it takes” by Mario Draghi. Subsequently, the levels of the index grow again but are at average levels lower than those of the crisis period are. The most recent data show a fall in the index, which seems to indicate that government instability and the Catalan “process” are not having a major impact on the economic uncertainty. Therefore, it seems clear that this index is more affected by both, international and national financial and economic turbulences than by national political uncertainty.

FIGURE 2: Evolution of partial indices used in the preparation of I3E from December 1999 to June 2018.



Source: Own elaboration based on IESE data

Figure 2 allows us to observe the individual performance of each of the indices used in the construction of I3E so that we can identify patterns of behavior of each of the variables over time and their contribution to the index of general uncertainty. In turn, this permits us to see which the factors that weigh the most on index levels are.

It should be noted that values at around 300 of the partial index of the Spanish 10-year bond in 2012, the moment in which historical maximums were reached - after the entry into force of the single currency – for the interest rate demanded by investors resulting from the lack of information on the ransom requested by the Spanish Government to its European partners to clean up the banking. Moreover, the current high levels of partial index for Brent barrel are remarkable given the huge drop in oil prices due to both increased supply and lower demand. Today, oil prices remain a factor of uncertainty for the markets and the exchange rate.

Finally, it is important to note that in recent months I3E data reflect that political uncertainty is not affecting economic uncertainty. The partial index of the Spanish 10-year bond reflects that there are no doubts about the solvency of Spain. Moreover, uncertainty about the stock - IBEX35- and especially oil prices did increase earlier this year, and this was reflected in increased economic uncertainty because of no specific causes of Spain, but rather to the coeval macroeconomic situation internationally. Finally, it is important to highlight that the index data for June 2016 reflects a significant increase in uncertainty because of Brexit.

It is important not to forget that the I3e Index reflects the external environment but is not very sensitive to politics in Spain. This is due to the fact of its unique aspect included respect to it is the evolution of the Spanish bond, which often reflects the political change with delay. This is because, for example, a specific fiscal policy decision made by the Government today

could have delayed effects on the price of the Spanish bond because sometimes (depending on the reaction of the media and population) it would only modify variables affecting bond prices - such as deficit or debt - once such a decision is completely executed and computed. Therefore, narrative methods such as the EPU index - explained in detail in the next section - could capture this governmental decision more instantaneously than the i3e Index. However, if the economic agents anticipate the fiscal decisions once the decision is known and not when it has already been executed, the impact on the uncertainty could be instantaneous in the same way that happens with other narrative methods.

If the aim of this study was to analyze the effects of the current complex political situation, a measure of political uncertainty should be used, as the so-called Index of Political Uncertainty (EPU) created by Baker et al. (2016) and that we analyze briefly in the next section. It is important to highlight that the EPU isolates political shocks because of governmental affairs or decisions and it does not consider uncertainty caused by other economic events that have not arisen because of political issues, such as uncertainty in global markets, volatility in commodities or trust of international investors in a specific country. However, the I3e Index considers a great variety of uncertainty economic shocks, including policy shocks. Thus, given the purpose of this paper, the Index of Economic Uncertainty I3E is the indicator used to analyze the impact of economic uncertainty shocks in various macro variables of Spain.

3.2 Data: Political uncertainty models

We have made additional estimates to analyze the impact of political uncertainty and be able to draw conclusions about the differences in the results depending on the type of uncertainty that an economy faces.

Therefore, before starting to expose the data used for this purpose in the work, it is important to clarify the term of political uncertainty. As its name suggests and we have previously explained, political uncertainty refers to any episode that generates uncertainty but of a strictly political origin. With this clarification, we separate from our field of research any other shock of a different nature that causes uncertainty in the macroeconomic variables as the ones included in the IE3 index of economic uncertainty. For example, a shock in the exchange rate or in the price of oil can cause some uncertainty and could have negative effects on economic growth. These kinds of shocks cause economic uncertainty, but if they are not caused by political events, we will not consider them when analyzing political uncertainty.

To better capture this phenomenon and in line with the most avant-garde studies in this regard, we will use the so-called Political Uncertainty Index EPU) created by Baker et al. (2016). The EPU measures the uncertainty related to political factors and for the case of Spain is constructed from the analysis of the news published in the two newspapers most prominent in the country. In Spain, the newspapers analyzed are *El Mundo* and *El País* with the *Factiva* database. Based on this news, a standardized index of the volume of articles dealing with issues of political economic uncertainty is constructed. To do this, the authors count the number of articles containing the terms *uncertain* or *uncertainty*, *economic* or *economy*, and other relevant political terms by always making a search in the native language of the newspaper. Specifically,

in the case of Spain, the terms used in the search are: *economic, economy, tax, tariff, regulation, policy, spending, spending, spending, budget, deficit, central bank, uncertainty* and *uncertainty.*

To estimate a model for political uncertainty, we have collected monthly data from January 2001 to June 2018 for Spain. The variables used are the EPU[4] as a measure of uncertainty, the Unemployment Rate, the Industrial Production Index, the Business Confidence Index, the Consumer Confidence Index and the IBEX 35 Index.

3.3 Methodology

In this paper, the methodology of Vector Autoregressive models (Sims, 1980) is used to carry out an analysis of the reaction of certain variables to shocks of economic uncertainty. Varieties of identification schemes are pursued: recursive (Cholesky) and sign restrictions.

The VARs are frequently used in the literature for its ability to analyze stylized facts concerning the behavior followed by a set of variables in front of orthogonal innovations to the model. The structural form of the VAR model can be expressed as:

$$A_0 y_t = (B_0 x_t + A_i y_{t-i} + u_t) \quad (3.1.1)$$

where, y_t is a vector of endogenous variables, x_t is an vector of exogenous variables, A_0 describes the contemporaneous relation among the variables collected in the vector y_t, A_i is a matrix finite-order lag polynomial containing the coefficients on the i lag of y, and u_t is a vector of structural disturbances with mean zero ($E[u_t] = 0$) and a diagonal variance-covariance matrix ($E[u_t u_t'] = I$). To derive the reduced form representation, we multiply both sides of the structural VAR representation (3.1.1) by A_0^{-1}:

$$y_t = A_0^{-1} B_0 x_t + A_0^{-1} A_i y_{t-i} + e_t \quad (3.1.2)$$

being $e_t = A_0^{-1} u_t$

The method of Cholesky decomposition (Higham, 1990) is used for the process of identifying the structural shocks of the VAR, which imposes a recursive structure that makes it possible to obtain the missing restrictions. The order for Cholesky Decomposition is imposed on the various models of this research based on the exogeneity of the variables as follows in the monthly (quarterly) model: Consumer Confidence Index (Consumption), Business Confidence Index (Investment), i3e Uncertainty Index, Industrial Production Index and Unemployment Rate. We have estimated the previous VARs in log-levels with nonstationary variables, as advocated by Sims et al. (1990) and Bloom (2009). Considering the monthly (quarterly) nature of the data, we have used VAR models with 12 lags (4 lags).

Identification through sign restrictions following Faust (1998), Uhlig (1999 y 2005) and Canova y De Nicoló (2002) has been established to impose a more flexible structure on the

[4] Detailed information about this index can be found in http://www.policyuncertainty.com/

response of the VAR to a shock considering admissible relationships between the reduced form shocks, u_t and the structural shocks, e_t. Sign restrictions involve a greater flexibility in the assumptions around the timing of variables responses to shocks and becomes a convenient identification method to study uncertainty shocks (Redl, 2017; Caldara et al., 2016). Concretely, we use the restrictions outlined in table 1.

Table 1: Sign restrictions for 6 months

	Consumer Confidence	**Business Confidence**	**IBEX 35 Index**	**Industrial Production**	**Unemployment Rate**	**Uncertainty Index (i3e or EPU)**
Model 1.1	**-**	**-**	**-**	**-**	**No included**	**+**
Model 1.2	**-**	**-**	**-**	**-**	**+**	**+**
Model 2.1	**-**	**-**	**-**	**?**	**No included**	**+**
Model 2.2	**-**	**-**	**-**	**?**	**?**	**+**

Model 1.1 and 1.2 impose restrictions on the responses of all the variables. In more detail, the restrictions illustrated imply that:

1.1) A positive economic uncertainty shock reduces instantly the Consumer and Business Confidence, IBEX35 Index and Industrial Production Index.
1.2) A positive economic uncertainty shock reduces instantly the Consumer and Business Confidence, IBEX35 Index and Industrial Production Index, and increases instantly the Unemployment Rate.

Models 2.1 and 2.2 follow Uhlig (2005) in applying what he calls an ‘‘agnostic’’ identification procedure by leaving unrestricted the response of the Industrial Production Index and the Unemployment Rate, our main variables of interests. In more detail, the restrictions illustrated imply that:

2.1) A positive economic uncertainty shock reduces instantly the Consumer and Business Confidence and the IBEX35 Index but does not affect instantly the Industrial Production Index.
2.2) A positive economic uncertainty shock reduces instantly the Consumer and Business Confidence and the IBEX35 Index but does not affect the Industrial Production Index or the Unemployment Rate instantly.

Additionally, we have conducted an SVAR under sign restrictions for persistent uncertainty shocks, following Bloom (2009), Haddow et al. (2013) and Redl (2017), since the persistence of an uncertainty shock can be prolonged if it is caused by structural shifts or important changes in policy, such as Brexit. Therefore, it becomes relevant to analyze if our results are robust when changing from a temporary to a persistent shock.

We approach this question following Redl (2017) by imposing sign restrictions on the duration of the positive response of uncertainty to an uncertainty shock while holding fixed (as in table 1) the duration of the sign restrictions on other variables. Specifically, we vary the restriction on how long the i3e uncertainty index must be positive from 6 months to 1 year, 2 years and 3 years to study the effects of persistence.

In order to assess the degree of transmission of shocks of uncertainty to the different variables used in this paper the generalized impulse response functions (IRFs) have been used. These functions describe the way in which a variable respond over time to a surprise in itself or in another variable. However, it is important to highlight that it is not about analyzing how a variable affect another, for that it would be enough to look at coefficients, but to observe how much is affected by unexpected changes.

4. RESULTS AND DISCUSSION

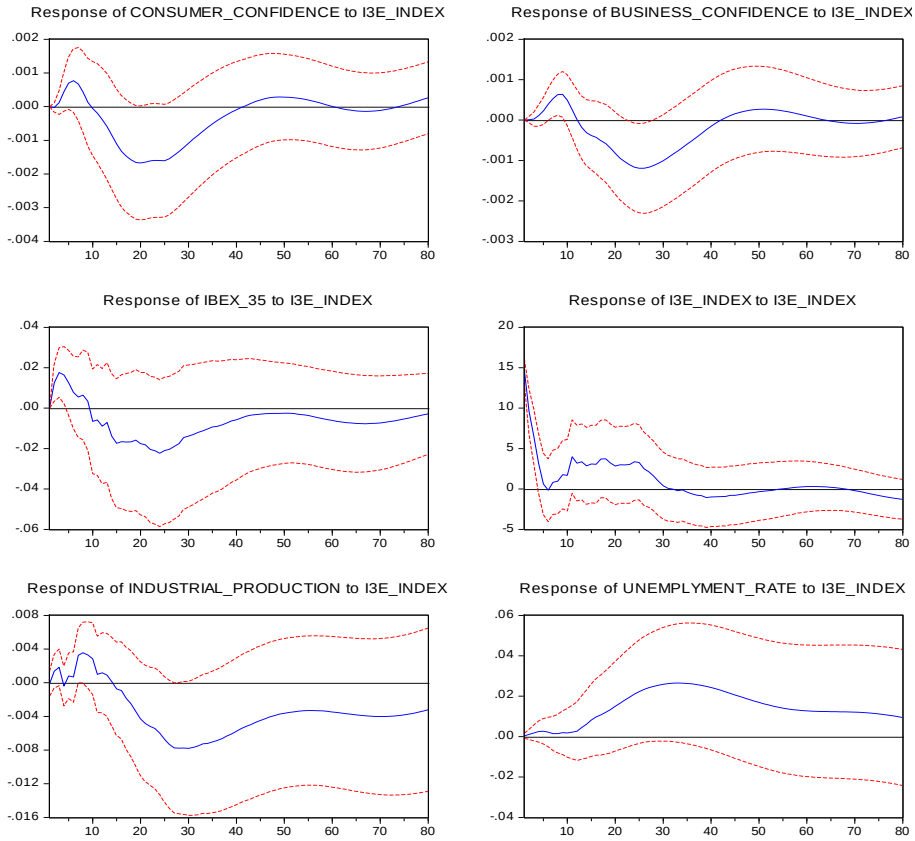
4.1 Recursive restrictions (Economic Uncertainty models)

In these sections, we present the impulse response functions obtained for the different models using a recursive identification method (Cholesky) which show the temporary reaction of the various variables under analysis to economic uncertainty shocks of magnitude equal to one standard deviation as +/- 2 standard errors (SEs) confidence bands (95% confidence interval). As previously explained this model includes the following six variables in monthly (quarterly[5]) frequency: Consumer Confidence Index (Consumption), Business Confidence Index (Investment), i3e Uncertainty Index, Industrial Production Index and Unemployment Rate.

Figure 1 shows that Consumer Confidence response to a shock of economic uncertainty is slightly negative but is only statistical significant around 20 months after the shock. Similarly, the responses of business confidence and industrial production are only statistically significant around 2 years after the shocks, when both decline slightly. Responses of the IBEX 35 and the Unemployment Rate are not statistically significant in our estimations. According to these results, we could conclude that economic uncertainty affects negatively, but only slightly, consumer confidence, business confidence and industrial production, whilst having no effect on the IBEX 35 and the Unemployment Rate. However, as explained in the methodology, using a recursive identification involves imposing a rigid structure on the response of the VAR system to a shock. Therefore, we prefer to follow in the next section a more flexible identification method to ensure the results of our SVARs. However, these first results seem to indicate that uncertainty affects mainly economic activity via investment as, for instance, Bernanke (1983) predicts, suggesting that uncertainty would affect activity through changes generated in savings and investment decisions.

[5] Results for the quarterly model are shown in figure A.1 in the appendix. Results are in line with those obtained in the monthly model, except for the IBEX 35, which shows statistical significance.

Figure 1: Impulse response functions under recursive restrictions (monthly model)



4.2 Sign restrictions *(Economic Uncertainty models)*

In this section, we present the impulse response functions obtained for the different models by restricting the sign of certain responses as previously explained. The graphs show the temporary reaction of the various variables under analysis to economic uncertainty shocks of magnitude equal to one standard deviation as +/- 2 standard errors (SEs) confidence bands (95% confidence interval).

4.2.1 Temporary uncertainty shocks

Figure 2 and 3 show the IRFs obtained by restricting the sign of the responses of all the variables. Results suggests for both models – independently of whether the unemployment variable is included or not in the estimation – that a positive shock in economic uncertainty leads to a decrease in consumer confidence, business confidence and industrial production, as well as to an increase in the unemployment rate. All these responses are statistically significant for a period longer than 9 months in all the cases. These results confirm the importance of the effects of economic uncertainty on some of the main interest macroeconomics variables.

FIGURE 2: Model (1.1) Impulse response functions

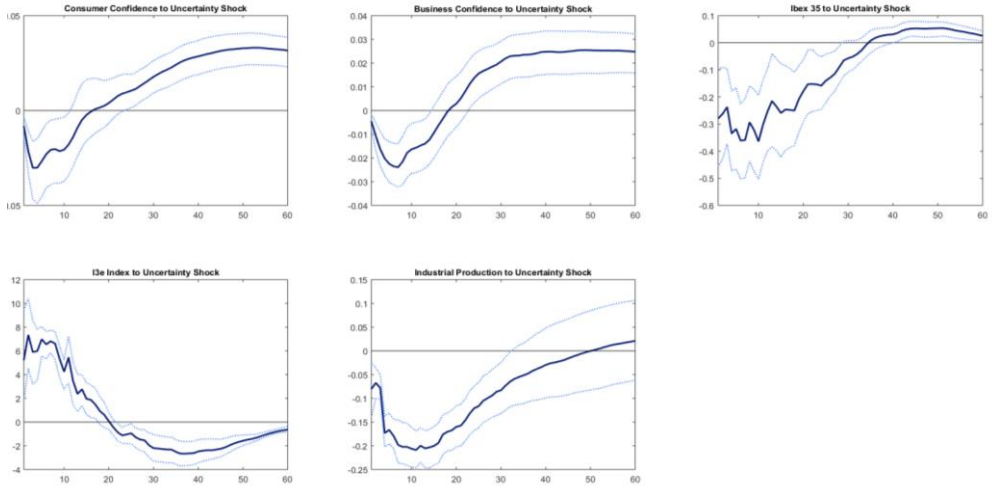
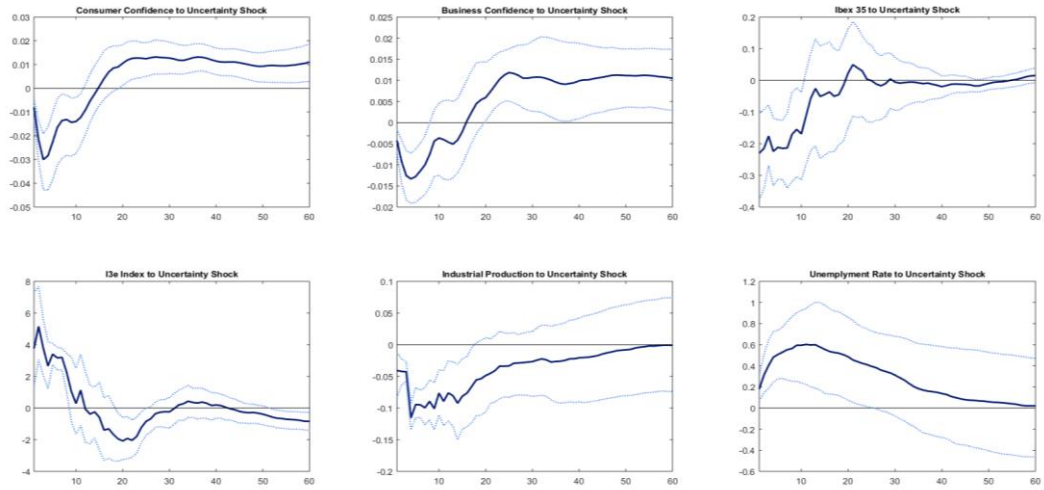


FIGURE 3: Model (1.2) Impulse response functions



Additionally, to the model 1.1 and 1.2, we have estimated models 2.1 and 2.2, which differ from the previous ones because industrial production and unemployment do not face any sign restriction. This is, we have decided to leave the response of industrial production and unemployment variables unrestricted because we want to let the data speak following an "agnostic" approach. The IRFs obtained from these models are represented in figures 5 and 6. As observed, the main conclusions obtained in models 1.1 and 1.2 generally remain regardless of leaving unrestricted some of the main variables of interests. However, the behavior of industrial productions and unemployment rate becomes no statistically significant for the 1-2 months after the shock. This is, in these models the decrease (increase) in industrial production (unemployment) is not immediate, although the magnitude and duration of the negative effects continues being similar than the one obtained in the previous models.

More specifically, the results of an increase of economic uncertainty in the model including unemployment and under an "agnostic" approach can be described as follows:

(1) Consumer confidence reacts negatively immediately, decreasing by -0.03 percentage points and reversing course within 20 months.
(2) Business confidence also reacts negatively and immediately, decreasing by around -0,015 percentage points and reversing course within two years.
(3) IBEX 35 index reacts immediately in a negative way, decreasing by -0,3 percentage points. This negative impact remains for a long-time horizon.
(4) Industrial production reacts negatively around 2 months after the shock, decreasing by a maximum of -0,12 percentage points approximately 1 year after the shock. This negative impact remains for a long-time horizon and thus makes especially relevant the behavior of this important macroeconomic variable. It seems that industrial production is affected negatively for a long period after an economic uncertainty shock.
(5) Unemployment rate reacts positively around two months after the shock, achieving a maximum increase of around 0.6 percentage points one year after the shock. This positive impact remains also in this case for a long-time horizon, thus becoming also a very relevant result.

The results of these SVARs are consistent with those of Bloom et al. (2012), who determined that the uncertainty has more than important consequences for the US economy as suggested also by Arslan et al. (2011) for the case of the Turkish economy and Petrakis et al. (2014) for the Eurozone Periphery and Germany. The same applies to the UK, where Driver and Moreton (1991), Denis and Kannan (2013) and Mumtaz (2016) conclude that the high uncertainty clearly affects economic activity and more recently Bloom et al. (2007) find evidence supporting this vision that determines that the high uncertainty reduces capital expenditures in UK companies. Our results finding a negative impact of uncertainty on the economy, are also in line with those obtained by the two novel studies previously explained that use a sign restrictions approach for the US and the UK, respectively (Caldara et al. (2016); Redl (2017)).

FIGURE 4: Model (2.1) Impulse response functions

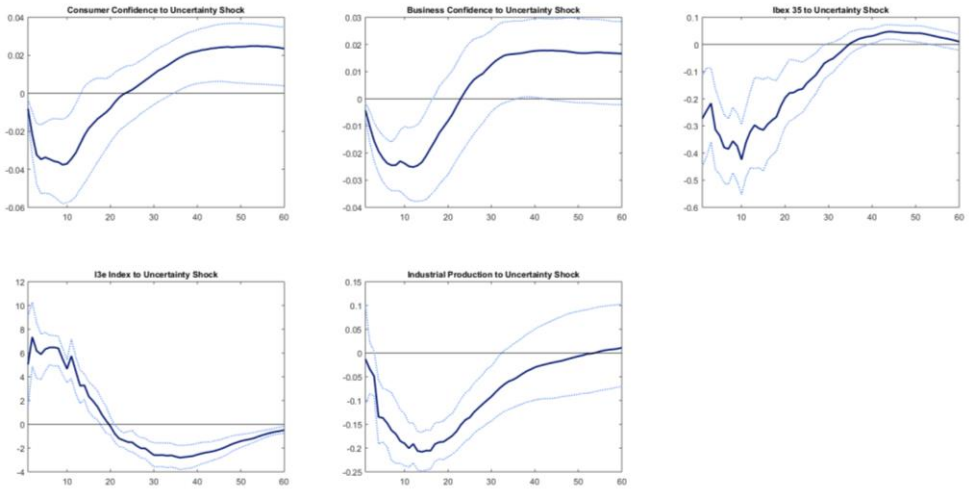
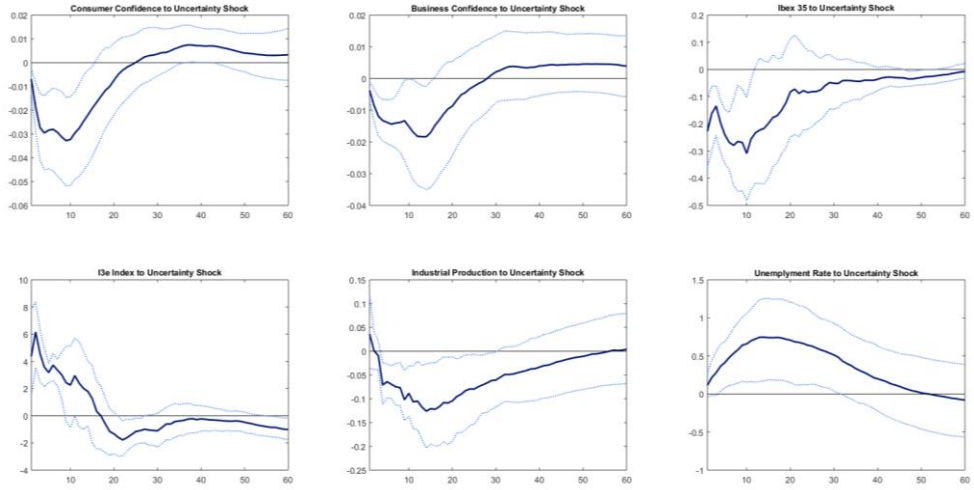


FIGURE 5: Model (2.2) Impulse response functions



4.2.2 Persistent uncertainty shock

Next, we show the IRFs for a persistent positive economic uncertainty shock for 1 year (figure 6), 2 years (figure 7) and 3 years (figure 8).

Our results are consistent with an imperfect information argument (see Bloom, 2009), since we observe a similar impact effect but a stronger long run effect than in the case of temporary shocks. This argument exposes how uncertainty deters investment as firms adopt "wait and see" behavior. Therefore, according to this theory, a persistent shock would predict a similar impact effect than a temporary shock but with a stronger long run effect. Concretely, Bloom (2009) shows that uncertainty shocks, defined as a shock to the variance of the idiosyncratic productivity process, generate bust-boom cycles. The response to persistent shocks that he finds is qualitatively the same as the response of a temporary shock since output simply responds as if a larger temporary shock has occurred. This is the same result that we find for the Spanish case when we analyze the effects of persistent uncertainty shocks following the methodological strategy of Redl (2017) for the UK. However, the effects we find contrast with the results obtained by Redl (2017), who finds a weaker impact effect and a greater proportion of the total response taking place at a later date. Nonetheless, our results are in line with those obtained by Haddow et al. (2013) also for the UK and Bloom (2009) for the US and we can confirm according to our research the imperfect information argument for the Spanish case.

FIGURE 6: Model (2.2 with persistent shock *1 year*) Impulse response functions

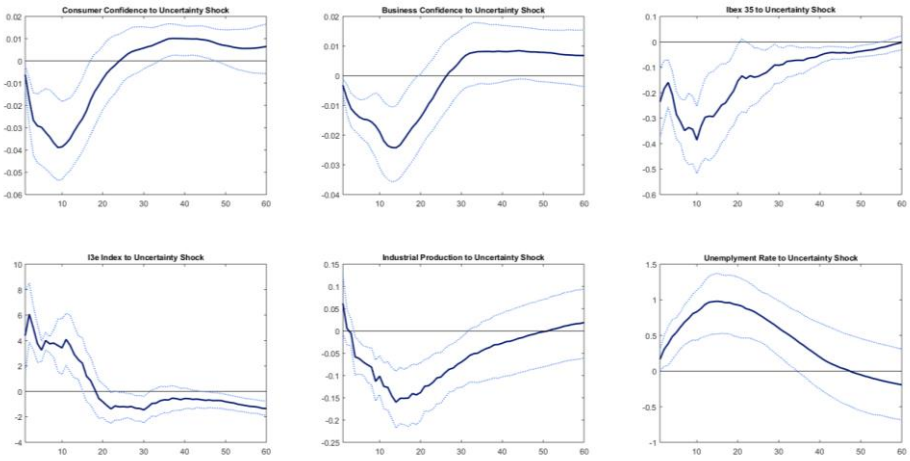


FIGURE 7: Model (2.2 with persistent shock *2 years*) Impulse response functions

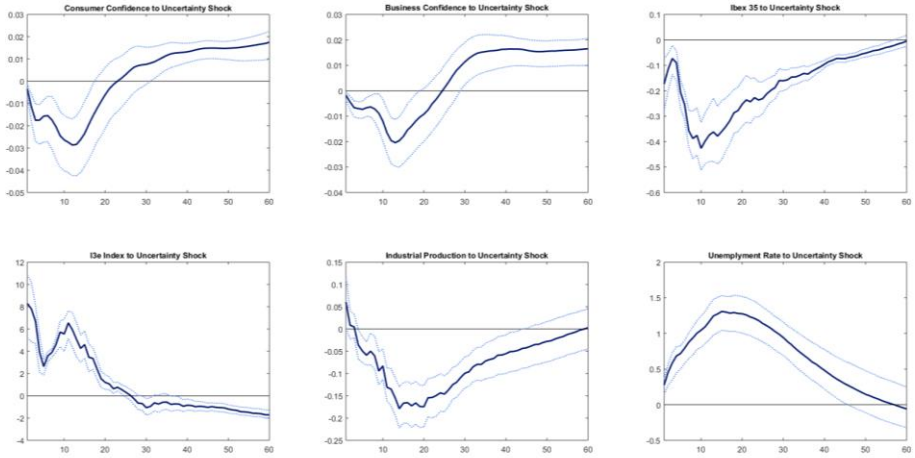
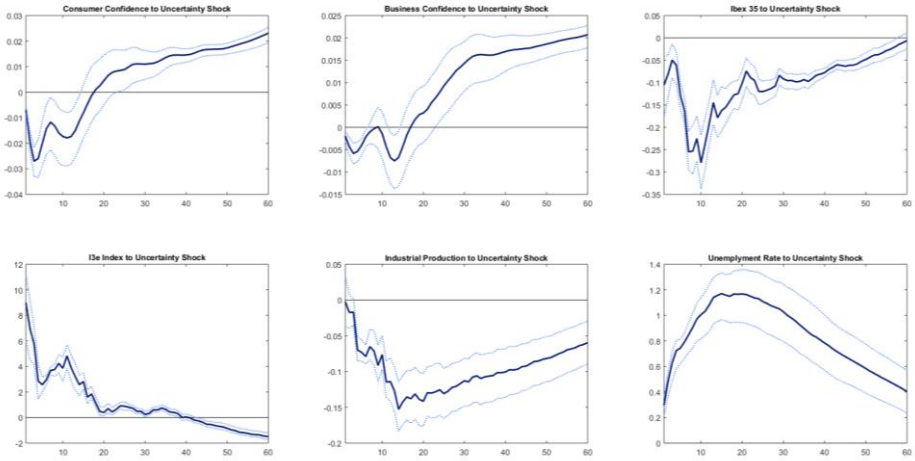


FIGURE 8: Model (2.2 with persistent shock *3 years*) Impulse response functions



4.3 Sign restrictions *(Political Uncertainty models)*

Additionally, we have isolated the impact of political uncertainty using the EPU index previously explained. In this section, we present the impulse response functions obtained for the different models by restricting the sign of certain responses as explained in table 1 and using EPU index as a measure of uncertainty. The graphs show the temporary reaction of the various variables under analysis to political uncertainty shocks of magnitude equal to one standard deviation as +/- 2 standard errors (SEs) confidence bands (95% confidence interval). Figures 9 and 10 show the impulse response functions for the "agnostic" models, whilst model 1.1 and 1.2 IRFs are available in the appendix (figure A.2 and A.3).

The results using EPU Index confirm that the effects of a political uncertainty shock are like those obtained when estimating the effects of an economic uncertainty shock by using the i3e Index. It seems therefore that uncertainty affects negatively (positively) consumer confidence, business confidence, IBEX 35 index and industrial production (and unemployment), independently of the origin of the uncertainty. Time horizons for the effects of the shocks are also similar for both, economic and political uncertainty shocks.

FIGURE 9: Model (2.1) Impulse response functions

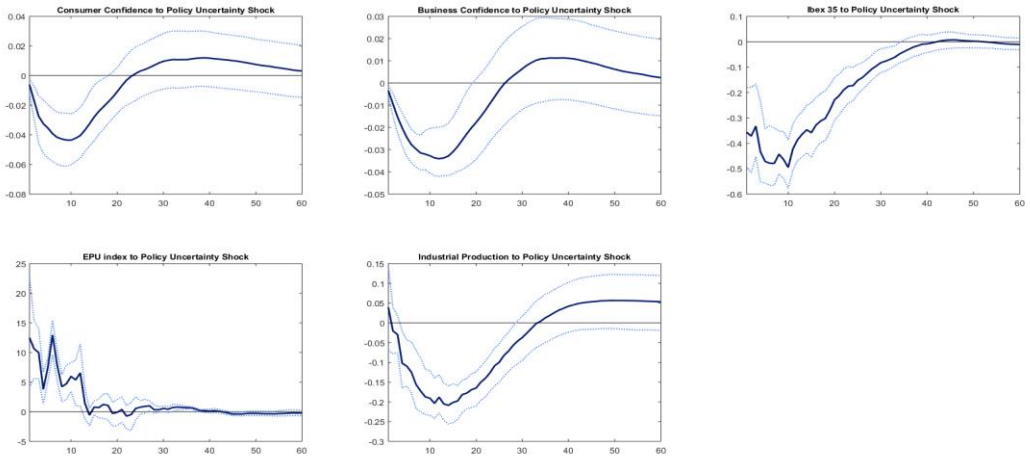
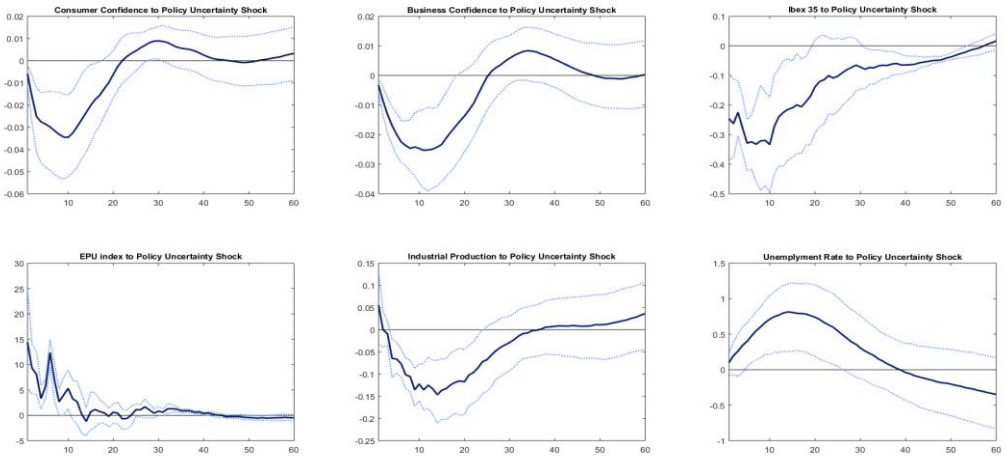


FIGURE 10: Model (2.2) Impulse response functions



4.4 Robustness tests

4.4.1 Alternative uncertainty measure

As robustness test, we use an uncertainty index different from the i3e Index and EPU Index used in our main models. This new index is provided by the Bank of Spain and adds to the components of the I3E economic uncertainty indicator prepared by IESE some additional indicators (Gil et al., 2017). More in detail, the index contains three groups of indicators:

a) indicators based on financial market data (group 1). Four of the indices in this group are the components of the I3E economic uncertainty indicator prepared by IESE.
b) indicators based on the degree of disagreement between economic agents regarding the economic situation and outlook (group 2)
c) indicators of uncertainty about economic policy and about the political situation of the country (group 3)

Results of the SVAR models estimated under an ‘‘agnostic’’ identification procedure by leaving unrestricted the response of industrial production and the Unemployment Rate and using the Bank of Spain Index as the measure of uncertainty[6], are available in figures A.4 and A.5 in the appendix. The results are in line with those obtained by using the i3e Index and thus confirm the robustness of our results: (1) consumer confidence, business confidence, IBEX 35 index and industrial production decrease after an economic uncertainty shock, (2) unemployment rate increases, and (3) it is of special relevance the long-time horizon for the effect on industrial production and unemployment rates.

4.4.2 Quarterly model

As a robustness test to ensure the results of our models, we have also conducted an SVAR under sign restrictions using variables in quarterly frequency equivalents to those used for the monthly models. However, as previously explained, we find necessary to state that because of the short

[6] Data are only available from January 2001 to January 2018.

sample size, the quarterly VAR estimated may have problems establishing statistical significance and thus the results must be interpreted cautiously. We use the restrictions outlined in table 2.

Table 2: Sign restrictions for 2 quarters

	Consumption	Investment	IBEX 35 Index	Real GDP	Unemployment Rate	Uncertainty Index (i3e)
Model 1.1	-	-	-	-	**No included**	+
Model 1.2	-	-	-	-	+	+
Model 2.1	-	-	-	?	**No included**	+
Model 2.2	-	-	-	?	?	+

Results of the SVAR models estimated under an ''agnostic'' identification procedure by leaving unrestricted the response of industrial production and the unemployment rate and using the i3e Index as the measure of uncertainty, are available in the appendix (figures A.6 and A.7). The results ensure our conclusions from the main model. Consumption, Investment, IBEX 35 and GP decline because of an economic uncertainty shock, whilst unemployment rate increases, being all these effects statistically significant for a long-time horizon.

5. CONCLUSIONS

This paper aims to quantify the impact of the shocks of economic uncertainty on some of the main macroeconomic variables. The research results suggest that positive shocks of economic uncertainty have statistically significant negative effects on the Spanish economy, in line with what economic theory predicts and empirical evidence shows for a wide range of countries. An increase in the unemployment rate and a fall in consumer confidence, business confidence, IBEX 35 Index and industrial production, is observed because of economic as well as political uncertainty shocks. Moreover, these negative effects remain for a long-time horizon, especially for the case of industrial production and unemployment. We also find that persistent shocks are consistent with an imperfect information argument, since these show a similar impact effect but a stronger long run effect than for the case of temporary shocks

Our main model's results can be considered robust after carrying out the different robustness tests in section 4.4. It is also striking that according to our model; the impact of uncertainty is similarly independently of its origin, since we find similar results when we isolate political uncertainty. These results indicate that the Spanish economy reacts in a similar way, independently of whether it faces an international or national economic uncertainty shock (like a disturbance in the financial markets) or an important political event (like the growing tension in Catalonia or the Brexit). Therefore, our findings suggest a great importance of politics to avoid uncertainty and get better economic outcomes that lead to a higher well-being of the population.

Research results also underscore that for Spain, the uncertainty may be one of the main sources of economic cycles as already indicated supporting the most avant-garde works of Bloom (2009) or Alexopoulos and Cohen (2009). However, as we mentioned in the introduction and in the theoretical framework, the importance of uncertainty in the economy is not novel. Keynes in the General Theory (1936) showed concern about this matter by obtaining the resulting conclusions on economic policy known to all. Whether we agree with the intervention of public policies to counteract the negative effects of uncertainty on growth or not, it is undeniable that increasingly empirical evidence supports that shocks of uncertainty should be considered by economists in its models at least with the same importance as monetary policy shocks, fluctuations in oil prices or productivity shocks are. Therefore, we consider it appropriate to highlight in order to further expand the field of research that future research can go on line to expand the channels of transmission of uncertainty to economic growth and focus these effects in specific episodes to try to quantify the impact of important events such as the Brexit and the Catalan "process" that are happening today and are highly generators of uncertainty and volatility.

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APPENDIX

Figure A.1: Impulse response functions under recursive restrictions (quarterly model)

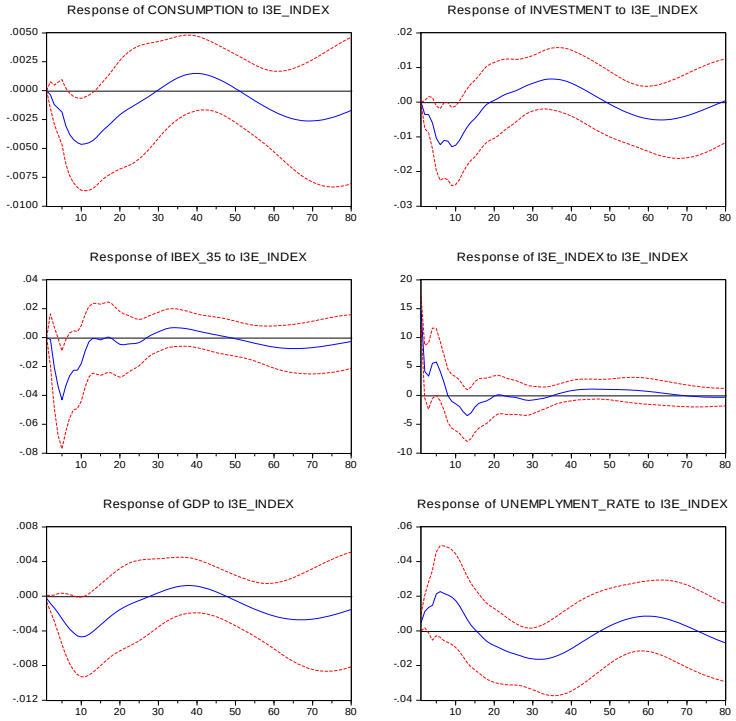


Figure A.2: Model (1.1) Impulse response functions with EPU Index

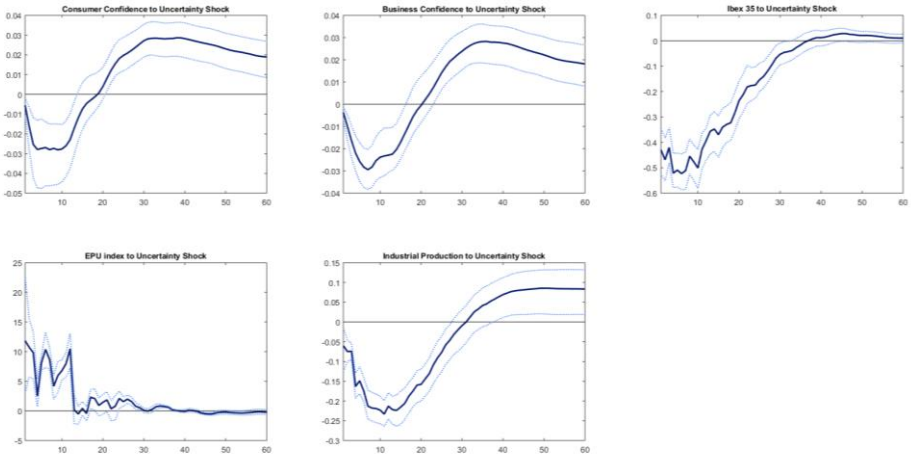
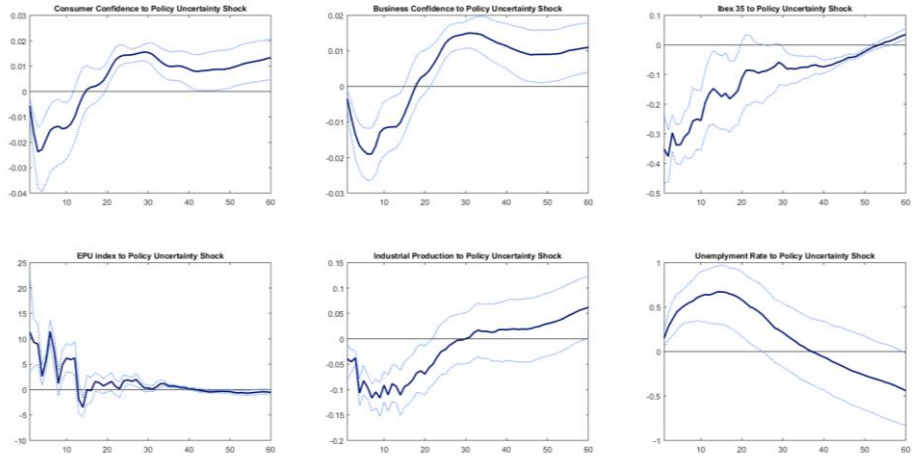
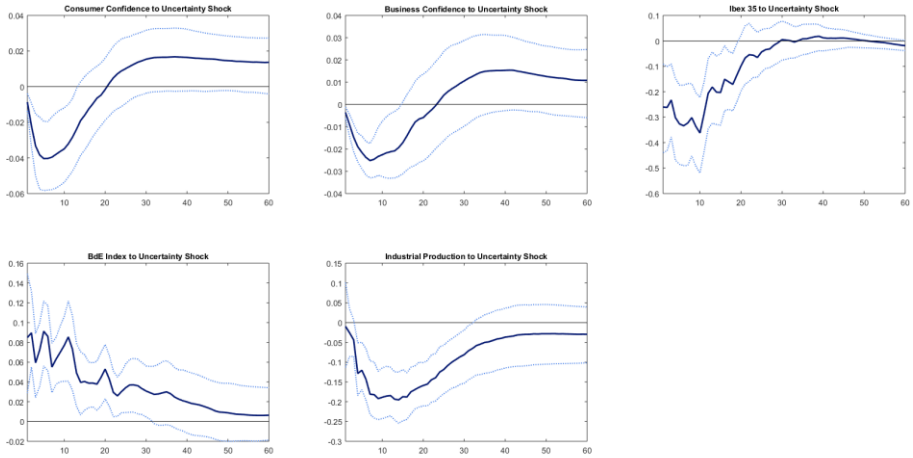


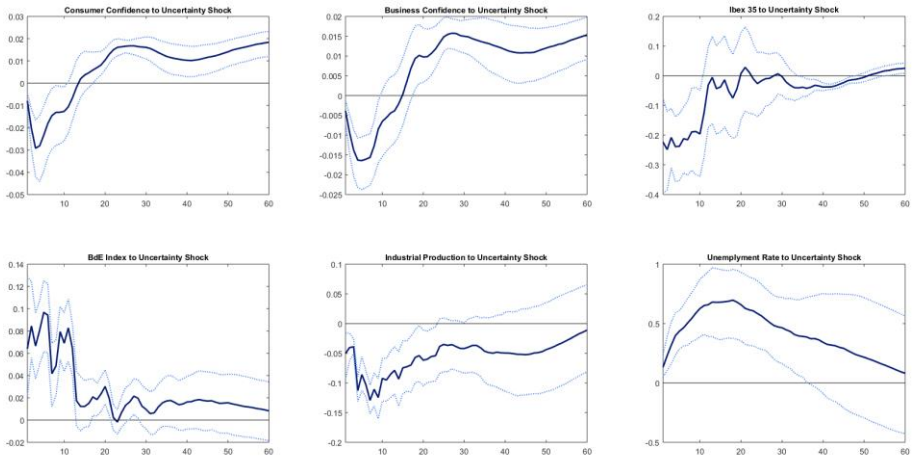
Figure A.3: Model (1.2) Impulse response functions with EPU Index



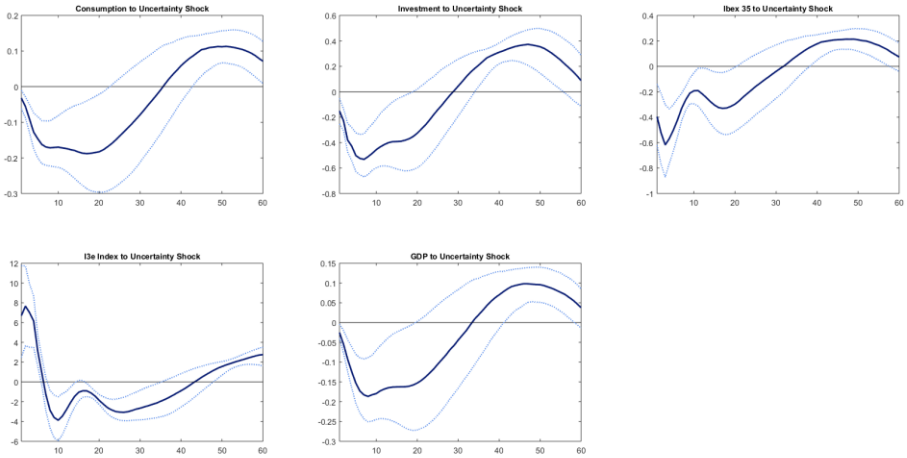
Figures A.4: Model (2.1) Impulse response functions with Bank of Spain Index



Figures A.5: Model (2.2) Impulse response functions with Bank of Spain Index



Figures A.6: Model (2.1) Impulse response functions with i3e Index (Quarterly)



Figures A.7: Model (2.2) Impulse response functions with i3e Index (Quarterly)