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Abstract

The economic events of the last fifteen years have been important to stimulate research. After the 2008 US crisis it was clear that the major macroeconomic models failed to explain what the recession's drivers were. The implementation of standard recovery policies did not produce the expected results, especially in Europe, where the first economic contraction lead to the sovereign debt crisis. Despite the implementation of extraordinary policy tools, like the "*Quantitative Easing*" from the Ecb, the European system did not fully recover the downturn. Among all, the policy implementation failed to enhance the Italian economic system. The evidences incite several researches to understand which frictions impeded the correct transmission of policies' stimuli. A paper from Bloom (2009) suggested a new point of view and started a trend in macroeconomics: the analysis of uncertainty's shock in macroeconomic models. Following this paper, several authors have published their research about the relationship between uncertainty and economic activities. Almost all the literature focus on the role uncertainty played in the US after the subprime crisis, while European economies have been neglected. But empirical evidences from these countries are more interesting because they suffered two crises. In particular, the Italian case offers an important example about the relationship between uncertainty, economic activities and policy implementation. This paper tries to analyse the relationship between uncertainty and macroeconomic quantities. The focus will be on the system's response to uncertainty shock. After the estimation of an empirical model and the implied impulse response functions, the system's behaviour will be compared with forecast based on a theoretical model, highlighting similarities, differences and some policy implications. The results suggest that the Italian economic system is not robust to uncertainty shocks, which effects persist in the long run.

1. Introduction

In the last decade Italy faced a recessive economic phase. Two financial crises hit the economy during this phase. Generally, economic downturns are transitory phenomena, but the last two have not been completely absorbed and their consequences still have impacts on the economic activities. Despite all national and international stimuli, GDP is lower than the 2009 level. Moreover, the international scenario is worsening,[1] therefore the possibility that another shock hits the weakened Italian system is increasing. How is it possible to explain the current economic phase and the determinants of this phenomenon?

There exists a flourishing literature about the economic effects of uncertainty, but these studies concentrate on the US economy only. This paper focuses on Italy and tries to provide an answer to the previous question. The main idea is that these effects persist because last shocks have been combined with the rise of uncertainty. Uncertainty is intended as the condition of being unaware about possible realizations of some contingencies. Its increase obstructed the recovery of the system and had effects on the business cycle. These deleterious effects were more relevant in credit markets, in public bonds markets and in investment decision. An empirical analysis will be conducted to highlight the relationships between uncertainty and other macroeconomic quantities. The quantities will be both financial and real. These results will be compared with forecasts based on a theoretical model. The empirical analysis will be performed estimating a V.AR. model that captures the relationship between macroeconomic variables and an uncertainty indicator. The theoretical analysis will be built on a new Keynesian model with nominal rigidities.

1.1 Literature review

After the 2009 financial crisis the interest in uncertainty analysis has increased in Macroeconomics. Economists began to construct models seeking to capture the effects of uncertainty on the business cycle. In this sense, one of the main contributions is "*The impact of uncertainty shocks*" by N. Bloom (2009).[2] In this article Bloom studies the firms' investment and hiring reactions to an exogenous shock. The author finds that firms react negatively to uncertainty, decreasing investment and hiring. This causes a short run

[1] For example, in the last months the USA rose the taxation on imported goods and oil price increases because the conflict between USA, Iran and other Arabic oil producers. In Europe the leading economy, Germany, is beginning a recessive phase.
[2] N. Bloom, '*'The impact of uncertainty shocks*'', Econometrica, 2009.

crisis. This article gave the impulse to produce complementary studies. J. Fernández-Villaverde et alt. (2013).[3] studied the effects of a shock in a small open economy. Recently, S. Basu and B. Bundick (2017)[4] published a more exhaustive article on the effect of uncertainty in a production economy. Alternative model specifications have been published, for example, by S. Yildirim-Karaman (2018)[5], that introduces an OLG model with limited living households. In one of the most recent published articles, C. Bayer et alt. (2019)[6] analyse the relationship between uncertainty shocks, monetary policy and asset holding. Another recent econometric study by A. Carriero et alt. (2018)[7] focus on the permanent effects that uncertainty shock has on macroeconomic variables.

Some economists, that belong to an alternative tendency, analyse the role of policy risks in uncertain scenarios. For example, B. Born and J. Pfeifer (2014)[8] or J. Fernández-Villaverde et alt. (2015)[9] studied the effect of uncertainty about fiscal policy on the economy. The uncertainty shock framework supports the idea that these shocks have strong effects on real variables, while results in the fiscal policy framework are not univocal. The existing literature regards mainly the US. Apart from A. Anzuini at alt. (2017)[10] and J. Crespo et Alt. (2019)[11], there are not published studies on the Italian case.

2. An econometric analysis on the impact of uncertainty on the economic system

2.1 Uncertainty measurement

While uncertainty can be easily defined, it is difficult to find an omni-inclusive measure able to capture all the sources of economic uncertainty. In literature, authors prefer to consider measures that proxy only a part of the uncertainty in the system. In this sense,

[3] J. Fernández-Villaverde, P. Guerrón-Quintana, J. F. Rubio-Ramírez, M. Uribe, ‘*’Risk Matters: The Real Effects of Volatility Shocks*’’, American economic review, 2011.
[4] S. Basu, B. Bundick, ‘*’Uncertainty shock in a world of effective demand*’’, Econometrica, 2017.
[5] S. Yıldırım-Karaman, ‘’*Uncertainty in financial markets and business cycles*’’, Economic modelling, 2018.
[6] C. Bayer, R. Lütticke, L. Pham-Dao, V. Tjaden, ‘*’Precautionary savings, illiquid assets, and the aggregate consequences of shocks to household income risk*’’, Econometrica, 2019.
[7]A. Carriero, T. E. Clark, M. Marcellino, ‘’*Measuring uncertainty and its impact on the economy*’’, The review of economics and statistics, 2018.
[8] B. Born and J. Pfeifer, ‘’*Policy risk and the business cycle*’’, Journal of monetary economy, 2014.
[9] J. Fernández-Villaverde, P. Guerrón-Quintana, K. Kuester, J. Rubio-Ramírez, ‘’*Fiscal Volatility Shocks and Economic Activity*’’, American economic review, 2015.
[10] A. Anzuini, L. Rossi, P. Tommasino, ‘’*Fiscal policy uncertainty and the business cycle: time series evidence from Italy*’’, Bank of Italy, Working paper, 2017.
[11] J. Crespo Cuaresma, F. Huber, L. Onorante, ‘’*The macroeconomic effects of international uncertainty*’’, E.C.B. working paper, 2019.

statistical indicators, such as volatilities, are employed[12]. This method represents one of the two possible alternatives. It consists in inferring the level of uncertainty in the economy analysing the behaviour and the choices of the economic agents. According to the standard economic framework, the agents react to uncertainty and adequate their actions in accordance with their view about future possible contingencies. Generally, agents react to changes in their beliefs reallocating their financial portfolio or modifying the consumption plan. From these changes it is possible to construct measures and to infer uncertainty level's movements. One issue with these indicators is the limited ability to distinguish between the value change due uncertainty and the value change due to other factors.

The alternative method consists of computing statistics and indicators based on surveys or on qualitative data. In general, these surveys are constructed to directly assess the interviewees' beliefs about future economic conditions. Typical interviewed people are either professionals, top managers or households. When these agents state their beliefs about the future, they will be influenced by their view about uncertainty. Most of the surveys are constructed to extrapolate the uncertainty view of each individual and to deduce the general level of uncertainty of the population. A classical uncertainty indicator built on surveys and publicly available is the ''Consumers' confidence level''. This indicator assesses the households' level of confidence about the current economic conditions and their opinion about future economic trends. Although these indicators[13] directly assess the uncertainty level, they may present some issues. For example, they are based on limited samples and the sampling procedure can introduce biases. Additionally, the answers of these interviewees are influenced by their cultural and social identity. Considering the Italian case, Istat[14] constructs the consumers' confidence indicator using a sample of 2000 consumers only while the population is above 60 million[15].

To overcome the shortfalls of both type of indicators, the following empirical analysis will be based upon several indicators considered.

2.2 Description of selected indicators

Among all possibilities, only indicators whose observation are available at least from the last quarter of 1999 have been considered. Other indicators have been discarded. The

[12] A classic example is the VIX index that assess uncertainty through equity prices' fluctuations.
[13] Similar indicators are constructed with samples of business managers, manufacture firms and similar categories.
[14] ''Istituto nazionale di statistica'', the Italian national institute of statistics.
[15] http://dati.istat.it/OECDStat_Metadata/ShowMetadata.ashx?Dataset=DCSC_FIDCONS&Lang=it.

survivors have been tested and used to estimate a preliminary V.AR. model. Only two indicators seem to be suitable for the Italian case. The first indicator is the Economic Policy Uncertainty index (EPU). This is a mixed index[16] freely available online.[17] The EPU index is the aggregation of three measures. The first measure is built analysing national newspapers articles. In particular, an algorithm computes the frequency at which some relevant triplets[18] appears in the articles. The second component of the index is built on the government reports about temporary tax code provision. Lastly, the authors compute a measure of disagreement about future economic forecasts provided by different professionals. The EPU index is published as a monthly time series. Since the V.AR. is estimated using quarterly data, the series used is the mean of every month realizations during each quarter.

The second indicator selected is an indicator of the FTSE MIB volatility. This index belongs to the first category of indicators because it is based on observed market prices. This uncertainty indicator, corresponding to the American VIX index, is the most used in literature. However, the FTSE MIB[19] volatility index, called FTSE MIB IVI, cannot be used since available times series are not long enough. To proxy the FTSE MIB IVI, an historic volatility index has been selected.

The two selected indicators have limitations. The EPU index, by construction, cannot be properly replicated in a theoretical model and the relationship between the triplet and uncertainty may be questioned. The historic volatility, contrarily to FTSE MIB IV index, is backward looking, hence it is only a proxy of the expected uncertainty in financial markets. Since these indicators presents issues, an alternative indicator has been constructed. This new estimator is a linear combination of consumers' confidences, FTSE MIB historic volatility, Euro Stoxx 50 implied volatility and a measure of uncertainty in bond markets. The last component, called ω, is an alternative indicator based on the divergences of the 10Y BTP and 10Y BUND interest rates.

2.2.1 The description of the indicator ω

The indicator ω is based on the divergence between the 10Y BTP and the 10Y BUND interest rate. Both BTP and BUND are long term government bonds. The 10Y BUND is amply considered as the European risk-free long-term investment and its rate of return

[16] S. R. Baker, N.s Bloom, S. J. Davis, "*Measuring Economic Policy Uncertainty*", The Quarterly Journal of Economics, 2016, Volume 131, Issue 4.
[17] https://www.policyuncertainty.com/.
[18] The triple must contain the word economy (or similar), the word uncertainty (or similar) and a word regarding economic policy. See the website or the original paper for further details.
[19] The Italian stock exchange.

can be used as risk free rate in most of economic and financial models based on European economies. The BTP is the Italian long-term government bond. It can be considered as the Italian riskless long-term investment. However, these securities are highly correlated. The European economic integration, started with the creation of the European Economic Community (ECC) and hastened with the creation of the European Union (EU), increased the cross-country financial integration. Nowadays, the European Central Bank (E.C.B.) takes all monetary policy decisions and has the duty to monitor the European banking system. This increasing economic integration of the European countries implies that also the financial instruments become closely related. Nevertheless, returns of many instruments, for example long term government bonds, are still different because of issuers' structural differences. In particular, returns on German government bonds are lower than the returns on Italian government bonds. According to the asset pricing theory, the return of an asset is higher if the risk associated with the asset is higher. Especially for long term bonds, differences come from structural aspect of the economy and from uncertainty about economic stability in unfavourable scenarios. The main idea behind ω is to infer changes in the uncertainty level from changes in the secondary market rates of return[20]. This can be possible because only professional agents invest in the government bonds' secondary market. Daily, they negotiate government bond, trying to adjust their portfolios to market changes or trying to speculate on bonds' mispricing. Actions of these agents are partly influenced by daily news, new issues, E.C.B. policies, political inference, and other social phenomena. These aspects define and contribute to the level of uncertainty in the economy. The aim of the indicator is to isolate uncertainty dynamic from bonds' rate movements. To isolate this effect, daily market rates time series are used. For each series, the daily change is calculated. A new indicator function can be computed using daily changes. This indicator function takes value 0 if the daily changes of the two bonds' return have same sign. If the BTP's return increases while the BUND's return decreases, the indicator function takes value 1. In the opposite case, the indicator function takes value -1. The logic behind this choice is to discard co-movement in returns and assume that divergence is also caused by change in uncertainty[21]. Without further information, if rates move in the same directions, it is not possible to do inferences. Differently, if rates move oppositely, agents are reacting to new information about one of the two economies. Considering German economy as the leading European economy, it

[20] Government bonds have predetermined returns. The payment structure is determined at the issue date. The rate of returns used in this analysis are the secondary market returns. These returns may differ from the return agreed in the first market.

[21] This change may be due to policy changes or cycle conditions.

is possible to assume that negative news about German economic conditions will directly afflict Italian government bonds. On the other side, since Italy is just the third[22] economy in the EU, it is possible to suppose that negative information about Italian economic conditions afflict mainly Italian bonds and marginally German securities. In this case, the spread between the rates increases if negative information about Italian economy become available, while tighten in case of positive information releases. Therefore, if rates diverge, economic view about the Italian economy worsen and uncertainty may be increasing. In the opposite case uncertainty decreases. The function is

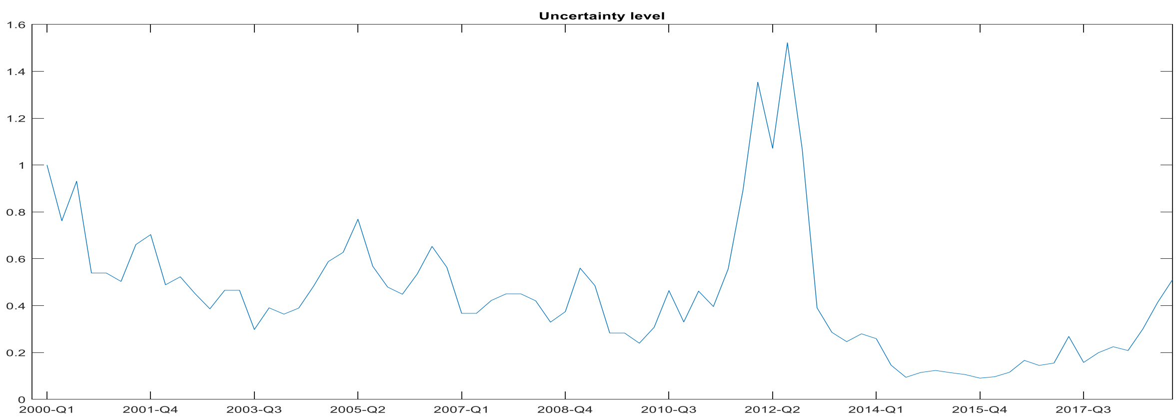
$$f(x) = \begin{cases} -1 & \Rightarrow sign(\Delta ir_{it}) < 0 < sign(\Delta ir_{de)} \\ 0 & \Rightarrow sign(\Delta ir_{de}) = sign(\Delta ir_{it}) \\ +1 & \Rightarrow sign(\Delta ir_{de)} < 0 < sign(\Delta ir_{it)} \end{cases} .$$

With this function it is possible to transform daily signals in a quarter index. At this point, a measure that includes both prevalent direction of uncertainty changes and frequency of the changes can be constructed. This measure is defined as follows:

$$\omega_{q_t} = \sigma[f(x_t)] * \frac{\sum_t f(x_t)}{10}$$

for any $t \in q_t$, where q_t is the quarter.

The first term is the standard deviation of the daily signals. This term captures the amount of divergent changes. The second term indicates whether the cumulative uncertainty level increases or not. If the sum is positive, more divergent shocks arose, so uncertainty increased. Contrarily, the sum is negative if uncertainty is diminishing and rates are converging. The graphic representation of the indicator ω is:



[22] Considering the United Kingdom, Italy would be fourth.

The constructed indicator suggests that uncertainty is decreasing at the beginning of the century. Later, it grew around 2005 and 2008. It is worth noting that the indicator increases but does not peak in 2007-2009 as traditional indicators suggests. This indicates that ω does not fully capture uncertainty coming from economic downturn caused by the U.S. financial crisis. After the American crisis, the European countries faced another downturn and uncertainty peaked. In particular, from 2010, European countries faced a sovereign debt crisis. Financial investors considered bonds of countries with high debt to G.D.P. ratio highly risky, causing a drop in bonds' prices and the beginning of a recession period. According to the indicator, this was a period of high uncertainty. From 2013 uncertainty fell, probably because the spread was strongly influenced by the intervention of E.C.B. and by changes in budget spending (austerity). However, from the second part of 2017, uncertainty seems to be strongly rising. This may be caused both by international frictions among developed countries and by the change in the domestic politic equilibrium.

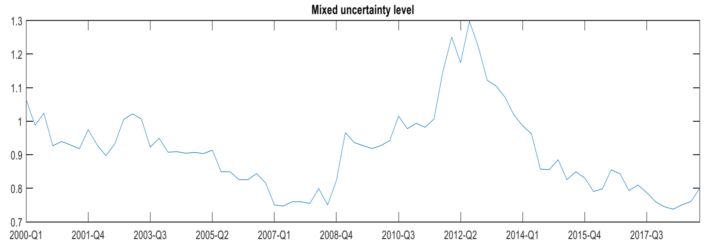
2.2.2 Mixed uncertainty indicator U

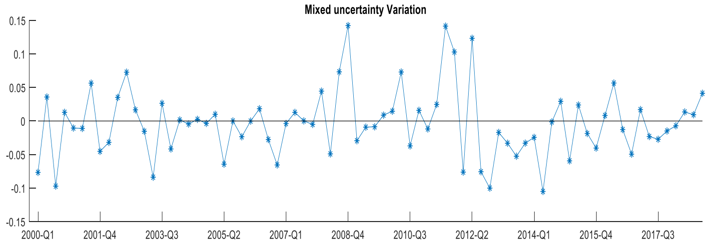
Every indicator available has weaknesses and captures only particular aspects of uncertainty. To improve the analysis, an indicator that comprehends all the previous measures as been constructed. This indicator includes consumers' confidence, signals from Equity markets volatility and signals from long-term public bonds' prices. A possibility to integrate this information is the construction of a linear combination between different measures. To capture consumers' uncertainty[23], consumers' confidence level is used. The indicator ω will be included to capture signals from the bonds' market. An Equity market signal will be included, but two indicators will be used, the FTSE MIB historic volatility and the Euro Stoxx 50 implied volatility index[24]. It is convenient to include the Euro Stoxx IV index because it captures changes in uncertainty at European level. The mixed indicator is computed as follows:

$$U_t = 0.425 * \left(\frac{Cons'.conf}{mean(cons'.conf)}\right)^{-1} + 0.075 * \frac{\omega}{mean(\omega)} + 0.35 * \frac{H.V.}{mean(H.V.)} + 0.15 * \frac{E.S.IVI}{mean(E.S.IVI)}.$$

In the next figure it is possible to observe the estimated level of uncertainty and the level movements during the dataset's period:

[23] To describe consumer's uncertainty the inverse of consumers' confidence has been considered.
[24] The Euro Stoxx 50 implied volatility has been downloaded from the Bloomberg platform.





According to the mixed indicator U_t uncertainty is decreasing until 2007. From late 2008, at first for the US financial crisis, then also for the European sovereign crisis, uncertainty strongly increased. After the 2012 the indicator suggests decreasing uncertainty. Analysing the first difference's path it is clear that two main shocks arose in uncertainty during the sample period: 2008 and 2010-2011 crises. However, after the 2008 crisis the uncertainty level did not move back, and it stayed constant for two years. At this point, another shock hit the economy, so the aggregate level reached its peak. This was the period of the feared sovereign default. To avoid the default and to contrasts rising uncertainty, Italian government began restrictive budget policies. When it was clear that Italy would not have defaulted, uncertainty diminished. At this point the economic system started to experience a slightly increasing period, while uncertainty kept decreasing.

To complete the description of the mixed indicator it is the case to study the relationship between the indicator and the GDP and between the different indicators. The correlation between U_t and the GDP is -48%. The following table contains the correlation coefficients between the various indicators:

Correlation matrix

	EPU index	Historic volatility	Omega	Cons.' Confidence	Euro Stoxx 50 IVI	Mixed indicator
EPU index.	1	50%	4%	17%	39%	45%
Historic volatility	50%	1	24%	22%	21%	82%
Omega	4%	24%	1	32%	16%	65%
Consumers'. Confidence	17%	22%	32%	1	5%	57%
Euro Stoxx 50 IVI	39%	21%	16%	5%	1	40%
Mixed indicator	45%	82%	65%	57%	40%	1

The mixed indicator is highly correlated with all the other considered measures of uncertainty. It is correlated also with the EPU index, which has not been used to construct U_t.

2.3 Data description and analysis

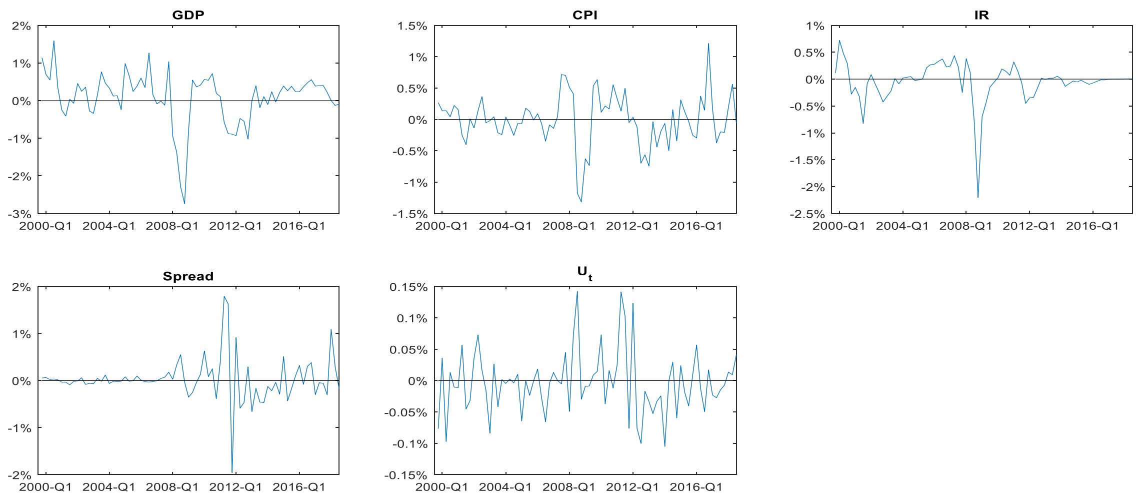
The econometric analysis is based on four macroeconomic variables and one uncertainty indicator. The first variable of the model is the Italian gross domestic product percentage change (GDP). The second variable is the consumer price index (CPI). The third variable is the short-term interest rate (IR), annualized. Data of these series are available online on the OECD website[25]. The last variable is the 10Y BTP-BUND spread. This time series has been computed using interest rates available on DataStream.

The uncertainty indicator employed in the V.AR. analysis is the composed indicator U. For completeness and comparison, other two V.AR. models will be estimated using the EPU index and the Historic volatility.

The V.AR. model requires stationary data[26]. To check stationarity, the Augmented Dickey–Fuller test and the K.P.S.S. test have been performed. The method used to detrend the series is first difference. The Augmented Dickey-Fuller tests indicates that all series are stationary in first difference. Contrarily, the K.P.S.S. indicates that only the GDP is not stationary in first difference. Series are all stationary in second difference. The estimation of the model will be performed in first difference. The first difference time series are presented in the following figure:

[25] The GDP series can be found here: https://data.oecd.org/gdp/quarterly-gdp.htm#indicator-chart; The CPI can be download here: https://data.oecd.org/price/inflation-cpi.htm#indicator-chart; The short term interest rate is available here:
https://data.oecd.org/interest/short-term-interest-rates.htm.

[26] This is controversy. Some authors argue that stationarity is not required if the variables have the same order of integration and are cointegrated.



Correlations between variables in first differences are summarized in the following table:

Table1 (correlation in first difference)

	GDP	CPI	IR	Spread	U
GDP	1	39%	59%	-8%	-23%
CPI	39%	1	48%	26%	14%
IR	59%	48%	1	12%	-3%
Spread	-8%	26%	12%	1	64%
U	-23%	14%	-3%	64%	1

Since in a V.AR.(p) model each variable depends on the p past realizations of the variables, it is the case to analyse the Autocorrelation and the Partial autocorrelation functions of each series. In general, the autocorrelations decay to 0 at high lags and the PACFs are negligible or become negligible after one period.

2.3.1 V.AR. order decision

To decide the order p of the V.AR.(p) model two information criteria are considered. The first criterion is the Akaike information criterion (AIC). The second is the Bayesian information criterion (BIC). Capping the search field to $p = 6$, the results are summarized in Table2:

Table 2

Order	1	2	3	4	5	6
AIC	-12.9	-0.4	9.0	8.5	-16.9	-17.5
BIC	56.6	126.4	192.3	247.5	277.2	331.0

The order with lower criterion value should be selected. The criteria diverge. The AIC criterion is minimum at order 6. According to the BIC criterion, a V.AR.(1) model should be selected. Because the criteria suggest different orders, a joint minimization approach is used. The V.AR.(2)'s BIC value is the second smallest and not very far from to the V.AR.(1)'s BIC value. The AIC is relatively small at order 1 and order 2. The order selected is $p = 2$.

2.4 V.AR.(2) model estimation

The V.AR. model consists of 5 equations with 10 coefficients each plus the intercepts. The parameters to be identified are 55.

The observations are 76 for each variable. The estimation method employed is the maximum likelihood estimator. It is possible to estimate the model with the ordinary least squares estimator. This is possible because the model is analogous to a seemingly unrelated regressions model (SUR) with the same regressors for each equation[27]. The estimated coefficients are presented in Table 3:

Table 3

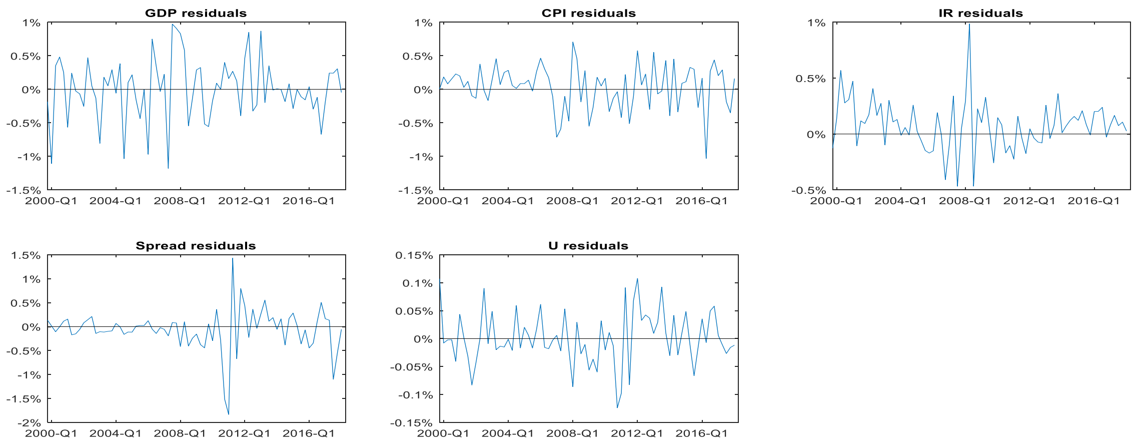
	GDP(t-1)	CPI(t-1)	IR(t-1)	Spread(t-1)	U(t-1)	GDP(t-2)	CPI(t-2)	IR(t-2)	Spread(t-2)	U(t-2)
GDP(t)	0,59	0,03	0,24	0,08	-2,27	0,10	-0,51	-0,32	0,00	1,25
CPI(t)	0,28	0,24	-0,06	0,11	0,13	0,09	-0,09	-0,04	-0,04	1,61
IR(t)	0,15	0,12	0,33	0,06	-2,16	0,10	-0,16	-0,12	0,02	-0,07
Spread(t)	-0,05	-0,03	0,20	-0,22	0,67	0,03	0,40	-0,07	-0,24	1,11
ω(t)	-0,02	0,02	0,01	0,00	-0,14	0,00	0,03	0,00	0,01	-0,19

Intercepts have been omitted. The adequacy of the estimated model is summarized in the following figure:

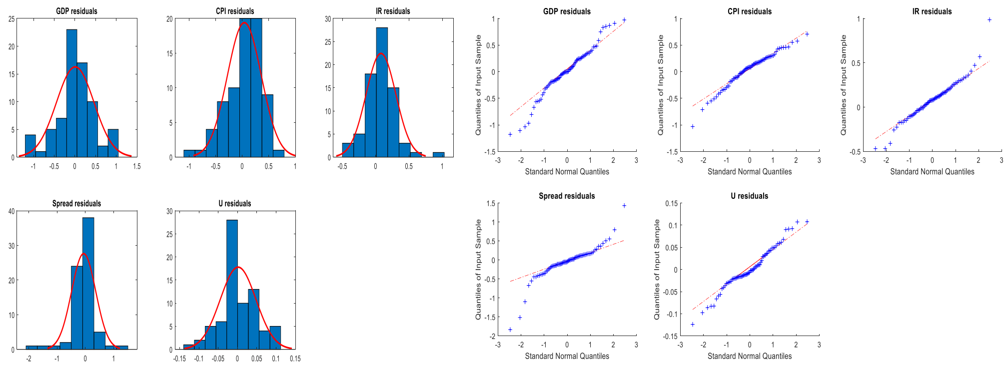
[27]This is one of the two sufficient Zellner's condition. Under this condition, the OLS estimation of the coefficients it consistent and it is possible to estimate the whole system estimating individually each of the equations.

2.4.1 *Analysis of the residuals*

Since the V.AR. model consists of linear regressions, it is the case to analyse the statistical properties of residuals. In theory, the generating process should be a Gaussian Normal distribution. Under this assumption, the asymptotic distribution of residuals should be normal. However, the dataset used to determine the coefficients has 76 observations, therefore asymptotic properties may not be verified. Additionally, SUR models tolerate correlated residuals at the same point in time, but there should be no correlation among residuals at different time. The residuals are presented in the following figure:



Extreme realizations are present in graph 3 and in graph 4. To investigate whether residuals' normality is verified or not, it is convenient to plot the histograms of each series. Additional information can be derived from the quantile-quantile plot (QQ-plot).



The equation 4's histogram highlights the presence of non-normal kurtosis. In particular, the distribution seems to be leptokurtic. It is the case to complete the analysis with a formal test. The chosen test is the Lilliefors test. Performing the test, the null hypothesis that the errors are normally distributed is rejected for equation 4 at 5% confidence level. Since evidence suggests that the estimated model does not satisfy normality of residuals, is it the case to modify the model? Probably not. Test failure is likely to be caused by sample shortness. Moreover, the sample covers the period from first quarter of 2000 to last quarter of 2018, where two major shocks arose. The presence of two important economic shocks in limited sample caused the extreme realizations and the residuals issues. A larger sample, including economic shocks arose in eighties and in the nineties, would have improved estimation performances[28].

The second part of residuals analysis is about correlation among residuals. In particular, it is the case to verify whether residuals are correlated across time or not. The Ljung–Box test has been performed. The test confirms the irrelevance of ACF and PACF.

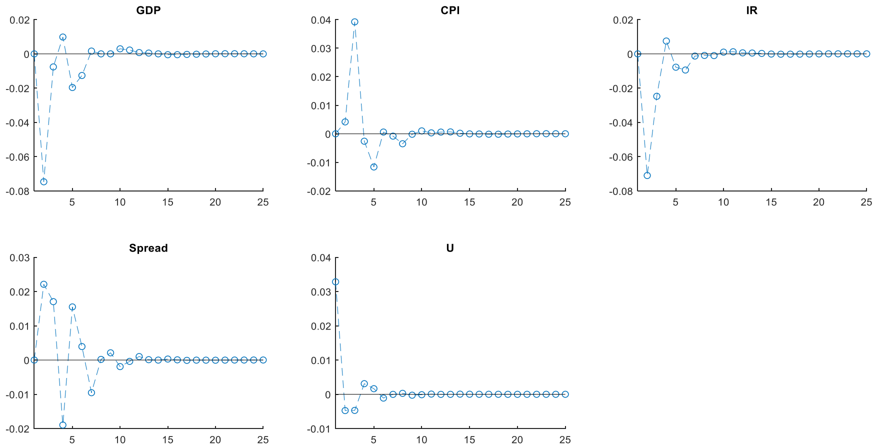
Since residuals are not autocorrelated and the Spread's non normality probably comes from the dataset's period peculiarities, the model will be considered valid and confirmed as the empirical baseline model.

2.5 Impulse response functions

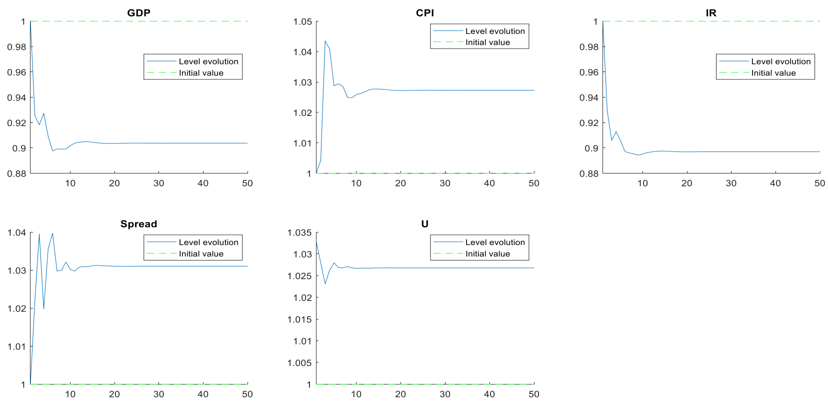
The estimated V.AR. model is useful to simulate the dynamic responses of the system to economic shocks. Assuming that the model is in equilibrium, the impulse response functions describe the dynamic behaviour of each variable of the system. When a shock hits one of the variable, it propagates in time to all the others. The effects of the shock's propagation is fully determined by the coefficients. In this analysis, a shock is the unpredicted realization of a variable. The main interest is to determine the system's

[28] For completeness, the Spread's residuals without extreme realizations have been tested. In this case, the Lilliefors test cannot reject the null hypothesis of normality.

response to an uncertainty shocks. The impulse response to other shocks are not presented.[29] The following figure shows the orthogonalized dynamic response to a positive unit shock in the uncertainty level:



The system's response in the first period is negative. Thereafter GDP and IR decrease for several periods. The Spread response is mainly positive but oscillatory. It is negative in economic terms because spread growth implies higher cost of financing. The CPI increases. Even the response of the uncertainty indicator U is positive but dries out quickly. Since the series are in first differences, it is the case to compute the level behaviour of the system to the uncertainty shock. Starting from the equilibrium level 1 for each variable, the level movements are desribed in the following figure:

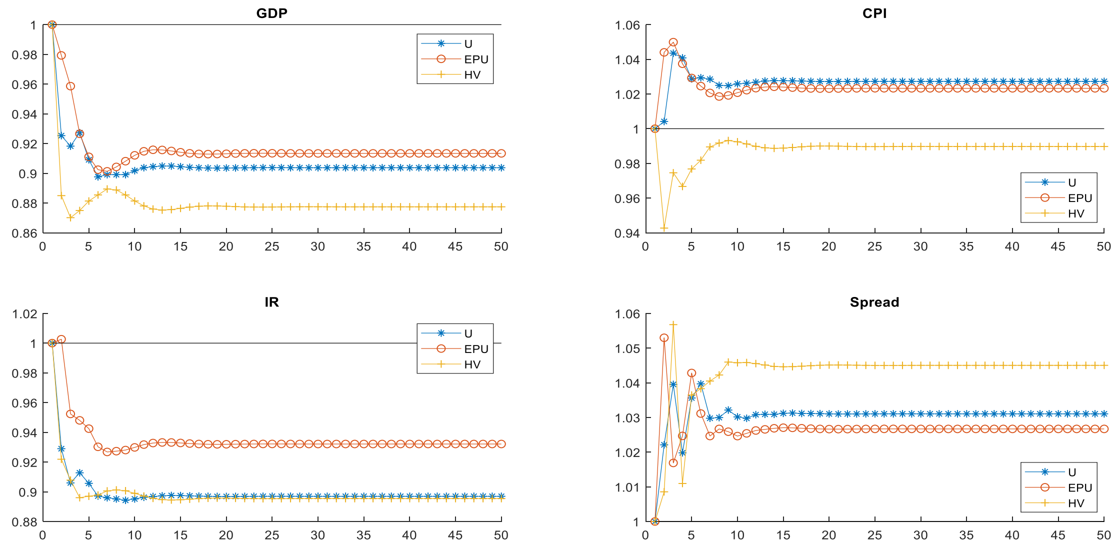


From the levels' changes it is possible to infer the impact that the shock has on the economic system. All quantities have new equilibrium level. The uncertainty level increase. The increase is associated with the decrease of the country production. The GDP permanetly diminishes. The CPI increases despite the crises. This result is affected by the Bce expansive monetary policy. But, if the Fisher equation holds, combined short term interest rate decrease and inflation increase imply that the real interest rate must decrease.

[29] They can be found in the thesis's appendix, available on the L.U.I.S.S. Thesis website.

The incentives to invest are lower and the long term recover may be longer. Additionally, the uncertainty indicator increase the spread. Although the short term dynamic is opaque, the long term increase in long term government bond may undermine the role of the government. If the cost of financing increase the policymaker cannot implement expansive policies and the economic stimuli coming from public spending diminish.

To complete the analysis, the dynamic beaviours of the systems has been simulated using the other uncertainty indicators. The aggregate movements caused by an uncertainty shock are compared in the following figures[30]:



The GDP's responses are similar. The empirical models predict 10% drop in GDP after the shock hit the economy. The historic volatility shock produces an higher drop in output, that recovers for some periods before dropping again to the minimum level. In any case, all models suggest that unexpected uncertainty increase imlpies a permanent decrease in GDP. The CPI behaviour is not univocal. The baseline model, as the V.AR. model with the EPU index, suggests that inflation rises +6% immediately after the shock and remains +2% higher in the long run. The model with HV predicts a symmetric dynamic behaviour, with an initial level drop of 6% followed by a convergence phase where inflations approch the level 0.99. In the IR case every models predict a permanent level decrease, although the permanent decrease in the EPU case is only 6% while the other predics a 10% permanent fall. The spread's impulse response functions are oscillatory. They converges to higher levels but in the short run their behaviour is not univocal. The oscillations of U and HV are sincronized, while EPU differs. After 5 periods, the EPU

[30] The indicators' impulse response functions are omitted. All indicators increase and reach an higher level. The new level of Historic volatility is particularly high.

model's level converges to the level predict by the indicator U, while in the model with historic volatility the level is slightly higher. It is the case to focus on the spread's short term oscillations. The oscillations may be problematic since they do not indicate a clear path followed by the spread in the short run and may questioned the goodness of the model. Nevertheless, this issue is common in all the estimated model. Since it is a common behaviour to uncertainty shock, the origin of this movement must be found in the dataset. Probably the limited data length entails estimation weakness for the coefficients of the Spread.

3. A Theoretical analysis on the impact of uncertainty on the economic system

To complete the analysis of the Italian economy's response to an uncertainty shock, it is necessary to compare the empirical findings with the results implied by a theoretical macroeconomic model.[31]

3.1 The description of the model

Consider a world inhabited by a representative household, a continuum [0,1] of firms that produce intermediate goods, a representative final producer and a neutral government. The household, which is economically rational, consumes, works and owns the firms. Final producer invests in intermediate goods that can buy from each intermediate producer. Intermediate producers are monopolistic competitors and produce using only labour. The government does not act in markets and enforces only an interest rate rule. The interest rate rule depends on inflation, interest rate level and output variations.

3.1.1 The household's problem

The household's decisions regard how much to consume each period, how much labour to supply, and the amount of money to hold. He can also decide to invest in a one period bond market. Through assets he can move wealth across different periods. Every period he receives salary for the work supplied, he earns profits from owned firms and pays tax.[32] Assuming that he lives forever, his problem can be formalized as follows:

$$\max_{\{C_t,N_t,M_t,B_{t+1}\}_{t=1}^{+\infty}} \left\{E_0\left[\sum_{t=0}^{+\infty}\beta^t\left[\frac{C_t^{1-\sigma}}{1-\sigma}-\frac{\psi N_t^{1+\eta}}{1+\eta}+\theta\ln\left(\frac{M_t}{P_t}\right)\right]\right]\right\}$$

[31] The theoretical model used is a new Keynesian model. The new Keynesian model were introduced by Smets and Wouters and by Galì and Gertler.

[32]As it would be explained later, because the government is neutral, the household may pay taxes or may receive a transfer from the government. This will depend on the money supply's change.

under the periodical budget constraint

$$P_tC_t + B_{t+1} + M_t - M_{t-1} = W_tN_t + \Pi_t - P_tT_t + (1 + i_{t-1}) * B_t.$$

The household is assumed to be ‘’impatient’’, because $\beta\epsilon(0,1)$.

This problem corresponds to an infinite constrained maximization. It can be solved introducing the correspondent Lagrangian function and maximizing for the choice variables and the Lagrangian multiplier. To find the maximum of the function[33] it is sufficient to consider first order condition with respect decision variables at time t[34]. Combining the F.O.C.s with respect C_t, C_{t+1} and B_{t+1}, it is possible to determine the associated stochastic Euler equation:

$$\left(\frac{C_t}{E_t[C_{t+1}]}\right)^{-\sigma} = \beta * (1 + i_t) * E_t\left[\frac{P_t}{P_{t+1}}\right].$$

From the derivatives with respect consumption and labour it is possible to determine the labour supply curve:

$$N_t^{\eta} = C_t^{-\sigma} * \psi\frac{P_t}{W_t}.$$

Lastly, the derivative with respect money holding and the derivative with respect bond holding implies that:

$$\left(\frac{M_t}{P_t}\right)^{-1} = \frac{1}{\theta} * C_t^{-\sigma} * \frac{i_t}{1+i_t}.$$

This is the real money balance demand. The household problem is synthetized in the conditions above and the budget constraint.

3.1.2) The final producer’s problem

The final producer has a constant elasticity of substitution production function that aggregates every intermediate good. The production technology[35] is:

$$Y_t = \left(\int_0^1 Y_t(j)^{\frac{\varepsilon-1}{\varepsilon}}dj\right)^{\frac{\varepsilon}{\varepsilon-1}}.$$

---

33 This utility function specification implies that the first order conditions are sufficient conditions for the constrained maximum.

34 B_{t+1} is the decided at time t.

35 It is assumed that ε>1.

The producer sells the final good at price P_t and buys input $Y_t(j)$ at price $P_t(j)$, that is chosen by producer j. Given the prices level, his optimality behaviour is described solving the correspondent static profit maximization problem:

$$\max_{y_t(j)\forall j\in[0,1]} P_t\left(\int_0^1 Y_t(j)^{\frac{\varepsilon-1}{\varepsilon}}dj\right)^{\frac{\varepsilon}{\varepsilon-1}} - \int_0^1 P_t(j)Y_t(j)dj.$$

Differentiating for any of the j^{th} good, the first order condition is:

$$\frac{d\Pi_t^f}{dy_t(j)} = 0 \Leftrightarrow y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon} Y_t.$$

This condition, valid for any j, is the final producer's demand for good $y_t(j)$. However, the price level is not determined yet. To derive the price level, consider the nominal output as the sum of nominal value of each intermediate good and include the optimal demand for $y_t(j)$:

$$P_t = \left(\int_0^1 P_t(j)^{1-\varepsilon}\, dj\right)^{\frac{1}{1-\varepsilon}}.$$

3.1.3 The j^{th} intermediate producer's problem

The intermediate producers' optimality conditions are needed to solve the model. In theory intermediate producers' problem comes before final producer's one, but they can anticipate the final producer's optimal demand of their product. Furthermore, they cannot freely adjust price each period. They may be constrained to maintain previous period prices with probability ϕ, or, with probability 1- ϕ, they can set the price they prefer. Their problem can be divided into two part. First, they choose the amount of labor needed to produce. This is a static problem. Second, they define a strategy such that if they are able to set their desired price, it should maximize the expected future profits flow. This is a dynamic problem. The production function of firm j is $Y_t(j) = A_t N_t(j)$, where A is an exogenous productivity shock defined as $\ln(A_t) = \rho_a \ln(A_{t-1}) + a_1\varepsilon_{a,t}$.[36] Firm's problem can be solved by the minimization of input cost:

$$\min_{N_t(j)} W_t N_t$$

[36] A_t follows a log AR(1) process with 0 mean. The factor a_1 is the component that will be used to introduce second order shock in the simulation with Dynare®.

where W_t is wage. Because firm j anticipates optimal demand from final consumer's problem, then the demand for its good can be considered as a constraint. Solving the optimization problem, it is possible to find the following optimality condition:

$$W_t = \delta_t(j)A_t.$$

Knowing the condition that satisfies optimal production choice, it is possible to solve the dynamic price setting problem. From the profits in real terms and calling $\mu_t = \frac{\delta_t(j)}{P_T}$ [37] the real marginal cost of firm j, the period t profit become:

$$\Pi_t(j) = \frac{P_t(j)}{P_t} Y_t(j) - \mu_t Y_t(j).$$

Firm j sets its price in order to maximize this quantity. But it must also consider that, with probability ϕ, next period it will not be able to reset the price and will be stack with previous period price. Hence, setting a price at time t implies that this price will be still charged *s* period ahead with probability ϕ^s.

It follows that resetting firm price problem is:

$$\max_{P_t(j)} E_t \left[\sum_{s=o}^{+\infty} \left\{ (\beta\phi)^s * \frac{U'(C_{t+s})}{U'(C_t)} * \left[\frac{P_t(j)}{P_{t+s}} Y_{t+s}(j) - \mu_{t+s} Y_{t+s}(j) \right] \right\} \right]$$

Where $\beta^n * \frac{U'(C_{t+n})}{U'(C_t)}$ is the stochastic discount factor.

Notice that $Y_t(j)$ is known and can be substituted. Differentiating with respect to price j, it is possible to derive the optimal reset price:

$$P_t^*(j) = \frac{\varepsilon}{1-\varepsilon} * \frac{E_t\left[\sum_{s=0}^{+\infty} \beta^s \phi^s U'(C_{t+s}) \mu_t P_{t+s}^{\varepsilon} Y_{t+s}\right]}{E_t\left[\sum_{s=0}^{+\infty} \beta^s \phi^s U'(C_{t+s}) P_{t+s}^{\varepsilon-1} Y_{t+s}\right]}.$$

It is possible to simplify notation introducing two auxiliary variables:

$$V_t = E_t\left[\sum_{s=0}^{+\infty} \beta^s \phi^s U'(C_{t+s}) \mu_t P_{t+s}^{\varepsilon} Y_{t+s}\right]; \; Q_t = E_t\left[\sum_{s=0}^{+\infty} \beta^s \phi^s U'(C_{t+s}) P_{t+s}^{\varepsilon-1} Y_{t+s}\right].$$

Notice that V_t and Q_t does not depend on j. thus resetting price, for any j, at time t is:

$$P_t^* = \frac{\varepsilon}{1-\varepsilon} * \frac{V_t}{Q_t}.$$

[37] Index j can be omitted because each producer has identical technology and faces identical economic conditions, so the marginal cost is common.

3.1.4 The role of the government

The economy is governed by a neutral government that controls monetary policy and taxes. The government, which neither spends nor participates in the bond market, sets the policy in terms of interest rate. The interest rate policy is a Taylor type rule:

$$i_t = (1-\rho_i)i + \rho_i i_{t-1} + (1-\rho_i)\varphi_\pi(\pi_t - \pi) + (1-\rho_i)\varphi_y\left(\frac{y_t - y_{t-1}}{y_t}\right) + a_2\varepsilon_{i,t}$$ [38]

Although policy is in interest rate term, there is money in the economy. Money level changes according to money holding demand. When money holding changes, government either earns a revenue or need to collect taxes. Its period budget constraint is:

$$P_t T_t = M_{t-1} - M_t.$$

3.2) The equilibrium conditions of the model

In this section the conditions above will be used to derive a system of aggregate equilibrium condition. It is the case to rewrite the household's budget constraint. $P_t T_t$ and Π_t are known, $B = 0$ in equilibrium, then:

$$P_t C_t = \int_0^1 P_t(j) Y_t(j)\, dj.$$

It is convenient to substitute optimal P_t and $Y_t(j)$, final producer's demand. It follows:

$$C_t = Y_t.$$

Y_t is not known yet but can be easily found:

$$\int_0^1 Y_t(j)dj \;=\; \int_0^1 A_t N_t(j)dj \;=\; \int_0^1 \left(\frac{P_t(j)}{P_t}\right)^{-\varepsilon} Y_t dj\,.$$

A_t is the productivity shock and does not depend on j, $\int_0^1 N_t(j)dj = N_t$, therefore, calling $\gamma_t = \int_0^1 \left(\frac{P_t(j)}{P_t}\right)^{-\varepsilon} dj$ it follows that

$$Y_t = \frac{A_t N_t}{\gamma_t}.$$

The full set of conditions derived in section 2.1 and in this section are sufficient to solve the model. However, because some conditions depend on j, model has heterogeneity. Moreover, equilibrium conditions depend on prices, that are not stationary by

[38] The coefficient a_2 will be used to introduce the second moment shock in the simulations.

construction.[39] To avoid these issues, it is possible to pass from prices to inflation rate, that is stationary, and to consider some variables in real terms.[40]

Starting from household's optimality conditions:

$$\left(\frac{C_t}{E_t[C_{t+1}]}\right)^{-\sigma} = \beta * (1 + i_t) * E_t\left[\frac{P_t}{P_{t+1}}\right] = \beta * \frac{(1+i_t)}{E_t[1+\pi_{t+1}]}.$$

The labour supply curve written in real terms becomes:

$$N_t^{-\eta} = -C_t^{\sigma} * \psi(w_t)^{-1}.$$

Likewise, money holding should be expressed in real money balance terms:

$$m_t^{-1} = \frac{1}{\theta} * C_t^{-\sigma} * \frac{i_t}{1+i_t}.$$

Calvo's pricing assumption[41] allows to simplify the model and to eliminate prices' heterogeneity:

$$P_t^{1-\varepsilon} = (1 - \phi)P_t^{*1-\varepsilon} + \phi P_{t-1}^{1-\varepsilon}.$$

This equation can be easily expressed in terms of inflation[42] dividing both sides for $P_{t-1}^{1-\varepsilon}$:

$$(1 + \pi_t)^{1-\varepsilon} = (1 - \phi)(1 + \pi_t^*)^{1-\varepsilon} + \phi.$$

Using the same logic, it is possible to derive γ_t in term of inflation:

$$\gamma_t = (1 - \phi)\left[\frac{(1-\pi_t)}{(1-\pi_t^*)}\right]^{\varepsilon} + \phi(1 - \pi_t)^{\varepsilon}\gamma_{t-1}.$$

Optimal reset price P_t^* is in function of future prices. It is possible to express it in terms of inflation dividing V_t by P_t^{ε} and Q_t by $P_t^{(\varepsilon-1)}$. The ratio $\frac{V_t}{Q_t}$ becomes $\frac{v_t}{q_t}P_t$.[43]

It follows that:

$$v_t = C_t^{-\sigma}\mu_t Y_t + \beta\phi E_t[(1 + \pi_{t+1})^{\varepsilon}v_{t+1}]; q_t = C_t^{-\sigma}Y_t + \beta\phi E_t[(1 + \pi_{t+1})^{\varepsilon-1}q_{t+1}].$$

Optimal reset price become:

---

[39] The monetary policy implies that mean inflation is different from zero and equal to π.

[40] In the following equations cursive letters means that the variable is in real term, for example: $g_t = \frac{G_t}{P_t}$.

[41] G. Calvo, "*Staggered prices in a utility-maximizing framework*", Journal of Monetary Economics, September 1983.

[42] π_t^* refers to the optimal resetting price inflation.

[43] A clarification on notation: In this case cursive letters does not mean that the original variables are divided by price level, but by the price elevated to the respective power.

$$(1+\pi_t^*) = \frac{\varepsilon}{\varepsilon-1} * (1+\pi_t) * \frac{v_t}{q_t}.$$

The optimality hiring condition for intermediate firms is:

$$\frac{W_t}{P_t} = w_t = \mu_t A_t.$$

3.3 Analysis of the system's reaction to shocks

The last part of the theoretical consists of the analysis of the model's impulse responses to shocks. In this model specification, the economy can be hit by two shocks, productivity shocks ε_a and interest rate shocks ε_i. As a starting point, it is necessary to define an equilibrium point for the economy. A classical choice for stochastic dynamic systems is the non-stochastic steady state.

3.3.1 The economy's non stochastic steady state

Model's non-stochastic steady state is defined as the equilibrium state of the system without uncertainty about future variables. In this state there are not shocks and the stationary variables do not evolve over time.

If there are not shocks, it follows that productivity is constant, then it is possible to assume that $A = 1 \;\forall\; t \in T$. Inflation will be at the targeted level π.

If consumption is constant over time, the Euler equation, becomes:

$$(1+i) = \frac{1}{\beta}(1+\pi).$$

This is the Fisher equation. This implies that $\frac{1-\beta}{\beta}$ is the real interest rate of the economy.

To find the other equilibrium values it is necessary to determine steady state inflation path, because both w_t and μ_t depends on inflation and γ_t. It is:

$$(1+\pi^*) = \left[\frac{(1+\pi)^{1-\varepsilon}-\phi}{1-\phi}\right]^{\frac{1}{1-\varepsilon}}.$$

Given the steady state inflation it is possible to derive the other steady state levels:

$$\gamma = \frac{\varepsilon-1}{\varepsilon}\left(\frac{1-\pi}{1-\pi^*}\right)^{\varepsilon}\frac{1}{1-\phi(1-\pi)^{\varepsilon}}\ .$$

$$\frac{v}{q} = \frac{1+\pi^*}{1+\pi} * \frac{\varepsilon-1}{\varepsilon}\,.$$

$$\mu = \frac{1+\pi^*}{1+\pi} * \frac{\varepsilon-1}{\varepsilon} * \frac{1-\phi\beta(1+\pi)^{\varepsilon}}{1-\phi\beta(1+\pi)^{\varepsilon-1})}.$$

$$w = \mu.$$

$$C = Y.$$

$$Y = \frac{N}{\gamma}.$$

$$N = \left(\frac{1}{\psi}\gamma^{\sigma}\mu\right)^{\frac{1}{\eta+\sigma}}.$$

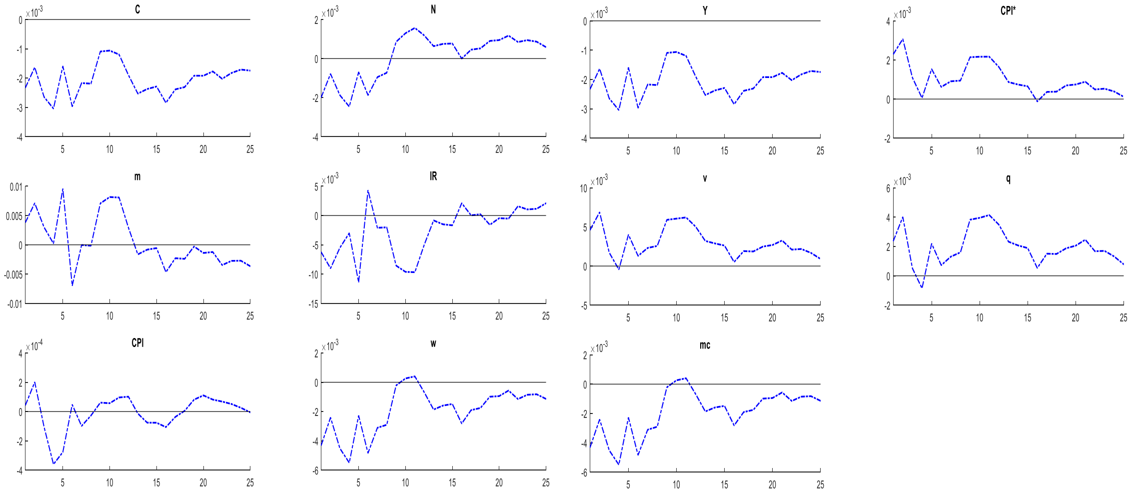
$$m = \theta Y^{\sigma}\frac{1+i}{i}.$$

3.3.2 The system's dynamic response to an interest shock

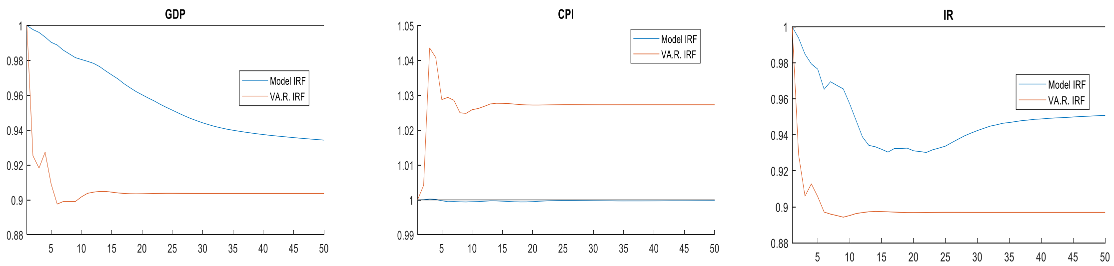
In this section the impulse response functions to the interest rate shock will be compared with the impulse response functions to the uncertainty shock. Before comparing these impulse response functions, it must be clarified why, and to what extent, it is possible to compare the responses to shocks of different nature. Is it possible that an interest rate unexpected decrease is consistent with an uncertainty increase? As already mentioned, dataset encompasses two financial crises. During these financial crises, the European central bank strongly decreased interest rate to stimulate the economy. Moreover, as all uncertainty measures indicate, uncertainty level has always increased as a crises' consequence. The interest rare level, contrarily, has always decreased. In this case, an unexpected interest rate movement may be consistent with an increased uncertainty level. This relationship is strengthening if GDP's recession and uncertainty shock are highly correlated. Evidence supports this conjecture because during both crises, GDP and U strongly comoved. Additionally, because E.C.B. policy decisions have been driven by GDP's performances and perspectives, the GDP variation has been included in the interest rate rule. This formulation has been chosen to capture the role that GDP and uncertainty changes have in policy decision

Starting from the steady state, it is possible to determine the system's dynamic response to an unexpected policy shock. The software Dynare® has been selected to compute the following impulse response functions. At least a third order approximation is needed to simulate second moment shocks. In particular, impulse responses below are computed given the following parameters' calibration:

σ	η	θ	ε	ρ_a	ρ_i	π	ψ	ϕ	β	φ_π	φ_π	i
0.99	1.01	1	10	0.9	0.7	0.0199	1	0.7	0.965	2	3	0.05



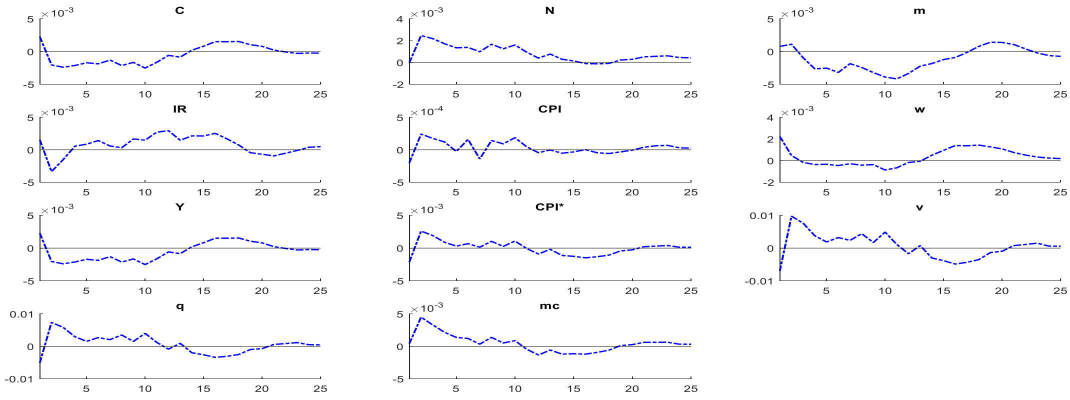
GDP decreases. Interest rate is decreasing in the short run and slightly recovers during the transition phase. CPI* starts a slow increase phase, but the CPI level is not really effected by the shock. The impulse response functions of the V.AR. model and of the theoretical model are presented in the figures below:



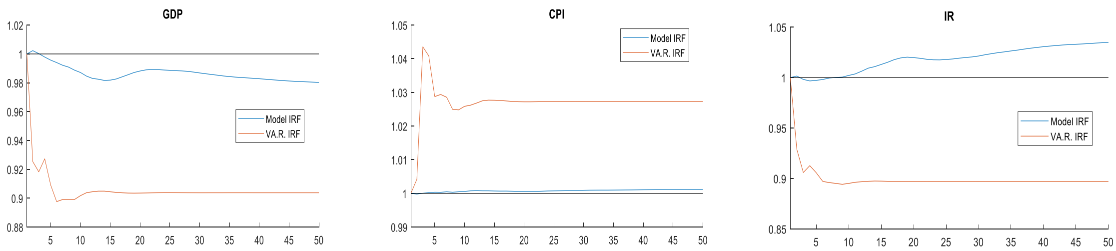
GDP's responses are similar. Both models predict decrease during short run and stabilization during the transition phase. Model's reaction is minor but more persistent. The inflation's dynamic is similar to CPI*, but the aggregate inflation level is not comparable. Finally, interest rates dynamics are similar, especially in the early stages. Both models predict decreasing interest rates. According to the theoretical model, IR should have slightly recovered.

3.3.3 The system's dynamic response to a productivity shock

The second alternative to channel an uncertainty shock in the economy is through productivity. A sudden negative variation in the technological level (ε_a) is consistent with an unanticipated recession phase, and then to uncertainty shock. In this chase uncertainty is caused by the increased variance of technological variations. The following figures show the percentage deviation from the steady state and the cumulative movements for relevant variables:



Model's response to a second moment shock is negative. To compensate drop in tecnology firms hires more. Interest rate falls in the short run, money holdings initially increase but the effect reverts in the transition phase. CPI* has an initial drop but recovers. Even in this case effects on total CPI are marginal. The comparison between the empirical estimation and the theoretical model is:



A second moment technological shock partially captures GDP movements. However, it produces opposite results in interest rate level. It is marginally afflicted after the crisis and start to increase in the transition phase, while empirical result is a sudden and persistent drop.

It is possible to conclude that the economic system's response to an uncertainty shock is coherent with an interest rate policy shock. This may be caused by the predominant use of expansive policy measure adopted by the E.C.B. to reacts to economic downturns and the widespread of uncertainty in the system.

4. Final comments and conclusion

For the desire to not limit the analysis to only part of uncertainty, especially not only financial uncertainty, the mixed indicator has been constructed. This indicator attempts to proxy uncertainty from different drivers. The empirical analysis produces interesting results. The first result is a strong negative relationship between GDP and uncertainty. This result was expected since the sample correlation between the variables is negative. However, the consequences of one standard deviation shock are notable because they cause a 7% sudden fall and a 10% persistent decrease.

The financial market variables suggest that the shock causes even structural effects on the economy. The spread's response indicates that the investors require higher premium to hold the long term bond. Higher interest rates for long term government bonds are a symptom of increased riskiness, caused by the increasing possibility of public default.[44]

Another interesting effect appears on the real interest rate. Since the short term interest rate falls and the inflation increases, the real interest rate has a strong decrease. Additionally, the nominal rate is currently at the zero bound, hence the shock may cause real interest rate to be negative. Negative real interest rate discourages investments.

In the second section of the thesis the empirical findings are compared with the theoretical results of a new Keynesian model. The model appears to capture some of the main facts. In particular, the impulse response functions to a second moment shock in interest rate policy capture the long-term effects and part of the short-term dynamics. In the case of a productivity shock the model responses are not totally coherent with the model, especially because the interest rate has opposite dynamics. In this sense, the model fails to match the forecast of the econometric analysis.

In conclusion, it is possible to state that uncertainty shocks have deleterious effects on the Italian economy. The GDP's reaction is particularly negative. There exist several interpretations to explain these effects. One of the main ideas is that rising uncertainty causes contraction in financial activities, in particular in the credit market. If borrowing conditions worsen, the economic activity wanes and the GDP contracts. But this is just one aspect. For example, the analysis above suggests that the increasing spread plays an important role during the downturn. The spread has an indented increase during a crisis. The agents, or part of them, may become doubtful about future stability of the system and demand higher returns to finance public expenditures. This spread effect is particularly important in Italy. Public spending policy has been focal in the Italian system, but, when cost of financing increases, the budget constraint becomes tighten. Assuming that the government budget policies are believed to be stabilising, the uncertainty shock increases

[44] This may be caused also by an increase in household's risk aversion, which can be also considered a response to increasing uncertainty.

the cost of finance and dwindles the stabilising role of the government[45]. This may cause another uncertainty shock and the cycle repeats. Moreover, the recent spread's movement suggest that the level changes are highly influenced by the government's spending intentions. This create a major friction between the government, that attempt to stimulate the economic system with expansive policies, and the agents, that are not willing to finance these policies. The uncertainty's rise depresses GDP and increase financing cost, stoking the spread effect.

Another result that the V.AR. analysis suggests is the interest rate level fall under rising uncertainty. As already pointed out, this mechanics has been important during the crises. The extraordinary expansive monetary policy adopted by the Ecb limited the growth of the spread and has increased financial market capitalization. It has partially worked against the credit crunch. The V.AR. captures these policy movements, but the long run responses suggests that the effect is to stabilize the system, not to reduce the uncertainty increase generated by the crisis, and not to enhance the recover. Thus, these types of measures are not sufficient to reduce the level of uncertainty. Moreover, the Ecb cannot keep decreasing the rates and, eventually, it will have to stop this expansive policy.[46]

The possibility that a new shock hits the economy must be feared, because the previous crises' effects have not completely vanished yet. The policy maker should not just pay attention to stabilizing the system, but also in mitigating the persistency of the uncertainty shocks and in enhancing the absorption ability. The monetary policy responses may stabilize the economy, but it does not appear to be effective against uncertainty.

[45] Press usually refers to the spread as the differential in secondary market interest rate. This differential does not affect directly the titles because the interest regime is predetermined at issuance and does not vary according to the spread. However, the spread influences new issuance because new issued bonds must be marketable.

[46] In a recent interview, the previous E.C.B. president Mario Draghi states his beliefs about the current economic conditions. He affirms that monetary policy is not enough and should be integrating with fiscal policies. https://www.ft.com/content/b59a4a04-9b26-11e9-9c06-a4640c9feebb.

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