Components of Uncertainty

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Introduction

Uncertainty and the economy

1. What is the effect of elevated uncertainty on the economy?
   - Several studies document that an increase in uncertainty is followed by worsening economic conditions, see e.g. Bloom (Ecma, 2009), Jurado et al. (AER, 2015) and Baker et al. (QJE, 2016)
2. Do different types of uncertainty exist? If, so, how do the different types of uncertainty affect the economy?
   - Some types of uncertainty is suggested to have a positive effect on the economy. See, e.g. Segal et al. (JFE, 2015) and Kraft et al. (2013)
   - These theories are often referred to as "growth options" theories, and have been suggested as a driver of the dot-com boom in the late 1990s.

Measuring uncertainty

Uncertainty is hard to measure, and several proxies for uncertainty have been suggested:

1. Implied stock market volatility, e.g Bloom (Ecma, 2019)
2. Forecast disagreement, e.g. Bachmann et al. (AEJ Macro, 2013)
3. The unforecastable component of a large set of macroeconomic indicators, e.g. Jurado et al. (AER, 2015)
4. **Uncertainty terms in newspapers**, e.g. Baker et al. (QJE, 2016) and Alexopoulos and Choen (2009)

This paper/Outline

1. Measures category-specific uncertainty
   - Using machine learning techniques, I create uncertainty measures based on the frequency of uncertainty terms in various types of news.
2. Identify distinct types of uncertainty
   - Extract orthogonal components from the various category specific measures
3. Study the effect of different (orthogonal) types of uncertainty on the economy.
   - Estimate the effect of uncertainty shocks in a Structural VAR

Classifying the news

Classifying news articles

- Data: Dagens Næringsliv, Norways biggest business newspaper and the forth largest irrespective of theme.
  - The data spans 1988–2016
  - Close to 500 000 articles
- The newspaper is decomposed according to the topics it writes about using a topic model called Latent Dirichlet Allocation (LDA) model introduced by Blei, Jordan, and Ng (JMLR, 2003).
- The LDA takes a set of articles as input and return two sets of distributions:
  - One set of distributions over words, one distribution for each topic j, given by $\boldsymbol{\theta}_j$
  - One set of distributions over topics, one distribution for each article i, given by $\boldsymbol{\varphi}_i$

Estimating the topic model

- The researcher must select the number of topics prior to estimation:
  $\rightarrow$ # topics $= 80$
- There is a trade off between interpretable topics and how well the topics are at explaining the whole newspaper, see Chang et al. (NIPS, 2009).
- Estimation is done using MCMC

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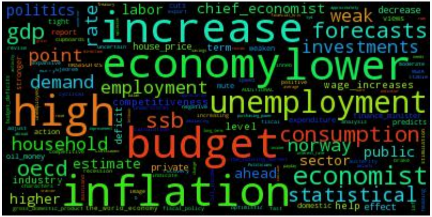
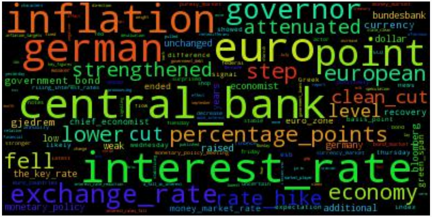
Here are two examples of the topic distributions $\boldsymbol{\theta}_j$:



Macroeconomics ($j = 19$)



Monetary policy ($j = 72$)

Category-specific uncertainty

Counting uncertainty terms in the newspaper

The words that are counted: *uncertain* and *uncertainty* (and also variations of these words)

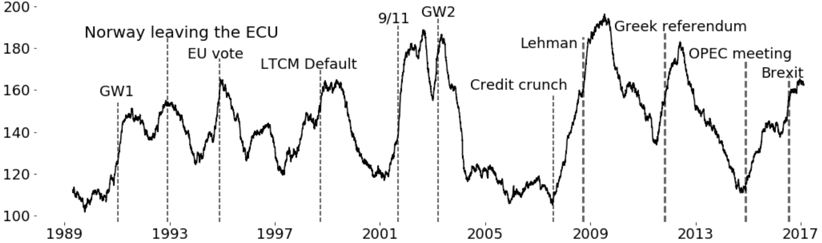
Let's define

$$\begin{aligned} \upsilon_i &\equiv \text{number of uncertainty terms in article } i \\ \omega_i &\equiv \text{number of total words in article } i \end{aligned}$$

I start by calculating an aggregate uncertainty measure:

$$\text{Aggregate uncertainty} = \sum_{i \in \text{day}} \frac{\upsilon_i}{\omega_i}$$

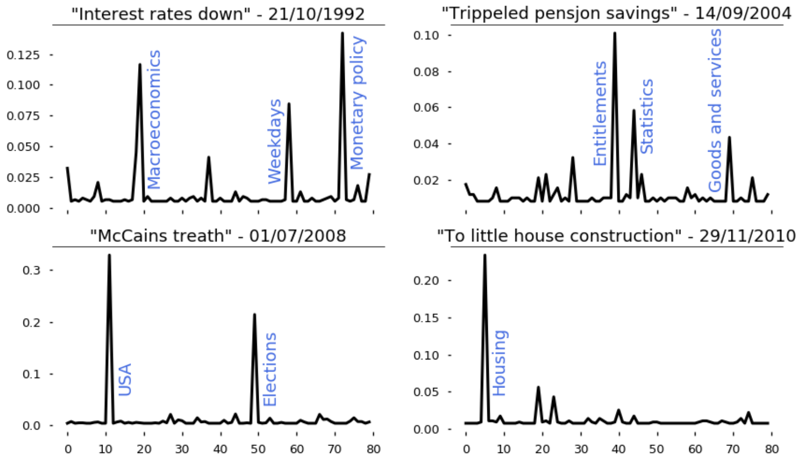
Aggregate uncertainty



Note: The 300 day backward-looking rolling mean is plotted. The series gives the share of uncertainty terms per 1 million words in the newspaper.

Classifying the news

The topic distributions are given by φ_i. Four example articles:

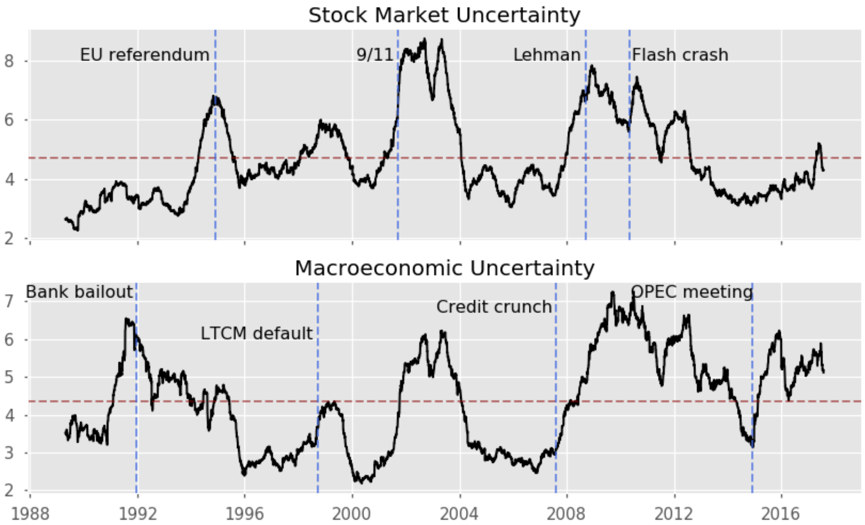


Category specific uncertainty

The category specific uncertainty measures are calculated for all topics j:

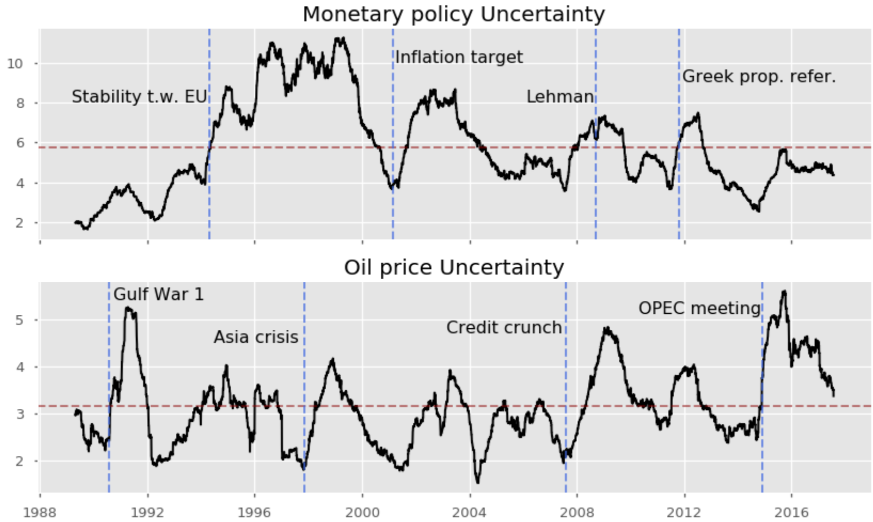
$$\text{Topic } j \text{ uncertainty on day } t \; = \frac{\sum_{i \in \text{day } t} \upsilon_i \varphi_i(\text{topic } j)}{\sum_{i \in \text{day } t} \omega_i}$$

Topic specific uncertainty



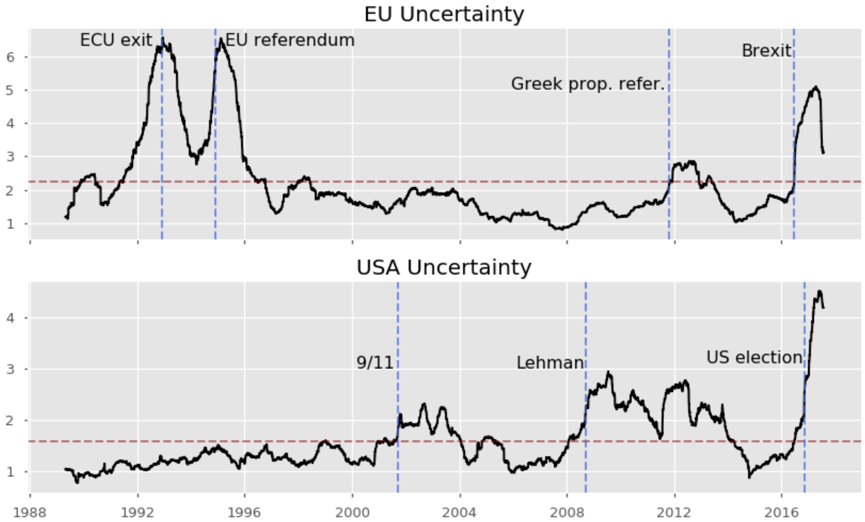
Word clouds

Topic specific uncertainty



Word clouds

Topic specific uncertainty



Word clouds

The frequency of uncertainty terms in different types of news

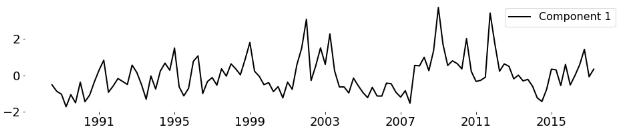
Top 10	words per 1 mil.	Bottom 10	words per 1 mil.
Monetary policy	5.7	*Drinks*	0.9
Stock market	4.7	*Movies/Theater*	0.9
Macroeconomics	4.4	*Food*	1.0
Fear	3.7	*Literature*	1.0
Oil price	3.2	*Music*	1.0
Debate	2.9	*Art*	1.0
Negotiation	2.4	*Sports*	1.1
Results	2.4	*Family business*	1.1
Oil production	2.3	*Watercraft*	1.1
Elections	2.3	*Tourism*	1.1

Components of uncertainty

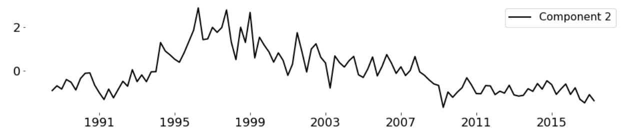
Finding orthogonal components

- The 80 uncertainty measures often capture similar types of uncertainty.
- I extract orthogonal components of uncertainty by principal component analysis (PCA)
- Keep the components that explain 5 percent or more of the topic-based measures
- Normalize the components according to the topic-based measure with the highest correlation

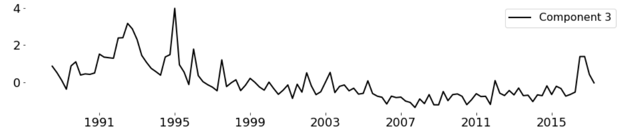
The component measures



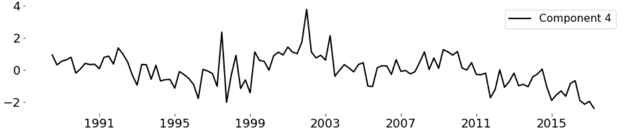
EV: 35% (35%)



EV: 15% (49%)



EV: 9% (58%)



EV: 6% (64%)

Labeling the components – highest correlated topics

	Component 1		Component 2	
		Correlation		Correlation
1st	**Narrative**	0.87	**Monetary policy**	0.75
2nd	**Fear**	0.83	**Employment**	-0.56
3rd	**Stock Market**	0.81	**Organizations**	-0.56
4th	**Statistics**	0.81	*Macroeconomics*	-0.46
5th	**Unknown**	0.81	*Weekdays*	0.46

	Component 3		Component 4	
		Correlation		Correlation
1st	**EU**	0.85	**Mergers & Acquis.**	0.55
2nd	**Europe**	0.72	**Stock listings**	0.55
3rd	**Agriculture**	0.68	**IT systems**	0.50
4th	**Argumentation**	0.59	*Engineering*	0.47
5th	**Fiscal policy**	0.55	*Telecommunication*	0.43

Labeling the components – highest correlated topics

	economic and financial distress		**instit. framework of mon. pol.**	
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Component correlations with alternative measures

	Component 1	Component 2	Component 3	Component 4
Norway EPU	0.69	-0.16	0.25	-0.2
US VIX	0.66	-0.033	-0.24	0.33
US EPU	0.55	-0.59	-0.094	0.0053
JLN Finance	0.52	-0.06	-0.29	0.37
EU EPU	0.48	-0.41	-0.11	-0.4
JLN Macro	0.42	-0.28	-0.41	0.34
China EPU	0.41	-0.52	0.24	-0.32
RSMV	0.38	-0.33	-0.56	-0.19
UK EPU	0.27	-0.62	0.34	-0.49

Uncertainty and the economy

A Structural VAR

I follow Baker et al. (QJE, 2016) and specify a structural VAR model where the identification is achieved using a Cholesky decomposition:

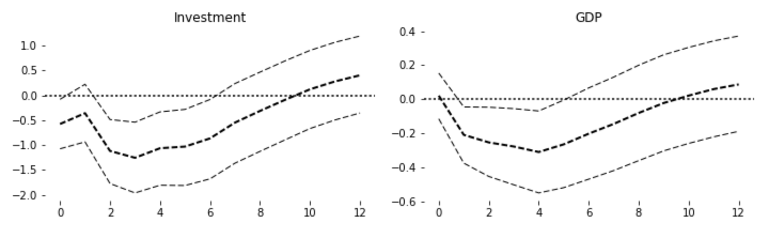
$$\mathbf{A}_0 \mathbf{y}_t = \sum_{j=1}^{3} \mathbf{A}_j \mathbf{y}_{t-j} + \mathbf{B}\varepsilon_t$$

$$\text{where } \mathbf{y}_t \equiv \begin{bmatrix} \text{Uncertainty} \\ \log(\text{OSEBX}) \\ \text{Interest rate} \\ \log(\text{Investments}) \\ \log(\text{GDP}) \end{bmatrix}$$

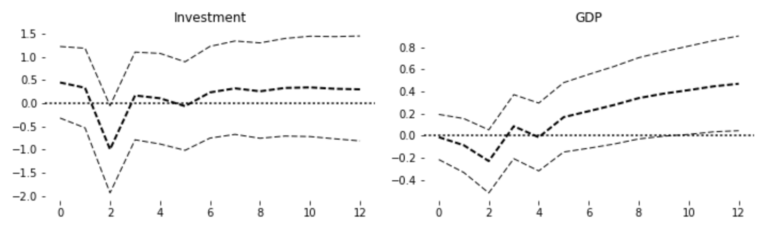
the data sample is 1988Q2 – 2016Q4

Impulse responses from Comp. 1 and Comp. 2 shock

economic and financial distress

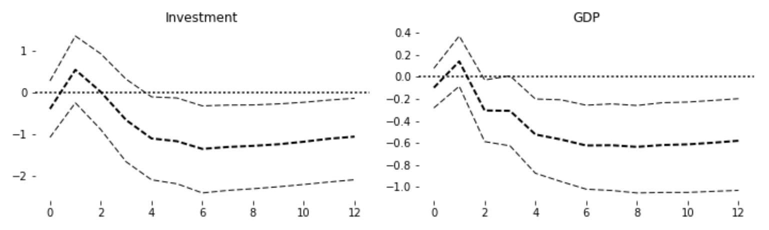


instit. framework of monetary policy

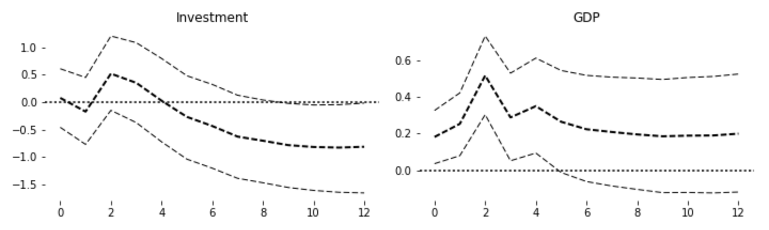


Impulse responses from Comp. 3 and Comp. 4 shock

relationship with the EU



technology and firm expansion



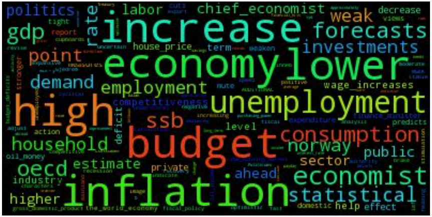
Conclusion

Summary

1. I have proposed a new method for constructing topic specific newspaper uncertainty
2. I have created 80 category specific measures of uncertainty for Norway based on the DN newspaper
3. Most topics have a clear interpretation
4. I extract four orthogonal components from the 80 topic-based measures
5. The effect of an uncertainty shock depends on the type of uncertainty
    5.1 A shock to Component 1, labeled as uncertainty related to economic and financial distress, yield an economic contraction in line with the uncertainty literature
    5.2 A shock to Component 4, labeled as uncertainty related to technology and firm expansion, yield a boom in GDP

Word clouds

Stock market ($j = 18$)



Macroeconomics ($j = 19$)

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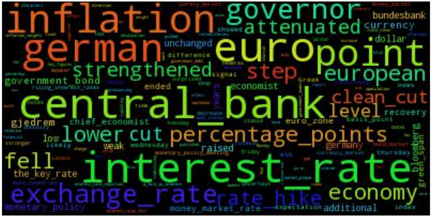
Word clouds



Monetary policy ($j = 72$)

Oil price ($j = 33$)

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Word clouds

EU ($j = 25$)

USA ($j = 11$)

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