Uncertainty Shocks and Economic Activity: A Meta-Analysis

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Motivation

If we are to understand the workings of the economic system, we must examine the meaning and significance of uncertainty...

Frank Knight (1921, p. 199)

- Knight famously distinguished ***uncertainty*** from ***risk***:
  - ***Uncertainty*** represents situations where probabilities are unknown.
  - ***Risk*** involves outcomes with well-defined probabilities.

Background

- Economic theory outlines **various channels** through which uncertainty can impact economic activity, both negatively and positively (Bloom, 2014).
- On the **negative** side, uncertainty can exert effects via mechanisms such as the:
  - '**real options**' channel, whereby firms delay investment and hiring decisions.
  - **risk aversion** and **risk premia** channel, which raises the cost of financing and depresses economic activity.
- On the other hand, uncertainty can also have **positive** effects:
  - the '**growth options**', which create opportunities for firms to innovate.
  - the **Oi-Hartman-Abel effect** shows how uncertainty leads to higher expected returns in certain contexts.
- These theoretical channels have been examined for decades; however, serious efforts to ***empirically test*** them have emerged much more recently, particularly in the aftermath of the Global Financial Crisis.

Background

- ***Bloom (2009): The Impact of Uncertainty Shocks***
  - Following the seminal contribution of Bloom (2009), a large body of empirical research has sought to measure the effects of uncertainty shocks on economic activity, primarily through VAR modelling.
  - Bloom (2014), Castelnuovo et al. (2017), Castelnuovo (2023) and Cascaldi-Garcia et al. (2023) provide excellent summaries of the literature.

- A wide range of **proxies or indicators of uncertainty** have been proposed in the literature:
  - Stock market volatility (Bloom, 2009) – like VIX
  - Textual analysis techniques of newspapers (Baker et al., 2016) – like EPU
  - Macroeconomic uncertainty estimates through econometric predictability (Jurado *et al.*, 2015) – like MU
  - Survey-based measures (Leduc and Liu, 2016) – like Consumer Uncertainty

Is There an Empirical Puzzle?

- A large VAR-based literature studies the **effect of uncertainty shocks**, but the results are not fully settled.
- Early studies provided strong evidence that an uncertainty shock can have a significant ***negative*** impact on the economy.
  - Bloom (2009) finds that an uncertainty shock is followed by a rapid decline in US industrial production of about 1% within four months.
- However, more recent studies find ***weaker*** effects, ***different timing***, or even ***positive*** responses:
  - Ludvigson et al. (2021) and Larsen (2021) find that uncertainty shocks may trigger an increase in industrial production.
- VAR impulse response (IRFs) estimates, especially the *magnitude* and *persistence* of the effect, can depend on a number of **study characteristics**:
  - The proxy used for measuring uncertainty
  - The estimation method and model specification
  - The identification strategy
  - The data and other characteristics

Our Contribution

- This paper provides the first ***systematic quantitative meta-analysis*** of the empirical VAR-based literature on the uncertainty-economic activity nexus.
- By focusing on the reported impulse responses (IRFs) across multiple horizons, we extract the numerical values from the graphical outputs in the studies.
- We, thus, have collected **2,165 point estimates** of impulse responses, along with their corresponding confidence intervals, from **73 published studies**.
- We investigate the effects of uncertainty shocks on economic activity across three different time horizons:
  - 1-2 quarters (***short-term***)
  - 4-8 quarters (***medium-term***)
  - 12-16 quarters (***long-term***)

Our Research Questions

- Does ***publication bias*** exist in the literature? In other words, we test whether researchers are predisposed to report negative responses to uncertainty shocks.

- What are the ***factors*** that can explain the ***heterogeneity*** in the reported impulse response estimates across studies?

- What are the ***'best-practice' estimates*** conditional on the design of the most prominent studies and after correcting for publication bias?

Construction of the Meta-Dataset

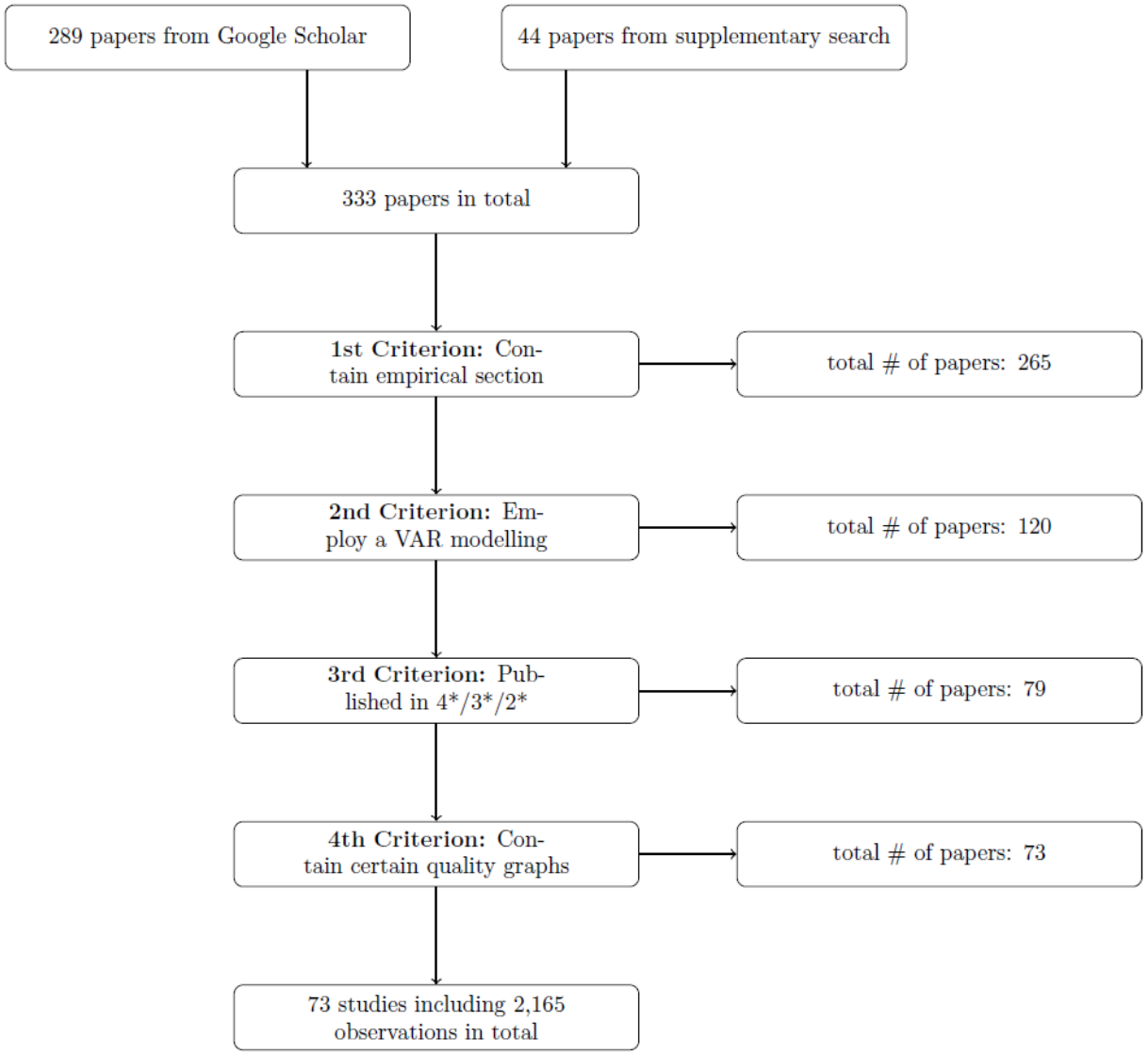
- Using several keywords combinations in Google Scholar and citation searches, we collected **333 papers.**
  - Keywords are: (i) '***Uncertainty***' or '***Macroeconomic Uncertainty***' or '***Economic Policy Uncertainty***', (ii) '***VAR***' or '***SVAR***' or '***vector autoregressive***', and (iii) '***impulse response***' or '***impulse responses***' or '***response***' or '***responses***'.
- We also searched articles citing the three most influential empirical works in this literature:
  - Bloom (2009); Jurado *et al*. (2015); and Baker *et al.* (2016).

- Then, we introduce four **inclusion criteria**:
  1. A study should contain an **empirical section.**
  2. A study should employ a **VAR-type modelling.**
  3. A study should meet journal-quality screen as being published in a **4*/3*/2* AJG** journal.
  4. The IRFs graphs should be reported with a **certain quality.**

Construction of the Meta-Dataset

- The distribution of the final meta-dataset is a pool of **73 published studies** as follows:
  - **20 articles** published in 4*AJG journals
  - **35 articles** published in 3*AJG journals
  - **18 articles** published in 2*AJG journals
  - This provides us with a sample of **2,165 observations**
- The impulse responses (and confidence intervals) are obtained using ***WebPlotDigitizer®***, which extracts response values by measuring pixel coordinates at selected time horizons in the IRF plots.
- The responses then are ***standardized*** as percentage changes in economic activity after a one-standard-deviation uncertainty shock.
- Horizon groups: **short run** (1-2 quarters), **medium run** (4-8), **long run** (12-16).

Our Data Collection Process

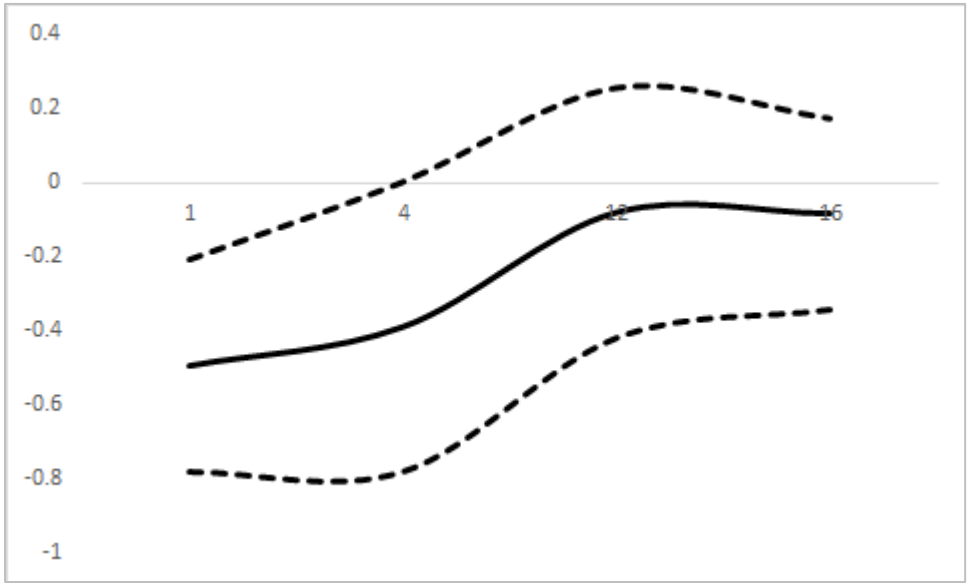


A First Look at the Meta-Dataset

Is there broad consensus in the existing literature of the impact of an uncertainty shock on the economy?

- Yes - ***Negative***

Mean reported response of economic activity to an uncertainty shock



Publication Bias

Key Question: What is Publication Bias?

- When editors/authors are positively predisposed in favour of certain results.
- If imprecise estimates are disproportionately negative, that suggests publication selection.

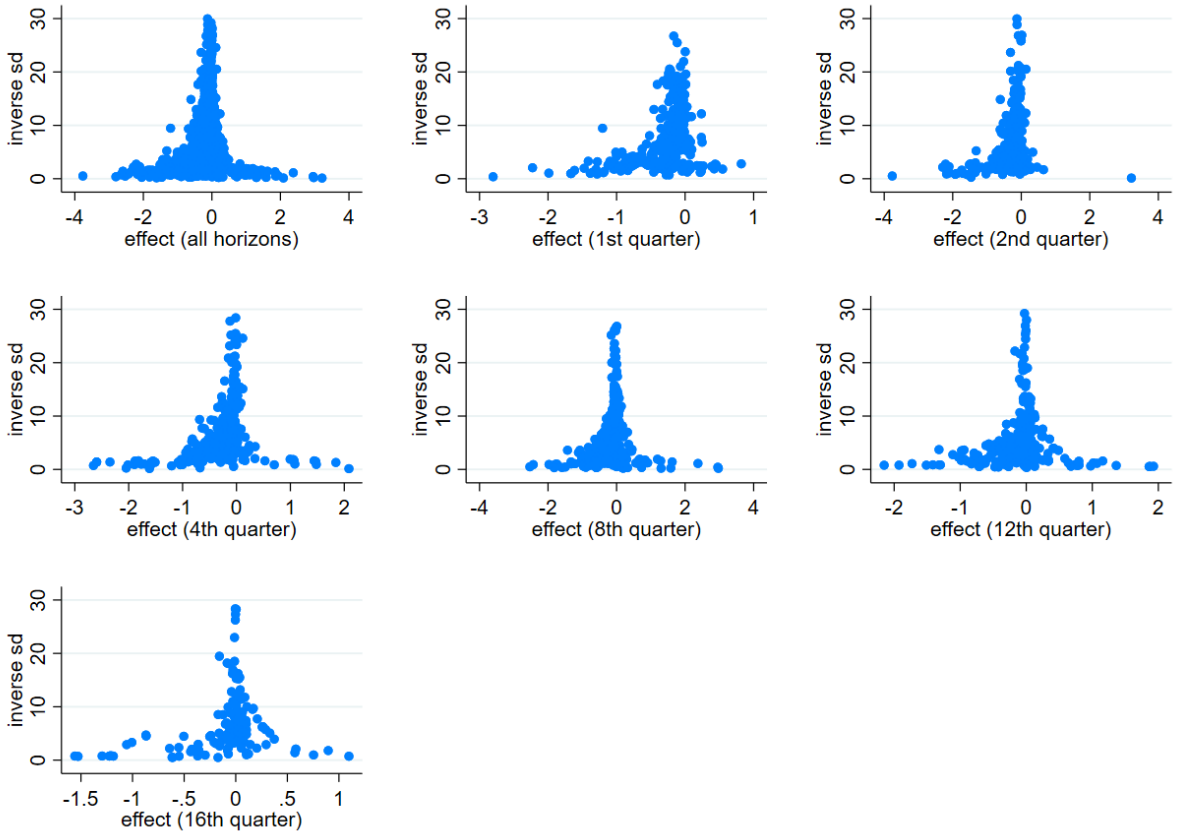
This can be detected by a statistically significant relationship between the **reported effects** and their ***standard errors***:

$$effect_{ij} = \alpha + \beta \mathrm{se}_{ij} + \varepsilon_{ij}$$

Publication Bias Results

Is there Evidence of Publication Bias?

- Yes, strong evidence mainly for those responses in the **short** and **medium-run**. The bias weakens and becomes statistically insignificant in **longer horizons**.



Publication Bias Results

Table 1: Testing Publication Bias

Time after an uncertainty shock	1st Q	2nd Q	4th Q	8th Q	12th Q	16th Q
Standard error (publication bias)	-1.687***	-1.620***	-1.044***	-0.391**	-0.289*	-0.282*
	(0.318)	(0.163)	(0.102)	(0.154)	(0.166)	(0.166)
Constant (corrected mean effect)	0.001	-0.001	-0.002***	-0.003**	-0.001	0.000
	(0.002)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)
Corrected mean effect (A&K)	-0.017*	-0.024***	-0.002***	-0.001**	-0.000	-0.000
	(0.013)	(0.012)	(0.000)	(0.000)	(0.000)	(0.000)

- However, even after correcting for publication bias, there is still evidence of a **genuine negative effect**.

What Explains this Pattern? (Heterogeneity of Estimates)

Key Question: Why Estimates Vary Across Studies?

Thus, what are the ***factors*** that drive this ***heterogeneity*** of the estimates?

- proxy used for measuring uncertainty?
- VAR modelling chosen?
- other factors?

This heterogeneity can be examined using both **BMA** and **least-squares** models based on the following meta-regression specification, where the estimated effect is related to various moderator factors.

$$effect_{ij} = \alpha + \beta \mathrm{se}_{ij} + \sum_{k=1}^{K} \gamma_k x_{k,ij} + v_{ij}$$

where ***K*** is the number of moderator variables, which in our case ***K = 15***.

Moderator Variables

- **Group I:** Uncertainty Type
  - EPU measure (*base category*)
  - Volatility measures
  - Macro Uncertainty measures
  - Other measures
- **Group II:** VAR Methodology Used
  - Standard VAR-Cholesky decomposition (*base category*)
  - BVAR modelling
  - Nonlinear VARs (such as STVAR, GVAR, FAVAR)
  - Other structural VARs (such as proxy, sign restrictions, other structures)
- **Group III:** Measure of Economic Activity
  - Industrial production measure (*base category*)
  - GDP based measure

Moderator Variables

- **Group IV:** Data Characteristics
  - Monthly data (*base category*)
  - Quarterly data
  - Number of observations (time span)
  - Number of variables
- **Group V:** Geographic Factors
  - US (*base category*)
  - Rest of western economies
  - Latin America
  - Asia
  - Mixed
- **Group VI:** Publication Characteristics
  - 4* AJG journal publication

Meta Regression Results (Short-Run)

	1st quarter				2nd quarter			
	BMA		OLS		BMA		OLS	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Standard Error	-.834[a]	.103	-.892***	.137	-.420[a]	.120	-.450***	.140
Uncertainty Measure								
EPU (base category)								
Volatility	-.004	.058	.050	.178	-.001	.049	-.002	.105
Macro Uncertainty	.845[a]	.113	.964***	.146	.372[b]	.093	.424***	.126
Other Uncertainty measures	.291[b]	.156	.337**	.152	.213[c]	.120	.270**	.133
Economic Activity Measure								
Industrial production (base category)								
GDP	-.043	.105	-.142	.184	-.004	.051	-.013	-.013
VAR Methodology								
Cholesky decomposition (base category)								
Bayesian VARs	.452[b]	.133	.492***	.183	.500[a]	.102	.564***	.115
Non-linear VARs	.101	.135	.209	.160	.272[b]	.109	.315***	.111
Other structural VARs	.198	.186	.380**	.164	.345[b]	.121	.429***	.140
Data Characteristics								
Quarterly	-.018	.078	-.066	.163	-.427[b]	.115	-.475***	.129
Number of observations (time span)	-.000	.000	-.001**	.000	-.001[b]	.000	-.001***	.000
Number of variables	.006	.012	.015	.019	.000	.006	002	.017
Publication Characteristics								
4* AJG	-.022	.074	-.140	.201	.145	.126	.224	.148
Geographical Factors								
US (base category)								
Rest of the West	.010	.060	-.091	.184	.010	.047	.054	.115
Latin America	-.024	.102	-.253	.332	-.009	.073	-.014	.241
Asia	-.057	.117	-.261	.207	.006	.055	.054	.116
Mixed	-.088	.162	-.313	.202	-.032	.091	-.105	.130

Meta Regression Results (Short-Run)

- *Publication Bias*
  - Publication bias is still present [Q1 & Q2]
- *Uncertainty Type*
  - Less negative results when macro and other measures of uncertainty are used compared to EPU [Q1 & Q2]
- *VAR Methodology Used*
  - Less negative results when BVAR is used compared to standard VAR [Q1 & Q2]
  - Less negative effect if non-linear VARs are used [Q2]
  - Less negative effect if other structural VARs are used [Q2]
- *Other Factors*
  - More negative effect if quarterly data is used compared to monthly [Q2]
  - More negative effect if there is a bigger time span [Q2]

Meta Regression Results (Medium-Run)

	4th quarter				8th quarter			
	BMA		OLS		BMA		OLS	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Standard Error	-.412^{b}	.189	-.551***	.205	-.815^{a}	.124	-.899***	.131
Uncertainty Measure								
EPU (base category)								
Volatility	.250^{b}	.112	.333**	.139	.003	.041	.037	.113
Macro Uncertainty	-.195^{c}	.113***	-.234*	.122	-.406^{a}	.079	-.448***	.111
Other Uncertainty measures	-.028	.072	-.091	.151	-.382^{b}	.107	-.391***	.146
Economic Activity Measure								
Industrial production (base category)								
GDP	-.006	.061	-.053	.178	-.017	.067	-.111	.160
VAR Methodology								
Cholesky decomposition (base category)								
Bayesian VARs	.-.227^{b}	.117	-.326***	.119	-.565^{a}	.093	-.617***	.101
Non-linear VARs	.073	.102	.112	.154	-.122	.144	-.243**	.107
Other structural VARs	-.064	.100	-.133	.132	-.382^{b}	.107	-.383***	.129
Data Characteristics								
Quarterly	-.130	.123	-.176	.171	.010	.060	.120	.142
Number of observations (time span)	-.000	.000	-.001	.000	.000	.000	.000*	.000
Number of variables	-.007	.011	-.018	.014	-.029^{c}	.014	-.032***	.011
Publication Characteristics								
4* AJG	-.055	.091	-.106	.171	-.028	.065	-.113	.116
Geographical Factors								
US (base category)								
Rest of the West	.010^{c}	.060	.257*	.140	-.013	.050	-.013	.108
Latin America	-.024	.102	.104	.313	.004	.077	.097	.232
Asia	-.057	.117	.086	.182	.027	.075	.111	.201
Mixed	-.088	.162	-.004	.197	.220	.180	.201	.137

Meta Regression Results (Medium-Run)

- *Publication Bias*
  - Publication bias is still present [Q4 & Q8]
- *Uncertainty Type*
  - More negative results when macro uncertainty measure is used compared to EPU [Q4 & Q8]
  - More negative results when other uncertainty measures are used [Q8]
- *VAR Methodology Used*
  - More negative results when BVAR is used compared to standard VAR [Q4 & Q8]
  - More negative results when other structural VARs are used [Q8]

Meta Regression Results (Long-Run)

	12th quarter				16th quarter			
	BMA		OLS		BMA		OLS	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Standard Error	-.250[c]	.137	-.251	.179	-.016	.063	-.120	.140
Uncertainty Measure								
EPU (base category)								
Volatility	-.313	.134	-.435***	.158	-.058	110	-.346***	.124
Macro Uncertainty	-.680[a]	-.680	-.885***	.179	-.091	.127	-.466***	.152
Other Uncertainty measures	-.510[b]	.154	-.590**	.204	-.080	.129	-.472***	.169
Economic Activity Measure								
Industrial production (base category)								
GDP	.154	.154	.027	.157	-.026	.103	-.256	.291
VAR Methodology								
Cholesky decomposition (base category)								
Bayesian VARs	-.375[b]	.128	-.455***	.131	-.017	.072	-.080	.182
Non-linear VARs	-.026	.101	-.134	.206	-.000	.080	-.045	.145
Other structural VARs	-.398[b]	.161	-.485***	.165	.080	.149	.352	.341
Data Characteristics								
Quarterly	.192	.171	.462***	.169	-.008	.084	.046	.275
Number of observations (time span)	.000	.000	.001	.000	-.000	.000	-.001	.000
Number of variables	-.002	.008	-.005	.021	.001	.011	.029	.036
Publication Characteristics								
4* AJG	-.019	.076	-.119	.171	-.008	.084	.136	.156
Geographical Factors								
US (base category)								
Rest of the West	-.040	.089	-.068	.167	-.013	.063	-.072	.178
Latin America	.089	.194	355	.318	.035	.168	-.299	.357
Asia	.025	.091	355	.148	.035	.079	.268	.236
Mixed	.564	.247	.502	.200	0.83	.170	.316	.333

Meta Regression Results (Long-Run)

- *Publication Bias*
  - No more evidence of publication bias [Q12 & Q16]
- *Uncertainty Type*
  - More negative results when macro and other measures of uncertainty measure are used compared to EPU [Q12]
  - More negative results when volatility is used as a measure of uncertainty [Q12]
- *VAR Methodology Used*
  - More negative results when BVAR is used compared to standard VAR [Q12]
  - More negative results when other structural VARs are used [Q12]

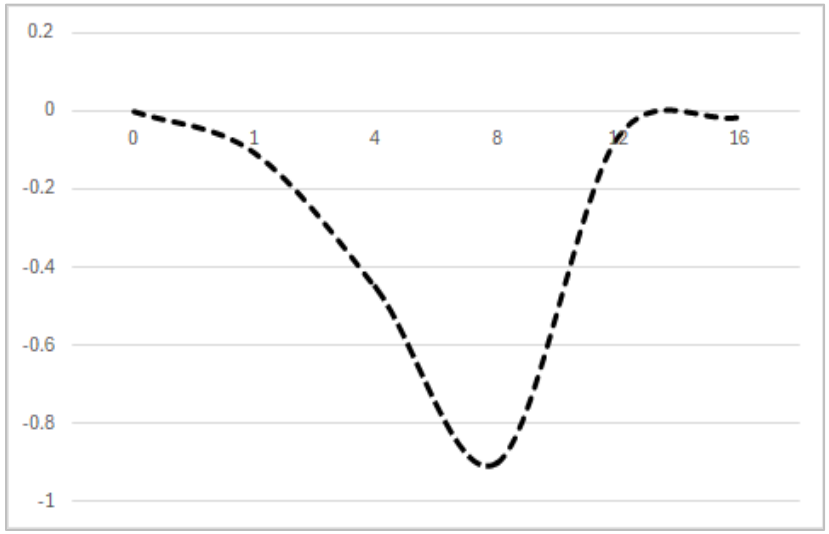
Our Results in a Nutshell

- **Two choices matter most:** how uncertainty is *measured* and how the VAR is *specified*.
- EPU measures tend to capture **sharper short-run** effects.
- MU and other measures often imply **stronger medium-** and **long-run** effects.
- Bayesian VARs and alternative structural VAR approaches can affect both **magnitude** and **timing**.
- Economic activity measure, data characteristics, publication tier, and geography play **more limited roles** overall.

	Q1	Q2	Q4	Q8	Q12	Q16
Publication bias	Yes	Yes	Yes	Yes	Not sig	Not sig
Macro uncertainty	Less negative	Less negative	More negative	More negative	More negative	Not sig
Other uncertainty	Not sig	Not sig	Not sig	More negative	More negative	Not sig
Volatility	Not sig	Not sig	Not sig	Not sig	More negative	Not sig
BVAR	Less negative	Less negative	More negative	More negative	More negative	Not sig
Non-linear VARs	Not sig	Less negative	Not sig	Not sig	Not sig	Not sig
Other Str. VARs	Not sig	Less negative	Not sig	More negative	More negative	Not sig

Best Practice Estimates

- A ***synthetic impulse response*** implied by the examined prior literature, conditional on the absence of any publication bias.
- It is calculated using a set of estimates from the previous results and a definition of the preferred values for the moderator variables. If there is no obvious choice regarding a preference, then we assign the average value of the corresponding variable.
- After adjusting for publication bias and preferred study characteristics, the response **looks different** from the meta-sample average.
- The **strongest negative impact** appears around **eight quarters** after the shock. While the short-run response is **less pronounced** than the literature average suggests.



Summary of Results

- Our results provide **evidence of publication bias**, with researchers more likely to report short-run negative effects.
- Nonetheless, there is a **genuine negative effect** of uncertainty on economic activity beyond any publication bias.
- The use of standard VAR models and the EPU measure results in a tendency to report **more negative effects** in the short-run period.
- Studies that use more elaborate techniques and other measures of uncertainty tend to report **more negative effects** in the medium and long-run (up to 12 quarters).
- This strategy tends to capture a **more long-run effect** of uncertainty.

Summary of Results

- Policymakers should treat uncertainty shocks as **economically meaningful** but not assume effects peak immediately.
- The uncertainty-activity link is **real**, but its measured size and timing are method-sensitive.
- Comparing studies without accounting for **uncertainty proxies** and **VAR design** can be misleading.
- Future work should be transparent about **identification assumptions** and **robustness** across uncertainty measures.
- Our findings underscore the importance of **methodological rigour** in empirical research on uncertainty and its macroeconomic implications.

➢ *Finally, you might need to think twice before reporting a positive impulse response!*

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