

# The Macroeconomic Effects of Climate Policy Uncertainty

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# Motivation

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# Uncertain times for climate policy

- Global shocks like Covid-19, energy crisis & geopolitical tensions shift focus from the climate challenge
- Economic pressures & political shifts may **reverse** climate commitments and **delay** stricter policies
- This creates substantial **uncertainty** about future path of climate policy
  - Especially since Trump's re-election
- How does **climate policy uncertainty** affect the environment and the economy?

# This paper

- We construct a new measure of **climate policy uncertainty** (CPU) based on newspaper coverage in the United States
  - Building on approach by Baker, Bloom, and Davis (2016)
  - Index spikes near important events related to climate policy:  
Presidential announcements on international climate agreements, congressional debates on climate bills, or disputes about the right of the EPA and states to regulate emissions . . .
- Propose new IV capturing plausibly exogenous shifts in climate policy uncertainty
  - Quantified using newspaper coverage in tight window around events
- Provide new estimates on the **dynamic effects** of climate policy uncertainty
  - Notable differences to recursive approach commonly used in literature

## Main results: aggregate impacts

- **Climate policy uncertainty** has significant **macroeconomic effects**
  - Higher uncertainty causes fall in **output**, private **investment** & **employment**
  - But also **increases commodity** and **consumer prices**
  - Emissions fall following economic contraction, **no green paradox** at aggregate level
- Climate policy uncertainty transmits to the economy as **supply shocks**
  - Differs from **economic policy uncertainty** moving output & prices in same direction
- **No increase** in other measures of uncertainty
  - Climate policy uncertainty is a distinct source of policy uncertainty
- **No effect** on government spending & emissions intensity unchanged
  - We successfully capture uncertainty and not news

## Main results: firm-level effects

- Climate policy uncertainty has substantial firm-level impacts
  - Firms view climate policy uncertainty as material financial risk
- Firms respond **more strongly** when their climate change **exposure is high**
  - Holds even when controlling for sector by time fixed effects
- We document rich **sectoral heterogeneity**
  - Most sectors lower investment and R&D; **higher investment** in mining, oil & utilities
- **But:** R&D decreases particularly strongly in these sectors
  - **Green paradox** at micro level
  - Exacerbate transition costs through misallocative forces

## Measuring climate policy uncertainty

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# Defining climate policy uncertainty

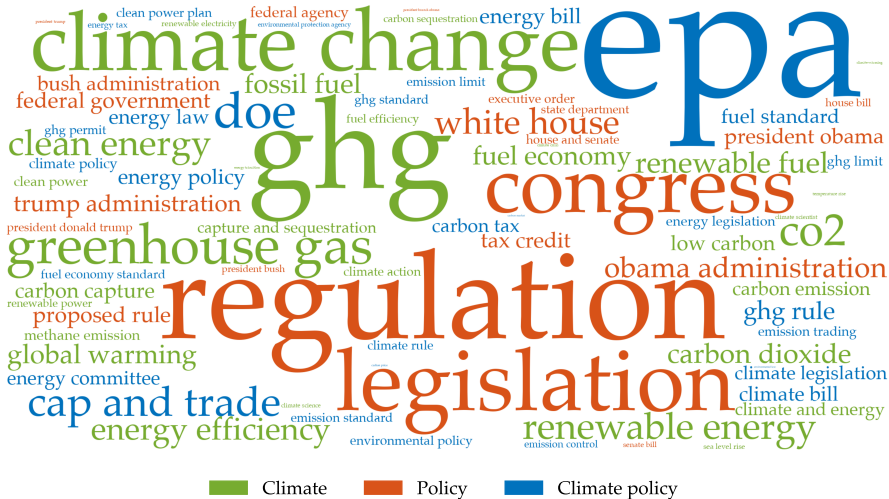
- **Definition:** Lack of clarity/predictability of government actions on climate change
  - Focus on climate policy with national significance
  - Includes uncertainty about new climate policies as well as political/legal challenges to existing policies
- Measurement is challenging
  - We follow approach by Baker, Bloom, and Davis (2016) leveraging informational content in newspaper articles



# Measuring climate policy uncertainty

- **Idea:** use dictionary of words whose occurrence in newspaper articles is associated with coverage of topics related to climate policy uncertainty
  - **Climate:** *climate change, carbon dioxide, greenhouse gas, green energy, ...*
  - **Policy:** *regulation, legislation, white house, congress, ...*
  - **Climate policy:** *carbon tax, emissions trading, energy policy, EPA, ...*
  - **Uncertainty:** *uncertain\**
- We specify these dictionaries based on corpus of news articles from specialized climate policy reporting agencies:  
*Inside Climate News, Carbon Control News, Washington Week (Energy)*
- Identify article as CPU if it contains at least one term in: (**Climate** AND **Policy** AND Uncertainty) OR (**Climate policy** AND Uncertainty)

## Measuring climate policy uncertainty

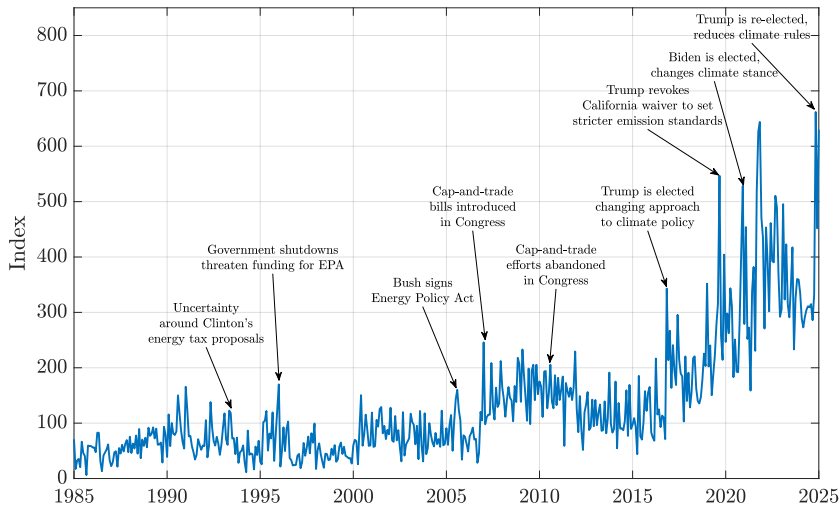


### Figure 1: Climate policy dictionary

# Measuring climate policy uncertainty

- Our sample contains  $\sim 5.46$  million news articles published leading American newspapers from mid-1980
  - *New York Times, Wall Street Journal, Washington Post*
  - These outlets provide comprehensive & systematic coverage of national climate policy developments
- Index counts, each month, the number of articles discussing uncertainty about climate policy, divided by the total number of published articles
  - Manual & LLM-augmented audit of sample of articles revealed that only few articles are false-positives
  - Results robust to varying dictionary terms

# Climate policy uncertainty since the 80s



**Figure 2: Climate Policy Uncertainty Index**

## Climate policy uncertainty since the 80s

- Climate policy uncertainty **increased** substantially, especially in recent years
  - Some notable spikes in first part of the sample, marked increase in late 2000s amid emissions trading proposals
  - Stark increase in uncertainty following Paris agreement and election of Trump
- Index uncorrelated with VIX & geopolitical risk
- Weakly correlated with EPU and trade policy uncertainty
  - Results robust to controlling for other uncertainty measures
  - CPU captures distinct variation from other dimensions of policy uncertainty

# Identification

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# Identification

- Uncertainty about climate policy may increase in times of **economic distress**
- Isolate plausibly **exogenous** increases in climate policy uncertainty
  - driven by climate-related, political or ideological considerations
- Based on **narrative account** of U.S. climate policy history, identify 72 events
  - legislative, regulatory, and judicial actions leading to climate policy uncertainty
- **Examples:**
  - inconsistent stance on international agreements like Kyoto or Paris agreement
  - debates over proposed legislation such as cap-and-trade policies
  - disputes about the right of the EPA and states to regulate emissions

► More

## A new climate policy uncertainty IV

- Quantify increases in climate policy uncertainty around events based on newspaper coverage (window: event day and the two days post-event)

$$CPU_d^{Event} = \frac{1}{3} \sum_i \sum_d \frac{n_{i,d}^{cp}}{n_{i,d}^{tot}}$$

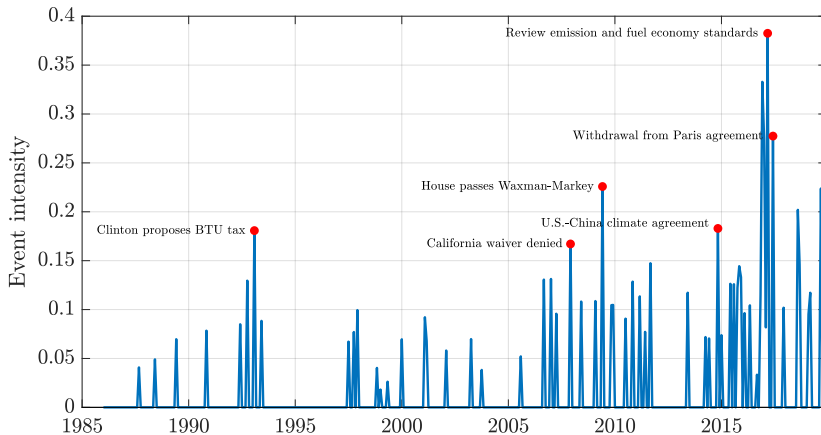
where  $i$  is the newspaper,  $n_{i,d}^{cp}$  and  $n_{i,d}^{tot}$  are daily climate policy articles and total article counts

- Aggregate to **monthly** series

$$CPU_t = \begin{cases} CPU_d^{Event} & \text{if one event} \\ \sum_{Event} CPU_d^{Event} & \text{if multiple events} \\ 0 & \text{if no event} \end{cases}$$



# Major climate policy uncertainty events



**Figure 3:** Climate policy uncertainty event series

# Econometric framework

- Use climate policy uncertainty **event series**,  $z_t$ , as an instrument to identify a climate policy uncertainty **shock**

- **Identifying assumptions:** [► Details](#)

$$\mathbb{E}[z_t \varepsilon_{1,t}] = \alpha \neq 0 \quad (\text{Relevance})$$

$$\mathbb{E}[z_t \varepsilon_{2:n,t}] = \mathbf{0}, \quad (\text{Exogeneity})$$

- For estimation, we rely on VAR techniques given the short sample
  - Sample: 1985 – 2019
  - Specification: 12 lags, 6 variables

CPU index, industrial production, unemployment rate ,commodity prices, consumer prices, policy rate

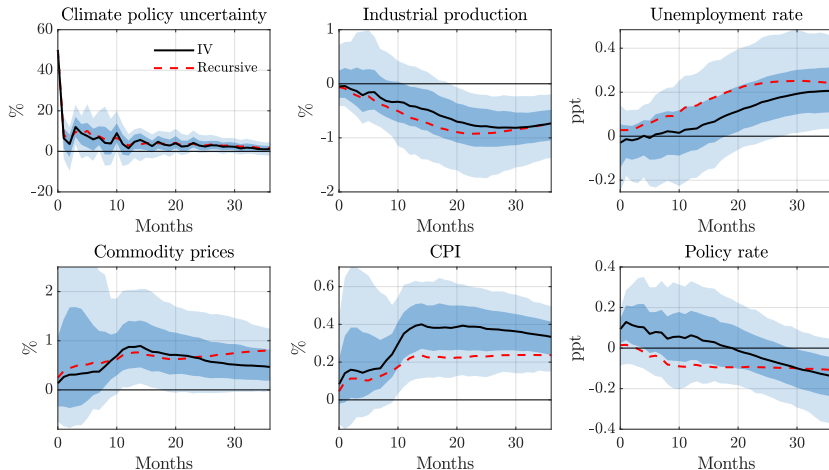
[► Data](#)

- Use local projections as robustness and to map out wider effects [► More](#)

## Aggregate Effects

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# The macro effects of climate policy uncertainty



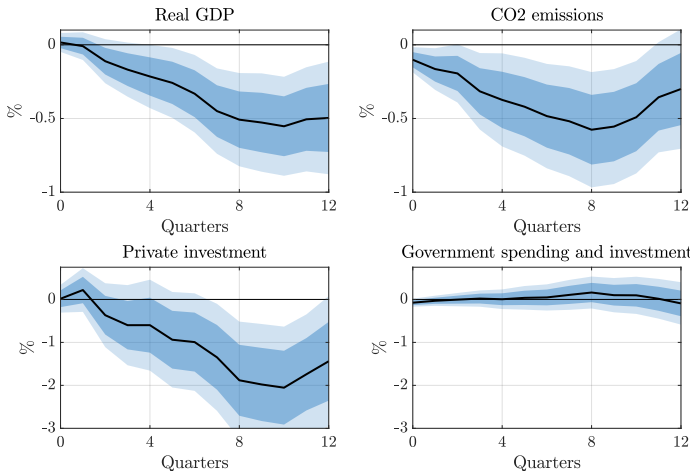
First-stage regression: F-Statistic: 10.10,  $R^2$ : 1.68%

**Figure 4:** Baseline VAR

# The macro effects of climate policy uncertainty

- Climate policy uncertainty has **meaningful** economic effects
  - Leads to significant fall in industrial production and an increase in unemployment
  - Importantly, commodity and consumer prices increase
  - Monetary response is ambiguous
- Thus, transmit more like **supply shocks**
- Notable differences to naive recursive approach, particularly for CPI and monetary response

# The macro effects of climate policy uncertainty



- Significant fall in GDP and **investment**
- No response of government spending & investment
- Emissions fall but emissions intensity **unchanged**
- No evidence for **green paradox**

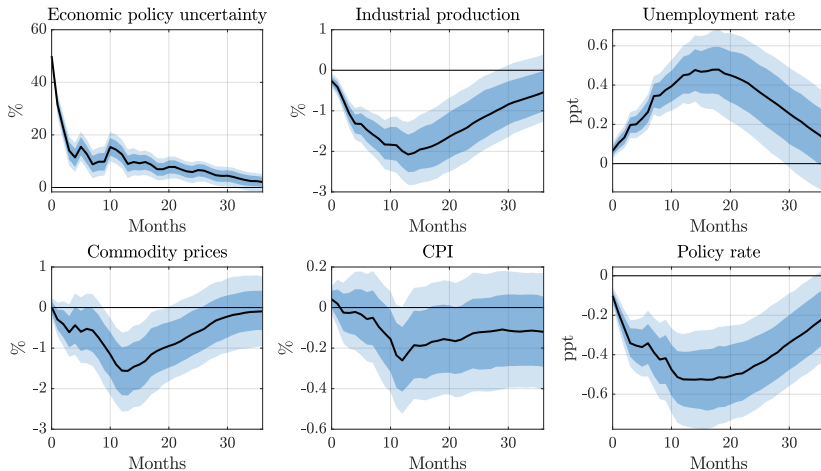
► Sensitivity

**Figure 5:** Impacts on GDP, emissions and investment

## Is climate policy uncertainty special?

- What do we learn from looking at **climate policy uncertainty**?
- Contrast with effects of broader **economic policy uncertainty**
  - Use index from Baker, Bloom, and Davis (2016)
  - Estimate responses based on recursive VAR

# The effects of economic policy uncertainty



**Figure 6:** VAR with EPU



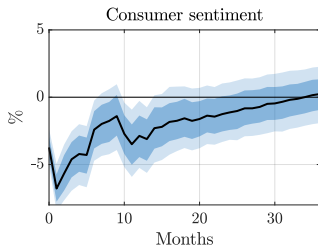
# Climate versus economic policy uncertainty

- Economic policy uncertainty transmits **differently** from climate policy uncertainty
  - Economic policy uncertainty also leads to fall in production and emissions
  - But commodity and consumer prices also tend to decrease
  - Monetary response accommodates the shock
- They thus transmit more like **demand shocks**
  - This is true for most uncertainty measures, e.g. an innovation to the VIX has very similar effects
- Response of prices to uncertainty shocks theoretically ambiguous
  - Different channels: precautionary demand, real options, precautionary pricing
  - Price response depends on relative strength of supply- and demand-side effects

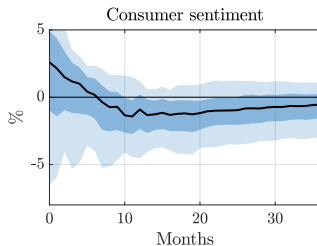
# Why is climate policy uncertainty inflationary?

- For CPU **supply-side** effects dominate, for EPU **demand-side** effects dominate
  - Consistently, consumer sentiment falls significantly for EPU but **not** for CPU shock

(a) Economic policy uncertainty shock



(b) Climate policy uncertainty shock



**Figure 7:** Impacts on sentiment

## Firm-level effects

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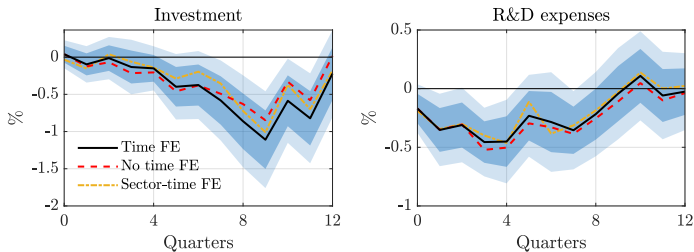
## Firm-level impacts

- We revisit effects of climate policy uncertainty shocks in panel of firms
  - Construct quarterly panel of US listed firms
  - Unbalanced panel from 1986 to 2019 (136 quarters) with 11,872 firms
- Average effects turn out to be comparable to aggregate impacts [▶ More](#)
- How does effect vary with firm-level **climate change exposure**?
  - use exposure measures by Sautner et al. (2023) based on earnings conference calls
- Estimate local projection on shock **interacted** with exposure

$$y_{i,t+h} = \mu_{i,h} + \delta_t + \theta_h(\text{Exp}_{i,t-1} - \overline{\text{Exp}_i}) \times \varepsilon_{1,t} + \gamma_h' \mathbf{x}_{i,t-1} + \nu_{i,t+h},$$

- focus on **within-firm** variation to net out permanent differences
- Allows to control for **time fixed effects**

## Heterogeneity by climate exposure

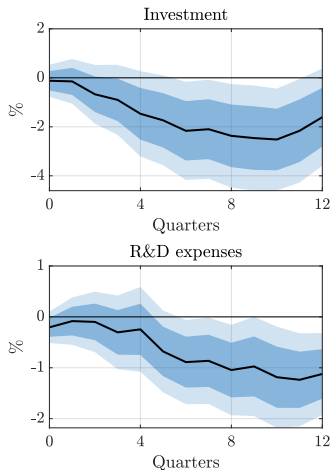


**Figure 8:** Heterogeneous effects based on prior climate exposure

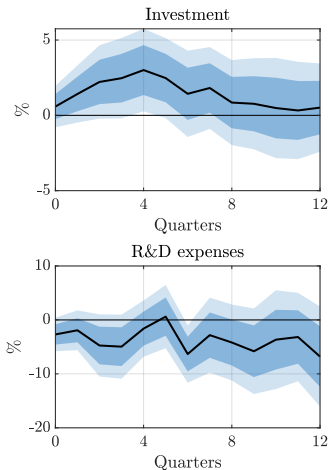
- Firms display **stronger fall** in investment and R&D when climate exposure is high
- Statistically and economically significant
- Robust to time or sector by time fixed effects

# Sectoral impacts

(a) All ex. oil, gas, utilities



(b) Oil, gas, and utilities



- Most sectors show significant fall in investment and R&D
  - Consistent with **average** response
- Except **oil, gas & utilities**
  - Investment increases!
  - R&D falls substantially
  - consistent with **green paradox** at micro level

► Sales

► Longer-term impacts

## Conclusion

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# Conclusion

- Climate policy uncertainty has **pervasive economic** effects at macro & firm-level
  - Broad-based effects beyond brown sectors
  - Effects more pronounced when exposure to climate is high
- Contrary to other uncertainty shocks, climate policy uncertainty transmits more like **supply shocks**
  - Very persistent impacts dragging on investment and innovation
  - Monetary policy can make matters worse by leaning against inflationary pressures
- Illustrates importance of **clear and predictable** climate policies & coordination between fiscal and monetary policy



**Thank you!**

## Related literature

**Climate policy actions:** Anderson, Marinescu, and Shor 2019; Martin, De Preux, and Wagner 2014; Metcalf 2019; Metcalf and Stock 2023; Bernard and Kichian 2021; Känzig 2023

**Measuring policy uncertainty:** Saiz and Simonsohn 2013; Baker, Bloom, and Davis 2016; Caldara and Iacoviello 2022; Caldara et al. 2020; Gambetti et al. 2023

**Climate news and uncertainty:** Engle et al. 2020; Sautner et al. 2023; Gavriilidis 2021; Basaglia et al. 2025; Noailly, Nowzohour, and Van Den Heuvel 2022; Fried, Novan, and Peterman 2021

# Index validation

- **Validation exercise:**
  - To validate the index, we use OpenAI's gpt-4o-mini model
  - We sample a set of articles from our Climate AND Policy corpus
  - Next, we ask the LLM to classify articles into CPU and non-CPU articles
  - This yields a false-positive rate **below 10%**
  - Human audit of subset of articles confirms the accuracy of the classification
- **Robustness:**
  - Results are robust to using less restrictive set of dictionary terms
  - Expanding the set of newspapers

# Climate policy uncertainty events

## (a) Timeline of the U.S. stance on the Paris Climate Agreement

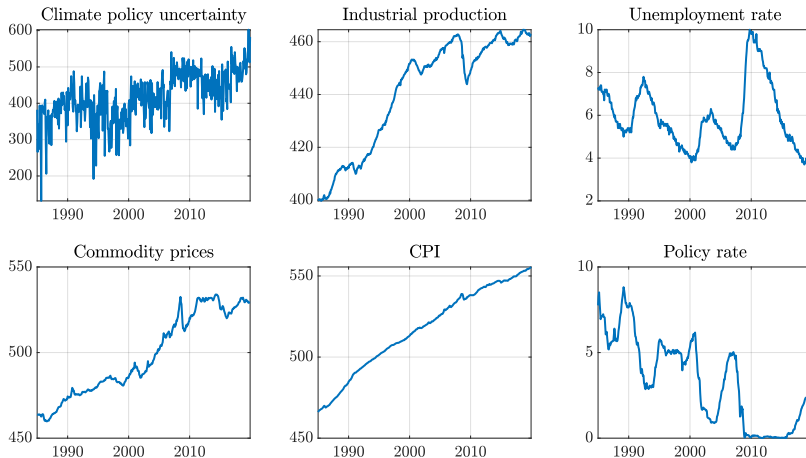


## (b) Timeline of the Waxman-Markey bill



## (c) Timeline of California's waiver to set stricter emissions standards





**Figure 11:** Transformed data series

- **Narrative account:** ✓ **Accords well** with accounts on key historical episodes
- **Forecastability:** ✓ **Not** forecastable by macroeconomic or financial variables
- **Orthogonality:** ✓ **Uncorrelated** with measures of other structural shocks  
(e.g. uncertainty, oil, or fiscal shocks)

**Table 1:** Granger causality tests

Variable	p-value
Instrument	0.1977
Industrial production	0.1643
Unemployment rate	0.9008
Commodity prices	0.5761
CPI	0.7375
Policy rate	0.9762
Economic policy uncertainty	0.4132
Trade policy uncertainty	0.5255
Geopolitical risk	0.7883
VXO	0.9294
Climate policy news	0.5455
Joint	0.6967

# Orthogonality

Shock	Source	$\rho$	p-value	n	Sample
<i>Panel A: Uncertainty shocks</i>					
Uncertainty	Bloom (2009)	-0.07	0.17	384	1986M01-2017M12
	Baker, Bloom, and Davis (2016)	0.08	0.10	384	1986M01-2017M12
	Piffer and Podstawski (2017)	-0.01	0.81	355	1986M01-2015M07
<i>Panel B: Oil shocks</i>					
Oil price	Hamilton (2003)	-0.07	0.20	384	1986M01-2017M12
Oil supply	Kilian (2008)	0.09	0.20	225	1986M01-2004M09
	Caldara, Cavallo, and Iacoviello (2019)	0.00	0.97	360	1986M01-2015M12
	Baumeister and Hamilton (2019)	-0.04	0.37	408	1986M01-2019M12
	Kilian (2009)	-0.03	0.62	264	1986M01-2007M12
Global demand	Kilian (2009)	-0.05	0.46	264	1986M01-2007M12
Oil-specific demand	Kilian (2009)	-0.07	0.29	264	1986M01-2007M12
Oil supply news	Känzig (2021)	-0.06	0.23	408	1986M01-2019M12
<i>Panel C: Productivity and news shocks</i>					
Productivity	Basu, Fernald, and Kimball (2006)	-0.11	0.27	104	1986Q1-2011Q4
News	Barsky and Sims (2011)	0.00	0.98	87	1986Q1-2007Q3
	Kurmann and Otrok (2013)	-0.02	0.86	78	1986Q1-2005Q2
	Beaudry and Portier (2014)	0.03	0.74	107	1986Q1-2012Q3
<i>Panel D: Monetary policy</i>					
Monetary policy	Bauer and Swanson (2023)	0.08	0.14	383	1988M02-2019M12
	Gertler and Karadi (2015)	0.09	0.12	324	1990M01-2016M12
	Romer and Romer (2004)	-0.03	0.70	132	1986M01-1996M12
	Smets and Wouters (2007)	-0.15	0.19	76	1986Q1-2004Q4
<i>Panel E: Financial shocks</i>					
Financial	Gilchrist and Zakrajšek (2012)	0.03	0.60	360	1986M01-2015M12
	Bassett et al. (2014)	-0.09	0.44	76	1992Q1-2010Q4
<i>Panel F: Fiscal policy shocks</i>					
Fiscal policy	Romer and Romer (2010)	-0.09	0.40	88	1986Q1-2007Q4
	Ramey (2011)	0.19	0.06	100	1986Q1-2010Q4
	Fisher and Peters (2010)	-0.00	1.00	92	1986Q1-2008Q4



- Use identified **climate policy uncertainty shock**,  $\varepsilon_{1,t}$  in local projection

$$y_{i,t+h} = \beta_{h,0}^i + \psi_h^i \varepsilon_{1,t} + \beta_{h,1}^i y_{i,t-1} + \dots + \beta_{h,p}^i y_{i,t-p} + \xi_{i,t,h}$$

- assess possible truncation bias by relaxing dynamic VAR structure
- can also estimate effects on variables only available at lower frequencies
- To relax invertibility requirement, also present results from local projections-instrumental variable specification

## External instrument approach

- Structural VAR

$$\mathbf{y}_t = \mathbf{b} + \mathbf{B}_1 \mathbf{y}_{t-1} + \cdots + \mathbf{B}_p \mathbf{y}_{t-p} + \mathbf{S} \boldsymbol{\varepsilon}_t, \quad \boldsymbol{\varepsilon}_t \sim N(0, \boldsymbol{\Omega})$$

- **External instrument:** variable  $z_t$  *correlated* with the **shock of interest** but *not* with the **other shocks**
- **Identifying assumptions:**

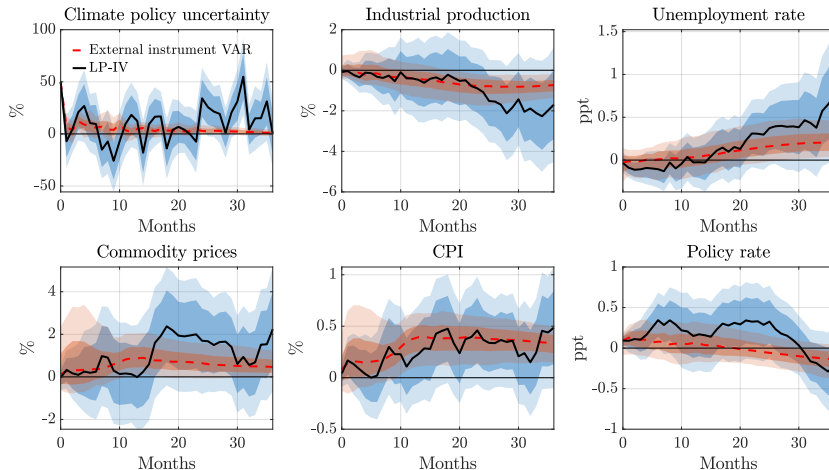
$$\mathbb{E}[z_t \boldsymbol{\varepsilon}_{1,t}] = \alpha \neq 0 \quad (\text{Relevance})$$

$$\mathbb{E}[z_t \boldsymbol{\varepsilon}_{2:n,t}] = \mathbf{0}, \quad (\text{Exogeneity})$$

$$\mathbf{u}_t = \mathbf{S} \boldsymbol{\varepsilon}_t \quad (\text{Invertibility})$$

- Use **climate policy uncertainty event series** as *external instrument* for **climate policy uncertainty index**

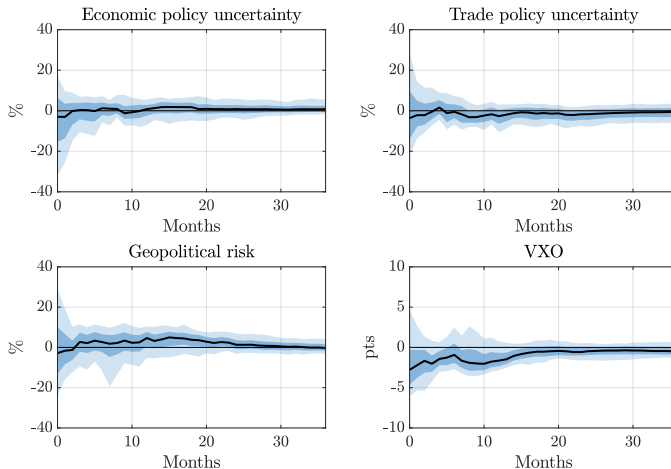
# The macro effects of climate policy uncertainty



**Figure 12:** Local projections

- CPU has **no** significant effect on other uncertainty measures [▶ Detail](#)
  - economic policy uncertainty, trade policy uncertainty, geopolitical risk, financial uncertainty, ...
- Results **robust** to
  - controlling for other uncertainty measures (other policy uncertainty, financial uncertainty, oil price uncertainty)
  - controlling for first moment shocks using climate news index [▶ Detail](#)
  - relaxing VAR assumptions (invertibility, dynamic VAR structure) [▶ Detail](#)

# Impacts on other uncertainty measures



**Figure 13:** Impacts on other uncertainty measures

# Controlling for news and other uncertainty measures

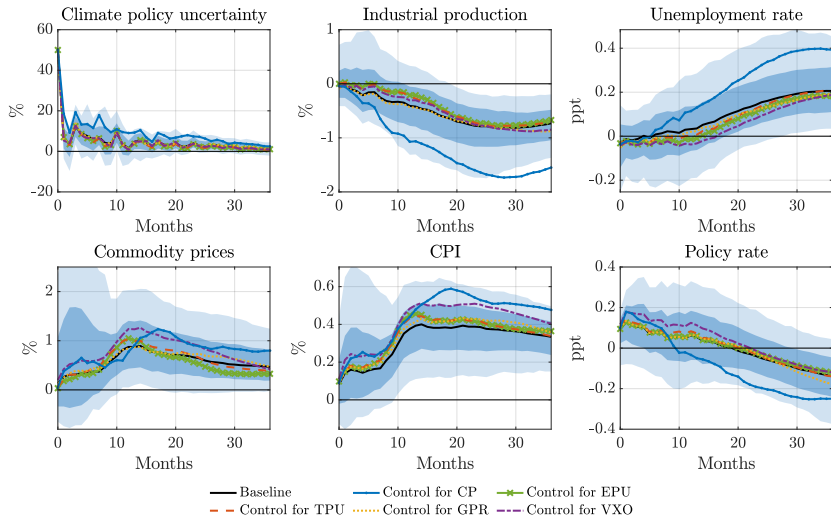
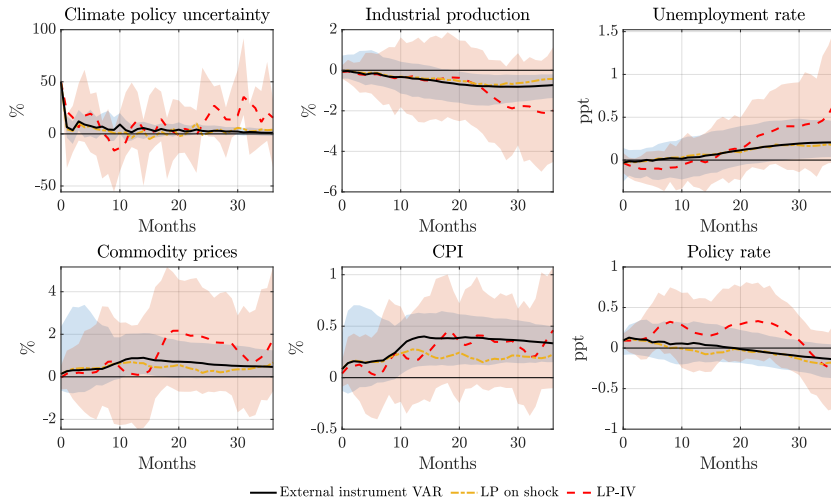


Figure 14: Additional controls

# Relaxing VAR assumptions



**Figure 15: Additional controls**

# Why is climate policy uncertainty inflationary?

- Response of prices to uncertainty shocks theoretically ambiguous
- Key channels
  - **Precautionary demand:** Higher uncertainty leads agents to cut spending, **reducing prices** via lower demand
  - **Real options channel:** After a rise in uncertainty, firms delay investment and hiring. Price response **depends** on strength of demand- and supply-side effects
  - **Precautionary pricing:** Increased uncertainty raises the potential for higher future costs, leading firms to **raise prices** preemptively
- Price response depends on relative strength of supply- and demand-side effects

▶ Simple model



# A simple two-sector NK model

- Why are CPU shocks inflationary?
- Study propagation of different uncertainty shocks in NK model with two sectors:
  - **Energy sector** producing energy/emissions using labor
  - **Non-energy sector** producing consumption good using energy and labor
- Standard household sector and fiscal/monetary authority

## Non-energy sector

- Technology

$$y_t = Z_{x,t} e_t^\alpha n_{x,t}^{1-\alpha}$$

- Cost-minimization

$$p_{e,t} = \alpha m c_t \frac{y_t}{e_t}$$

$$w_t = (1 - \alpha) m c_t \frac{y_t}{n_{x,t}}.$$

- Price setting

$$\pi_t (\pi_t - \bar{\pi}) = \beta \mathbb{E}_t \left[ \frac{\lambda_{t+1}}{\lambda_t} \pi_{t+1} (\pi_{t+1} - \bar{\pi}) \frac{y_{t+1}}{y_t} \right] + \frac{\varepsilon}{\Omega_p} \left( m c_t - \frac{\varepsilon - 1}{\varepsilon} \right)$$

- Consider uncertainty shock about productivity,  $\sigma_{Z_{x,t},t}$

## Energy sector

- Technology

$$e_t = Z_{e,t} n_{e,t}$$

- Cost-minimization

$$(1 - \tau_t) p_{e,t} = \frac{\eta}{\eta - 1} \frac{w_t}{Z_{e,t}}$$

- Price setting

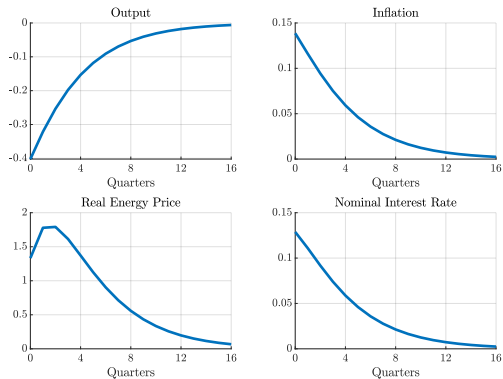
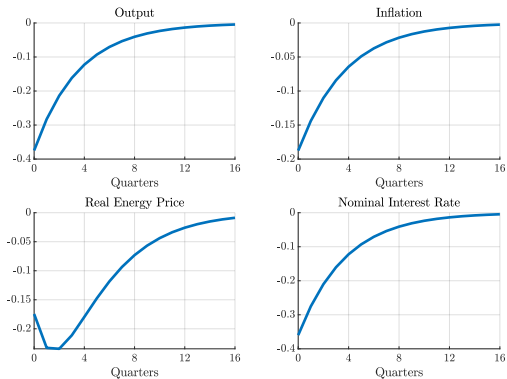
$$\pi_t^e (\pi_t^e - \bar{\pi}^e) = \beta \mathbb{E}_t \left[ \frac{\lambda_{t+1}}{\lambda_t} \pi_{t+1}^e (\pi_{t+1}^e - \bar{\pi}^e) \frac{e_{t+1}}{e_t} \frac{p_{e,t+1}}{p_{e,t}} \right] + \frac{\eta}{\Omega_p^e} \left( \frac{w_t}{Z_{e,t} p_{e,t}} - \frac{(1 - \tau_t)(\eta - 1)}{\eta} \right)$$

- In line with the data assume that energy prices much more flexible than goods prices
- Consider uncertainty shock about carbon tax,  $\sigma_{\tau_t,t}$

# The differential impact of uncertainty shocks

(a) Uncertainty about productivity

(b) Uncertainty about carbon tax



**Figure 16:** Uncertainty shocks in model

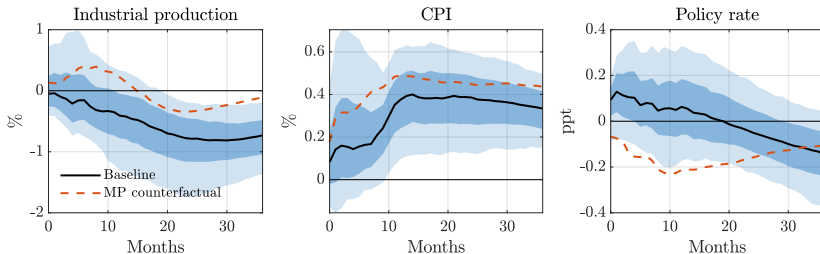
# The differential impact of uncertainty shocks

- Uncertainty about productivity in non-energy sector has very different implications
- Consistent with data, uncertainty about productivity is **disinflationary** while climate policy uncertainty is **inflationary**
- Precautionary pricing channel dominates precautionary demand channel for climate policy uncertainty

# The role of monetary policy

- How important is **monetary policy** for transmission of climate policy uncertainty?
- Perform a **counterfactual exercise** using McKay and Wolf (2023) approach
  - Use monetary shocks from Bauer and Swanson (2023)
  - Robust to Lucas critique
- Use MP shocks to impose same monetary response after CPU shock as for EPU shock

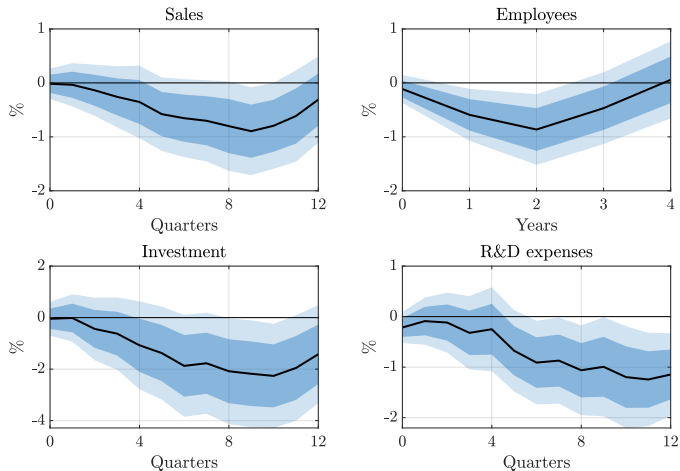
# The role of monetary policy



**Figure 17:** Monetary policy counterfactual

- Monetary policy response matters a **great deal** for the transmission of CPU shocks
  - Mitigates unemployment response substantially
  - Comes at cost of tolerating slightly higher inflation
- ◀ Back • Should monetary policy respond **differently** to different sources of uncertainty?

# Average effect

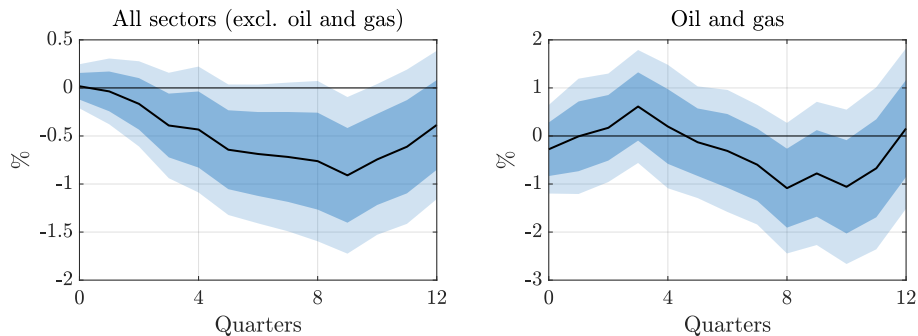


- Sales and employees fall significantly
- Substantial fall in firm-level **investment** and **R&D**
- Evidence consistent with macro results

**Figure 18:** Average effect on firm outcomes



# Sectoral impacts



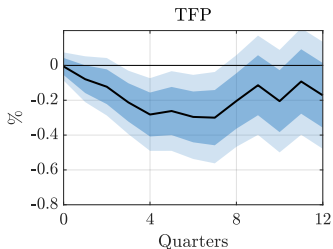
**Figure 19:** Sectoral impacts

## Longer-term impacts

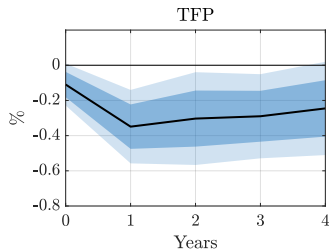
- Results are consistent with **green paradox** at micro level
- Climate policy uncertainty strengthens incentives to extract fossil fuels
- **But:** reduces R&D expenses that spur the green transition
- Climate policy uncertainty can exacerbate transition costs through **misallocative** forces

# Longer-term impacts

(a) Aggregate TFP (Utilization adj.)



(b) Average firm-level TFP



- Climate policy uncertainty is a drag on investment and innovation
- Distorts allocation leading to overinvestment in firms with uncertain long-term viability
- Confirmed by significant and persistent fall in TFP