



# Tipping into Hyperinflation: Uncertainty and European Inflation Dynamics after World War I

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# Why do hyperinflations begin?

- We know the answer...at least mechanically
  - Governments (or their central banks) print money, quite often to meet a budget shortfall or unsustainable fiscal policy
- But consider Europe at the end of World War I
  - Ex ante, it's not obvious which countries would tip into hyperinflation
  - For example, in 1920s, France ran large budget deficits and financed these via a rising national debt and money creation.



Prices in Europe rose by large amounts **throughout** Europe after abandoning fixed exchange rates

<b>1914-1918 Annualized Inflation</b>	
<b>Austria</b>	<b>13.5%</b>
<b>Belgium (1914-1920)</b>	<b>25.2%</b>
<b>Britain</b>	<b>20.6%</b>
<b>France</b>	<b>30.0%</b>
<b>Germany</b>	<b>17.9%</b>
<b>Holland</b>	<b>33.1%</b>
<b>Hungary</b>	<b>53.7%</b>
<b>Italy</b>	<b>36.3%</b>
<b>Poland</b>	<b>66.4%</b>
<b>Switzerland</b>	<b>20.7%</b>

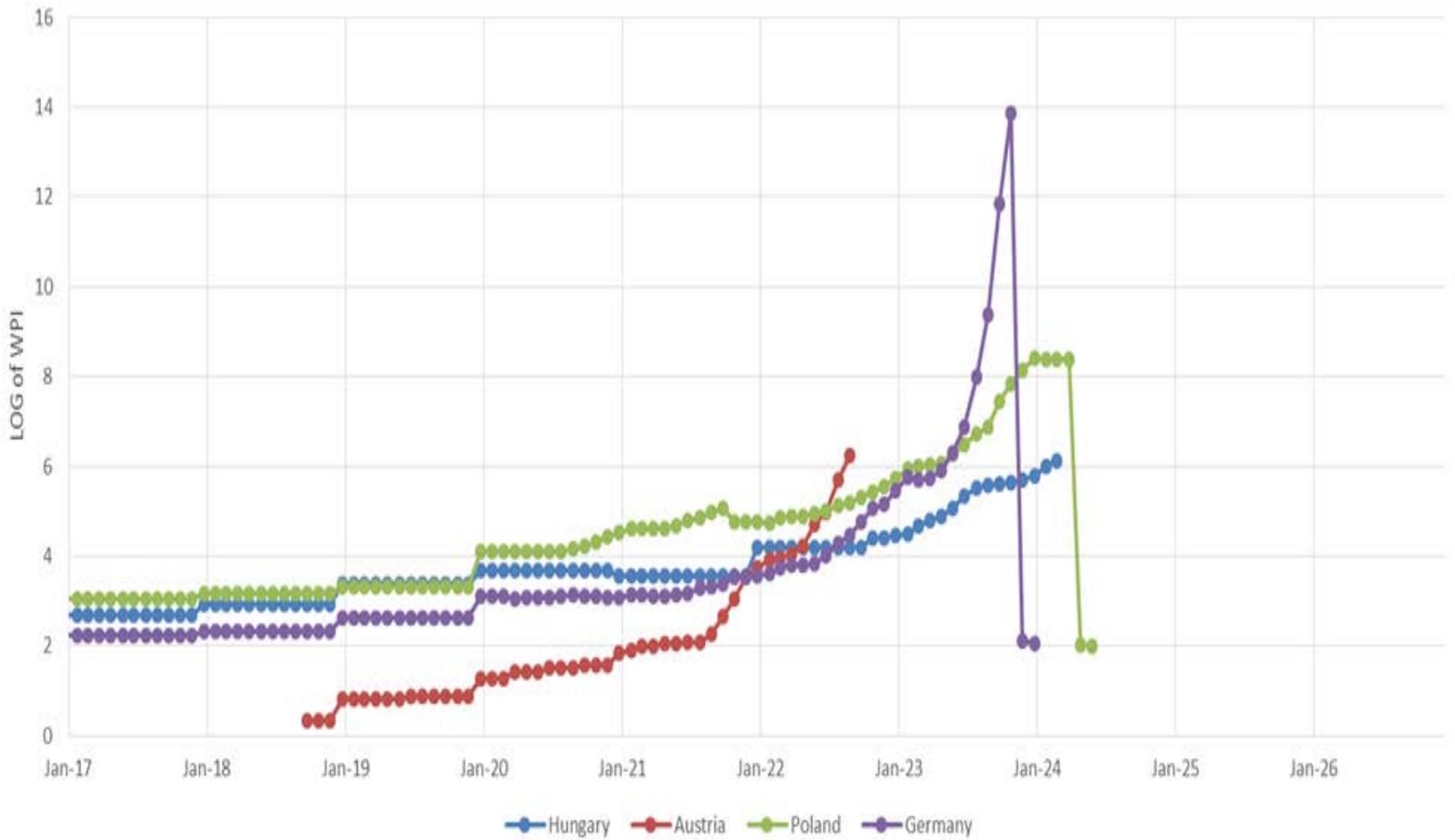
# Debt-GDP Ratios Pre and Post WWI

	1913	1920
Austria	63.3	
Belgium	49.5	102.7
France	66.3	185.5
Germany	42.1	
Hungary	63.3	
Netherlands	61.6	59.6
Italy	69.2	142.3
Switzerland	29.2	
UK	25.8	130.7

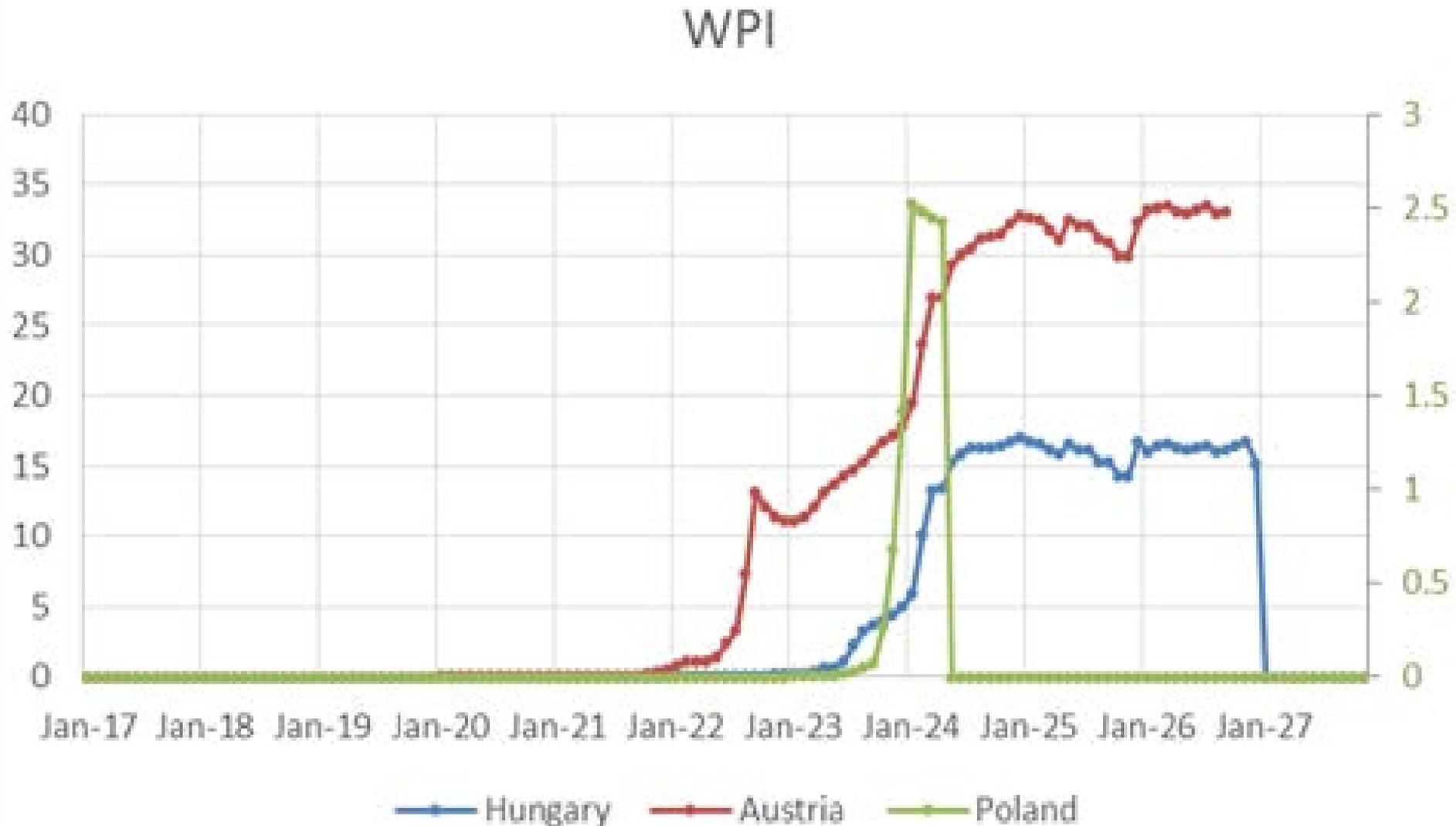
# Question

- So, how does one identify the likelihood of a particular country experiencing hyperinflation given macroeconomic indicators that look broadly similar?
- *Ex post*, we know only a subset actually succumbed to it

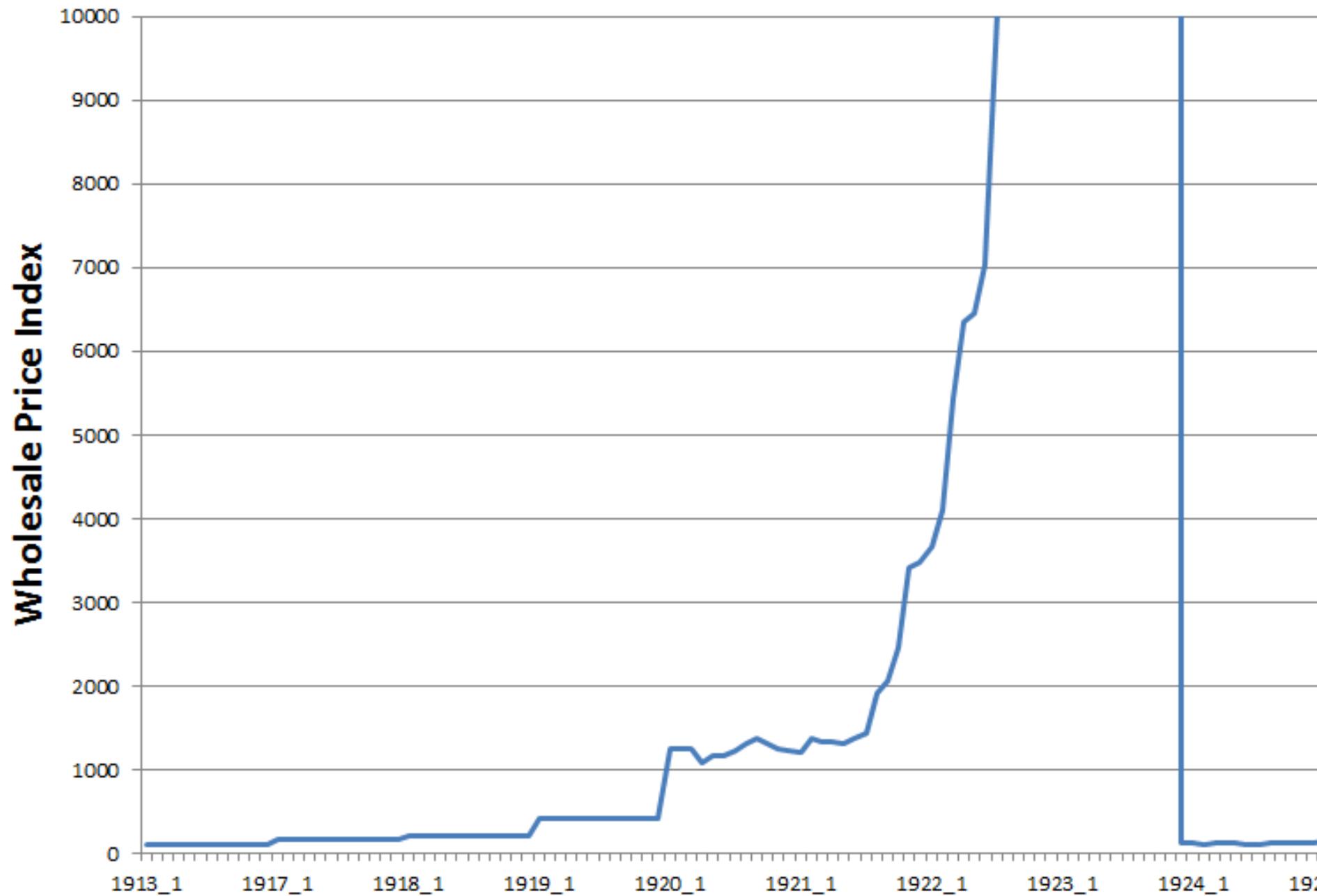
# Hyperinflations in Germany, Hungary, Austria, and Poland



# Hyperinflations in non-German states



# Germany





# Our Contribution

- We examine how hyperinflation was triggered, and in particular, how policy uncertainty brought its ravages to some parts of Europe
  - Sargent (1982) alludes to the role of uncertainty
- We provide a formal test of it by developing a quantitative measure of policy uncertainty (PU)
  - Asset price data → a high-frequency measure of PU
- Test whether PU contributed to the onset of hyperinflation and examine dynamics in a small macro VAR model
- We extend the newer literature on uncertainty to inflation and to extreme macro environments

# Why did these countries tip into hyperinflation?

- Simply losing a war per se does not seem to be sufficient to set it off
  - Not all Central Powers in WWI suffered hyperinflation
    - Bulgarian and Turkish/Ottoman prices rise by more than 3000% between 1914-1925, but never more than double in any given year
    - Czechoslovakia – a newly formed state – saw its prices rise by roughly 1600% between 1914 and 1921, but thereafter stabilized
  - Russia had hyperinflation but was part of Entente
  - Japan, Italy, and Germany didn't have it after WWII



# Policy Uncertainty Hypothesis

- H1: Pronounced policy uncertainty can tip countries into hyperinflation
- H2: Policy uncertainty was high throughout Europe, but particularly high in countries condemned to hyperinflation. Why?
  1. Lack of agreement over reparations
    - Corollary of Keynes' *Economic Consequences of Peace*
    - In this sense, losing WWI might have mattered
  2. Non-existent or shattered state capacity

# How do we measure policy uncertainty?

- Following Bloom (2009), we use asset price volatility to capture uncertainty
- We assemble a new daily data set on exchange rates for a panel of 10 European economies – both the victors and the vanquished
- We develop a high-frequency measure of uncertainty based on the monthly realized volatility (RV) of exchange rates

# How does uncertainty generate hyperinflation?

- Credibility of economic policymaking
  - Central bank independence and governance important for maintaining control over inflation dynamics
    - (Bordo & Siklos 2014, 2015; Bordo & MacDonald, 2002)
  - Fiscal policy uncertainty has been shown to influence medium-run macroeconomic outcomes
    - (Paredes et. al., 2015)
  - Fiscal volatility shocks have adverse effects on U.S. economy in 20<sup>th</sup> century
    - (Fernández-Villaverde et al., 2015)

# Uncertainty measured by realized volatility of exchange rates

- For a given month, we calculate the sum of squared daily, demeaned first differences as a consistent estimate of the true, but unobservable, variance of monthly changes in the foreign exchange rates

$$RV_{kt} = \frac{1}{N_t - 1} \sum_{i=1}^{N_t - 1} (\Delta x_{ki+1} - \mu_{kt})^2,$$

- Data: spot rates trading in New York as reported in the *Commercial and Financial Chronicle*.

# Advantages of RV vs. other measures of uncertainty

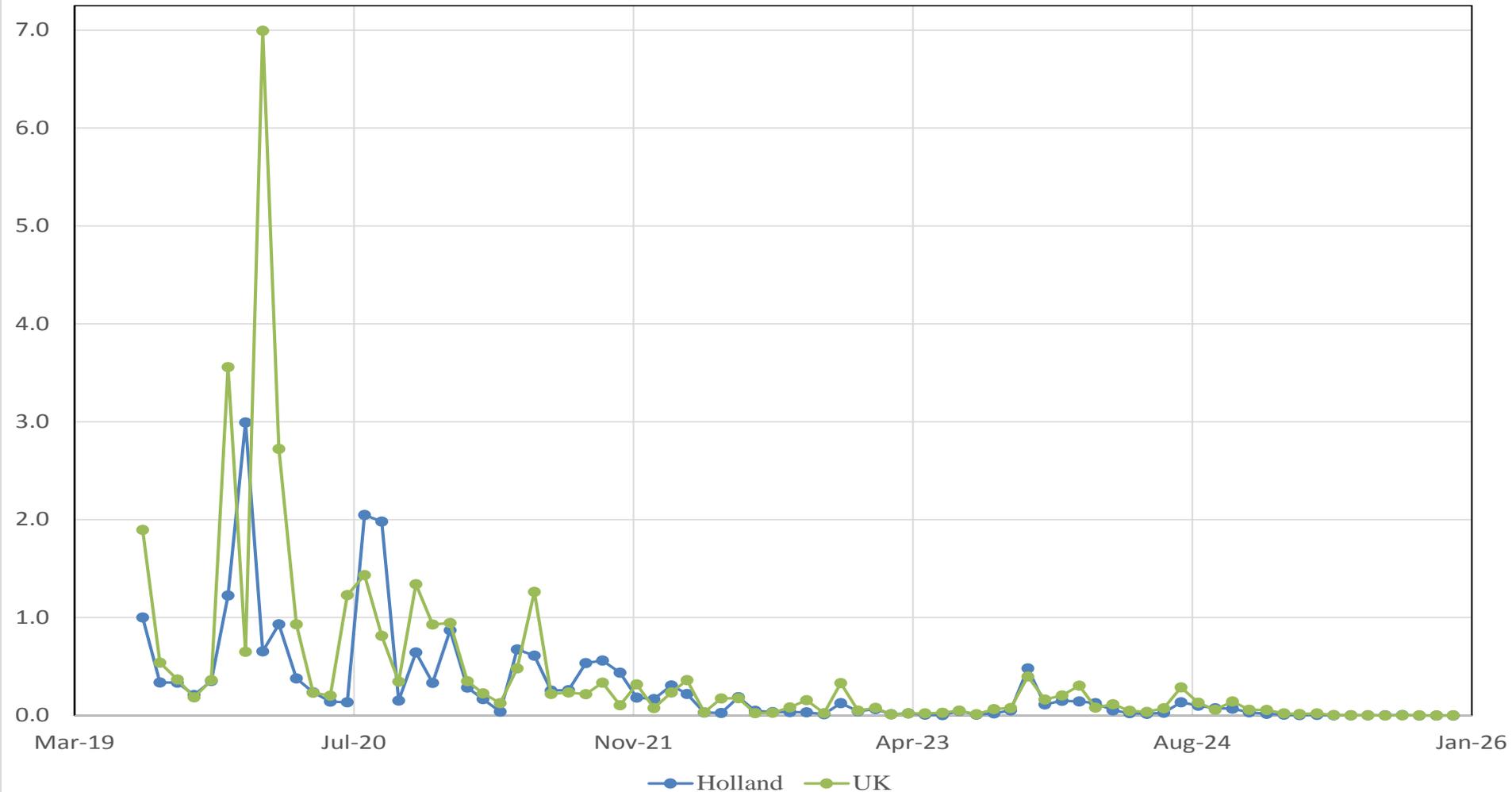
- Advantages vs. other measures of uncertainty
  - Since FX rates traded in NYC, it is still possible to obtain a measure of policy uncertainty in an extreme macroeconomic environment
  - Market data are less susceptible to political manipulation, wartime disruption, etc.
- Unitless measures: can be scaled to examine both the cross-sectional and time-series dimensions



# UK and Netherlands RV start high, but then decline over the 1920s

(Measured relative to Holland, July 1919)

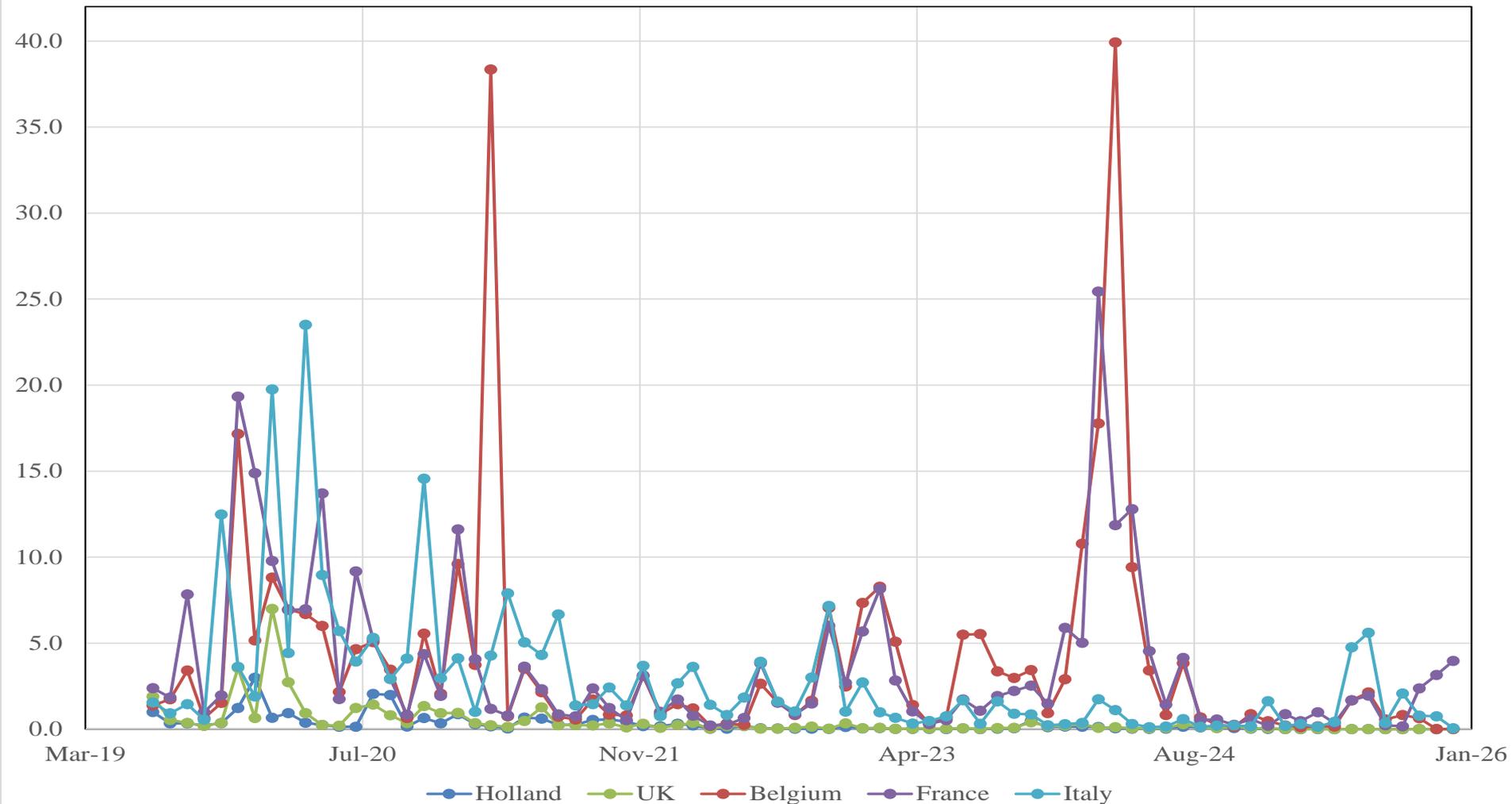
**Holland and UK relative RV measure**



# Belgium, France and Italy are more volatile and have higher peaks and troughs than UK & Holland

(Measured relative to Holland, July 1919)

Relative RV measure for non-hyperinflation countries





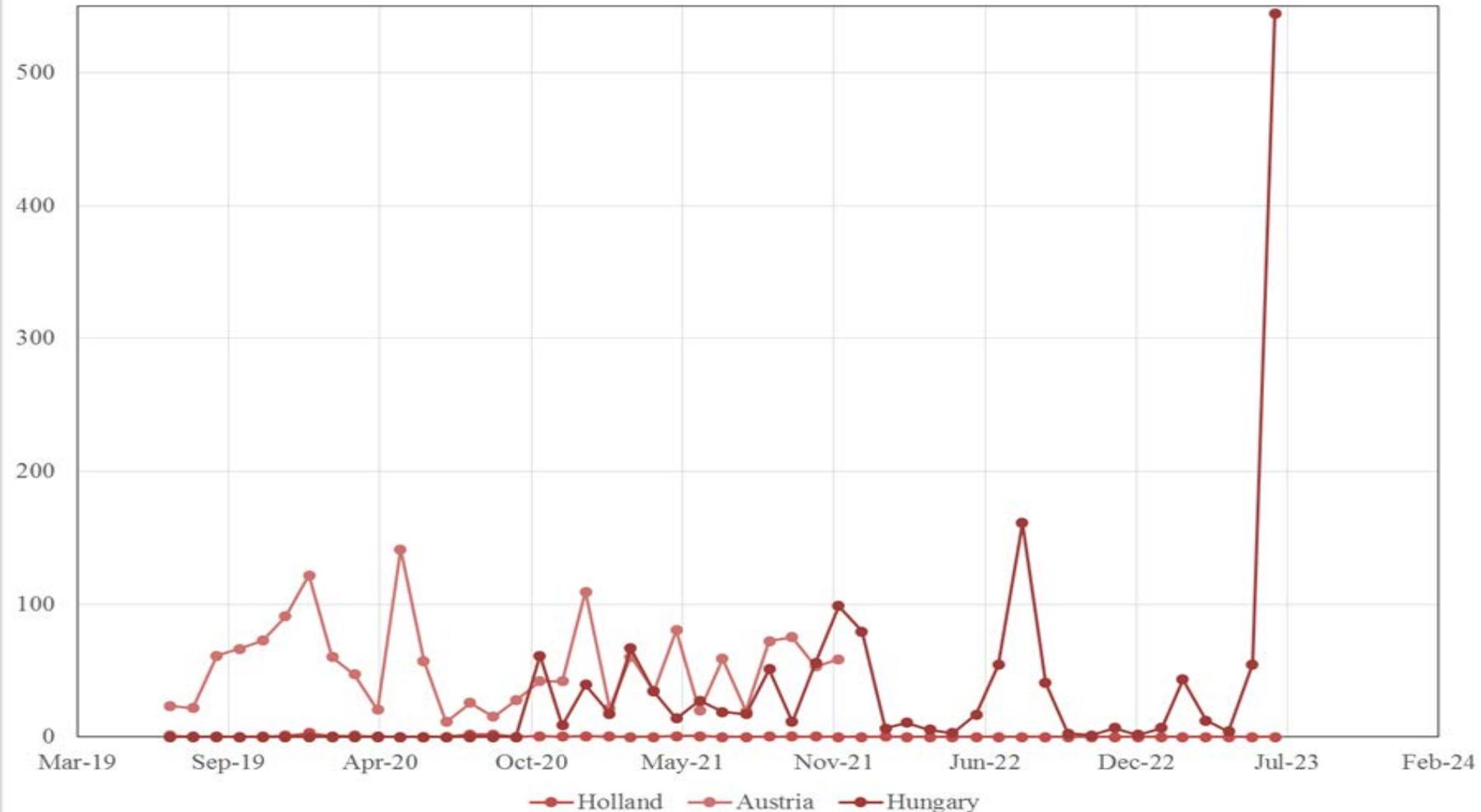
# Why would uncertainty be higher in these?

- Partly to the entanglement over reparations
  - France felt justified in running large budget deficits, believing Germany would eventually pay reparations for the reconstruction of territories destroyed or damaged during WWI
  - “Le Boche paiera tout”
    - Louis Lucien Klotz, French Finance Minister, 1917-20
- Uncertainty over security
  - Belgium and France maintain high military expenditure into 1920s

# Austria and Hungary have extremely high RV even before hyperinflation commences

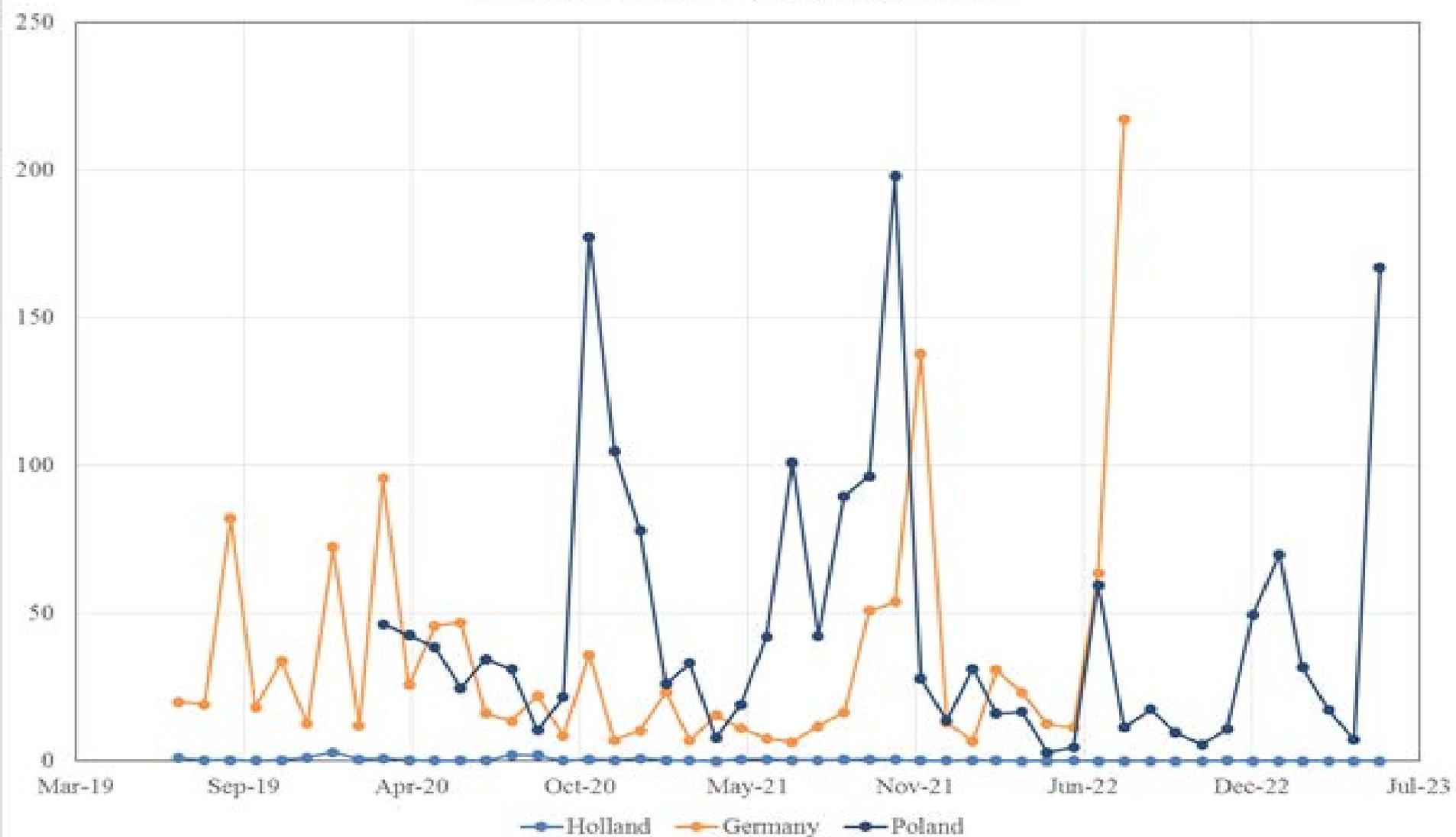
(Measured relative to Holland, July 1919)

Relative RV measure for Austria/Hungary



# Germany & Poland have extraordinarily high and variable RV – even before hyperinflation commences (Measured relative to Holland, July 1919)

Relative RV measure for Germany/Poland



# RV is more pronounced in hyperinflation countries, even before hyperinflations occur in these countries

(Relative to Holland, 1919)

## Average monthly RV

Year	Holland	Britain	Belgium	France	Italy	Germany	Austria	Poland	Hungary
1919	1.0	2.0	7.5	9.9	5.9	53.8	97.3	---	---
1920	1.5	2.6	8.3	11.3	14.2	58.1	88.6	92.4	---
1921	0.7	0.7	9.5	4.7	6.3	50.9	96.1	110.1	65.6
1922	0.2	0.2	3.0	3.0	4.2	118.8	73.8	28.9	56.4
1923	0.1	0.1	6.5	4.3	1.7	1,974.1	--	282.7	103.7
1924	0.1	0.2	13.1	10.6	0.8	88,339.0	---	18.2	51.6
1925	0.0	0.0	1.0	2.4	2.5	0.0	---	21.2	---

# Policy uncertainty in high RV countries

1. Germany, Hungary, Poland, and Austria faced large fiscal obligations of an unknown size and duration
  - Treaties ending WWI didn't specify the **total amount** or **number of years** payments would have to be made
2. All four faced unstable political environments that made negotiation of budgets protracted and subject to wars of attrition



# Uncertainty over reparations

- For Germany, Versailles Treaty didn't specify the **total amount** or **number of years** payments would have to be made
  - Only an interim payment and that the total sum would get discharged in 30 years
- Instead of specifying terms, the treaty created a Reparations Commission charged with deciding on these parameters by May 1, 1921

# Reparations:

## Versailles Treaty, Articles 231-2

The Allied and Associated Governments affirm and Germany accepts the responsibility of Germany and her allies for causing all the loss and damage to which the Allied and Associated Governments and their nationals have been subjected as a consequence of the war imposed upon them by the aggression of Germany and her allies.

The Allied and Associated Governments recognize that the resources of Germany are not adequate ... to make complete reparation for all such loss and damage.

The Allied and Associated Governments, however, require, and Germany undertakes, that she will make compensation for all damage done to the civilian population of the Allied and Associated Powers and to their property during the period of the belligerency of each as an Allied or Associated Power against Germany by such aggression by land, by sea and from the air.



# Reparations Commission met repeatedly without completing a deal

- In San Remo, Bath, Hyde, Spa, and Brussels
- Paris – Jan. 1921
  - France demands 226 billion gold marks or ~ \$53 billion U.S.
  - Germany counter proposal of 50 billion gold marks
- London – 5 May 1921
  - U.S. Congress won't ratify, reduced to “observer status”
  - Payments of 123 billion gold marks agreed to (~ \$31 billion), but 50 billion g.m. = “A” and “B” bonds that were required payment based on capacity to pay

# Reparations uncertainty takes its toll on Weimar Republic – undermining state capacity

- Budget deficit from 1920-22 due to reparations payments
  - Single largest expense (replacing armaments): German statistics claim 48% of the budget deficit for the three financial year's April 1<sup>st</sup> 1920 to March 31<sup>st</sup>, 1923.
- Hitler denounces the London Payments Schedule and begins to attract crowds in early 1921
- Assassination of Walter Rathenau, a key proponent of financial reform and founder of German Democratic party, seen as key turning point in prices -- rose rapidly in the 6 months following his death.
- 1922 RC declares Germany to be in default for failing to deliver timber
- Constant threat of invasion undermines stability
  - With eventual outcome of French and Belgian occupation of Ruhr 1923-5 in response of German failure to pay reparations



# Dissolution of the Austro-Hungarian Empire

- Treaty of Saint-Germain-en-Laye of September 10, 1919 establishes Republic of Austria
- Hungary becomes independent state under the terms of the Treaty of Trianon, June 4, 1920
- Both treaties specify **reparations will be paid, neither sets terms**



# Newly established successor states

- Czechoslovakia
- Poland
- Kingdom of Slovenes, Croats, and Serbs



CZECHOSLOVAKIA

AUSTRIA

YUGOSLAVIA

RUMANIA

RUMANIA

YUGOSLAVIA

- KÉSMÁRK
- TRENCSEN
- IGLÓ
- EPERJES
- PÖSTYÉN
- NAGYSZOMBAT
- BESZTERCEBÁNYA
- KASSA
- UNGVÁR
- POZSONY
- NYITRA
- RIMASZOMBAT
- MUNKÁCS
- LOSONC
- LÉVA
- FÜLEK
- KOMÁROM
- BEREGSZÁSZ
- MÁRAMAROS SZIGET
- MISKOLC
- EGER
- NYIREGYHÁZA
- SOPRON
- GYŐR
- BUDAPEST
- SZOMBATHELY
- SZÉKESFEHÉRVÁR
- SZOLNOK
- DEBRECEN
- SZATMÁRNÉMETHI
- NAGYKÁROLY
- KAPOSVÁR
- KECSKEMÉT
- GYULA
- TASNÁD
- DÉS
- BESZTERCE
- PÉCS
- BAJA
- GYULA
- NAGYVÁRAD
- KOLOZSVÁR
- VARASD
- ARAD
- SZÁSZRÉGEN
- ZÁGRÁB
- BELOVÁR
- TEMESVÁR
- MAROSVÁSÁRHELY
- KÁROLYVÁROS
- LUGOS
- NAGYENYED
- SEGESVÁR
- FIUME
- ESZÉK
- ÚJVIDÉK
- GYULAFEHÉRVÁR
- BRASSÓ
- BRÓD
- ZIMONY
- VERSEG

Duna

Dráva

Tisza

Maros

Száva

olt



# Fiscal policy uncertainty in failed/new states (1)

- New states would eventually be allocated portion of debt of Austrian Monarchy:
  - Millions of Krone: Austria (976), Czechoslovakia (898), Poland (291), Yugoslavia (32), Romania (4) & Italy (24)
  - Unsecured debt allocated 41.7% to Czechoslovakia, 36.8% to Austria, 13.7% to Poland, 4.1% to Italy, 2% to Yugoslavia and 1.6% to Romania.
- But this assignment of debt wasn't ratified until Innsbruck Protocol of 1925!

# State Capacity in failed/new states (2)

- Given political instability and fate of old and new countries was uncertain, military expenditures remained high well into 1920s
  - Hungary still spent a third of its budget on military expenses in 1920-21.
  - In 1923, Polish military expenditures were 53% of the budget deficit and 1/3<sup>rd</sup> of the budget
- Uncertainty over borders
  - Upper Silesia only forcibly incorporated into Poland in June 1922 by the League after plebiscite mandated by the Versailles Treaty failed and both Poland and German paramilitary units occupied it





# Uncertainty over reparations in Hungary & Austria

- Austria was to pay reparations according to treaty but goes bankrupt before payment
- Hungary's amount not fixed in Treaty of Trianon
  - Fixed later, in 1924, at 200 million gold crowns.
  - In addition, the amount of compensation payable to Hungary by the Succession States for the so-called *biencedes* (i.e., state properties in the territories separated from Hungary) was never fixed.
    - Idea of such compensation was canceled in 1930

# Sargent (1982) on Hungary's reparations

- “This circumstance alone created serious obstacles in terms of achieving a stable value for Hungary's currency and other debts, since the unclear reparations obligations made uncertain the nature of the resources which backed those debts.”



# State Capacity: Hungary

- End of the Austro-Hungarian Empire reduced Hungary to nearly 33% of its former size, left it with few raw materials, a loss of its markets, and no sea access
- Political chaos also ensued from its dissolution
  - Béla Kun's communist regime and Romanian occupation of Budapest (Aug.-Nov.1919) led to delayed state formation
- Formulating fiscal policy was challenging even in spite of reparations

# Budget gridlock in Hungary

- By December 1920, the Minister of Finance, Lóránt Hegedüs, drafted a financial program striving for general deflation, tax reforms, and reduced budget expenditures.
- The plan failed for various reasons, including strong political opposition and the reparation payments, which made it difficult to create a balanced budget for the country.

# Preliminary evidence

- If policy uncertainty is a driver of inflation, one might expect to observe a correlation between RV and inflation (or price levels) in our sample

# Correlation of monthly inflation and RV: excluding hyperinflation period

Correlation of $\Delta WPI : \Delta RV_{(t-i)}$						
	t-4	t-3	t-2	t-1	t	n
Austria	-0.36	0.26	0.23	0.11	0.27	21
Belgium	-0.03	0.11	-0.05	-0.23	0.20	52
Britain	-0.08	-0.04	0.06	0.03	-0.06	65
Czech	0.07	-0.02	-0.27	-0.10	-0.01	51
France	0.15	-0.06	0.13	0.01	0.07	65
Germany	0.19	0.15	0.19	0.23	0.13	43
Holland	0.21	-0.25	0.21	-0.22	0.23	64
Hungary	0.04	-0.16	0.09	0.51	0.19	20
Italy	-0.01	-0.09	0.18	-0.31	0.23	64
Poland	0.10	0.03	0.02	0.04	-0.02	44
Switzerland	0.25	-0.12	-0.07	0.02	0.23	59

# Correlation of price level and lagged RV: excluding hyperinflation period

Correlation of WPI : $RV_{(t-i)}$						
	t-4	t-3	t-2	t-1	t	n
Austria	-0.55	0.08	0.18	0.60	0.21	22
Belgium	-0.23	-0.15	-0.14	-0.14	-0.01	53
Britain	0.56	0.54	0.55	0.55	0.54	66
Czech	0.40	0.39	0.39	0.47	0.54	52
France	0.47	0.46	0.45	0.40	0.39	66
Germany	0.49	0.69	0.94	0.79	0.44	44
Holland	0.64	0.57	0.59	0.49	0.63	65
Hungary	-0.04	0.02	0.03	0.10	0.06	21
Italy	-0.23	-0.22	-0.19	-0.21	-0.11	65
Poland	0.57	0.60	0.54	0.29	0.08	45
Switzerland	0.22	0.24	0.25	0.39	0.41	60



# VAR Analysis

- We more formally test how uncertainty influences inflation dynamics using vector autoregressions. Our hypothesis: effects are more pronounced for countries that tipped into hyperinflation
- Estimate a four variable system:
  - (1) RV growth
  - (2) Industrial Production growth,
  - (3) WPI growth, and
  - (4) growth in either notes or the discount rate (depending on availability)

# VAR Analysis (con't.)

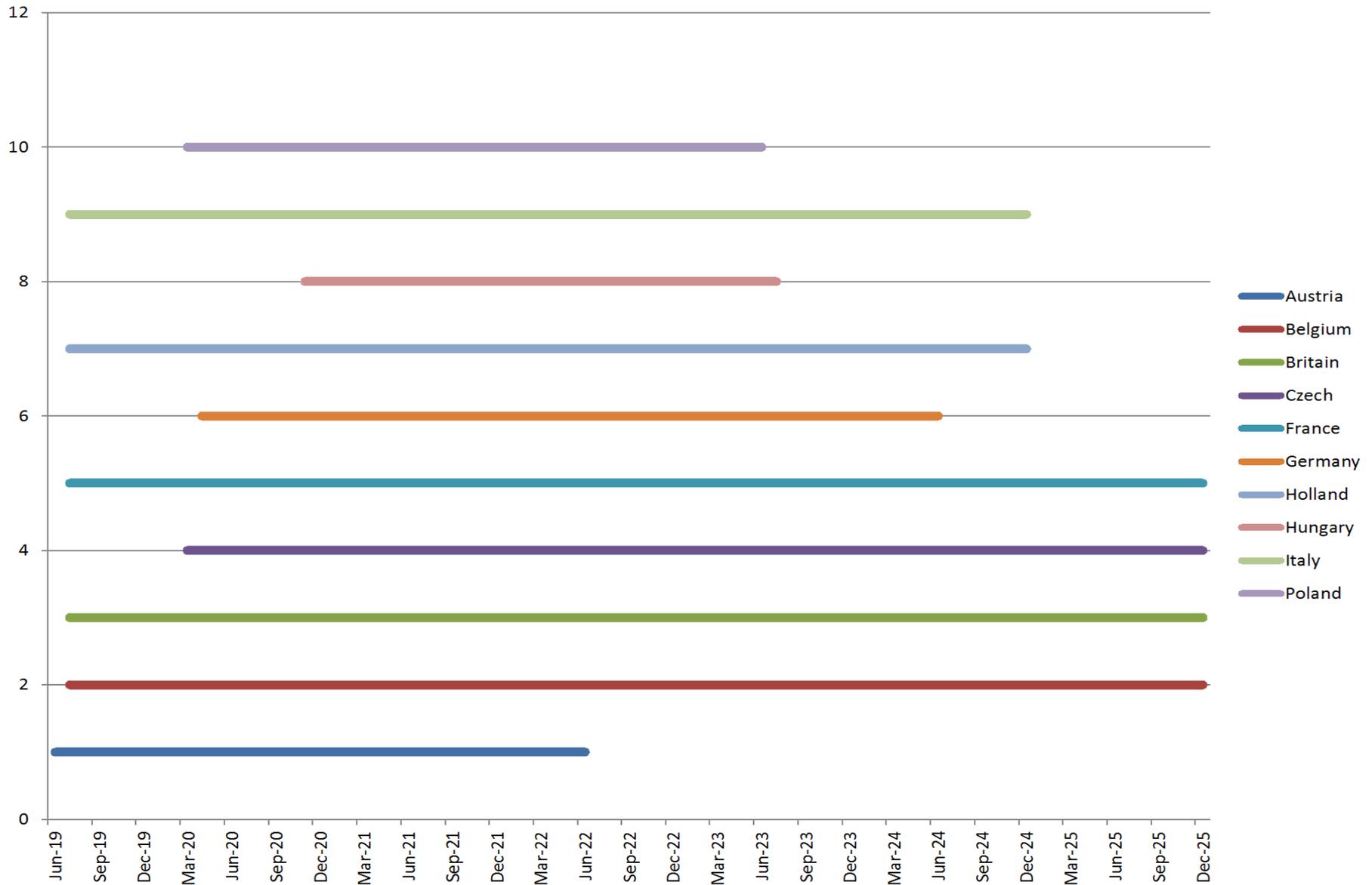
- We chose the RV series as the first variable in the model, such that
  - uncertainty does not respond to macroeconomic shocks in the impact period,
  - while the other series can change based on an uncertainty shock
  - see the discussion of this ordering in Leduc and Liu (2015).
- Generate standard impulse response functions (IRFs) from our VAR system



# What is a hyperinflation?

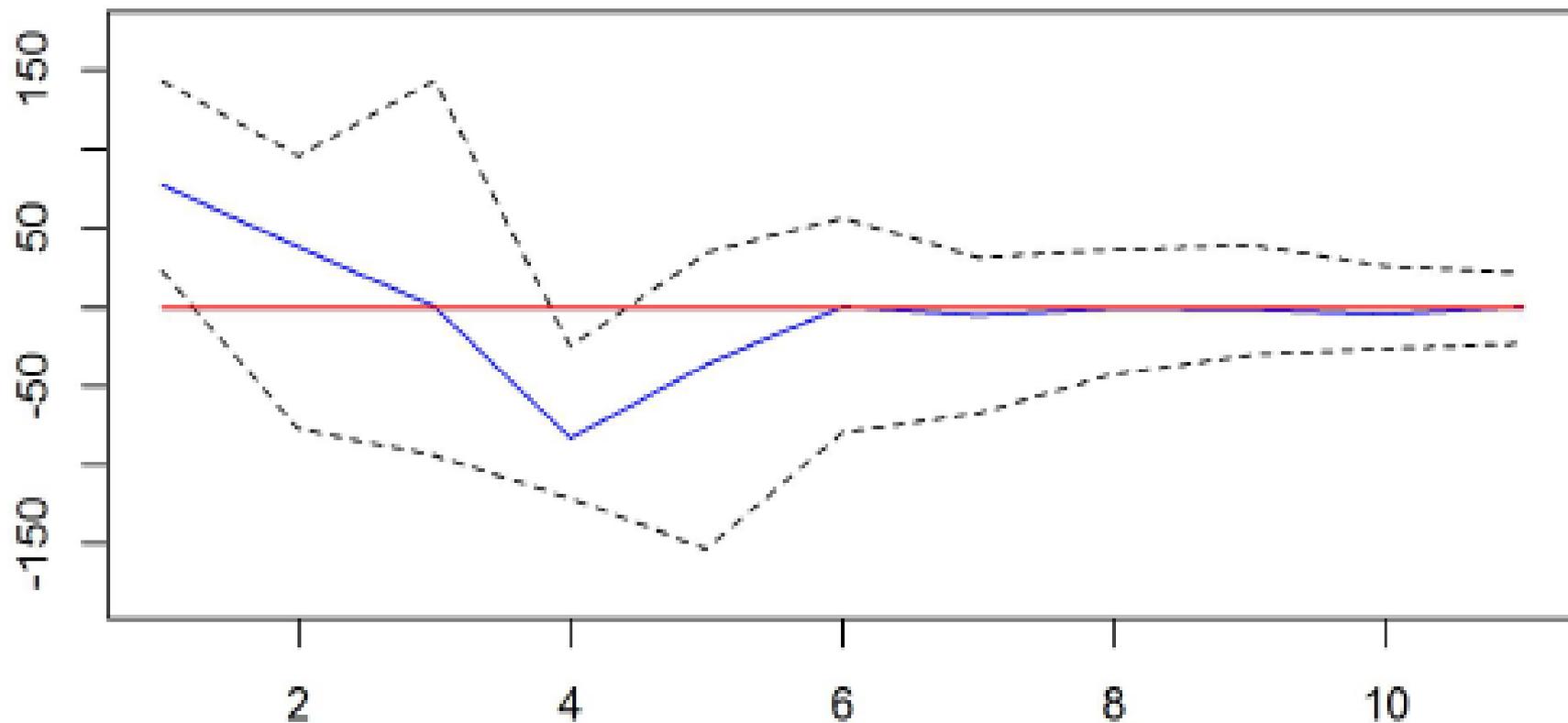
- “Know it when we see it,” so consider several def’s:
- First instance when the three-month average inflation rate exceeds 50%
  - Austria: Oct. 1921
  - Hungary: Mar. 1923
  - Germany: Oct. 1921
  - Poland: Dec. 1920
- First month when prices change by 50% or more
  - Austria: Dec. 1921
  - Hungary: July 1923
  - Germany: Aug. 1922
  - Poland: June 1923

# Estimation sample period



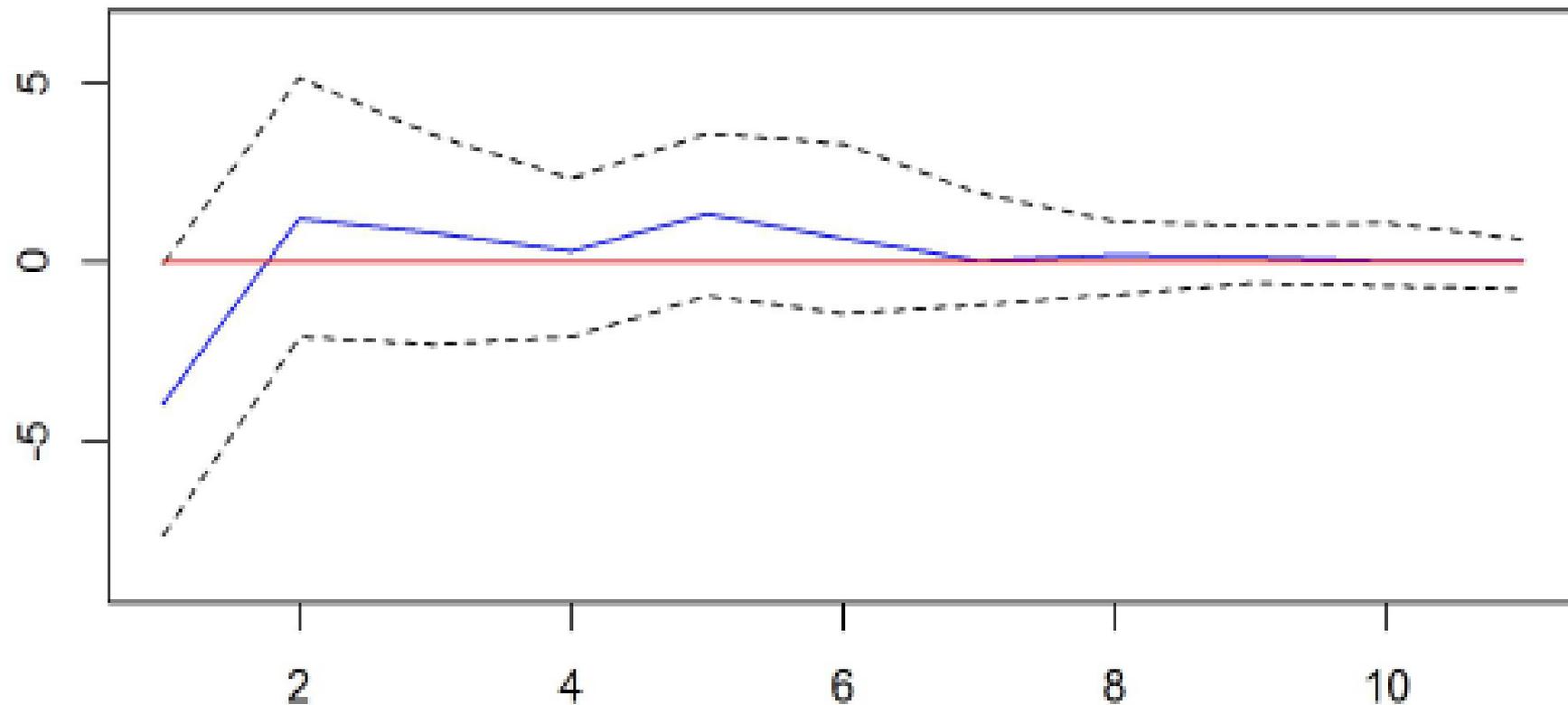
# Germany's IRF: Response of inflation to one-unit increase in RV

Germany WPI Rate Growth



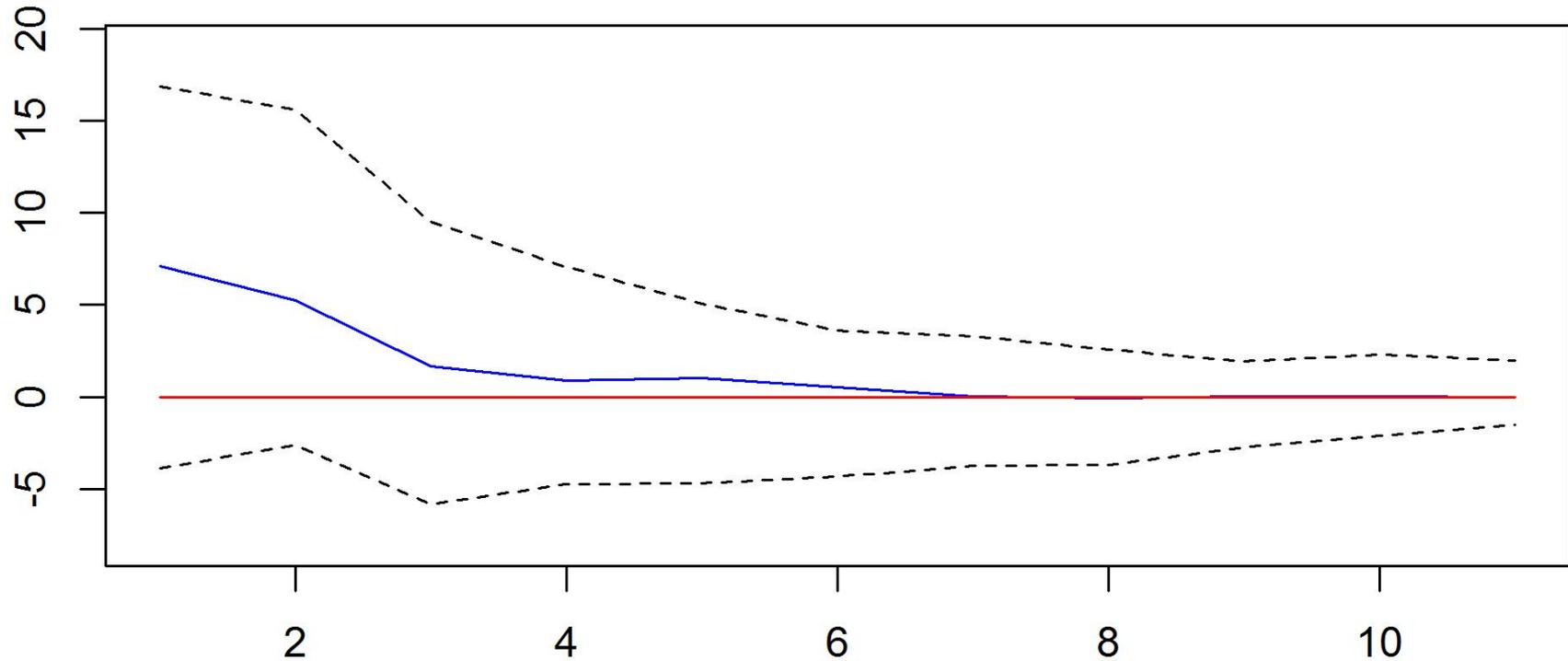
# Germany's IRF: Response of IP to one-unit increase in RV

Germany Industrial Production Growth Rate



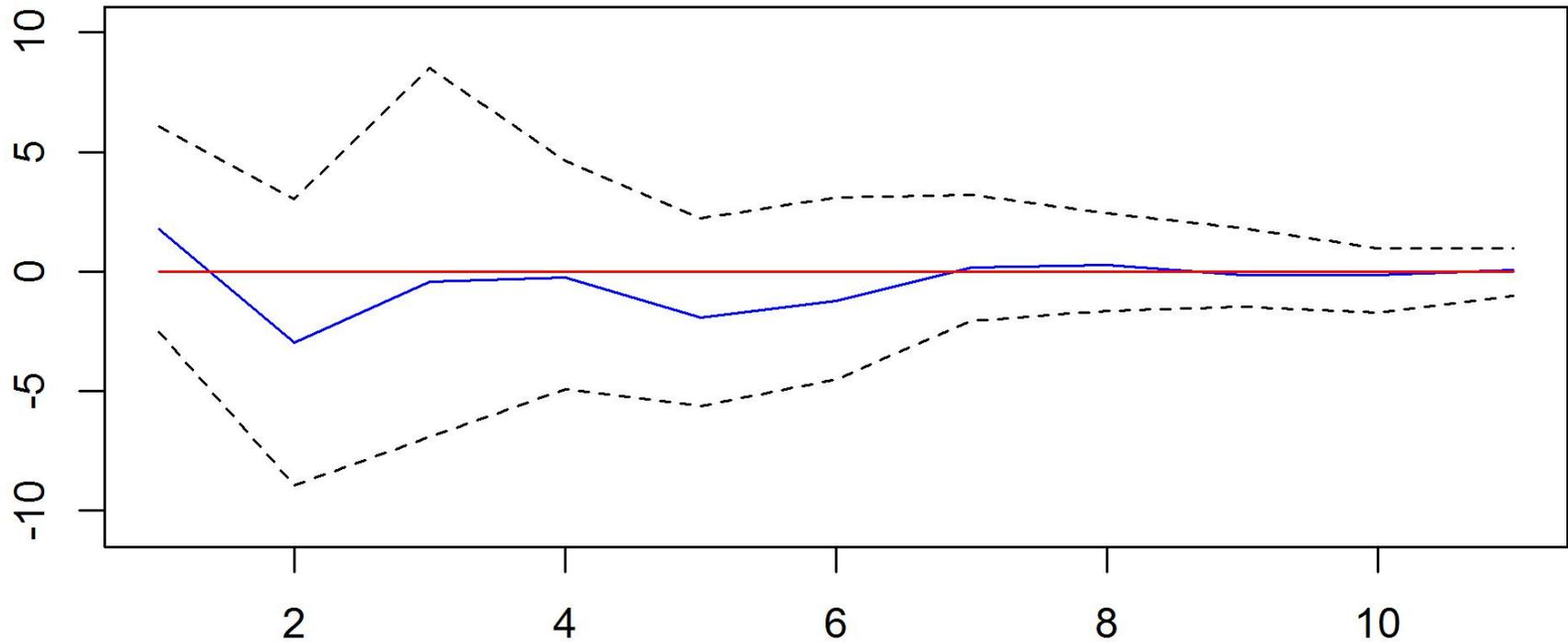
# Poland's IRF: Response of inflation to one-unit increase in RV

**Poland WPI Growth Rate (units: percentage points)**



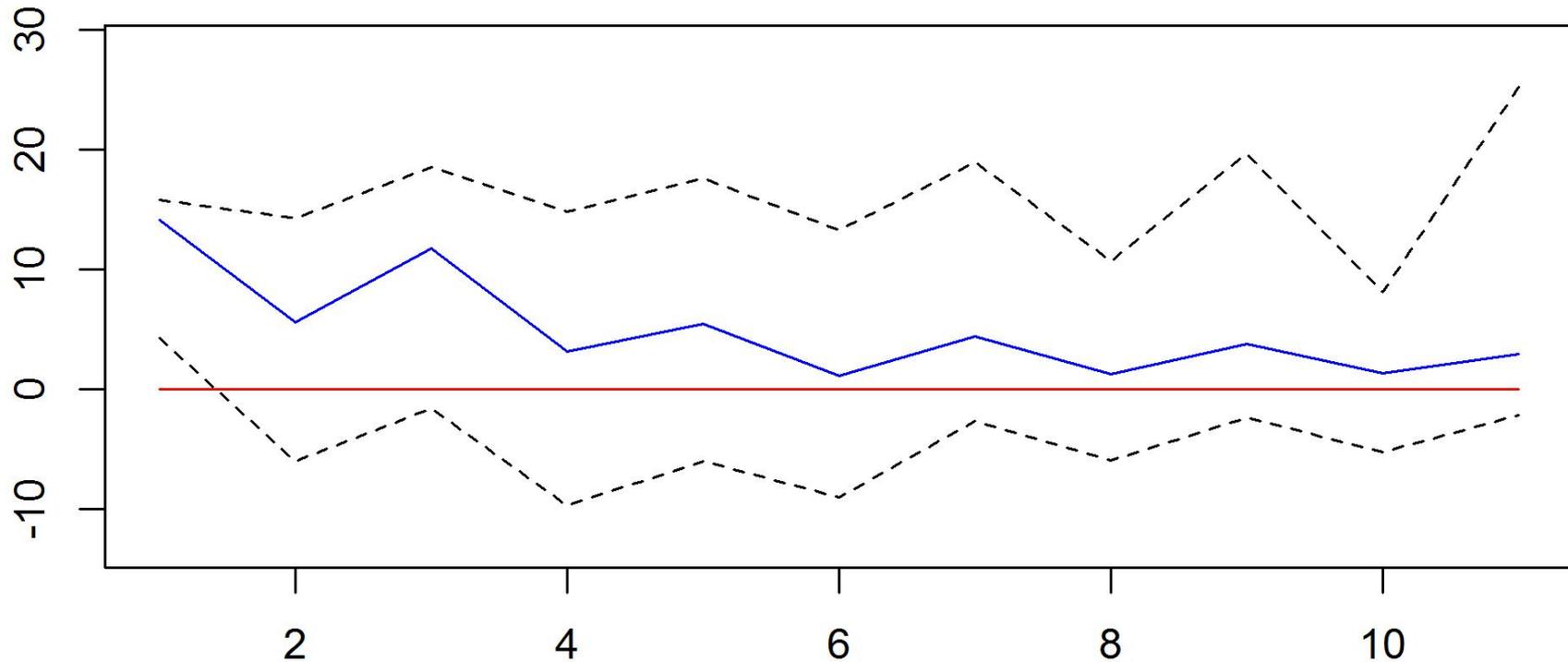
# Poland's IRF: Response of IP to one-unit increase in RV

Poland Industrial Production Growth Rate (units: percentage points)



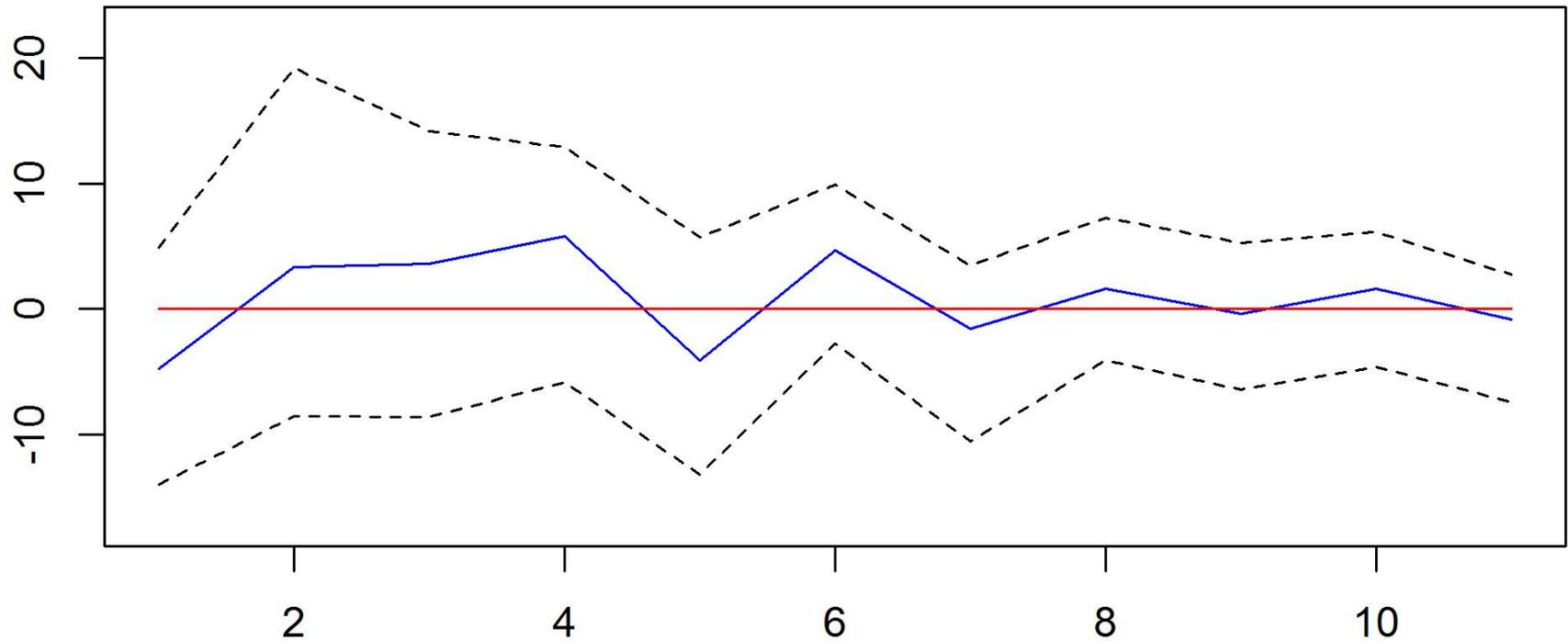
# Austria's IRF: Response of inflation to one-unit increase in RV

**Austria WPI Growth Rate (units: percentage points)**



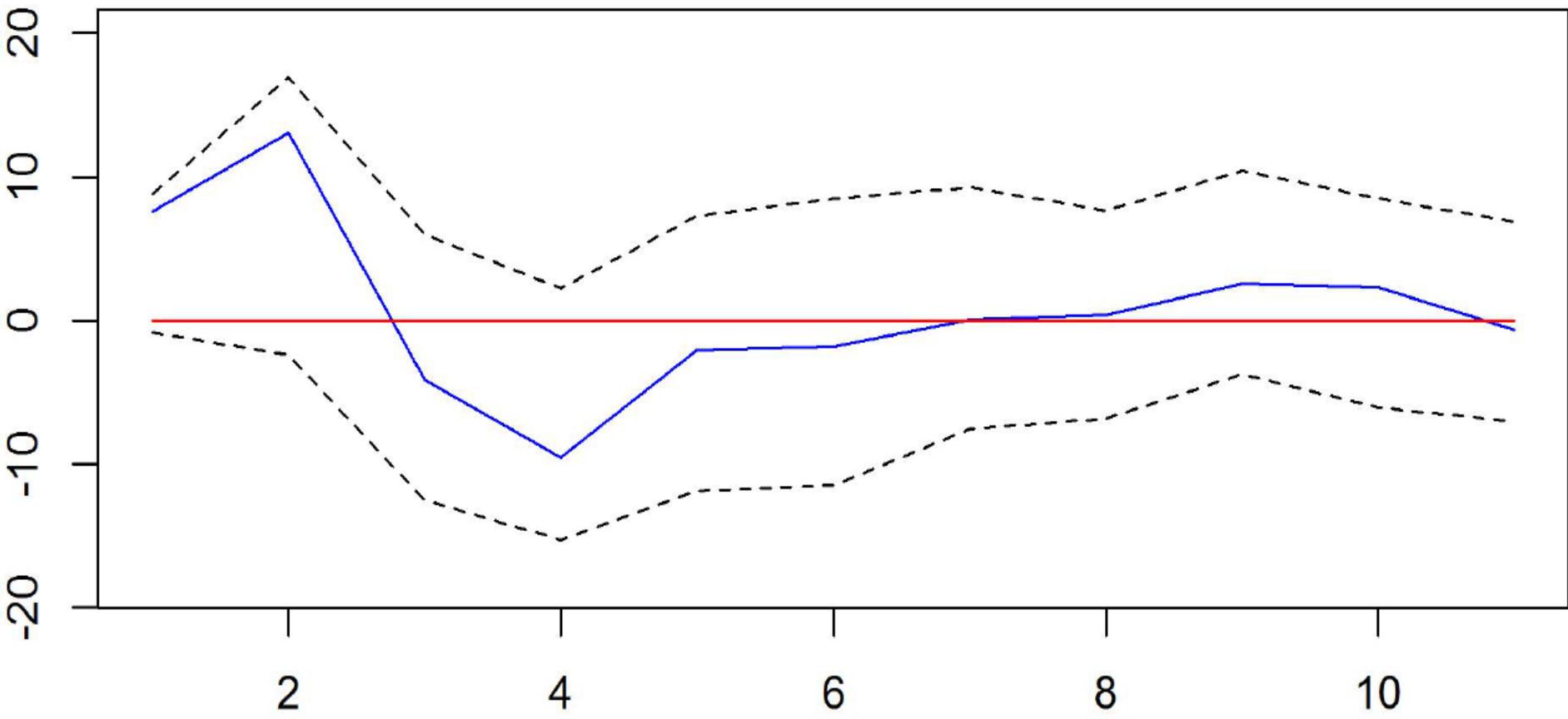
# Austria's IRF: Response of IP to one-unit increase in RV

**Austria Industrial Production Growth Rate (units: percentage points)**



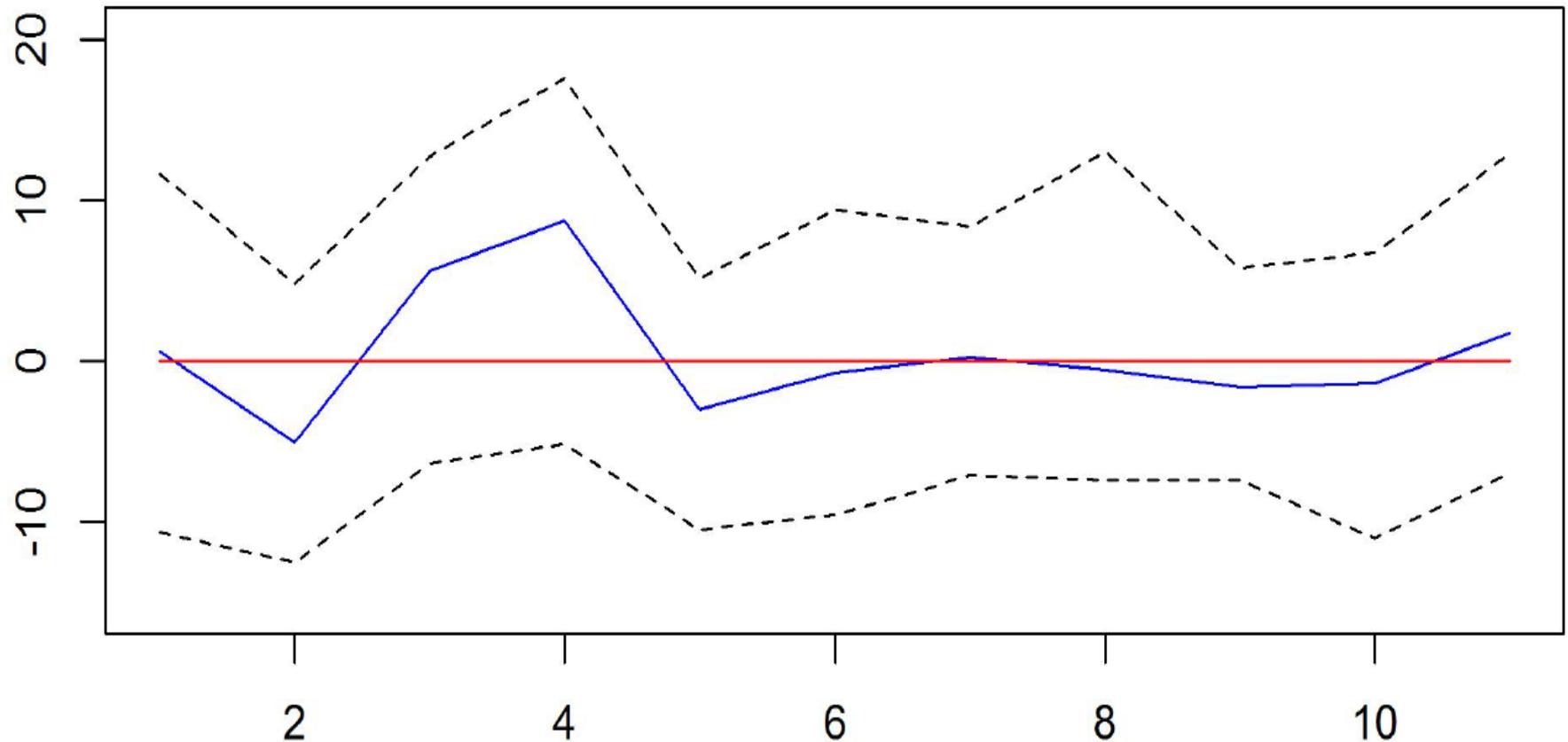
# Hungary's IRF: Response of WPI to one-unit increase in RV

**Hungary WPI Growth Rate (units: percentage points)**



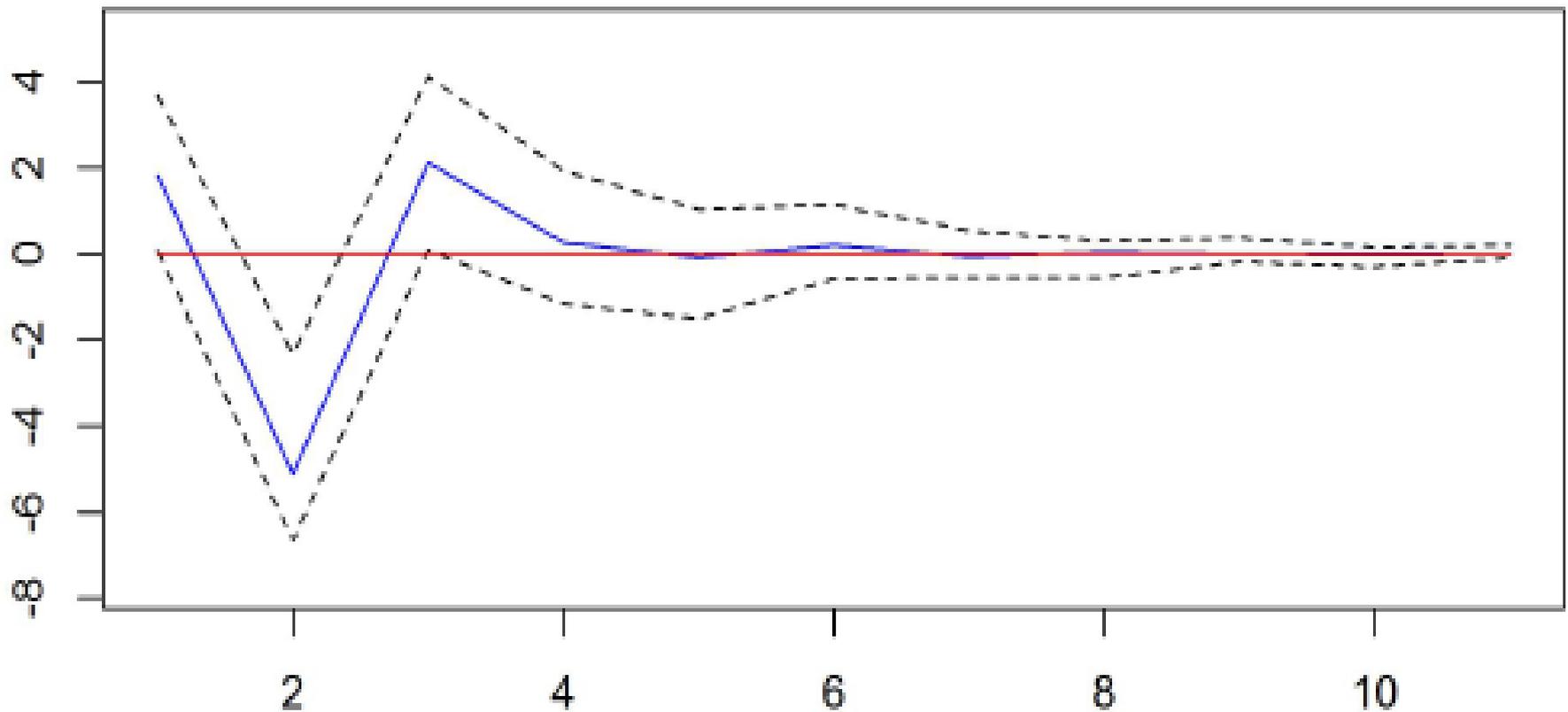
# Hungary's IRF: Response of IP to one-unit increase in RV

Hungary Industrial Production Growth Rate (units: percentage points)



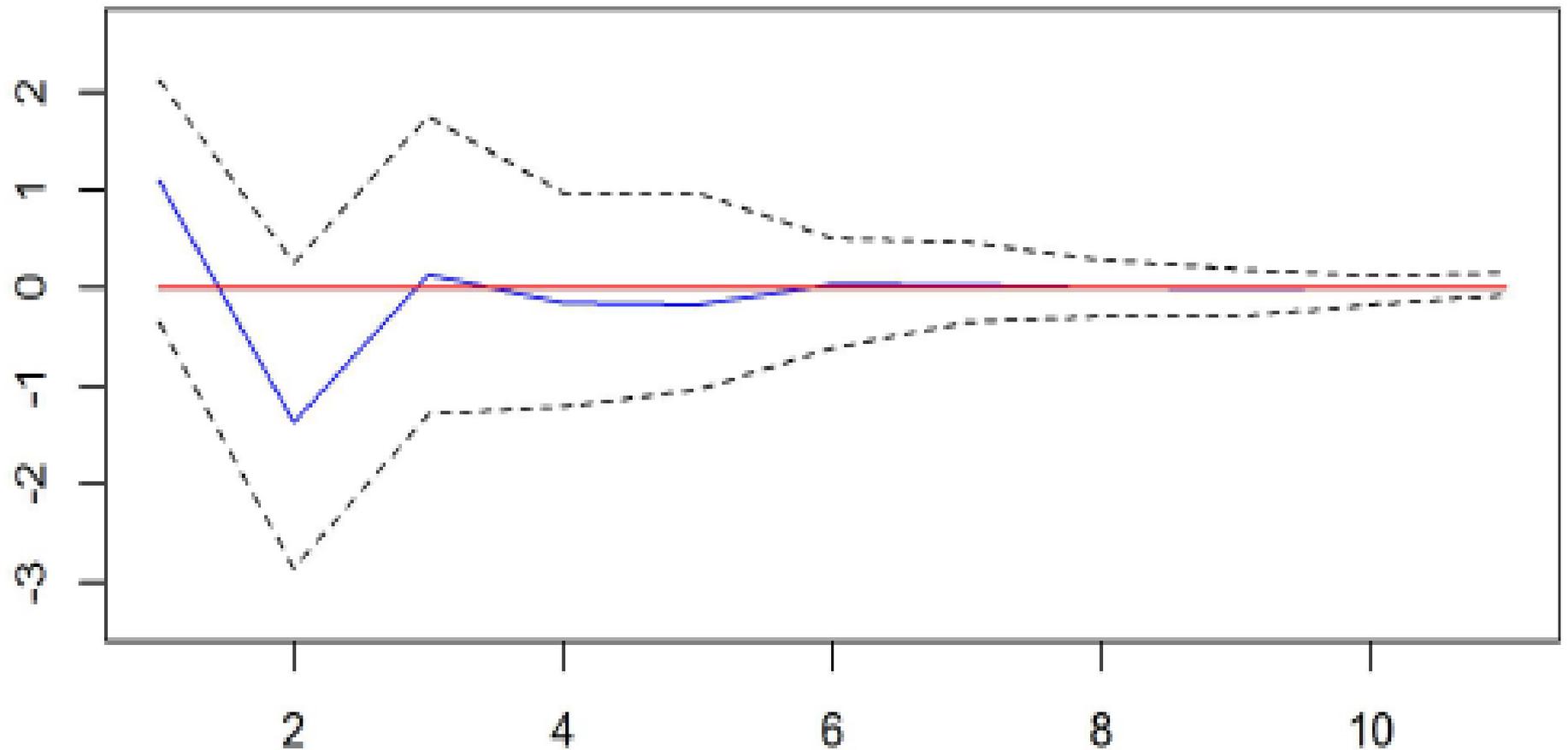
# Holland's IRF: Response of Inflation to one-unit increase in RV

**Holland WPI Rate Growth**



# Holland's IRF: Response of IP to one-unit increase in RV

## Holland Industrial Production Growth Rate





# Directions for future work

- Conceptual:
  - Linking political and economic events to RV and inflation spikes
- Econometric:
  - Using lagged RV to improve VAR identification
  - Improved data for VARs?
  - VAR variance decompositions
  - Testing the significance of full time paths as per Jorda (2009)