The Ends of 30 Big Depressions

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What we do

- What does it take to end a long, deep, deflationary recession or depression?
- Our Q: How did countries recover from the Great Depression?
- Our approach:
  - A new dataset: 30+ countries, 1,500+ variables, 230,000+ monthly and quarterly observations
  - Modern nowcasting methods (NY-Fed model) for estimating real-time inflation expectations
- Leaving the gold standard $\rightarrow \pi^e \uparrow$ and $r \downarrow$
- For five countries we can claim that the relationship is "causal"
  - Counterfactual analysis using synthetic control matching techniques

Golden fetters and inflation expectations

- Eichengreen and Sachs (1985) - leaving the gold standard was a prerequisite for recovery
  - Campa (1990), Bernanke and Carey (1996), Obstfeld and Taylor (2004)
- Sargent (1982) - going back on gold after WWI replaced expectations of hyperinflation with stable prices
- We argue that going *off* gold replaced expectations of deflation with stable or increasing prices

A collapse in ex ante real interest rate

↓

A rebound in interest-rate-sensitive expenditures

↓

Economic recovery

Related literature: Temin and Wigmore

- Temin (1989) and Temin and Wigmore (1990) – the regime shift view for the US
- Romer (1992) – rising M^S and falling *ex ante* real interest rates in the US crucial for recovery
  - She used Mishkin's single-equation methods to estimate *ex ante* real interest rates
    - Fitted values from regression of *ex post* real interest rates on nominal and real variables
- Eggertsson (2008) – DSGE model of US incorporating mechanism
- Jalil and Rua (2016) and Binder (2016) offer narrative evidence

Related literature

- Extensive literature on historical inflationary expectations, largely focussed on whether Great Depression deflation was anticipated
  - Dominguez et al. (1988), Hamilton (1992), Cecchetti (1992), Evans and Wachtel (1993), Klug et al. (2005), Romer and Romer (2013), Binder (2016), Saleuddin and Coffman (2018)
- Shibamoto and Shizume (2014) and Chouliarakis and Gwiazdowski (2016) make Temin/Wigmore-style arguments for Japan & UK
- We offer the most comprehensive study to date on the topic
  - Country coverage (30+)
  - Methods
  - Dorval and Smith (2015), Hamilton et al. (2016), Albers (2018), and especially Daniel and Steege (2020) closest to our work

Data

- Principal sources:
  - International Abstract of Economic Statistics
  - Statistisches Handbuch Der Weltwirtschaft
  - Detailed and comprehensive info on a large number of economic indicators in many countries
    - Prices and quantities at both aggregate and industry level
    - Volumes and values of aggregate and disaggregated international trade
    - Prices and quantities in financial markets
    - Measures of labour market conditions
  - At monthly, quarterly, and annual frequencies, from Jan 1919 to Dec 1936

Data

- Complementary sources:
  - Federal Reserve Bulletin
  - NBER Macrohistory Database
  - Statistical Yearbook of the League of Nations
  - Individual countries' statistical authorities
- The availability of many datasets enables thorough cross-checks

Key variables

- Nominal interest rate
  - Following Romer (1992), three to six month market interest rates wherever possible
  - Central bank discount rates otherwise
- Aggregate price index
  - Wholesale price index wherever possible
  - Cost of living index or wholesale price of a key product/commodity otherwise
- Aggregate output
  - Total production index or its variant wherever possible
  - Quantity of a key product/commodity otherwise

Methodology

- The ex ante real interest rate is defined by the Fisher equation:

$$r = i - \pi^e$$

- i is observed but π^e requires estimation
- And we need an estimate that is updated in real-time as new data get released
- We adopt the nowcasting methodology to estimate π^e in real-time
  - Currently used by NY-Fed (Bok et al., 2018)
  - Exploits big data and makes it tractable
  - Builds on dynamic factor models
  - Can handle data with different sample lengths, publication delays, reporting frequencies, and missing observations (ideal for historical data)

Dynamic factor models

- Country index $j = 1, 2, ..., J$; variable index $i = 1, 2, .., N_j$; factor index $k = 1, 2, .., r_j$; time index $t = 1, 2, .., T_j$ (months)
- The large set of variables for each country ($y^j_{i,t}$) is related to a small number of latent factors ($f^j_{k,t}$) and an idiosyncratic component ($e^j_{i,t}$)

$$y^j_{i,t} = \mu^j_i + \sum_{k=1}^{r_j} \lambda^j_{i,k} f^j_{k,t} + e^j_{i,t}$$

$$f^j_{k,t} = \alpha^j_k f^j_{k,t-1} + u^j_{k,t}$$

$$e^j_{i,t} = \rho^j_i e^j_{i,t-1} + \varepsilon^j_{i,t}$$

- The parameters μ^j_i, $\lambda^j_{i,k}$, α^j_k, ρ^j_i and the latent factors $f^j_{k,t}$ are estimated using the Kalman filter and maximum-likelihood methods

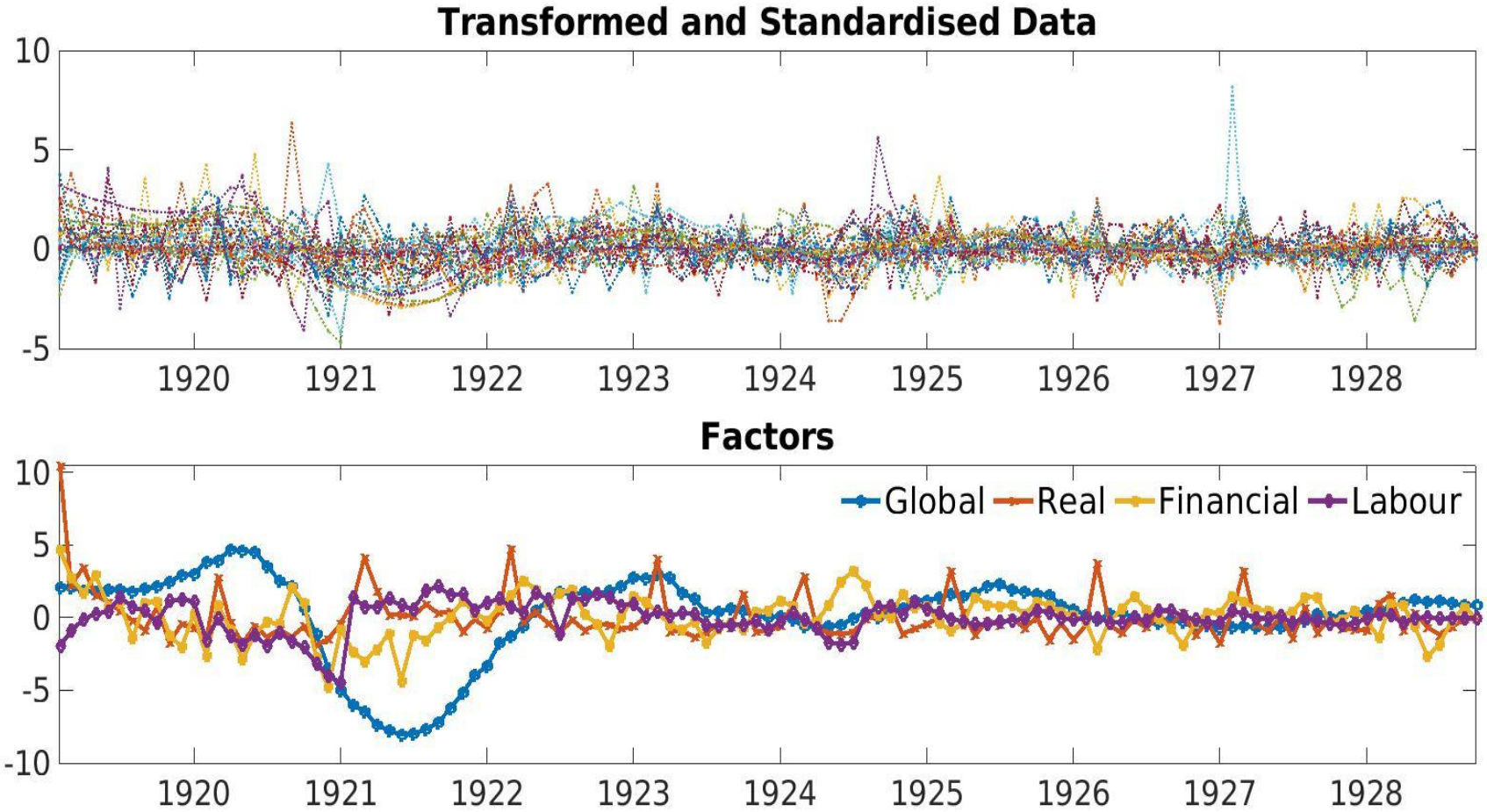
Dynamic factor model

- Four latent factors following the NY-Fed model
  - Global, real, financial, and labour factors
- Evidence from the Federal Reserve Bulletin is used to determine the release delay for each type of variable
  - This is important because we want to estimate real-time expectations, which can be conditioned only on what could have been known at a particular point in time
  - Financial prices – no delay
  - Prices, sales, logistics/transportation and financial quantities – two months
  - Production, labour and international trade – three months
  - Our results are robust to alternative assumptions

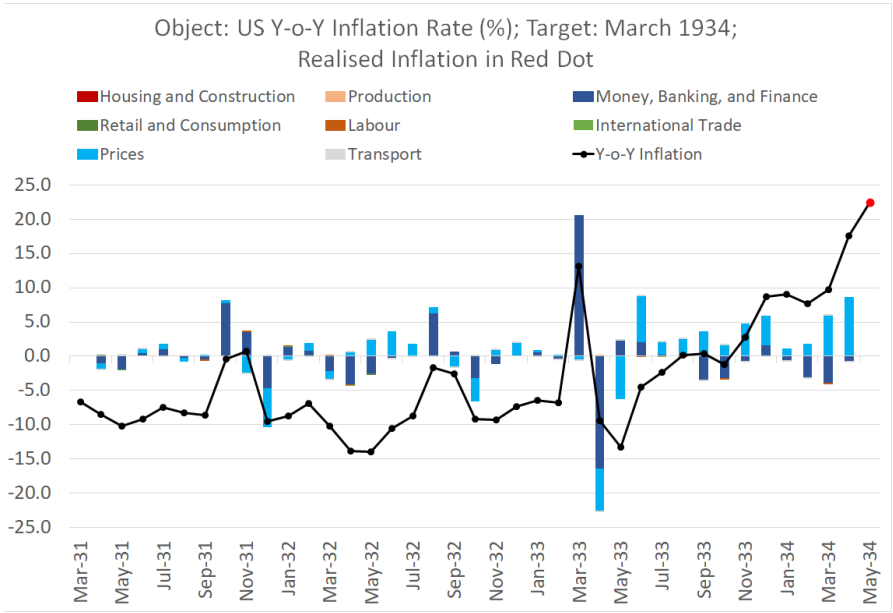
Dynamic factor model

- All data series are transformed to ensure stationarity as required by the methodology
- For instance, inflation rather than price level (which is I(1))
  - Stationarity is checked visually and also formally using statistical tests whenever possible (e.g., no missing data)
- Following Bok et al. inflationary expectations are accounted for by the global factor
- Model parameters are estimated using data before the Great Depression
  - Prevents overfitting
  - But the latent factors are revised as new data arrive (using the Kalman filter and smoother)

Illustration based on the US data



Real-time inflation expectations



Data Flow (Mar 1933)

Model Update	Release Date	Data Series	Actual	Impact	Inflation Forecast
Fed 33					**-6.77**
	Mar 33	Prime Commercial Paper Rate	3.06%	8.75	
	Mar 33	Bank Rate on Customer Loans - Leading Cities	5.30%	3.20	
	Mar 33	Banker's Acceptance Rate for New York	2.38%	5.20	
	Mar 33	New York Fed - Discount Rate	3.44%	2.59	
	Mar 33	Yield on Long-term US Bonds	3.31%	0.07	
	Mar 33	Federal Reserve System Reporting Member Banks - Loans on Securities	$4224m	-0.02	
	Mar 33	Volume of Commercial Paper Outstanding	$85m	0.02	
	Mar 33	Business Failures	2889	-0.07	
	Mar 33	Average Stock Price - Industrials	57.75	0.58	
	Mar 33	Average Stock Price - Railroads	23.75	0.14	
	Mar 33	Wholesale Price Index (PPI)	61.0	-0.52	
Mar 33					**13.20**

Dating departures from the gold standard

- Surprisingly tricky
- Different references disagree
  - Brown (1940), Kremmerer (1954), Officer (2008), Obstfeld and Taylor (2003), Wolf (2008)
- Candidates: official suspension, devaluation, exchange controls
- Q: What constituted a regime change sufficient to change inflation expectations?
- We privilege official suspension and devaluation over exchange controls

Dating departures from the gold standard

"If one regards the guarantee of convertibility for capital transactions as an essential feature of the gold standard, then Germany left the gold standard in July 1931. On the other hand, for contemporaries we have to notice that only leaving the parity against gold seemed to be the real breaking of the rules of the gold standard. At least this is the way our sources regard it. Till long after July 1931, and thus after the introduction of the "Devisenbewirtschaftung" the question was asked, whether Germany would or should leave the gold standard. This could only mean leaving the parity in favour of floating." (Borchart 1984)

Dating departures from the gold standard

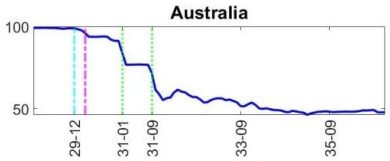
- Group A – unambiguous dates for suspension or devaluation
  - Belgium, British India, Canada, Denmark, the Dutch East Indies, Finland, France, Japan, the Netherlands, New Zealand, Peru, South Africa, Sweden, Switzerland, and the UK
- Group B – exchange controls
  - Bulgaria, Germany, Hungary, Lithuania
- Group C – exchange controls followed by suspension or devaluation
  - Chile, Estonia, Poland, Romania, the US
- Group D – ambiguous departure dates
  - Argentina, Australia, Austria, Brazil, Czechoslovakia, Italy

Example: Australia

- Private banks had managed the exchange rate: while the Australian pound fluctuated against sterling "this had appeared unnatural"
- December 1929: legislation allows government & Commonwealth Bank to require that banks exchange gold for notes & ban gold exports
  - League of Nations views this as suspending gold standard, government disagrees
- January 1930 CB exercises right to requisition banks' gold
  - Schedvin says this was the end of the gold standard but the decision was made instead of banning gold exports (which government feared would be seen as abandoning gold)

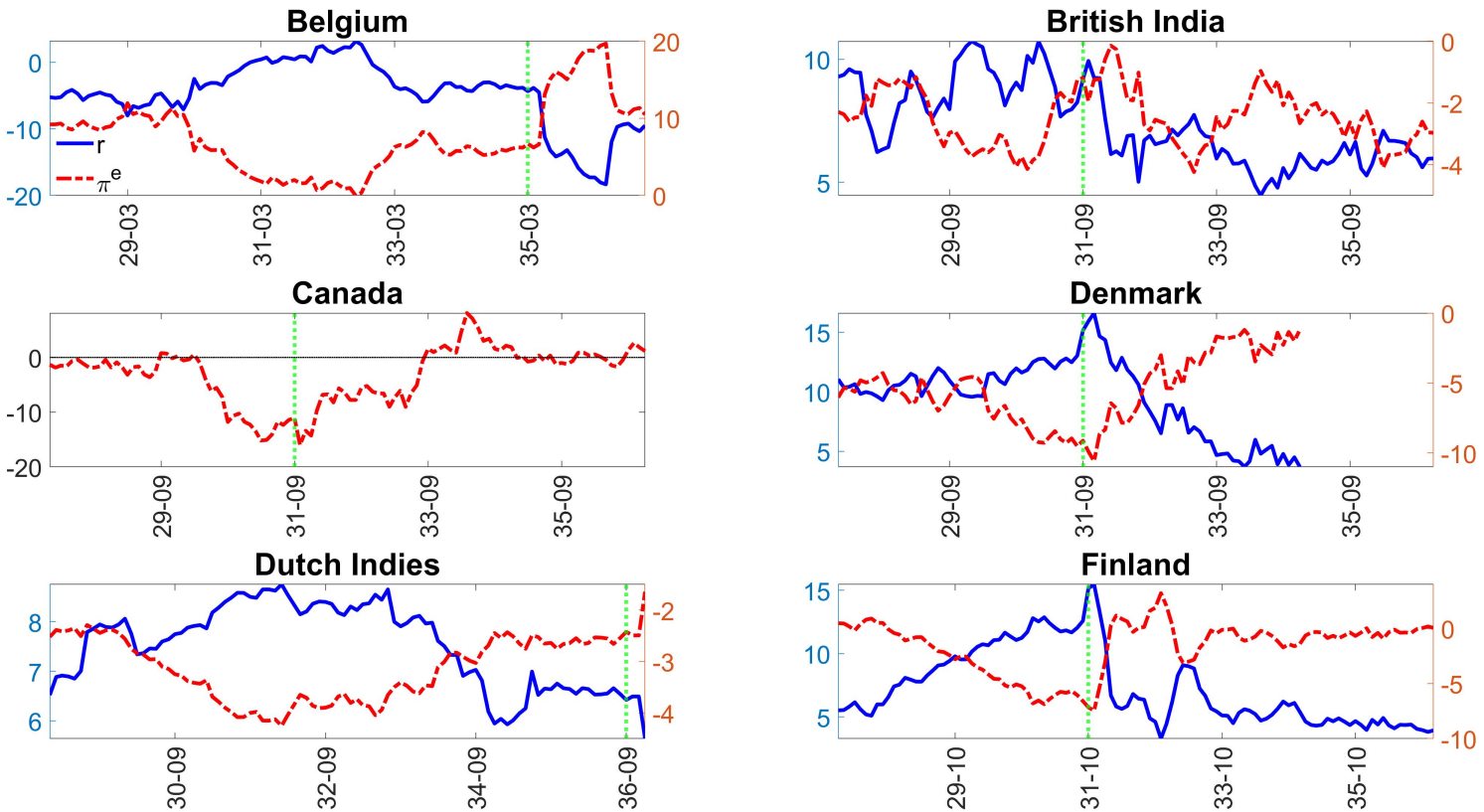
Example: Australia

- Australian pound slips gradually against sterling (not unusual) & slides sharply in January 1931
- "now that a more nearly "true" exchange rate has been established, the normal economic forces should come into play." (Economist, January 10)
  - February: Premier of New South Wales calls for abandonment of gold standard
- Pegged to sterling for best part of a year (but sterling leaves gold in September 1931)
- Big shifts in pound's gold value are in Jan & Sep 1931



	League of Nations (1937)				Brown	Kemmerer	Officer	OT	Wolf	Our coding		
Country	**Official suspension of gold**	**Exchange control**	**Depreciation or devaluation in relation to gold**	**Introduction of a new gold parity**	**Departure from gold**					**Group**	**Departure from gold**	**Exchange control**
Argentina	Dec-29	Oct-31	Nov-29		Nov-29	1929	1929	Dec-29		D	Dec-29 & Nov-33	
Australia	Dec-29		Mar-30		Mar-30	1929	1930	Jan-30		D	Jan-31 & Sep-31	
Austria	Apr-33	Oct-31	Sep-31 & Apr-34	Apr-34	Oct-31	1931	1931	Oct-31	Sep-31	D	Oct-31 & Apr-33	
Belgium	Mar-35	Mar-35 & Apr-35	Mar-35	Mar-35		1935	1935	Mar-35		A	Mar-35	
Brazil		May-31	Dec-29	Dec-29	Dec-29	1930	1929	Dec-29		D	Dec-29 & Oct-30	
British India	Sep-31		Sep-31		Sep-31	1931	1931	Sep-31		A	Sep-31	
Bulgaria		1918				1931	1931			B	N/A	Oct-31
Canada	Oct-31		Sep-31		Sep-31	1931	1929	Jan-29		A	Sep-31	
Chile	Apr-32	Jul-31	Apr-32		Apr-32	1932	1931	Jul-31		C	Apr-32	
Czechoslovakia		Oct-31	Feb-34 & Oct-36	Feb-34 & Oct-36		1931	1931		Sep-31	D	Feb-34 & Oct-36	
Denmark	Sep-31	Nov-31	Sep-31		Sep-31	1931	1931	Sep-31		A	Sep-31	
Dutch Indies	Sep-36		Sep-36			1936	1936			A	Sep-36	
Estonia	Jun-33	Nov-31	Jun-33			1931	1931			C	Jun-33	
Finland	Oct-31		Oct-31		Oct-31	1931	1931	Oct-31		A	Oct-31	
France			Sep-36	Oct-36		1936	1936	Sep-36	Sep-36	A	Sep-36	
Germany		Jul-31				1931	1931	Jul-31	Jul-31	B	N/A	Jul-31
Hungary		Jul-31				1931	1931	Aug-31	Jul-31	B	N/A	Jul-31
Italy		May-34	Mar-34 & Oct-36	Oct-36		1934	1934	Dec-34	May-34	D	Jul-35 & Oct-36	
Japan	Dec-31	Jul-32	Dec-31		Dec-31	1931	1931	Dec-31		A	Dec-31	
Lithuania		Oct-35								B	N/A	Oct-35
Netherlands	Sep-36		Sep-36			1936	1936			A	Sep-36	
New Zealand	Sep-31		Apr-30		Apr-30	1931	1930	Apr-30		A	Sep-31	
Peru	May-32		May-32		May-32	1932	1932			A	May-32	
Poland		Apr-36				1936	1936		Apr-36	C	Oct-36	
Romania		May-32	Jul-35			1932	1932			C	Jul-35	
South Africa	Dec-32		Jan-33		Jan-33	1931	1933	Jan-33		A	Dec-32	
Sweden	Sep-31		Sep-31		Sep-31	1931	1931	Sep-31	Sep-31	A	Sep-31	
Switzerland			Sep-36	Sep-36		1936	1936			A	Sep-36	
UK	Sep-31		Sep-31		Sep-31	1931	1931			A	Sep-31	
US	Apr-33	Mar-33 & Nov-34	Apr-33	Jan-34	Apr-33	1933	1933	Apr-33		C	Apr-33	

Expected inflation and real interest rate (Group A)



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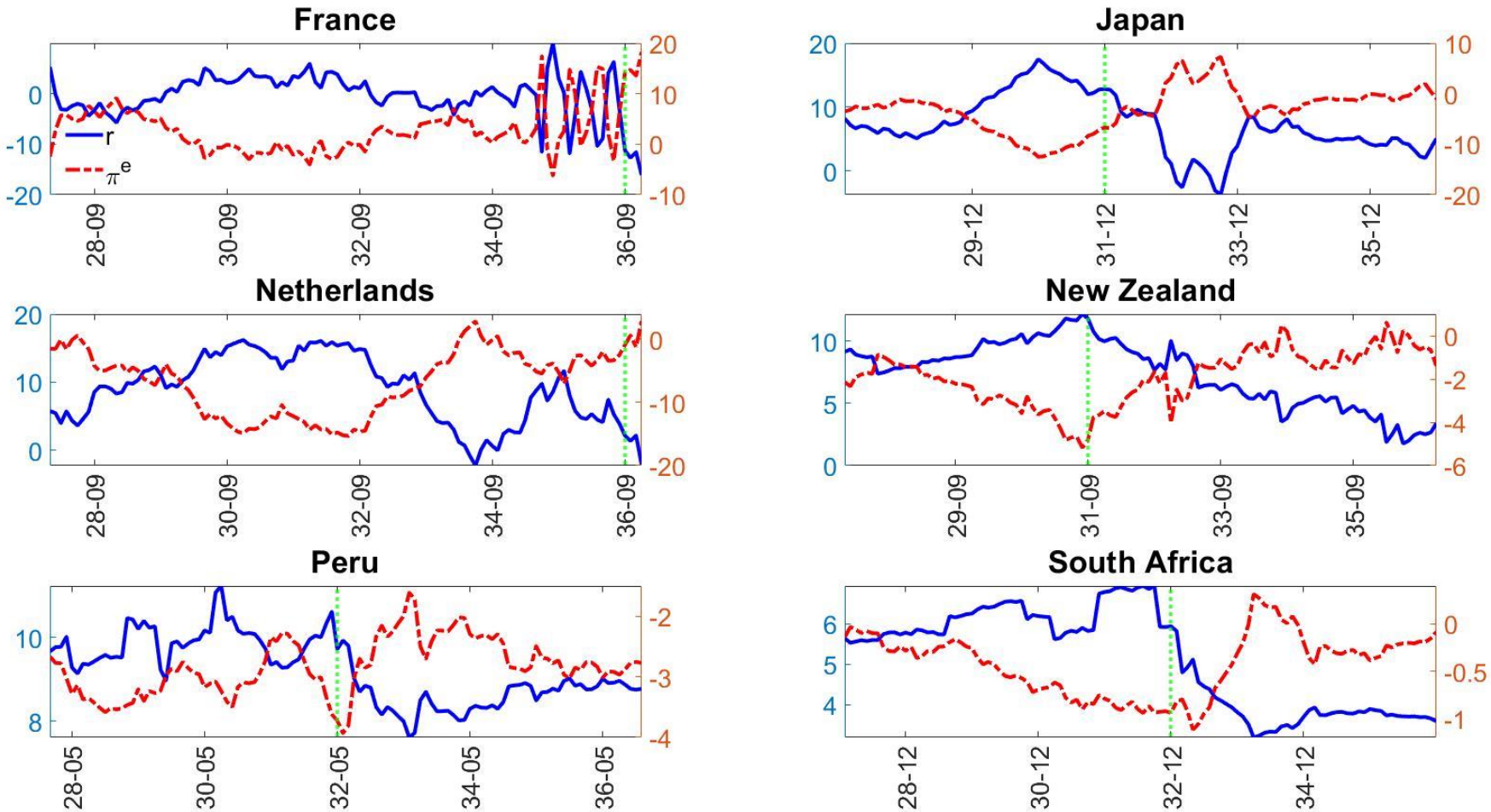

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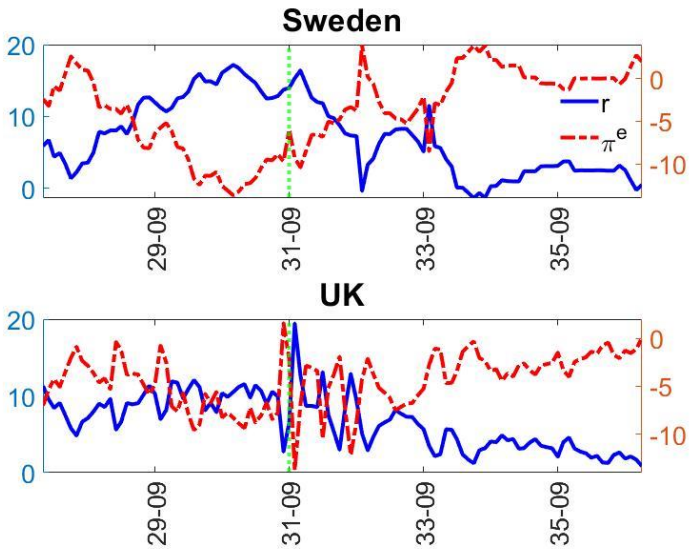
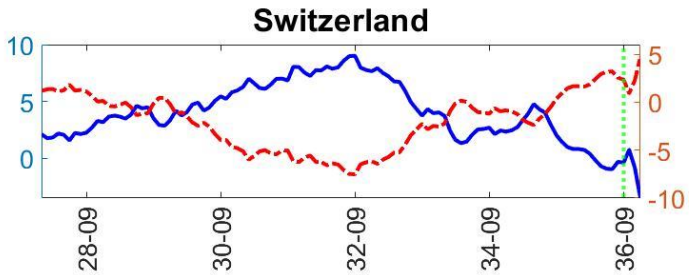
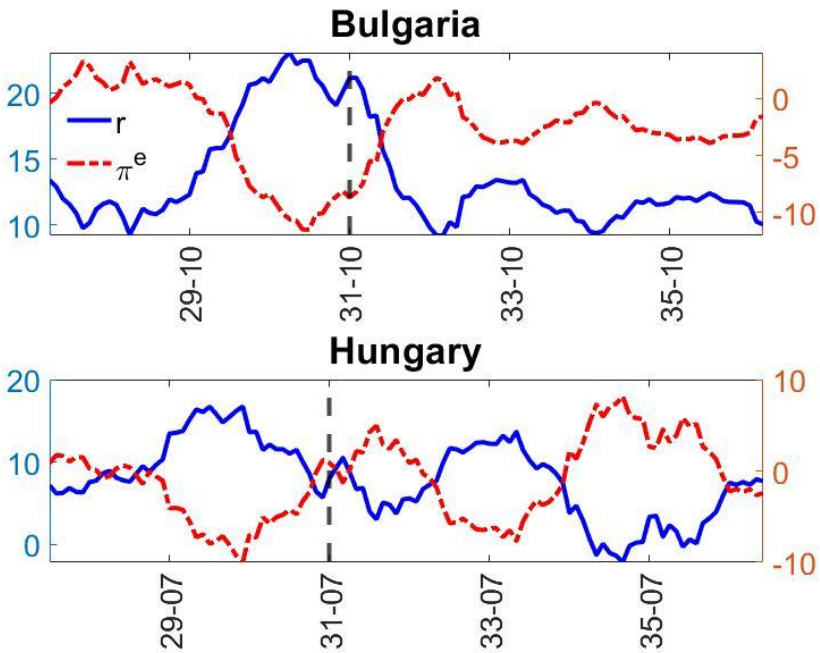
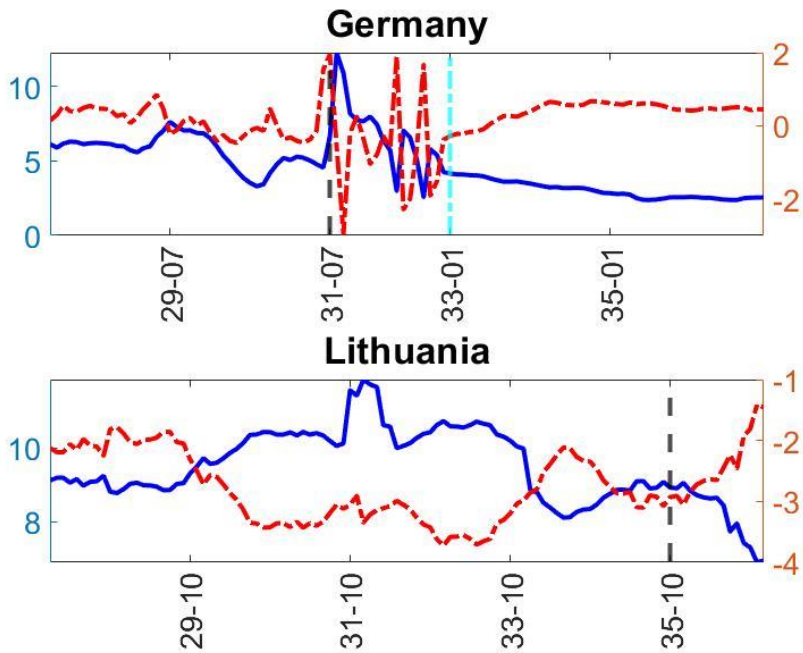


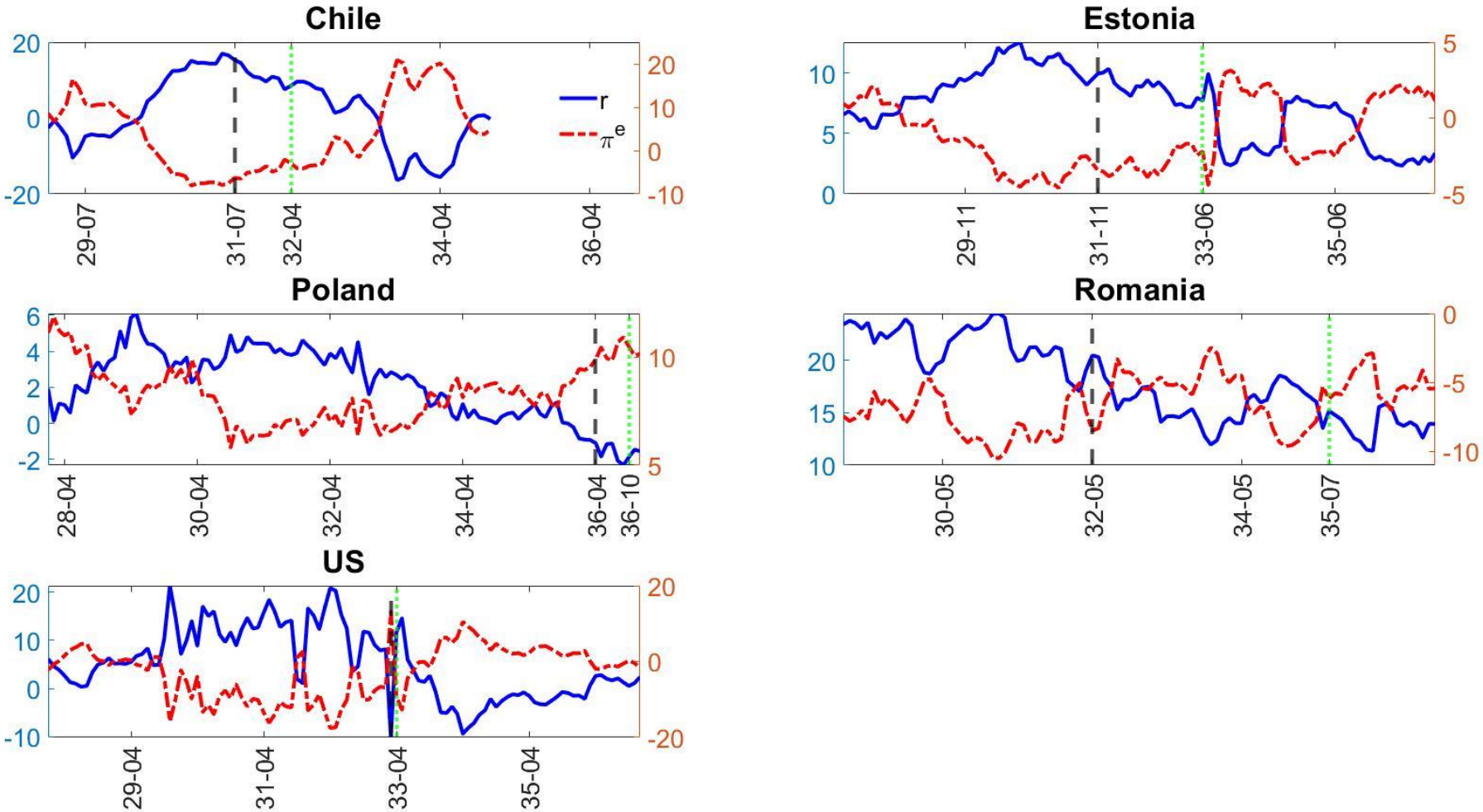


Expected inflation and real interest rate (Group B)

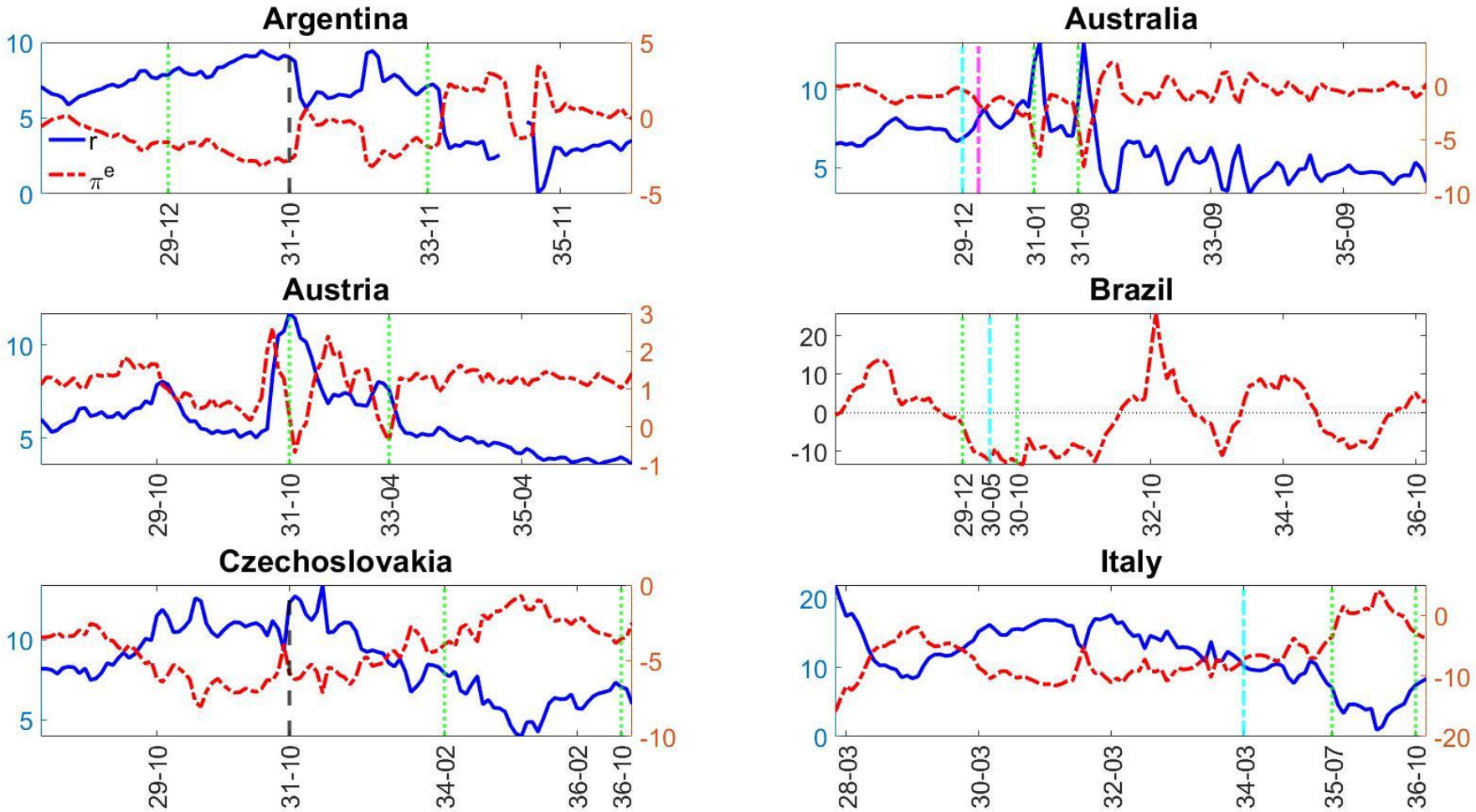




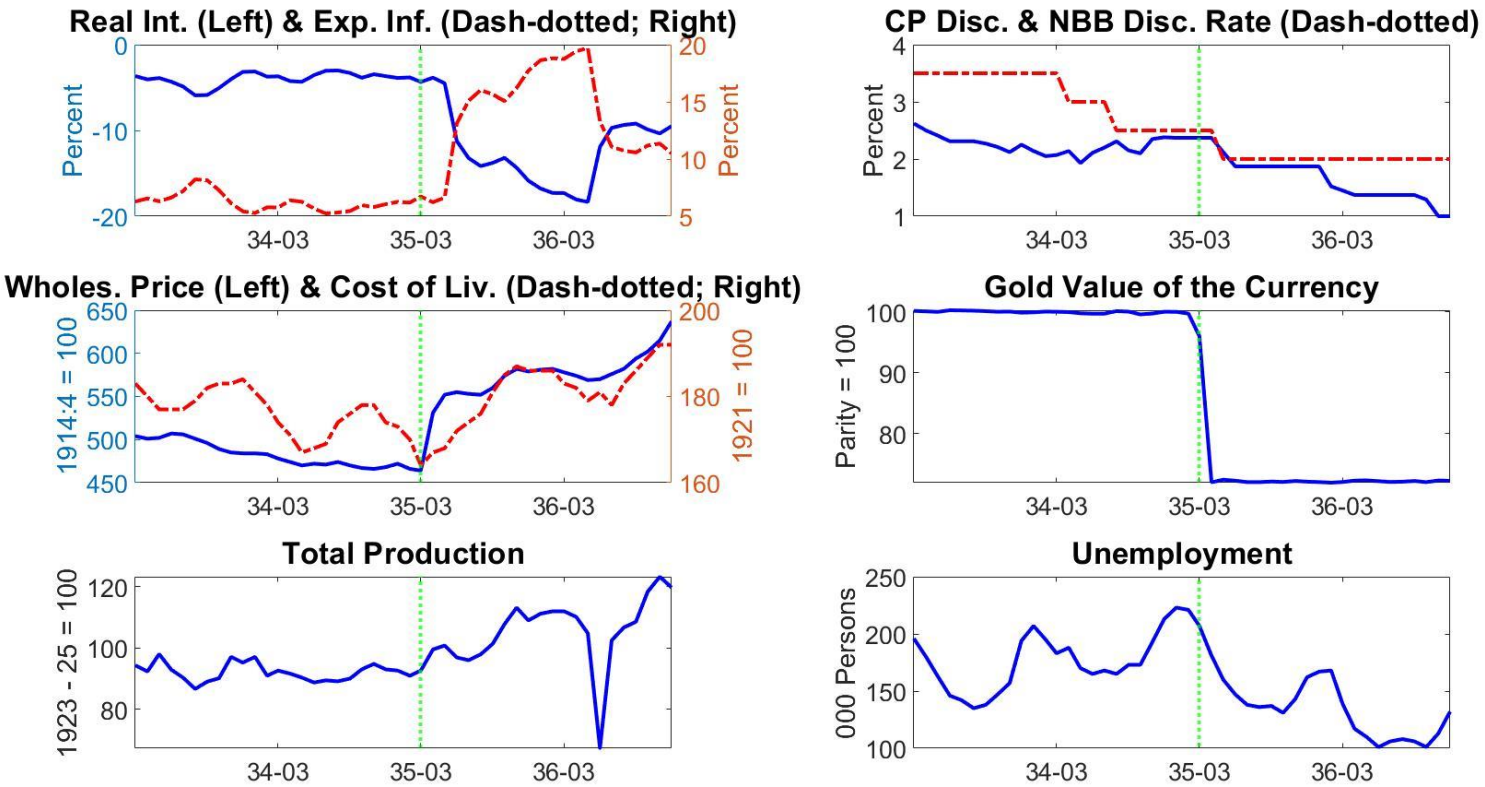
Expected inflation and real interest rate (Group C)



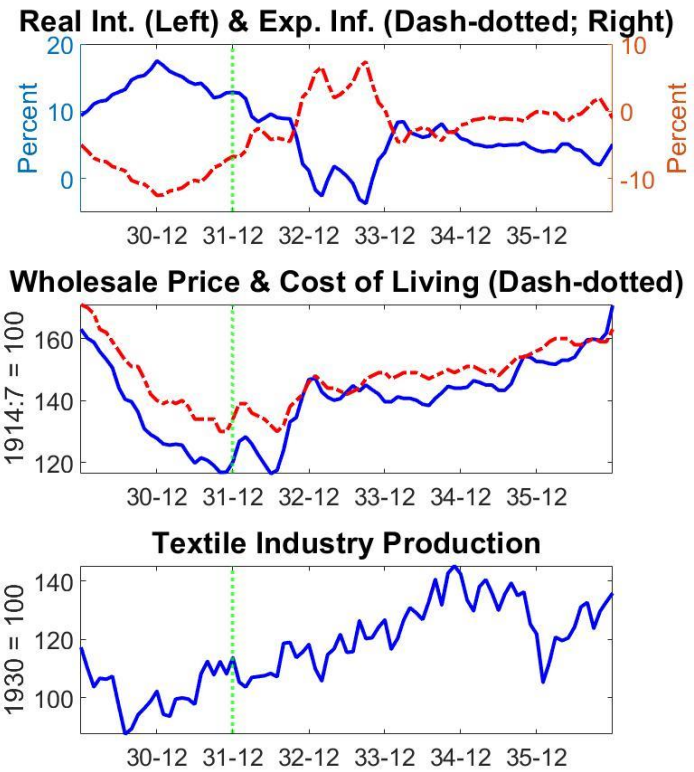
Expected inflation and real interest rate (Group D)

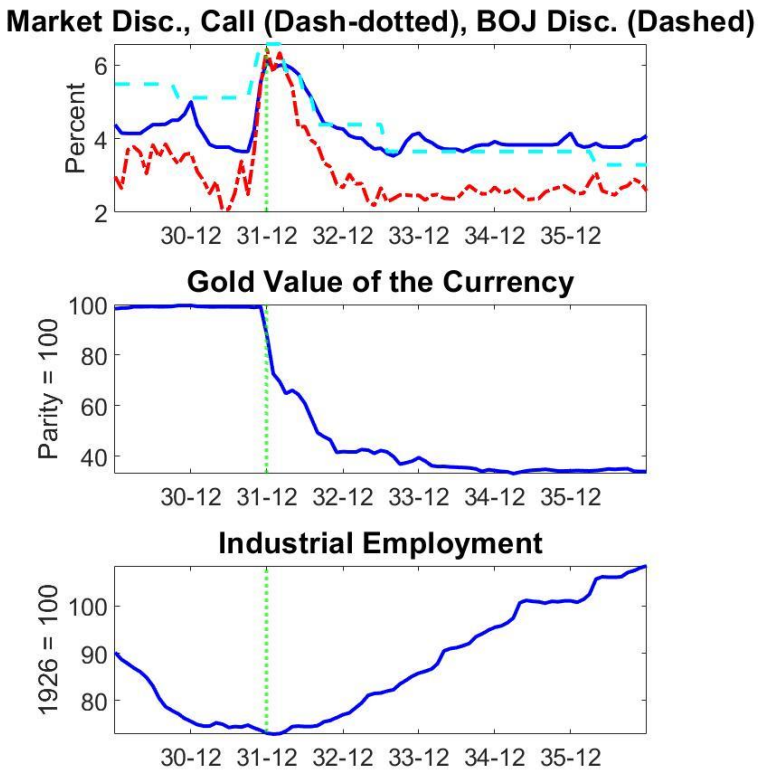


Case study - Belgium

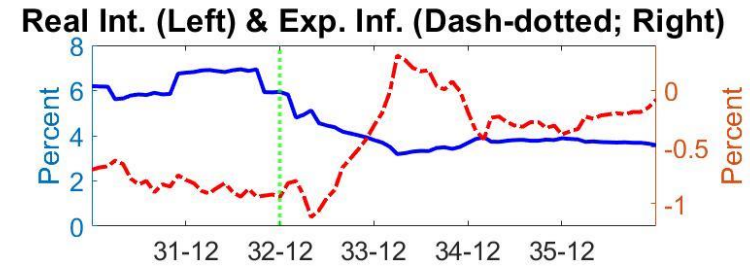


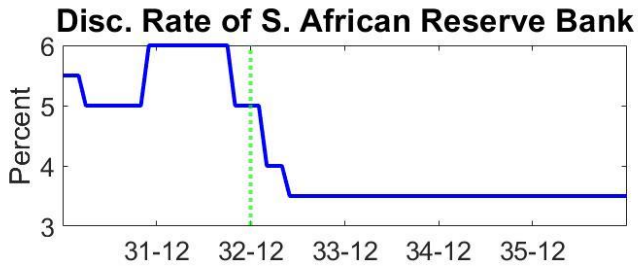
Case study - Japan

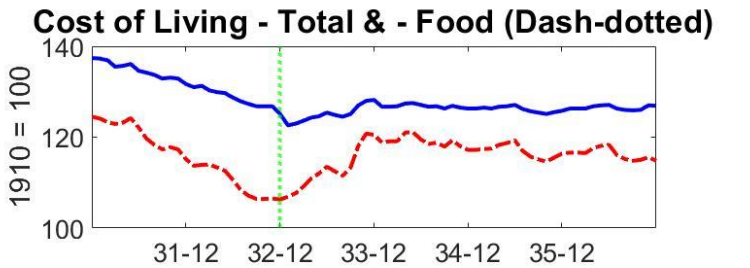


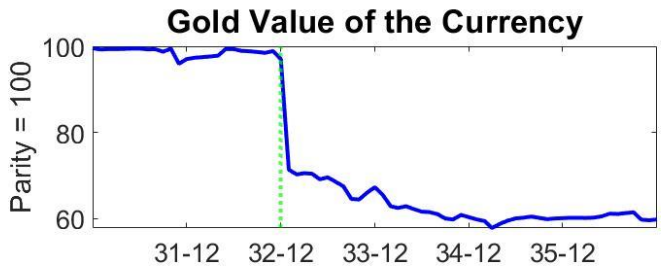


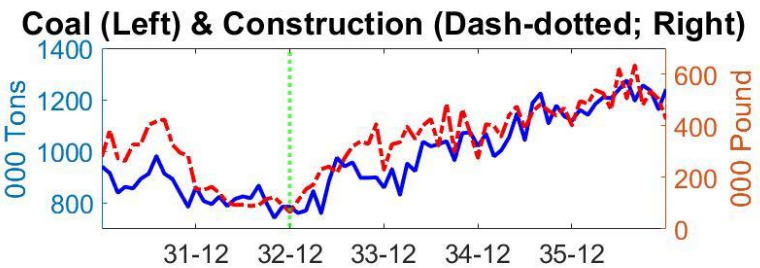
Case study – South Africa

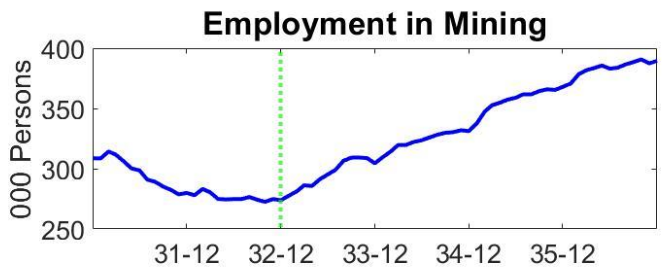












Cross-country comparisons

- The country group figures and the case studies suggest that leaving the gold standard was an important pre-condition for recovery
- However, difficult to generalise to all 30 countries
- So, we take a conservative approach and focus on our Group A countries where timing is unambiguous
  - Ex ante real interest rate, real output, and total trade (exports + imports)
- The first troughs in real interest rates after leaving gold are dated using the Bry-Boschan method (Harding and Pagan, 2002)
  - The results align with the visual evidence

Real interest rates

Country	Departure from gold standard	Cumulative change in real interest rate upon or after: departure	one quarter	two quarters	one year	two years
Belgium	Mar-35	-0.6	-7.5	-10.0	-13.5	-
British India	Sep-31	1.2	1.2	-1.8	-1.1	-2.1
Denmark	Sep-31	2.4	1.9	-1.0	-4.4	-8.1
Dutch Indies	Sep-36	-0.2	-0.9	-	-	-
Finland	Oct-31	3.1	-1.1	-6.5	-7.5	-7.0
France	Sep-36	-13.7	-18.5	-	-	-
Japan	Dec-31	0.5	-3.1	-2.7	-11.2	-8.4
Netherlands	Sep-36	-3.4	-7.6	-	-	-
New Zealand	Sep-31	0.0	-1.9	-2.1	-4.2	-5.8
Peru	May-32	-0.6	-1.3	-1.5	-2.3	-2.0
South Africa	Dec-32	-0.3	-1.3	-1.8	-2.5	-2.6
Sweden	Sep-31	0.9	1.5	-1.2	-5.8	-7.9
Switzerland	Sep-36	0.4	-2.8	-	-	-
UK	Sep-31	-1.2	1.0	5.4	1.7	-2.1
Average		**-0.8**	**-2.9**	**-2.3**	**-5.1**	**-5.1**

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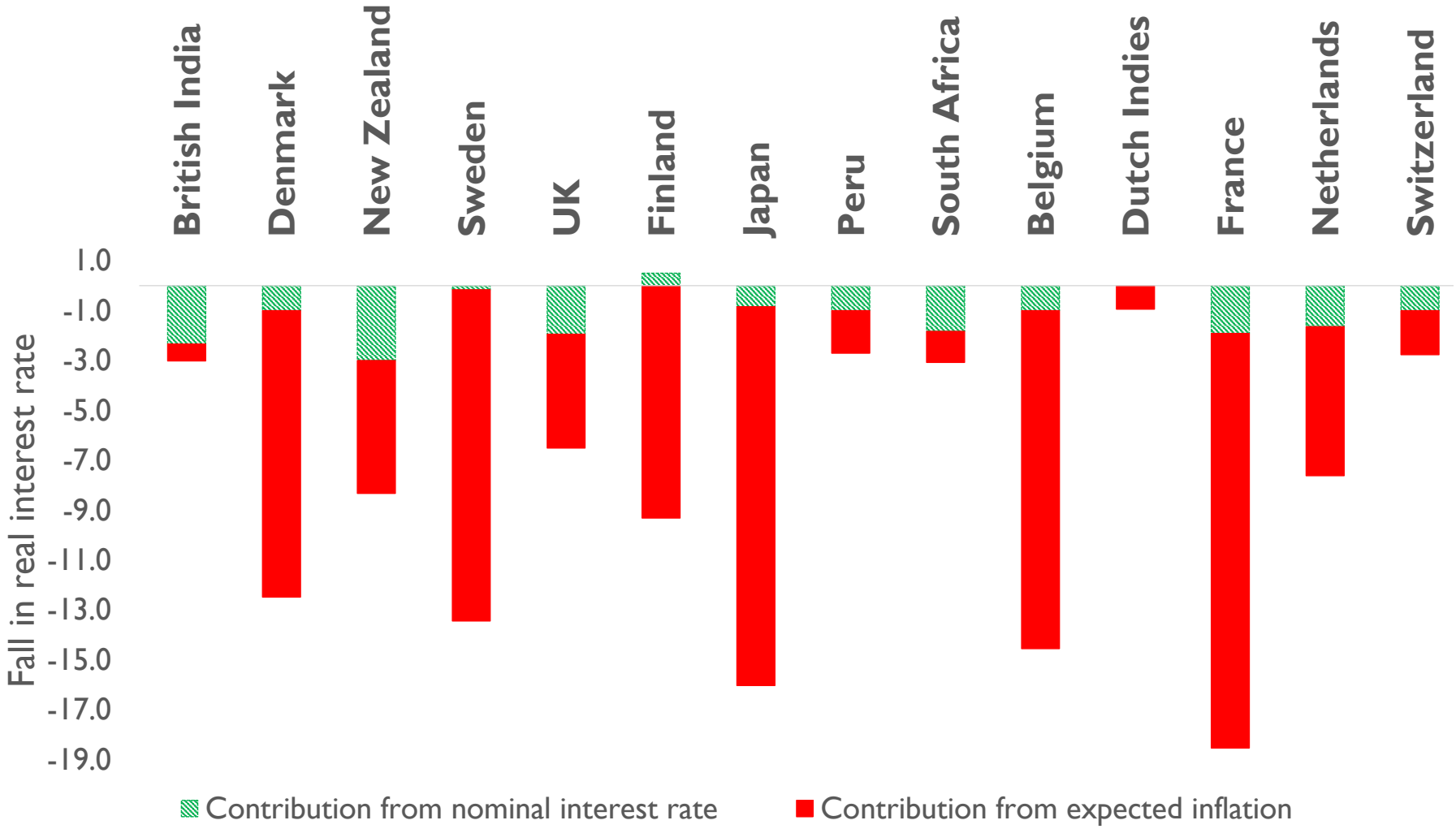
  - The results align with the visual evidence

Real interest rates

Country	Number of months to trough	Change in real interest rate	Change in nominal interest rate	Change in expected inflation
Belgium	14	-14.5	-1.0	13.5
British India	10	-3.0	-2.3	0.7
Denmark	43	-12.5	-1.0	11.5
Dutch Indies	-	-0.9	0.0	0.9
Finland	13	-8.8	0.5	9.3
France	-	-18.5	-1.9	16.6
Japan	21	-16.0	-0.8	15.2
Netherlands	-	-7.6	-1.6	6.0
New Zealand	35	-8.3	-3.0	5.3
Peru	13	-2.7	-1.0	1.7
South Africa	15	-3.1	-1.8	1.2
Sweden	13	-13.4	-0.2	13.3
Switzerland	-	-2.8	-1.0	1.8
UK	33	-6.5	-1.9	4.6
Average	**21**	**-8.5**	**-1.2**	**7.3**


British India
Denmark
New Zealand
Sweden
UK
Finland
Japan
Peru
South Africa
Belgium
Dutch Indies
France
Netherlands
Switzerland
1.0
-1.0
-3.0
-5.0
-7.0
-9.0
-11.0
-13.0
-15.0
-17.0
-19.0
Fall in real interest rate
Contribution from nominal interest rate
Contribution from expected inflation

Real output

Country	Departure from gold standard	Cumulative change in real output upon or after: departure	one quarter	two quarters	one year	two years
Belgium	Mar-35	0.5	5.1	10.0	21.5	-
Canada	Sep-31	4.2	-8.8	-11.8	-17.5	3.4
Dutch Indies	Sep-36	4.7	-1.1	-	-	-
Finland	Oct-31	-4.4	17.6	25.3	15.4	33.0
France	Sep-36	-3.1	2.0	-	-	-
Japan	Dec-31	3.9	-2.3	-1.0	8.0	15.7
Netherlands	Sep-36	6.6	6.9	-	-	-
South Africa	Dec-32	1.2	9.1	25.7	10.8	31.5
Sweden	Sep-31	28.9	19.0	39.2	7.0	38.2
Switzerland	Sep-36	12.1	32.0	-	-	-
UK	Sep-31	-3.8	-3.3	-1.5	-3.3	5.7
Average		**4.6**	**6.9**	**12.3**	**6.0**	**21.3**

Total trade

Country	Departure from gold standard	Cumulative change in total trade upon or after: departure	one quarter	two quarters	one year	two years
Belgium	Mar-35	2.5	29.1	26.8	56.5	-
British India	Sep-31	-7.9	7.4	2.8	3.2	-13.5
Canada	Sep-31	-7.4	-4.7	-0.1	-19.3	1.8
Denmark	Sep-31	2.8	5.5	-12.9	-14.1	6.9
Dutch Indies	Sep-36	7.2	56.3	-	-	-
Finland	Oct-31	-2.9	-42.8	-33.2	12.4	25.2
France	Sep-36	3.4	57.6	-	-	-
Japan	Dec-31	10.7	53.0	23.7	88.8	103.4
Netherlands	Sep-36	11.3	40.2	-	-	-
New Zealand	Sep-31	-9.0	23.9	35.1	-7.5	13.4
Peru	May-32	-6.5	33.4	18.8	49.2	121.8
South Africa	Dec-32	-7.3	53.3	32.7	45.4	55.1
Sweden	Sep-31	4.8	16.7	-31.9	-14.3	-0.8
Switzerland	Sep-36	8.2	72.2	-	-	-
UK	Sep-31	-0.7	0.3	-13.1	-18.2	-8.4
Average		**0.6**	**26.8**	**4.4**	**16.6**	**30.5**

Synthetic control methods

- The results so far do not identify the causal effect of leaving
  - A shortcoming shared by much of the existing literature
- Q: What would have happened if these countries had not left the gold standard at the time they did?
- Synthetic control matching methods of Abadie and Gardeazabal (2003)
  - Treatment group: all the countries that had unambiguously left by Dec 1931
  - Control group: the countries that were still unambiguously on the gold standard in the middle of 1932
  - 'Matching' variables: population size, GDP per capita in 1930, average inflation between Jan 1929 and Aug 1931, and the behaviour of the ex ante real interest rate before the country left the gold standard

Synthetic control methods

- Control group index $j = 1, 2, ..., J$
- For each treated country we construct a 'synthetic' counterpart which is a weighted average of the control group countries, with weights defined by $W^* = (w_1, w_2, ..., w_J)$, a $J \times 1$ vector
- We choose the weights so that the synthetic country resembles the treated country, *before it was treated*, as much as possible
- Y_1 is a $T \times 1$ vector of an outcome variable (e.g. the *ex ante* real interest rate) for a treated country in T post-treatment periods, and Y_0 is a $T \times J$ matrix of the outcome variable for control group countries in the post-treatment periods
- The synthetic or counterfactual outcome is estimated by $Y_1^* = Y_0 W^*$

Weights

	Australia	Denmark	Finland	New Zealand	Sweden
Belgium			0.003	0.023	
Czechoslovakia	0.029		0.196	0.239	0.032
Italy			0.349	0.218	
Netherlands	0.090	0.101	0.045		0.927
Poland	0.293				
Romania	0.146	0.327	0.064	0.103	0.042
Switzerland	0.442	0.572	0.343	0.417	

Estimating W^*

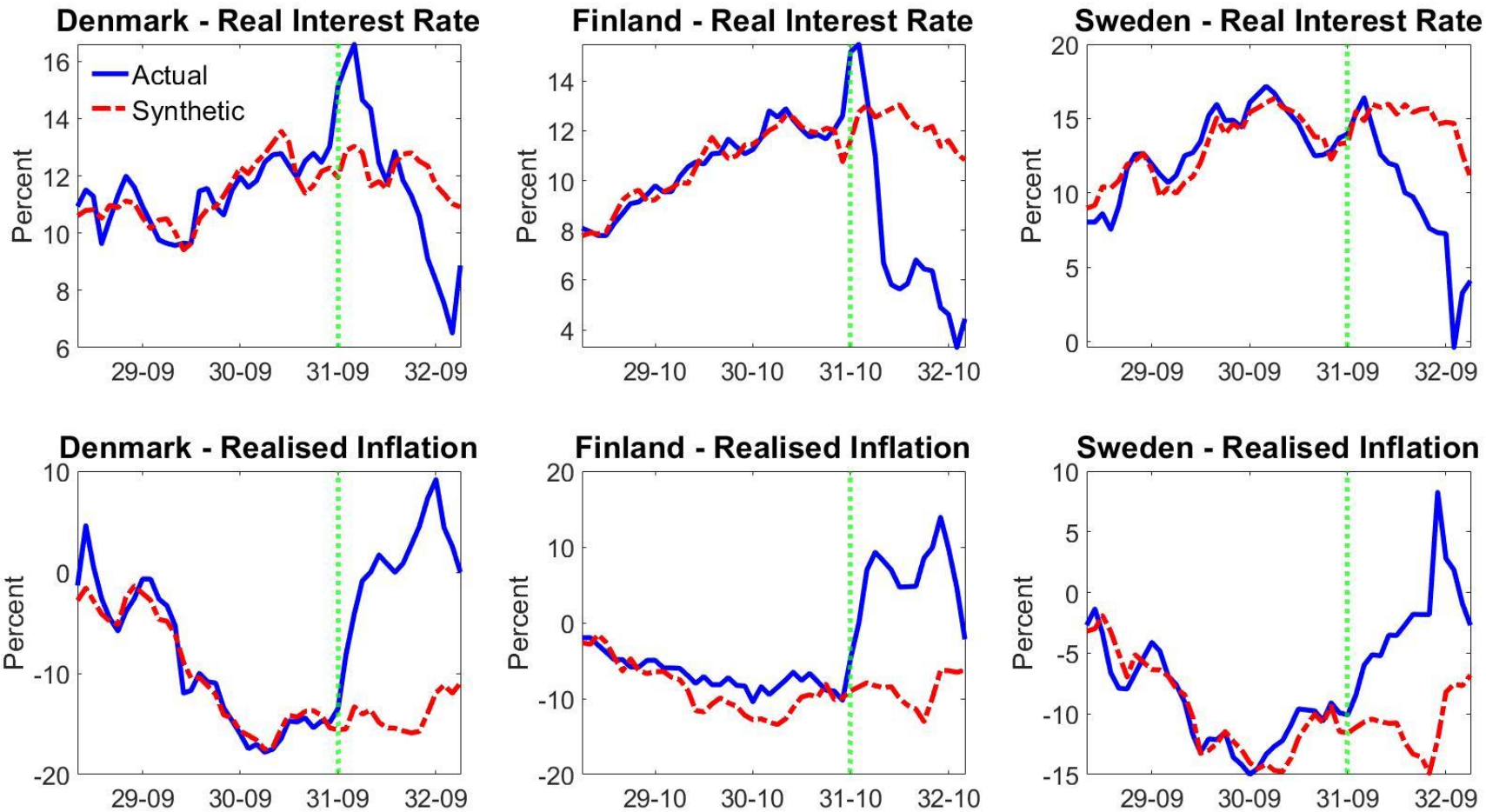
- We consider X_1, a $K \times 1$ vector of pre-treatment 'matching' variables, for the treated country, and X_0, a $K \times J$ matrix of the same variables for the control group. W^* is chosen by solving

$$\min_W (X_1 - X_0 W)' V (X_1 - X_0 W) \text{ s.t.}$$

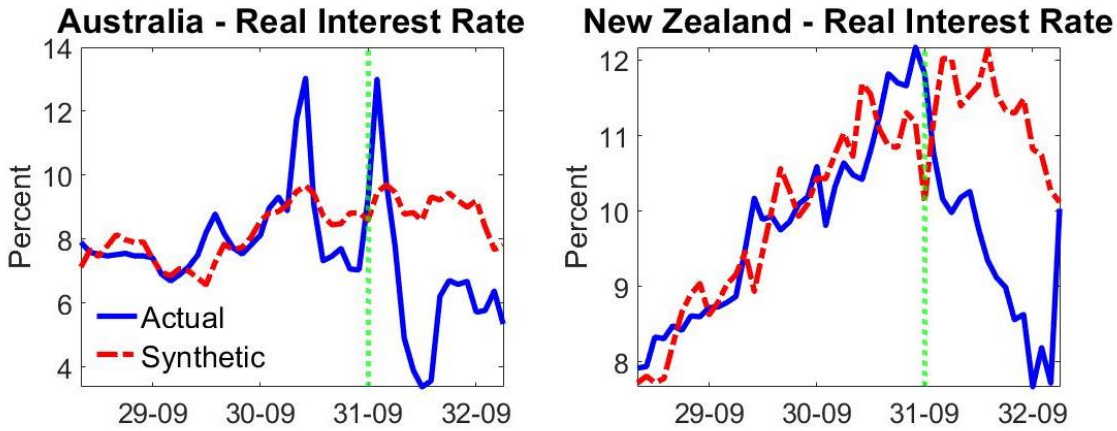
$$w_j \geq 0 \text{ for } j = 1, 2, ..., J \text{ and } \sum_{j=1}^{J} w_j = 1$$

- V, a diagonal matrix with non-negative weights, is in turn chosen by minimizing the quadratic distance between the actual and synthetic outcome variable of interest in the pre-treatment periods

Denmark, Finland, and Sweden



Australia and New Zealand



This paper

- Fifteen of our thirty countries unambiguously left the gold standard on clearly defined dates (Group A)
- An increase in inflation expectations and a decrease in real interest rate for these countries as well as some others
- We provide evidence that the relationship is causal for five countries
- For the countries where the timing of departure is less clear, our results can help us to see what really mattered in turning around expectations
- Overall strong support for the Sargent/Temin-Wigmore hypothesis