The Ends of 27 Big Depressions*

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Abstract

How did countries recover from the Great Depression? In this paper, we explore the argument that leaving the gold standard helped by boosting inflationary expectations, lowering real interest rates, and stimulating interest-sensitive expenditures. We do so for a sample of 27 countries, using modern nowcasting methods and a new dataset containing more than 230,000 monthly and quarterly observations for over 1,500 variables. In those cases where the departure from gold happened on well-defined dates, inflationary expectations clearly rose in the wake of departure. IV, diff-in-diff, and synthetic matching techniques suggest that the relationship is causal.

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1 Introduction

What does it take to end a big depression? Maybe history can provide us with guidance. In this paper we study the end of the Great Depression in 27 countries. Many authors, notably Eichengreen and Sachs (1985), have suggested that leaving the gold standard was a prerequisite for recovery: how true was this in general?[1] And if going off gold and recovery were linked to each other then what was the mechanism? Monetary loosening, in the form of lower nominal interest rates? Beggar thy neighbour currency devaluations (Bouscasse, 2022)? Fiscal expansion, as intellectual straitjackets were jettisoned along with the peg to gold? Or did going off gold matter in some other way?

The title of this paper is of course a tribute to Thomas Sargent's celebrated article on the end of four central European hyperinflations in the aftermath of World War I. Just as Sargent (1982) argued that changing expectations was central to halting hyperinflation, so we argue that changing expectations was central to stopping the Great Depression. And just as he argued that going back on gold, or pegging to the dollar, was essential to replacing expectations of continuing hyperinflation with expectations of stable prices, so we argue that leaving gold was essential to replacing expectations of continuing deflation with expectations of stable or increasing prices. The result was a collapse in real interest rates, a rebound in interest-rate-sensitive expenditure, and economic recovery. In both cases it took a regime shift to change expectations: as Sargent stressed, a simple change in policies would not have sufficed. Our paper offers a historical bookend to his argument: the monetary institution that allowed individual countries to escape hyperinflation in the 1920s had to be abandoned in the 1930s so that the world could escape the Depression.

We are not the first people to argue that going off gold mattered because it signalled to economic agents that the policy regime had shifted and that the era of deflation was over (Romer, 2014). This paper is, however, the most comprehensive study to date on the topic, breaking new ground not only in its country coverage but also in the methods used. Fisher (1935) was an early advocate, in a contribution that was often overlooked before

[1] Campa (1990) extended the Eichengreen and Sachs argument from Europe, which was their focus, to Latin America, and found that their argument held there as well. See also Bernanke and Carey (1996) and Obstfeld and Taylor (2004), pp. 141-5.

being revived by Dimand (2003). Read in conjunction with his better-known debt-deflation theory of the Great Depression (Fisher, 1933), the piece suggests that Fisher saw price dynamics as central to both the start and end of the Great Depression. Temin and Wigmore (1990) made the case for the United States in a paper which cites Sargent in theoretical support of their argument, and whose title also mirrors his. Temin reprised the argument in his Lionel Robbins Lectures (Temin, 1989), and Romer (1992) took it one step further by estimating US real interest rates using the single equation methods of Mishkin (1981) and quarterly data. In her account, an autonomous inflow of gold from Europe shifted US price expectations in an inflationary direction and enabled the economy to recover. More recently, Eggertsson (2008) embedded the argument within a theoretically well-specified dynamic stochastic general equilibrium model, while Jalil and Rua (2016) and Binder (2016) provided empirical support using narrative evidence. Similar arguments have also been made for Japan and the UK (Shibamoto and Shizume, 2014; Chouliarakis and Gwiazdowski, 2016).

We focus on the links between going off gold, inflation expectations, real interest rates, and economic recovery, extending the argument along two dimensions. First, we provide empirical evidence for 27 countries, many more than other work has analysed. Second, we estimate inflation expectations using state-of-the-art dynamic factor models that take all the real-time data available into account, rather than relying on single equation techniques. With a greatly expanded dataset and a valid econometric technique, we compare the separate contributions of the nominal interest rate and inflation expectations to changes in *ex ante* real interest rates, economic recovery, and the ends of 27 big depressions. Causality is addressed using instrumental variables (IV), difference-in-difference, and synthetic control methods.

Dynamic factor models are ideal for our purpose, keeping track of expectations in real time by updating model forecasts whenever there is news in the latest releases of a large number of economic indicators. Developed to assist decision-making in modern central banks, the method for extracting inflation expectations mirrors that employed until recently to produce the New York Fed Staff Forecast.[2] We use 778 variables to estimate our dynamic factor models, taken from a newly assembled database of over 1,500 cleaned and cross-validated

[2]The publication of the New York Fed Staff forecast was suspended in September 2021 due to uncertainty around the COVID-19 pandemic and consequent volatility in the data.

series for 35 countries, which are in turn based on more than 6,800 original "raw" series. All data are being made available to other researchers via the internet.

There is an extensive literature on historical inflationary expectations (Binder, 2016) to which this paper contributes. This includes several papers on the Great Depression, although most of those focused on the question of whether or not the deflation of the downturn was expected, rather than on the role of expectations during the recovery (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). There is also a large literature on the role of monetary policy during the Great Depression and subsequent recovery in the United States, notably Friedman and Schwartz (1963), but including more recent model-based contributions such as Christiano et al. (2003). The contribution of Eichengreen and Sachs (1985), in whose steps we follow, was to analyze monetary policy in the US (and elsewhere) in an international context, viewing the Depression as a global phenomenon linked to widespread adherence to the gold standard. Choudhri and Kochin (1980) identify the effect of selected European countries being on gold using the experience of Spain, a country that never was. As indicated at the outset, leaving gold could have facilitated recovery in a variety of ways. For example, Hausman et al. (2019) show that leaving the gold standard led to economic recovery in the United States by boosting farm prices, incomes, and expenditure. Inflation could thus have had a direct impact on economic activity in an environment where highly indebted farmers had a relatively high marginal propensity to consume. Jacobson et al. (2019) argue that leaving gold converted what had been real US government debt to nominal debt, making possible a policy of unbacked fiscal expansion that made an important contribution to American recovery. Our expectations mechanism provides another, complementary, channel through which leaving the gold standard could have facilitated recovery, and we show that it was at work in many countries.

The papers which are closest to us in spirit are Dorval and Smith (2015), Hamilton et al. (2016), Albers (2018), and Daniel and Steege (2020). Dorval and Smith calculate expected and unexpected inflation in over 20 countries during the interwar period. They use univariate methods, and their interest is in the relationship between inflation and output growth. Hamilton et al. estimate *ex ante* real interest rates for 15 countries between 1858

and 2014. They use annual data and single equation methods, and do not have our focus on the Depression. Albers independently collected data from the same interwar data sources that we use. He extracted about 1,150 time series from the sources, and used these to derive monthly economic activity indices for 28 countries. We have collected and cross-validated in excess of 1,500 time series for 35 countries, based on an even larger dataset; more importantly, we use these to trace the links between going off gold, inflationary expectations, real interest rates, and economic recovery. Like us, Daniel and Steege use a dynamic factor model to calculate expected inflation in Germany. They conclude that the German recovery was not due to an increase in inflationary expectations (see also Voth, 1999). The New York Fed model that we use is a more recent variant of this class of models; more importantly we look at the experiences of 27 countries, not just Germany.

In Section 2 we introduce the data and document our sources. Section 3 explains the methodology used to estimate real-time inflation expectations and *ex ante* real interest rates. The estimates are compared with other evidence on inflation expectations in Section 4. Section 5 discusses the surprisingly tricky issue of when to date countries' departure from gold. Sections 6, 7 and 8 explore the relationship between going off gold, inflation expectations, and economic recovery. Section 9 uses IV, diff-in-diff, and synthetic matching techniques to argue that these relationships are causal. A final section concludes.

2 Data

The principal data sources for our study are the *International Abstract of Economic Statistics* (Tinbergen, 1934; Derksen, 1938) and the *Statistisches Handbuch Der Weltwirtschaft* (1936, 1937). The former were compiled by the International Conference of Economic Services and the International Statistical Institute, based on information provided by national statistical institutions and economic research institutes; Jan Tinbergen edited the first volume. The latter was published by the German Statistiches Reichsamt, and relied on data gathered from national statistical offices, the League of Nations, central banks, periodicals, and other sources. These publications provide detailed and comprehensive information on a large number of economic indicators in many countries, at monthly and quarterly frequencies

from January 1919 to December 1936. The indicators include a wide range of economic and financial data, such as prices and quantities at both the aggregate and the industry level, volumes and values of aggregate and disaggregated international trade, prices and quantities in financial markets, and measures of labour market conditions. Albers (2018) discusses the quality of the data in his own work on the Great Depression, concluding that the compendia provide a reliable and invaluable source for interwar macroeconomic time series. He also notes that contemporaries praised the *Handbuch* for its coverage and accuracy (Mitić, 1936).

We began by digitising 2,115 monthly and quarterly series from the *International Abstract* (204,330 observations), and 4,673 series from the *Statistisches Handbuch* (282,776 observations). We then constructed a cleaned and cross-checked database based on these raw data. When the same series appeared in both sources we combined them into a single variable, checking for consistency and making any necessary adjustments (for example because of differing base years). When a variable could not be harmonised, it was dropped from the analysis. We then cross-validated the surviving series, using sources such as the NBER Macrohistory database, the Federal Reserve Bulletin (FRB), and League of Nations publications. In the course of this process, we added 17 series from the NBER database (3,210 observations) and 7 series from the FRB (1,440 observations). We ended up with a database containing 1,573 series and 233,040 observations covering 35 countries.

The paucity of data for Brazil, Chile, Greece, Latvia, Norway, Romania, and Yugoslavia precluded their inclusion in this study. We also omitted Spain from the analysis because it did not join the Gold Standard after World War I (Choudhri and Kochin, 1980), although the Spanish data are included in the online database for completeness. This left us with 27 countries: Argentina, Australia, Austria, Belgium, British India, Bulgaria, Canada, Czechoslovakia, Denmark, Dutch East Indies, Estonia, Finland, France, Germany, Hungary, Italy, Japan, Lithuania, the Netherlands, New Zealand, Peru, Poland, South Africa, Sweden, Switzerland, the United Kingdom, and the United States. Variables are not used in estimation if they display large instability or do not appear to help reduce forecast errors. For example, the gold stock in British India is not utilised because it became much more volatile after September 1931, while there is little gain in including all 18 subcategories of the Wholesale Price Index for Germany. This leaves us with 778 series that capture the major

data categories in each country. They are available online, along with the original raw data and the cleaned 35-country database.[3]

Given our paper's emphasis on the role of *ex ante* real interest rates, we draw particular attention to our preferred measures of the nominal interest rate, inflation, and aggregate output. For the nominal interest rate, we follow Romer (1992) in using three to six month market interest rates wherever possible, with the central bank discount rate acting as a proxy for countries where market rates are unavailable. For inflation, we focus on the 12-month change in the wholesale price index as this is the most commonly available measure across our sample of countries.[4] For Bulgaria and South Africa where a consistent monthly wholesale price index is unavailable, we select 12-month changes in a cost of living index. Aggregate output is measured by the index of total production or its variant whenever feasible; otherwise it is proxied by the quantity of a key product or commodity produced. A summary of the preferred measures for each country is in Appendix A.

Camacho et al. (2015) argue that it is better to seasonally adjust each data series before estimating a factor model and we follow their approach. Most of the output data we use are already seasonally adjusted and there is unlikely to be significant seasonal variation in nominal interest rates, but price series in our data sources are generally not adjusted for seasonality. To circumvent the problem, we use 12-month changes in price levels and apply statistical tests to check that the resulting series are free of residual seasonality. We also confirm that there is no seasonal variation in our estimates of the real interest rate.[5]

[3]The data are available at https://cepr.org/node/402920.

[4]Our decision to focus on wholesale prices may not be innocuous. However, if the Fisher (1933) debt deflation theory is correct then what matters is the price index relevant for the most indebted agents. Jordà et al. (2016) calculate that the average share of mortgages in total bank lending in 1929 across 17 advanced economies was only about 30%. With the much larger non-mortgage lending being dominated by firms, expectations of wholesale price inflation are likely to have been central to economic recovery.

[5]For example, we test for seasonality by applying the X-13ARIMA-SEATS procedure to our 12-month change measures of inflation. The procedure is employed as standard by the US Census Bureau and subsumes practically all known methods of seasonal adjustment. It finds no evidence of residual seasonal variation in our inflation or real interest rate measures.

3 Methodology

The *ex ante* real interest rate is defined by the Fisher equation as the difference between the current nominal interest rate and the expected rate of inflation over the next 12 months. To keep track of the real interest rate, we therefore need an estimate of forward-looking inflation expectations that is updated in real time as new macroeconomic data are released. Fortunately for us, the real-time estimation of inflation expectations is a core input to decision-making in modern monetary policy-making. Central banks worldwide have therefore developed sophisticated nowcasting and forecasting techniques that we can apply retrospectively to our data. In essence, our estimate of the real interest rate is that which a modern central bank would have made had they been exposed to the flow of information released from January 1919 to December 1936.

We adopt the nowcasting methodology of Bańbura et al. (2010) and Bańbura and Modugno (2014) that was until recently used to construct the New York Fed Staff Nowcast.[6] The version we employ is documented in Bok et al. (2018). The method builds on the machinery of dynamic factor models, which view movements in observed data as driven by a limited number of latent factors. This conceptual reduction allows us to analyse our large and complex dataset in a statistically consistent and tractable manner. In particular, we can account for the impact of new data releases on forward-looking real-time inflation expectations, which is crucial for tracking movements in the *ex ante* real interest rate. The method is conveniently able to handle data with different sample lengths, publication delays, reporting frequencies, and missing observations. Historical data are replete with such problems, so adopting the nowcasting methodology improves upon earlier historical studies based on more traditional factor models (e.g. Ritschl et al., 2016 and Albers, 2018).

In our dynamic factor model, the large set of variables observed for each country is related to a small number of country-specific latent factors and idiosyncratic components. The number of variables to be explained ranges from a minimum of $n = 11$ in Lithuania to a maximum of $n = 49$ in Canada. These are related to r dynamic factors. To be precise, observations $y_{i,t}^{j}$ of variable i in country j and period t are explained by country-specific

[6]The New York Fed Staff Nowcast is at https://www.newyorkfed.org/research/policy/nowcast.

latent factors $f^j_{1,t}, \ldots, f^j_{r,t}$ and an idiosyncratic component $e^j_{i,t}$:

$$y^j_{i,t} = \mu^j_i + \sum_{k=1}^{r} \lambda^j_{i,k} f^j_{k,t} + e^j_{i,t} \qquad \text{for } i = 1, \ldots n \tag{1}$$

The observed variables are related to the dynamic factors through the estimated factor loadings, $\lambda^j_{i,1}, \ldots, \lambda^j_{i,r}$, with the idiosyncratic component capturing sources of variation unrelated to the factors. The latent factors and the idiosyncratic components are assumed to follow autoregressive processes:

$$f^j_{k,t} = \alpha^j_k f^j_{k,t-1} + u^j_{k,t} \qquad \text{for } k = 1, \ldots r \tag{2}$$

$$e^j_{i,t} = \rho^j_i e^j_{i,t-1} + \varepsilon^j_{i,t} \qquad \text{for } i = 1, \ldots n \tag{3}$$

where the variance-covariance matrices of the innovations are set as diagonal to facilitate estimation, as common in the literature (Bok et al., 2018).

Equations (1)-(3) form a state space model in which (1) is the measurement equation and (2)-(3) are state transition equations. The system is estimated using the Kalman filter and maximum-likelihood methods, and forecasts for key variables are constructed from forecasts of the latent factors and idiosyncratic components by applying the appropriate factor loadings. Of special interest is expected inflation over the coming 12 months, which requires a forecast at time t of $y^j_{1,t+12}$ if the first observable variable in country j is the 12-month change in prices:

$$E_t y^j_{1,t+12} = \hat{\mu}^j_1 + \sum_{k=1}^{r} \hat{\lambda}^j_{1,k} (\hat{\alpha}^j_k)^{12} \hat{f}^j_{k,t} + (\hat{\rho}^j_1)^{12} \hat{e}^j_{1,t} \tag{4}$$

A dynamic factor model is estimated separately for each country. We adopt the four latent factor structure of the New York Fed Staff Nowcast model, which features a single factor that loads on all variables and three additional factors that load on real, financial, and labour market variables, respectively. For countries that lack consistent labour market data for the whole sample period, we omit the labour factor and estimate a model with only three latent factors. Data are transformed where necessary and checked for stationarity using the augmented Dickey-Fuller (ADF) and Phillips-Perron tests. For those variables with missing

values where standard tests cannot be applied, we find stationarity-inducing transformations by evaluating the series graphically. Our results are robust to suitable alternative specifications with different numbers of dynamic factors or lags in the autoregressive process; the specification of the model estimated for each country is provided in Appendix B.

Our focus on the real-time updating of inflation expectations means that we need to identify what data were available when and control for the dates at which new information is released. The principal data sources are not helpful in this respect, but the *Federal Reserve Bulletin* is published monthly and so allows us to check the data in real time and see the delay with which each variable is reported in many of our countries. We use evidence from Bulletins published between January 1919 and December 1936 to estimate the release date for each type of variable. For example, the May 1926 edition reports wholesale price indices from 24 out of our 27 countries. Of those, 18 relate to prices in March 1928 and two to prices in April 1928. The information was cabled to the Fed from various foreign statistical offices, suggesting widespread availability of price data with a two-month delay. Broadly speaking, prices, sales, logistics/transportation, and financial quantities are released with a delay of two months; production, labour, and international trade with a delay of three months. Financial prices are observed immediately. We apply the same structure to all countries, on the understanding that alternative assumptions regarding release delays may affect the precise timing of monthly forecast revisions but are unlikely to fundamentally change the evolution of 12-month change forecasts one or more years ahead. The assumption that financial prices are observed without delay is in any case uncontroversial.

The dynamic factor models are initially estimated using data from the period before the Great Depression. For all but Denmark, the Dutch East Indies, Finland, New Zealand, and Belgium, we start estimation with data from January 1919 to January 1928, one year before the Great Depression began in the United States.[7] After the initial period, the models are re-estimated semiannually each January and July using expanding windows that incorporate the latest observations. This ensures that we are always making appropriate pseudo out-of-

[7]Data for Denmark, the Dutch East Indies, Finland, and New Zealand are only available from January 1925 and are incomplete in the early part of the sample, so initial estimation is extended to include data up to January 1929. For Belgium, some early observations are similarly missing, and initial estimation is with data up to July 1928.

sample forecasts for the period after the start of the Great Depression.[8] Full details of the data used to estimate each country's model are in Appendix B. As we will see below, the results are consistent with the established narrative about how big depressions ended in well-studied countries. This serves as a proof of concept for our empirical approach, validating our application of the same method to the analysis of the many countries in our sample whose interwar economic experiences have been relatively less studied.

Forecasts from the dynamic factor model depend on the latent factors whose estimates evolve as new information becomes available. Updates to the forecasts are driven by changes in these estimates, which in turn depend on the amount of news in each new data release and the importance of that news to the variables of interest that are being forecast. The dynamic factor model methodology calculates these automatically, and allows us to track how forecasts are updated as new information is released.

4 Other evidence on inflation expectations

The estimates of expected inflation produced by our dynamic factor models are the optimal forecasts of agents who use a dynamic factor structure to interpret the real-time dataflows we have collated. This raises questions about the appropriateness of our exercise. Did agents at the time have access to our real-time dataset and did they behave as if they used a dynamic factor model to interpret the data and form inflation expectations? If we see now that some data predicted inflation, was that understood at the time?[9] If expectations had been surveyed then we could straightforwardly assess our approach by showing that our estimates of expected inflation were consistent with those in the surveys. Unfortunately, systematic surveys of inflation expectations are not available until much later.

[8]The use of expanding windows may help to allay the theoretical concern that our expectations are based on models initially estimated for the pre-Great Depression period, and that rational agents should not base their inflation forecasts on the same relationships once countries had left gold. Note that there might be potentially offsetting biases involved here. On the one hand, agents in countries leaving gold late might have had a better understanding than they would have had in the 1920s that leaving gold would raise inflation, based on the experiences of early leavers. On the other hand, a one-time devaluation-induced jump in prices might have a smaller impact on expected inflation than a same-sized move occurring for other reasons.

[9]For example, Barsky and DeLong (1991) show that the amount of gold mined before 1914 predicted inflation but did not affect inflation expectations. Their explanation stresses the difficulties of interpreting the data and forming expectations, rather than a lack of access to real-time information.

Figure I presents estimates of expected inflation in Germany and the US taken from Voth (1999) and Binder (2016) respectively, alongside those produced by our dynamic factor model. The comovement for Germany is high, which is not surprising given that Voth's estimate is from a statistical model that shares many of its inputs with ours. More thought-provoking is the US comparison to Binder (2016), who followed Jalil and Rua (2016) in constructing a monthly index of inflation expectations based on the frequency with which the words "inflation" and "deflation" appeared in the *New York Times*. Her measure tracks ours until the middle of 1930 but recovers quickly thereafter, whereas we estimate that agents continued to expect deflation well into 1933. Both series show US inflation expectations rising from 1933 to 1935.

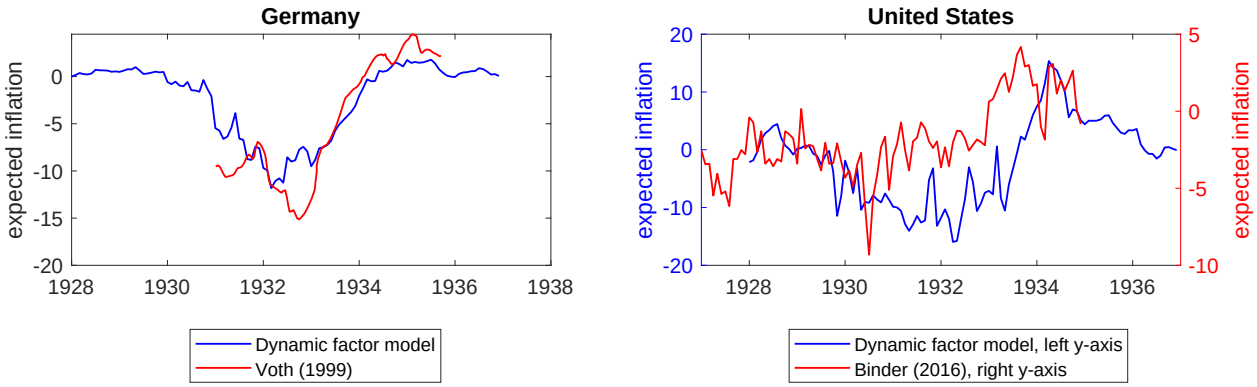

Figure I: Expected inflation from the dynamic factor models (blue lines, left y-axes) and two estimates from the existing literature.

Financial market data offer an alternative source of independent evidence, in particular from commodity futures markets that operated in the US, UK, France, Germany, and Japan during the period. Futures markets are forward-looking, so the spreads between futures contract prices and the spot price are potentially informative about agents' inflation expectations. Prices in commodity futures markets are set by traders making actual financial transactions, so by definition reflect the information and beliefs held by some agents at the time.[10]

[10]Modern approaches extract a measure of market-based expectations from the spread between the yields on nominal and index-linked bonds. The first index-linked government bonds to be issued at scale were in

We begin with futures and spot prices quoted on the New York Cotton Exchange, which we transcribed from *Barron's* and cross-checked with the *New York Times* and the *Washington Post*. The data are monthly from June 1921 to December 1936, each observation taken as close to the beginning of the month as possible. Spreads for the sample period are plotted in Figure II, based on futures contracts for raw cotton expiring 3, 6, and 9 months ahead. There were negative spreads in 1928 and early 1929, with futures prices below the spot price. Afterward, the spread turned positive with futures priced above the spot price. This remained the case until late 1934, when spreads once again became negative.

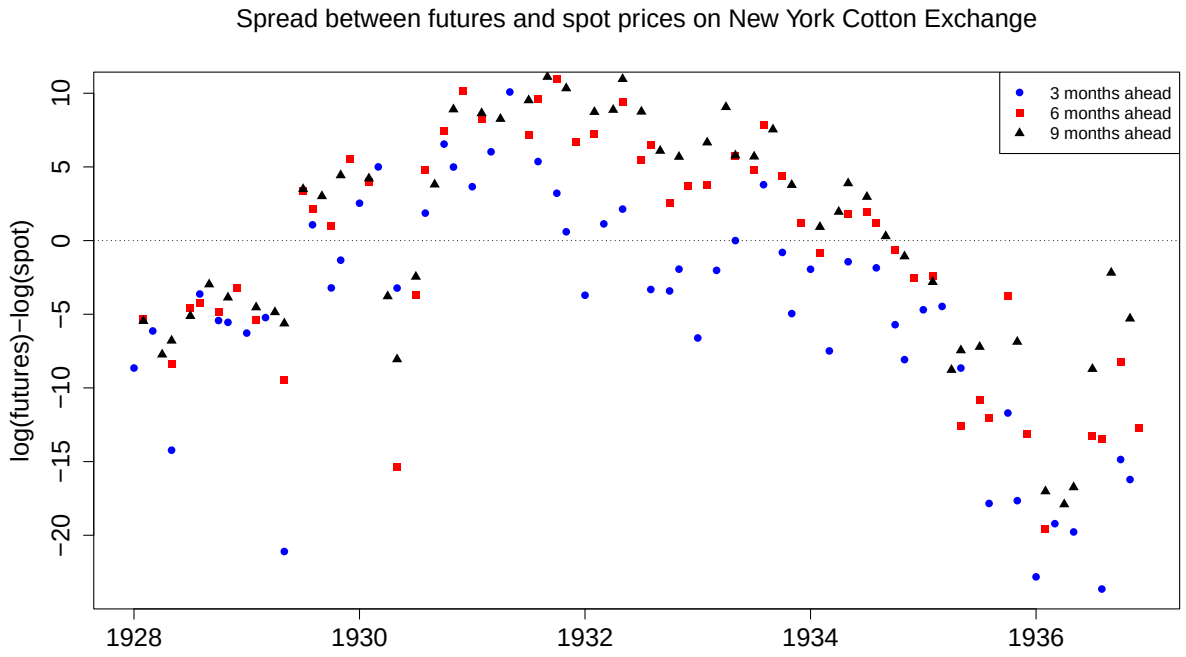

Figure II: Spreads between futures and spot prices on the New York Cotton Exchange

Interpretation of the evidence in Figure II is contentious. Hamilton (1987) argues that futures prices predict future spot prices, so that traders expect cotton prices to fall when spreads are negative, and to rise when they are positive. If raw cotton is representative of the goods in the wholesale price index, then on this interpretation expectations regarding the general price level were deflationary in 1928 and early 1929, prior to onset of the Great

the UK in 1981, far beyond our time horizon. An interesting counter-example is Austria, which issued gold, silver, and paper bonds in a way that allowed Mitchener and Weidenmier (2010) to recover a market-based measure of inflation expectations, but only until April 1911, before the start of our sample.

Depression; they became inflationary during the Great Depression; and they were once again deflationary from late 1934, after it had ended. One possible objection to this argument is that raw cotton may not have been representative of goods in the wholesale price index. A more fundamental objection is that even if it was, the data in Figure II can be interpreted in more than one way. Saleuddin and Coffman (2018) argue that positive spreads during the Great Depression were consistent with expectations of deflation, and negative spreads before and after with expectations of inflation. The more the general price level was expected to fall the more commodities ended up in storage, paying higher storage costs and providing lower convenience yields. By the theory of Working (1949), this should have led to futures prices rising relative to spot.[11] The evidence in Figure II is consistent with our dynamic factor model estimates if the data are interpreted in this way. The fall and subsequent recovery in US inflation expectations in Figure I occurred against a backdrop of similar dynamics in spreads, which storage theory associates with a progressive deterioration in the general price level expectations of cotton futures markets traders, followed by an improvement.

5 Dating departures from the gold standard

To explore whether or not leaving the gold standard helped boost inflationary expectations, we need to know when countries left the gold standard. But what exactly does that mean? Full adherence to the gold standard involved a domestic monetary rule (maintaining the convertibility of local currency into gold at a fixed price); no exchange controls (so that, in particular, gold could flow freely into and out of the country); and (as an automatic consequence of the previous two commitments) a fixed exchange rate vis à vis other countries

[11] That storage costs matter was vividly apparent on April 20th 2020 when the price of West Texas Intermediate crude turned negative for the first time in its history. As the Covid-19 pandemic hit demand, producers did not immediately halt oil production and storage facilities quickly started to fill up. At the margin, over-supply had to be stored in floating oil tankers, which was so expensive that producers were prepared to pay traders to take oil off their hands. The net convenience yield went deep into negative territory as front-end May 2020 futures closed at -$37.63 (the closest thing to a spot price in this market) and May 2021 futures closed at $63.38. Another reason why futures prices rose relative to spot prices during the Great Depression may be risk aversion on the part of traders. If uncertainty rose in the Depression and traders were not risk neutral, then they would have demanded a higher risk premium for holding futures contracts, driving up futures prices and widening the spread between futures and the spot price. A full analysis of these arguments is presented in Appendix C, alongside results for other US commodities and four other countries for which we collected commodity futures data.

on the gold standard. By implication, leaving the gold standard could involve an official suspension of convertibility; the imposition of exchange controls or restrictions on international gold shipments; or depreciation or devaluation against either gold or other currencies on gold. The League of Nations (1937) published data on all three dimensions of the phenomenon which have been widely reproduced: Table I gives the League's data for countries we are interested in. It also gives five sets of judgements regarding exactly when each country should be regarded as having left the gold standard: the authors in question being Brown (1940), who relied on the September 1933 issue of the Bank of Nova Scotia's Monthly Review; Kemmerer's (1954) testimony to the US Senate; Officer's (2008) widely-cited encyclopaedia article on the gold standard; Obstfeld and Taylor (2003); and Wolf (2008).

For our purpose the key issue is: what constituted a regime change sufficient that it would change inflationary expectations? *De jure* suspension, or *de facto* devaluation, seem more obvious candidates than exchange controls: countries could and often did impose exchange controls while maintaining the link between the money supply and gold reserves. Indeed, one motive for imposing exchange controls was precisely to prevent gold outflows that threatened to destroy this link: it is not surprising, therefore, that Mitchener and Wandschneider (2015, p. 189) find that "countries imposing exchange controls did not actively pursue expansionary monetary policy after abandoning gold. An examination of discount rate policy of exchange-control countries suggests that, while they did not follow France and continue to raise rates after imposing controls, they also did not pursue a discount rate strategy similar to the U.S., a country which floated and then aggressively pursued expansionary monetary policy."

Similarly, in discussing Germany's decision to impose foreign exchange controls in July 1931, Knut Borchardt (1984, p. 475) writes that "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." Efforts to reduce wages and prices in an attempt to regain competitiveness

continued in Germany after the imposition of exchange controls (Brown, 1940, pp. 1214-5; Eichengreen and Temin, 2000, p. 203). For this reason, we privilege suspension or devaluation when timing the departure of countries from the gold standard.

Our task is straightforward when countries left the gold standard without imposing exchange controls, or when they imposed exchange controls at the same time, or after, devaluation or suspension. This is the case for Belgium, British India, Denmark, the Dutch East Indies, Finland, France, Japan, the Netherlands, Peru, Sweden, Switzerland, and the UK. For each of these 12 countries there is one unambiguous date of departure. Canada devalued in September 1931 and officially suspended the following month: the Economist commented that the latter decision was "simply the conferring of legal recognition to a previous *fait accompli*".[12] South Africa was forced to suspend convertibility in December 1932 and the following month the pound reached parity with sterling (Drummond, 1981, pp. 61-4, 95–6). In both cases we take the earlier of the two months as the date of departure. The New Zealand experience was more complicated, but Appendix E argues that its real departure from gold was unambiguously September 1931, when the UK left. We refer to these 15 countries, for which there is one unambiguous departure date, as Group A.

In eight of our countries the abandonment of the gold standard took place in stages. A second group of countries (Group B) first imposed exchange controls and then unambiguously suspended convertibility, devalued or depreciated. Given our prioritisation of devaluation or suspension over exchange controls, Estonia is taken to leave in June 1933 rather than November 1931 and Poland is taken to leave in October 1936, when it devalued, rather than in April when it imposed exchange controls (Bernanke and James, 1991, p. 37; Wolf, 2007). In March 1933 the newly elected President Roosevelt imposed restrictions on foreign exchange transactions and gold exports, but it was only the following month that the dollar was devalued and, in the eyes of most commentators, taken off gold (Eichengreen, 1992, pp. 328-32; League of Nations, 1937).

[12] "Canada and Gold." Economist, 24 Oct. 1931, p. 752.

	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		C	Dec-29 & Nov-33	
Australia	Dec-29		Mar-30		Mar-30	1929	1930	Jan-30		C	Jan-31 & Sep-31	
Austria	Apr-33	Oct-31	Sep-31 & Apr-34	Apr-34	Oct-31	1931	1931	Oct-31	Sep-31	C	Oct-31 & Apr-33	
Belgium	Mar-35	Mar-35 & Apr-35	Mar-35	Mar-35		1935	1935	Mar-35		A	Mar-35	
British India	Sep-31		Sep-31		Sep-31	1931	1931	Sep-31		A	Sep-31	
Bulgaria		1918				1931	1931			D	N/A	Oct-31
Canada	Oct-31		Sep-31		Sep-31	1931	1931	Jul-31		A	Sep-31	
Czechoslovakia		Oct-31	Feb-34 & Oct-36	Feb-34 & Oct-36		1931	1931		Sep-31	C	Feb-34 & Oct-36	
Denmark	Sep-31	Nov-31	Sep-31		Sep-31	1931	1931	Sep-31		A	Sep-31	
Dutch East Indies	Sep-36		Sep-36			1936	1936			A	Sep-36	
Estonia	Jun-33	Nov-31	Jun-33			1931	1931			B	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	D	N/A	Jul-31
Hungary		Jul-31				1931	1931	Aug-31	Jul-31	D	N/A	Jul-31
Italy		May-34	Mar-34 & Oct-36	Oct-36		1934	1934	Dec-34	May-34	C	Jul-35 & Oct-36	
Japan	Dec-31	Jul-32	Dec-31		Dec-31	1931	1931	Dec-31		A	Dec-31	
Lithuania		Oct-35								D	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	B	Oct-36	
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		B	Apr-33	

Table I: Dates of principal measures affecting adherence to gold standard.

Sources: League of Nations (1937, p. 16), Brown (1940, p. 1075), Kemmerer (1954), Officer (2008), Obstfeld and Taylor (2003), Wolf (2008). For our coding, see text.

Group C consists of countries where the timing of devaluation or suspension is ambiguous, or where a country left the gold standard more than once. Argentina is a good example of the latter. The Argentinian paper peso depreciated relative to gold in November 1929, but at the time this was not perceived as a break with the gold standard: on December 14 the Economist was still describing the country's exchange rate system as being based on gold.[13] Three days later, however, the *Casa de Conversión*, which was responsible for converting paper currency into gold and vice versa, was unexpectedly closed: we follow other scholars in dating Argentina's original departure to December 1929 (see for example Smith, 1934, p. 433; Brown, 1940, p. 883; Eichengreen, 1992, p. 237). However, in December 1931 Argentina pegged its currency to the US dollar and French franc, both of which were tied to gold. This in turn eventually led to a second suspension of the gold standard, in November 1933 (when the currency was devalued and a bill was introduced in parliament that would lead to the creation of a new central bank and a fiat money system: Brown, 1940, pp. 1168; Gerchunoff and Machinea, 2015). Table I thus lists two dates for Argentina: December 1929 and November 1933. The table also lists two possible departure dates for the four other countries in Group C (Australia, Austria, Czechoslovakia and Italy): interested readers are referred to Appendix E for a full discussion of each case.

The four remaining sample countries imposed exchange controls without ever formally abandoning the gold standard or devaluing (Group D). Germany and Hungary both introduced exchange controls in July 1931 but the official parities remained unchanged throughout our period (League of Nations, 1937). In Bulgaria, the government dismissed the possibility of going off gold, but was forced to impose exchange controls: in October 1931 the Bulgarian National Bank was given a monopoly on all foreign exchange transactions (Tooze and Ivanov, 2011, p. 41). Similarly, Lithuania imposed exchange controls in October 1935 while maintaining the link with gold (League of Nations, 1937).

In summary, there are four categories of countries. First, there are 15 countries that suspended the gold standard and/or devalued, unambiguously, at a clearly defined date, and did so either without, or before, or at the same time as imposing capital controls (Group A). These are Belgium, British India, Canada, Denmark, the Dutch East Indies, Finland,

[13] "Finance and Banking." Argentine Supplement. Economist, 14 Dec. 1929, p. 7+.

France, Japan, the Netherlands, New Zealand, Peru, South Africa, Sweden, Switzerland, and the UK. Second, there are three countries that first imposed exchange controls, and then broke the link with gold at clearly defined dates: Estonia, Poland, and the US (Group B). Third, there are five countries (Argentina, Australia, Austria, Czechoslovakia, and Italy) that clearly left the gold standard, but where the timing of the departure is ambiguous (Group C). And finally, there are four countries that imposed exchange controls but maintained the formal link with gold (Bulgaria, Germany, Hungary, and Lithuania) (Group D). In the following section we look at movements in inflation expectations and real interest rates in each of these four groups.

6 Results by country group

This section traces the evolution of expected inflation and *ex ante* real interest rates before and after countries left the gold standard. Figure III plots expected inflation (the dashed red lines, on the right axes) and real interest rates (the solid blue lines, on the left axes) for each of the countries in Group A: these all left the gold standard on clearly defined dates.[14] The date of departure from the gold standard is indicated in each case by a green vertical dotted line. While it is more difficult to see for countries that left the gold standard in 1936 (i.e. the Dutch East Indies, France, the Netherlands, and Switzerland), which is when our data end, it seems clear that leaving the gold standard was followed by an almost ubiquitous increase in expected inflation and a decline in real interest rates. Indeed, in many countries – Belgium, British India, Canada, Denmark, New Zealand, Peru, Switzerland, and the UK – expected inflation had actually been flat or declining, and real interest rates flat or rising, prior to departure, so leaving gold coincided with a turning point in expectations. In the UK inflationary expectations increased following the departure from gold; October 1931 was clearly a turning point for UK real interest rates. Leaving gold was less obviously a turning point for inflationary expectations in the Dutch East Indies, Finland, France, Japan, the Netherlands and Sweden, since they had already been on an upward trajectory, but *a priori*

[14] Only the expected inflation rate is available for Canada because we do not have suitable nominal interest rate data.

that does not invalidate our argument since other forces may have been at work in those countries raising inflationary expectations.[15]

Figure IV gives the results for those countries that first imposed exchange controls and later devalued (Group B). Once again suspension or devaluation is indicated by the vertical green dotted lines, while exchange controls are indicated by the black dashed lines. In the US case it is difficult to disentangle the two events since they occurred in successive months: consistent with the argument of Temin and Wigmore inflationary expectations clearly rose, and real interest rates fell, following this policy shift. Yield curve evidence confirms this finding (see Appendix F). Capital controls did not interrupt declines in real interest rates, and rises in inflationary expectations, underway in all three countries, but there is no evidence of the systematic reversal of expectations evident in Figure III. There does seem to have been a dramatic shift in expectations in Estonia following that country's departure from gold in 1933, but in Poland inflationary expectations were already rising prior to their final abandonment of the gold standard. Perhaps the signal provided by suspension or devaluation was muted in countries that were already withdrawing from international financial markets.

[15] Alternatively, agents may have anticipated that the gold standard was going to be abandoned, and adjusted their expectations of inflation accordingly. We find it striking that in 8 of our 15 Group A countries leaving gold coincided with a turning point in expectations, suggesting that in many cases it was unanticipated.

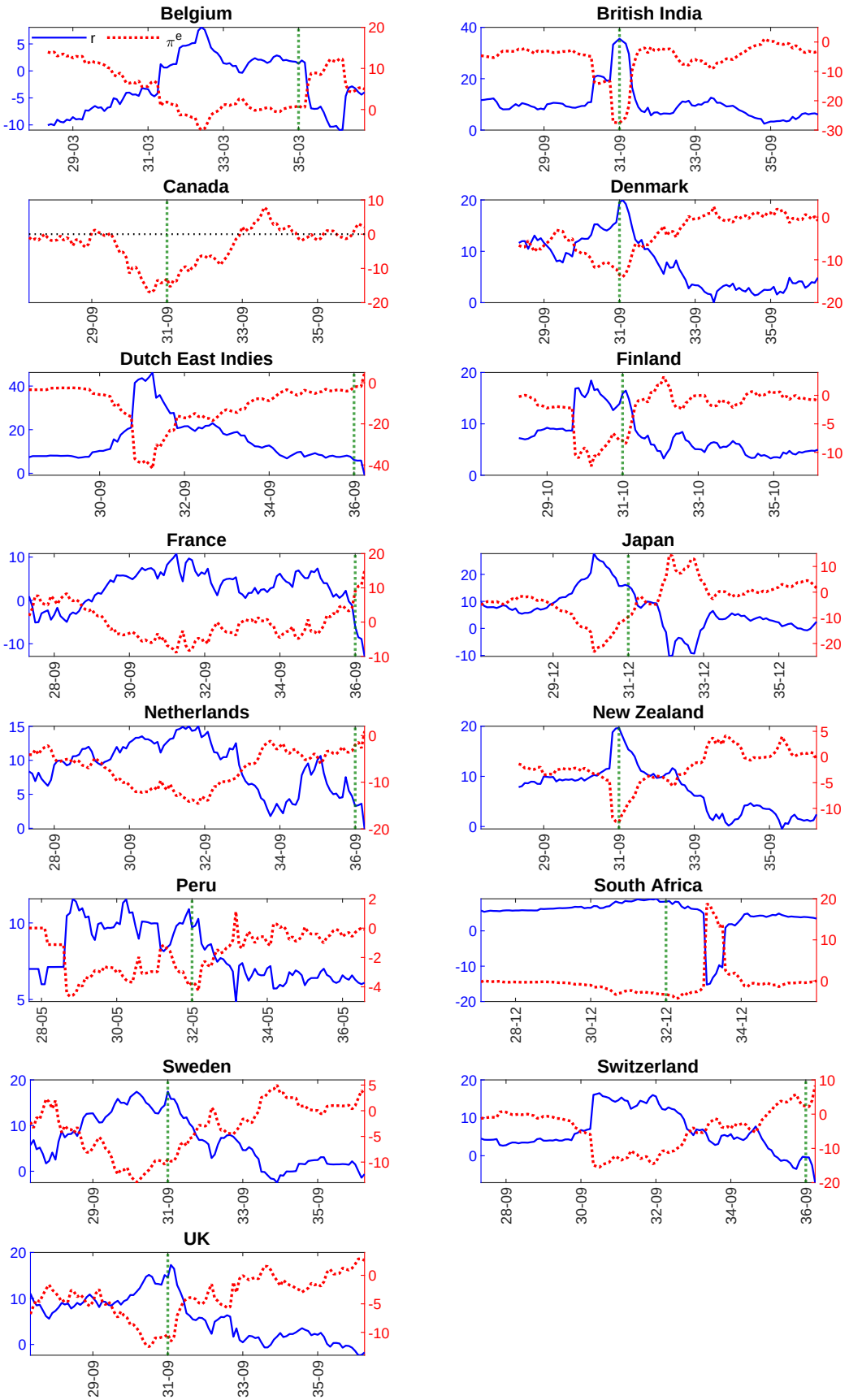

Figure III: Real interest rates (solid blue) and expected inflation (dashed red), Group A

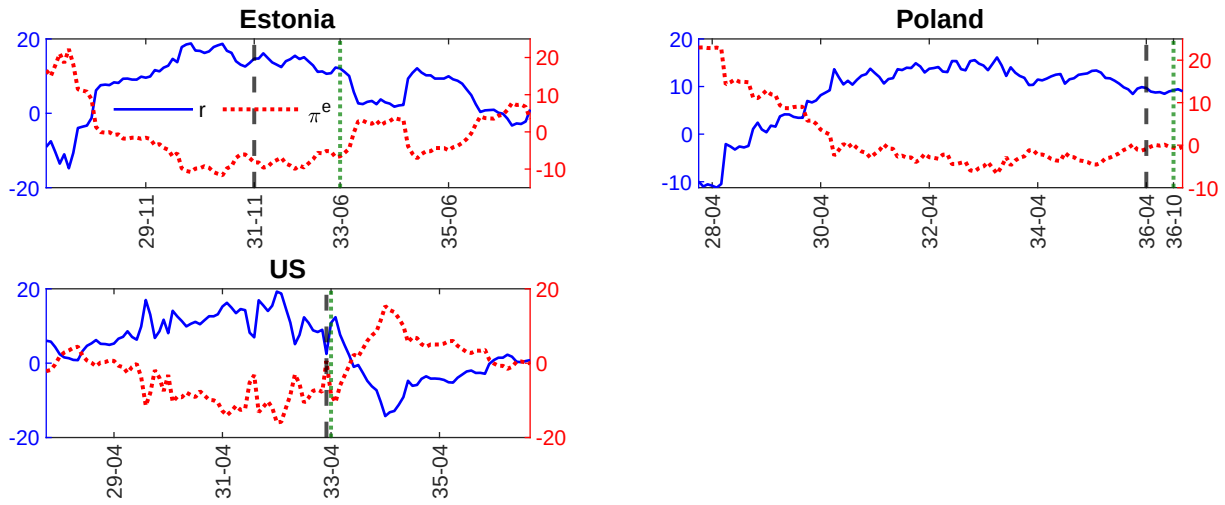

Figure IV: Real interest rates (solid blue) and expected inflation (dashed red), Group B

Figure V considers those countries where the timing of departure is genuinely ambiguous (Group C).[16] Once again capital controls are indicated by black dashed lines, and candidate dates are indicated by green dotted lines. Other dates mentioned in the text, or Appendix E, are plotted in cyan and magenta dash-dotted lines. In Argentina the 1929 departure had no impact on expectations; the imposition of exchange controls in October 1931, and the second departure in November 1933, clearly did. In Australia both the devaluation of January 1931, and sterling's departure from gold in September 1931, were followed by a rise in inflationary expectations and a decline in the real interest rate, but it was the former date that marked the real turning point, rather than the latter as in the case of New Zealand. In the Austrian case there was a major reversal of expectations after March 1931, six months before our first candidate departure date, and a second, smaller reversal in April 1933. Given that our data end in 1936, it is hard to see whether October 1936 was a real turning point in Czechoslovakia, but in any event inflationary expectations rose after that date (and continued to rise in February 1934). In July 1935 the 40% reserve requirement regarding paper money was abolished in Italy, allowing the government to monetise a greater portion of its budget deficits. Our results suggest that inflationary expectations rose sharply shortly thereafter, consistent with the argument that this marked an important turning point in

[16]It would clearly be circular to use our data on expectations to infer when the countries concerned "really" left gold, which is why we omit these countries from the analysis of Section 8. Nevertheless the data themselves remain, we hope, informative.

Italy (Appendix E).

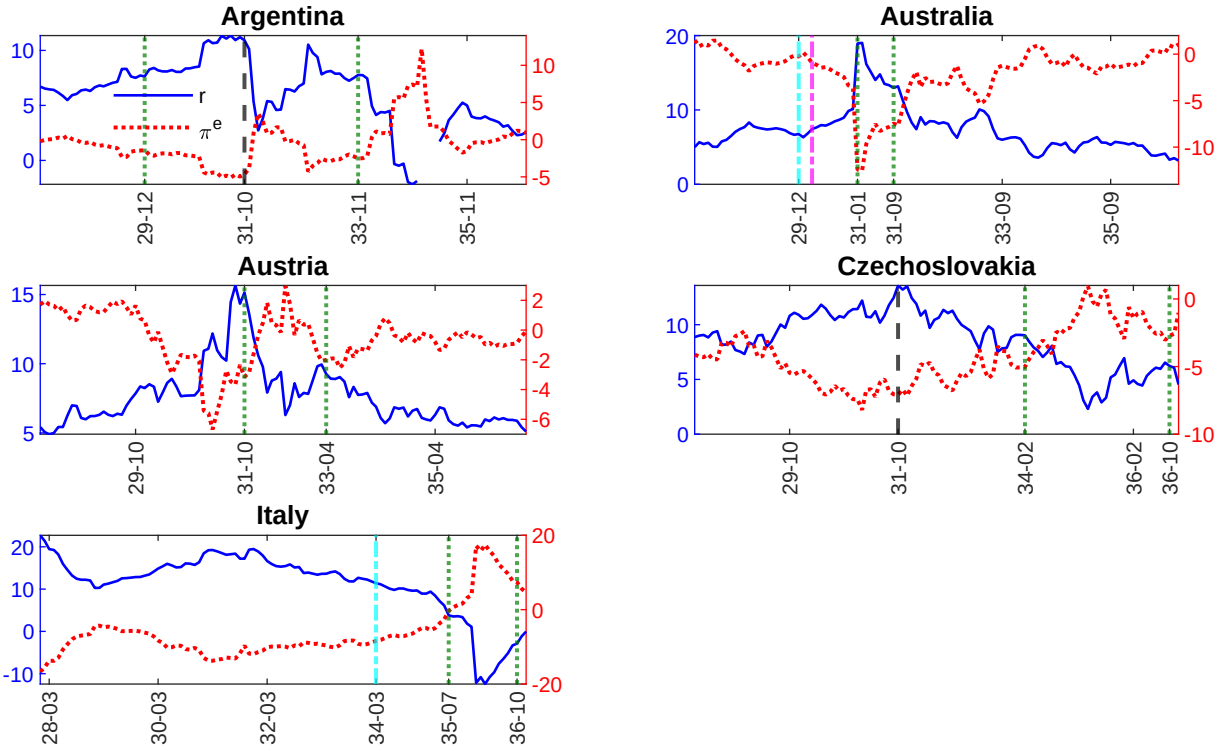

Figure V: Real interest rates (solid blue) and expected inflation (dashed red), Group C

Finally, Figure VI plots inflationary expectations and real interest rates for the four countries in Group D. Recall that these imposed exchange controls on well-defined dates (indicated by black vertical dashed lines) but never formally suspended the link with gold. In Germany real interest rates declined before and after July 1931; the Lausanne conference of July 1932, which led to the suspension of German reparations to its European creditors, and the accession of Hitler to power in January 1933 (indicated by the cyan vertical dashed line) seem to have been more important in permanently shifting expectations. This is unsurprising. Reparations had overshadowed the German economy for years, while Eichengreen and Temin (2000, p. 205) comment that "whatever else might be said about it, no one could mistake the rhetoric of the Nazis for the rhetoric of the gold standard". In 1932 the Commercial Counsellor of the British Embassy in Berlin described the Nazis' programme as "consisting chiefly of departure from the gold standard and ejection of all Jews": according to Borchardt

(1984, p. 497) sticking to gold was "understood as a kind of bulwark against Hitler". In Bulgaria and Hungary inflationary expectations had already been on an upward trajectory, and real interest rates on a downward trajectory, prior to the imposition of exchange controls. In Lithuania inflationary expectations rose, and real interest rates fell, following the imposition of capital controls in October 1935: only here is there evidence of a turning point in expectations. Overall, it is unclear that imposing exchange controls had the same consistently positive impact on inflationary expectations that seems to have been associated with devaluation or suspension.

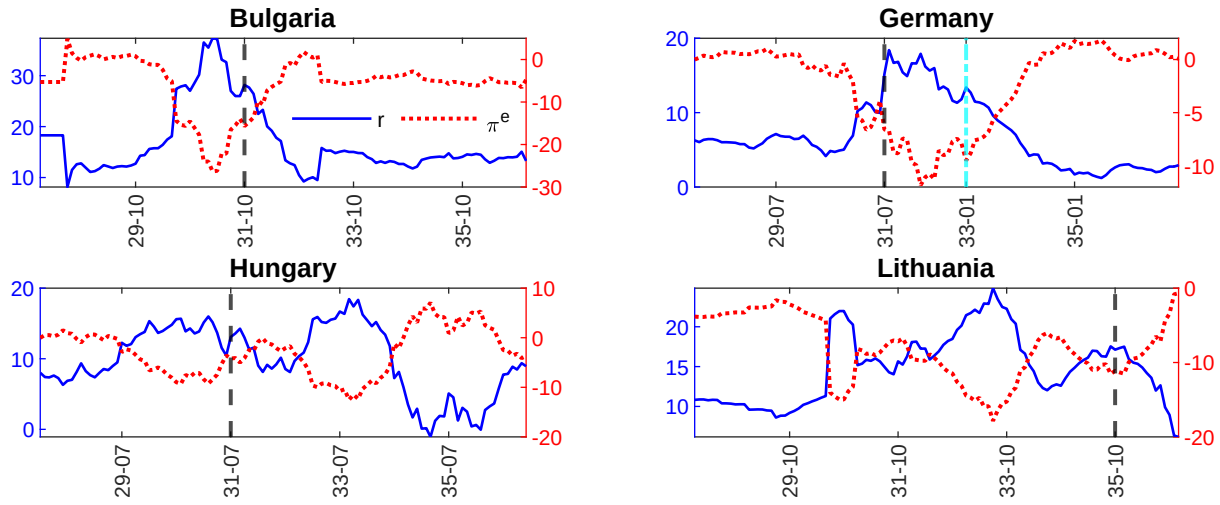

Figure VI: Real interest rates (solid blue) and expected inflation (dashed red), Group D

7 Expected inflation in three countries

This section asks why our estimates of expected inflation and *ex ante* real interest rates behave as they do in three countries (the UK, US, and Germany) after they left the gold standard. The estimates evolve over time as new data are released and the date of the 12-month change being forecast moves forward. To manage this complexity, we follow the practice of the New York Fed Staff Forecast by fixing the date of the 12-month change being forecast and asking how data released before then contribute to that forecast being revised. The dynamic factor model methodology is especially suited to our task, as it allows us to explain in detail which data series are responsible for each and every revision to forecasts

and expectations. For the specific cases we are interested in, it turns out that revisions to the inflation forecast are the dominant factor for expectations of the real interest rate. The remainder of this section therefore reports on the behaviour of expected inflation, with further results in Appendix G.

To obtain our decomposition we use a more general version of equation (4):

$$E_t y^j_{1,t^*} = \hat{\mu}^j_1 + \sum_{k=1}^{r} \hat{\lambda}^j_{1,k} (\hat{\alpha}^j_k)^{(t^*-t)} \hat{f}^j_{k,t} + (\hat{\rho}^j_1)^{(t^*-t)} \hat{e}^j_{1,t} \tag{5}$$

Here $E_t y^j_{1,t^*}$ is the estimate, at time t, of the inflation forecast in the 12 months to time t^* (in equation (4) t^* was set equal to $t+12$). Consider the forecast of UK inflation in the 12 months to the end of September 1932, one year after the UK left gold. The factor model generates a forecast of inflation for this period when it is first estimated with pre-Great Depression data: in December 1928 the forecast was -5.0%. The forecast is then revised each month to take account of any information in new data releases, giving us a time series of real-time forecasts for UK inflation in the 12 months to September 1932 that runs from December 1928 to November 1932, when the final inflation data were released. By looking at which data series contain the new information that leads to forecasts being revised, we can identify exactly what causes our estimates of expected inflation to move after countries left the gold standard.

The real-time forecasts for UK inflation to September 1932 are in the upper panel of Figure VII, with the stacked bars in the lower panel decomposing each month's forecast revision (in a format that mimics the New York Fed Staff Forecast). Starting from the initial forecast of -5.0% in December 1928, things are stable until early 1930 when the forecast begins a steady decline to -10.7% in August 1931, the month before the UK left the gold standard. The accelerated decline in January 1931 is due to the semiannual re-estimation of the model that month. Nothing much then happens to the forecast until December 1931, when data released after a two-month delay show that the wholesale price index had stopped falling in October 1931 and that railways had enjoyed a recovery in receipts for all goods and the weight of general merchandise transported. The upward revision in the forecast is

undermined slightly by negative news on unemployment, released after a three-month delay. The forecast continues on an upwards trajectory in the coming months on further positive news in new data releases (some from financial market indicators available without delay), eventually settling on the final value of 2.1% marked by the star in the upper panel.

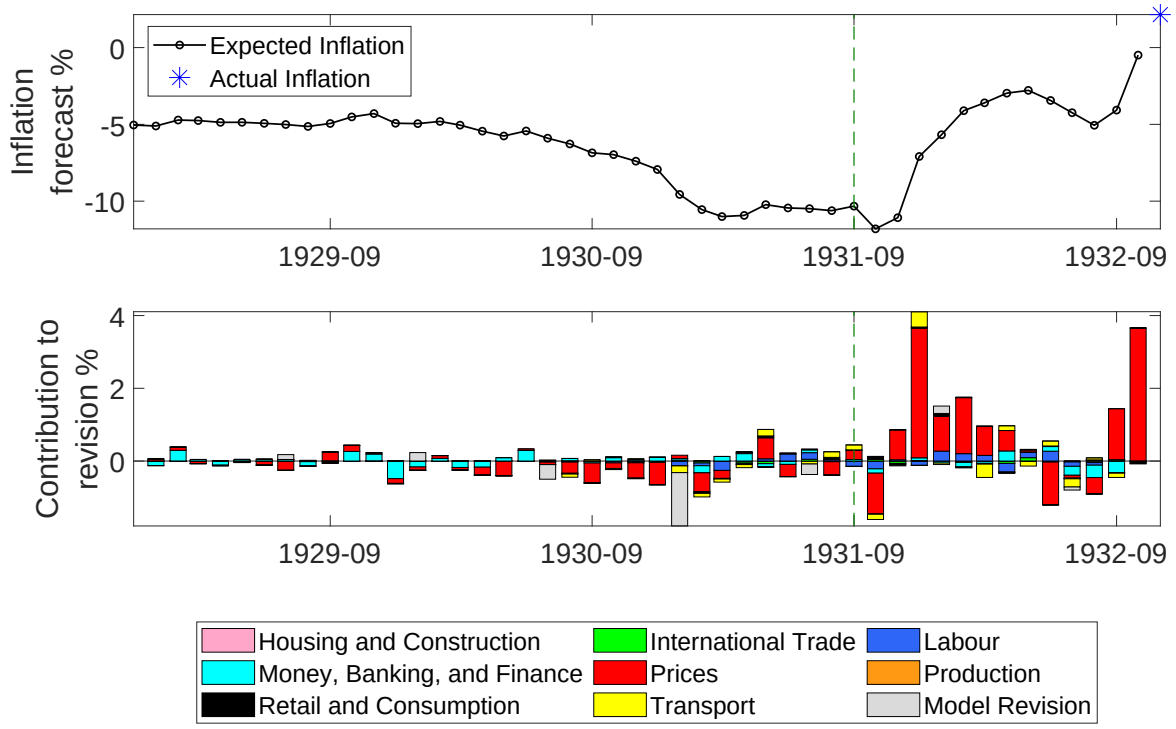

Figure VII: Real-time forecasts of UK inflation in the 12 months to September 1932.

The corresponding real-time forecasts of US inflation are in Figure VIII. The forecast is always for the 12 months to the end of April 1934, a year after the US left the gold standard. There are three temporary peaks, and evidence of a trend break after leaving gold. The first peak begins in October 1931, when the Fed raised interest rates in response to the UK's departure from the gold standard. In our dynamic factor model, the rise in expected inflation is driven by the dynamics of the banker's acceptance rate for New York and the rates on prime commercial paper and customer loans. The second peak coincides with stock

markets recovering from the depths of the Great Depression, with almost all of the dynamic factor model's upwards forecast revision for August 1932 coming from booming industrial and railroad stocks. The third peak comes just before the US left gold in April 1933. This is the month that Roosevelt declared a bank holiday, which restored interest rates and boosted stock prices after a month-long run on banks. The dynamic factor model associates these developments with an improvement in inflation expectations. Although the initial recovery is short-lived, the trend is now upwards as successive releases of the wholesale price index come in higher than expected.

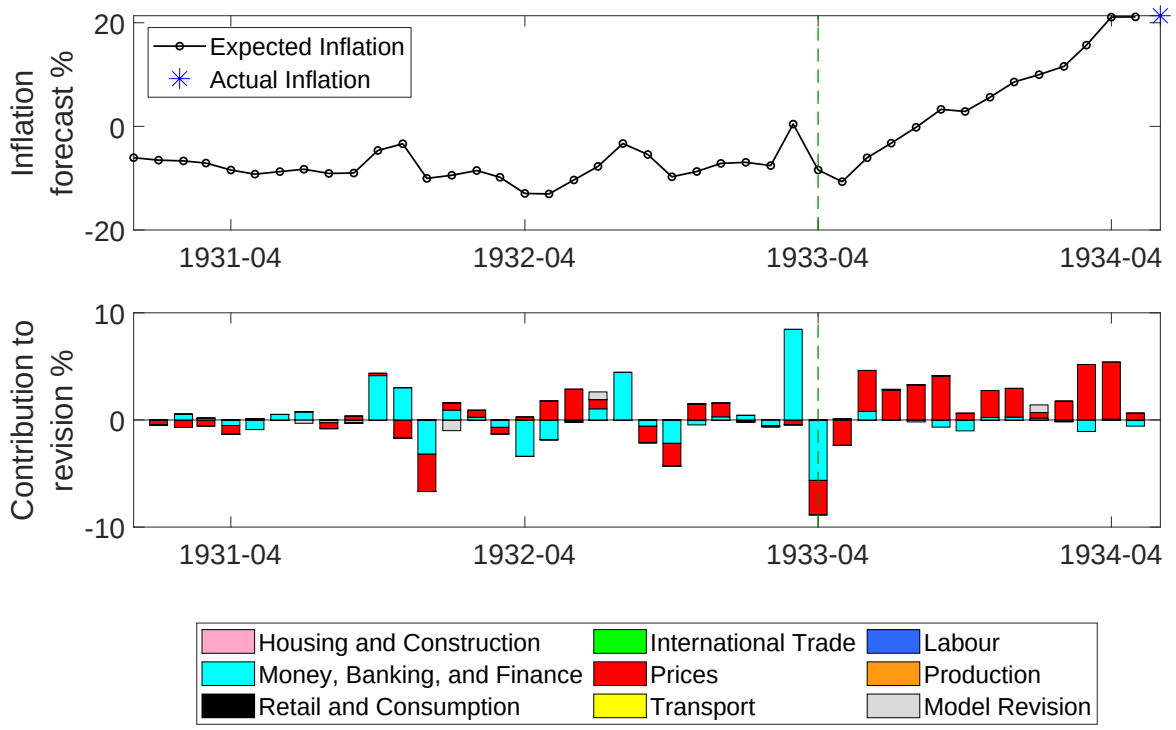

Figure VIII: Real-time forecasts of US inflation in the 12 months to April 1934.

Our dynamic factor models forecast every variable in each country's dataset at every point in time, which means we can produce around 50,000 more decomposition figures. For countries where inflation expectations rose after leaving the gold standard, a common

theme in their recovery is the contribution of financial variables and price indices. Rather than discuss more of these, we finish this section with a decomposition for Germany in Figure IX. The forecast is inflation in the 12 months to January 1934, a year after Hitler's accession to power. Most noticeable are the large revisions that accompany the semiannual re-estimation of the model in January and July of each year, which point to structural changes in Germany. As expected from the discussion in Section 6, there is only a small uptick in inflation expectations associated with the German banking crisis of June 1931 and very little movement when exchange controls were imposed in July 1931. The downwards revision of the forecast in March 1932 is in part due to the collectively-bargained hourly wage rate for 1932 falling. Finally, the recovery in expectations that starts in March 1933 is associated with a boom in urban construction activity and the turning point in wholesale prices.

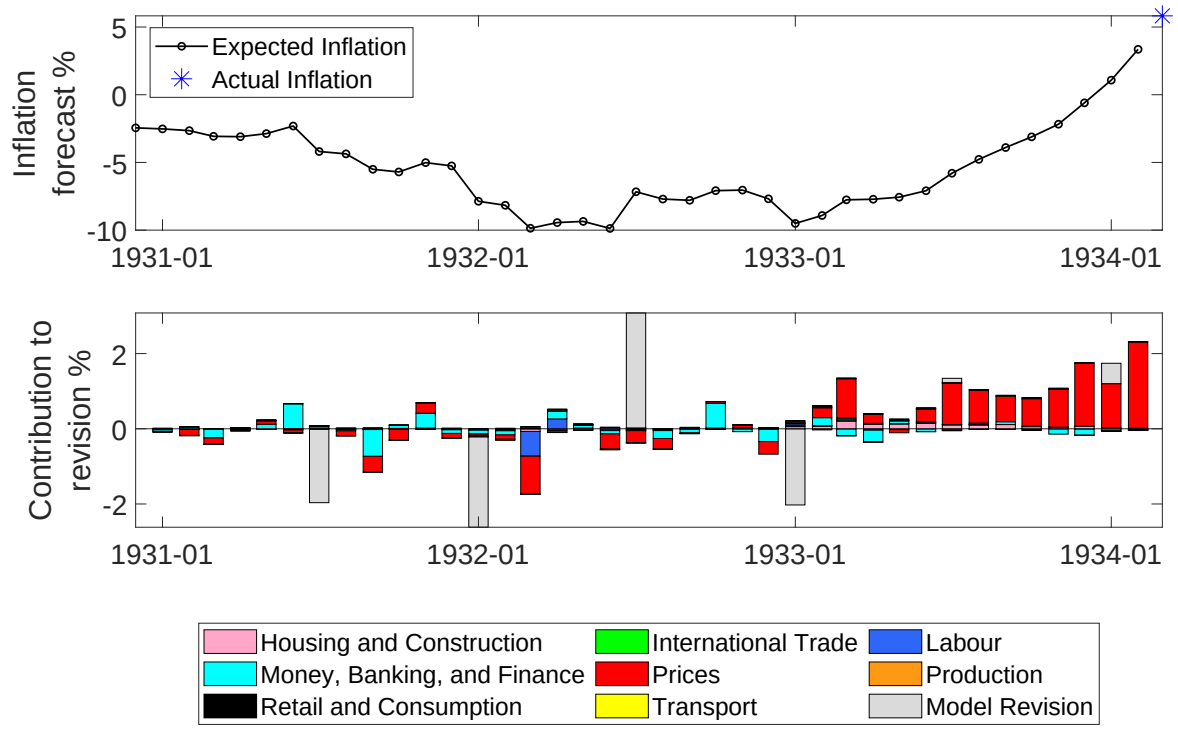

Figure IX: Real-time forecasts of Germany inflation in the 12 months to January 1934.

8 Cross-country comparisons

We now turn to a more systematic investigation of the links between departure from the gold standard, real interest rates, and economic recovery. The aim in this section is to make cross-country comparisons that are as clean as possible, so we take a conservative approach and only compare those countries that belong to our Groups A and B, i.e., countries that unambiguously left the gold standard on a single clearly-defined date or that first imposed exchange controls and then devalued on clearly defined dates. Our focus is on countries for which we have data for at least 12 months after they left the gold standard, meaning that the event studies in this section are based on the experiences of 12 countries.[17]

We start in Table II with changes in real interest rates on and after leaving the gold standard. The reference point is the average real interest rate in the three months prior to departure, so for example for Belgium, which left the gold standard during March 1935, the changes are relative to the average real interest rate between the end of December 1934 and the end of February 1935. The table shows that the real interest rate in Belgium fell by 0.4 percentage points between then and the end of March 1935, by 6.1 percentage points within a quarter, by 8.8 percentage points within 6 months, and by 11.9 percentage points within a year. In some countries there was a rise in the real interest rate on departure, but one quarter out it had fallen in all but two countries and by two quarters it had fallen in all. It is striking that the countries that experienced the largest initial rises were those that left the gold standard right at the start, in September or October 1931.[18] Outside the US, the average decline in real interest rates one year after leaving gold was 8.4 percentage points.

[17] We do not have monthly nominal interest rate data for Canada, which means that for this country we can discuss inflation expectations, prices and output, but not the real interest rate. British India is omitted because of the huge swing in the estimate of expected inflation that occurs around the time of leaving the gold standard. Although including it reinforces our results, we consider it prudent to treat British India as an outlier.

[18] Figure X shows that in Denmark, Finland, Sweden, and the UK, real interest rates initially rose largely or entirely because of higher nominal rates; in New Zealand they rose because of rising expectations of deflation. Eichengreen (1992, p. 292-3) notes that the early devaluers were reluctant to engage in expansionary open-market operations despite the fact that they had quit gold: sterling area money supplies remained essentially unchanged during 1932. In order to "release their golden fetters, it was necessary for policymakers to abandon not only the gold standard's institutions but also the gold standard's ethos."

A simple test of the change in the real interest rate n months after our countries left gold shows a significant rise on departure and after one month but a significant fall after three months all the way out to 12 months, where statistical significance is evaluated at the 1% level. Corresponding nonparametric tests of how many of the countries saw the real rate fall after n months confirm a statistically significant effect; it is highly unlikely that all 11 countries would see falls from 4 months on if rising or falling rates were independently equally likely. These tests are potentially sensitive to the presence of aggregate trends or shocks, so we also perform placebo tests in which we randomly permute the dates at which countries leave gold and see what we would have concluded about real interest rates had we thought that countries left on those dates. Our analysis rejects the null hypothesis that when countries left gold is statistically independent from their outcomes for real interest rates. Details of all tests are in Appendix H, but the results should only be seen as indicative until we address causality in Section 9.

Country	Departure from gold standard	Change in real interest rate on or after			
		departure	one quarter	two quarters	one year
Belgium	Mar-35	-0.4	-6.1	-8.8	-11.9
Denmark	Sep-31	4.4	2.3	-3.5	-7.3
Estonia	Jun-33	0.8	-5.5	-8.2	-9.5
Finland	Oct-31	2.6	-0.9	-5.9	-8.6
Japan	Dec-31	-0.1	-7.4	-5.9	-17.2
New Zealand	Sep-31	3.0	-1.3	-4.3	-6.9
Peru	May-32	-0.7	-1.8	-1.8	-3.2
South Africa	Dec-32	-0.2	-0.2	-2.2	-3.6
Sweden	Sep-31	3.8	1.0	-1.8	-7.1
United Kingdom	Sep-31	0.9	-0.8	-6.9	-8.5
United States	Apr-33	3.7	-2.0	-7.3	-21.0
Average excl. US		1.4	-2.1	-4.9	-8.4

Table II: Change in real interest rate on and after leaving the gold standard.

The stacked bar plots in Figure X decompose the changes in the real interest rate in Table II into a part due to rising expectations of inflation and a part due to falling nominal interest rates. The grey bars show the contribution from changes in expected inflation, positive for a fall and negative for a rise. The black bars indicate the contribution from changes in the nominal interest rate, positive for a rise and negative for a fall. The reference point for changes is again the average value in the three months prior to leaving gold.

The grey bars dominate the black bars in Figure X, especially at longer horizons. The evidence is thus overwhelmingly in favour of falling real rates being driven by rising expectations of inflation, rather than declining nominal rates. Nominal interest rates did not change much after countries left the gold standard, and even rose for a few months in Denmark, Finland, Japan, Sweden and the UK.[19] By contrast, expectations of inflation soon increased everywhere, and by enough that after two quarters the sum of the stacked bars is always negative: the real interest rate fell in every country shortly after leaving the gold standard. There is only one country for which the real interest rate fell more because of falling nominal rates than because of rising inflationary expectations: South Africa. Of the average 8.4 percentage points decline in the real interest rate outside the US one year after leaving gold, 7.8 percentage points were due to rising inflation expectations.

[19]The temporary rise in nominal rates in these countries is a consequence of steep nominal rate increases that occurred shortly before leaving the gold standard. It took some time for nominal rates to fall after departure, so at a monthly frequency we record an increase in the nominal interest rate. See the individual country plots in Appendix D for more details.

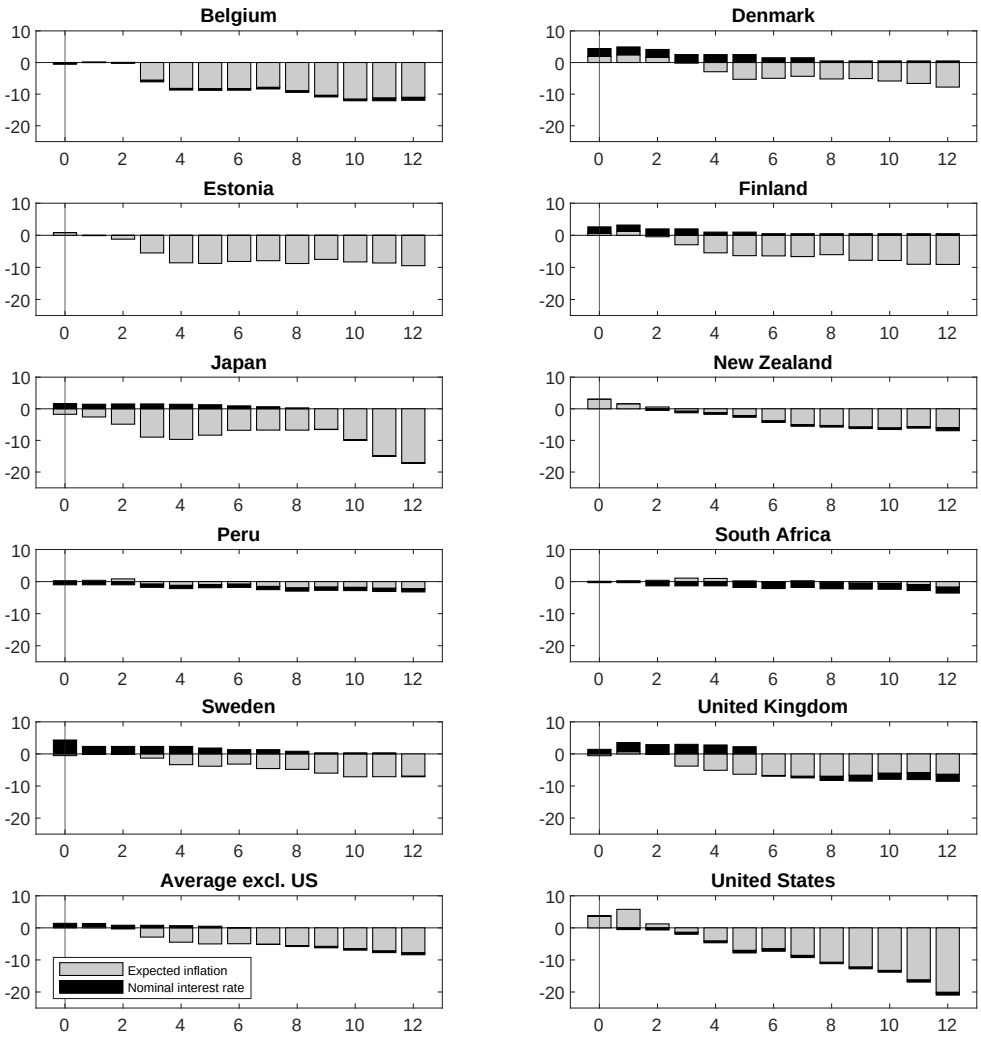

Figure X: Decomposition of change in real interest rate n months after leaving gold standard (grey change in expected inflation, **black** change in nominal interest rate).

A fall in the real interest rate is a likely pre-requisite for economic recovery, but to really see whether leaving gold was instrumental in the ends of big recessions we need to know what happened to prices and output. Figure XI plots the data we have for the 12 countries in our event study. We centre each country's month of departure on zero, and normalise to 100 the indices for prices and output in the three months prior to departure. Prices are the wholesale price index for all but South Africa, for which it is a total cost of living index. Output is total industrial production or production of coal, although it is only available for 7 of our countries. We cannot include Peru and New Zealand because we have no suitable output data, and the data we have for Denmark (pig slaughtering for export), Estonia (shale gas) and Finland (production of export industries) are unfortunately too narrow.

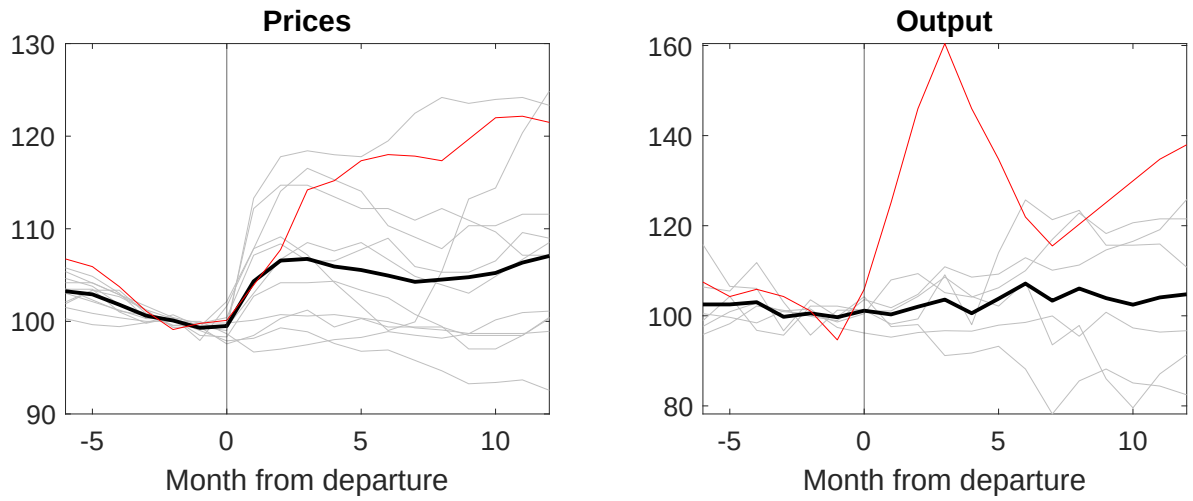

Figure XI: Prices and output after leaving the gold standard (red US, **black** average excluding US).

Prices were on a downward trajectory in every country before they left the gold standard, with a panel regression of the change in the index before or after leaving gold showing significantly higher prices 4, 5, and 6 months prior to departure. Prices stabilised rapidly for most countries on leaving the gold standard and were on average significantly higher already one month later. Nonparametric tests of the number of countries where prices rose after

leaving gold also support a significant effect, with only Canada, South Africa and Sweden yet to see prices rising after a month. The pattern of falling prices before leaving and rising prices after is particular to the actual dates when countries left the gold standard; placebo tests based on randomly perturbed dates support the actual dates being important for the turnaround in a country's prices. Some of this is driven by price dynamics in the US (in red), which are stronger than those experienced in the other countries (averaged in black). That the US was special among recovering countries is also argued by Romer (1993), but even setting aside the US, we find that leaving the gold standard ended the declines in prices in all countries and started the upward trend in many (Appendix H).

For some countries that left gold on clearly-defined dates, departure is accompanied by both a one-time jump in the domestic price level and an apparent change in its trend. Although far from ubiquitous, the former likely reflects the effect of currency devaluations on the wholesale price index via the prices of imported goods. These pass-through effects are observed in Belgium, Estonia, Finland, and Peru, and to a lesser extent in Denmark, Japan, the UK, and the US (see Appendix D). There is no evidence of a jump in the wholesale price index in New Zealand, South Africa, Sweden, or Canada. The experience in countries that did not leave the gold standard on clearly-defined dates is similarly mixed, with domestic prices not jumping in many countries.[20]

The limited number of countries for which monthly output data are available makes it challenging to draw firm conclusions regarding the recovery of the real economy. There is a lot of volatility and heterogeneity, but the average trend is a mild decline before leaving the gold standard followed by a gradual pickup afterward. The laggards are the UK, where the recovery took a long time to get going, and Canada, where industrial production continued its downward trend throughout the year after they left gold. The exceptionalism of the US is again apparent. No other country had such a huge rebound in industrial production, a result that cautions against extrapolating from the US experience.

[20] If agents know that there are strong pass-through effects then inflation expectations may react differently to domestic price developments when a country leaves gold. Since the dynamic factor models are regularly re-estimated and updated, this is unlikely to create a persistent bias in our results.

9 Causality

The previous sections concluded that leaving the gold standard was accompanied by an increase in expected inflation, a reduction in the real interest rate, and a recovery in real activity. While indicative, the results so far do not identify the causal effect of leaving, a shortcoming shared by much of the existing literature on the interwar gold standard. In this section we address causality via three different but complementary approaches: instrumental variables (IV), diff-in-diff, and the synthetic control matching methods of Abadie and Gardeazabal (2003) and Abadie et al. (2010).

9.1 IV

The first step in giving our correlations a causal interpretation is to discuss possible endogeneity, reverse causality, and simultaneity biases. It is not obvious that these concerns are all that large in our case; it is straightforward to think of mechanisms through which leaving the gold standard would cause a fall in the real interest rate, but harder to imagine why falling real rates would cause a country to leave gold. If anything, countries went on gold to anchor inflation expectations, and since a drop in real rates predicts economic recovery it would be more likely to strengthen than to weaken a country's commitment to gold. Furthermore, Bernanke and James (1991) argue that the countries leaving gold in 1931 had similar macroeconomic fundamentals to those that did not, while Bernanke (1995) sees decisions about leaving gold as not being driven by prevailing macroeconomic conditions. Instead, the dominant view (e.g. Eichengreen, 1992; Wandschneider, 2008) is that decisions were strongly affected by political factors and philosophical/economic beliefs. If so, endogeneity is not a major issue.

The idea that allegiance to the gold standard in the 1930s was influenced by philosophical and economic beliefs led Eichengreen and Sachs (1985) and Eichengreen and Irwin (2010) to propose that a country's experiences in the 1920s could be a valid instrument in an IV regression. For example, a country that experienced high inflation in the 1920s and witnessed the stabilising disinflationary effect of going back onto gold (e.g. the 1926 Poincaré

stabilisation in France) would have been more reluctant to abandon the gold standard. While a country's experience in the 1920s may have had a direct influence on the probability of leaving the gold standard, it should have had no direct effect on what happened to the real interest rate after leaving – the conditions needed for an instrument to be valid.

We thus estimate IV regressions for a sample of 11 European countries (Austria, Belgium, Czechoslovakia, Denmark, France, Hungary, Italy, the Netherlands, Poland, Sweden, and the UK) for which we have sufficient data from the period in the 1920s before they returned to gold. The specification is:

$$(i_{j,1935} - \pi^e_{j,1935}) - (i_{j,1930} - \pi^e_{j,1930}) = \mathrm{c}_0 + \mathrm{c}_1 \left(\frac{\mathrm{GoldPrice}_{j,1935}}{\mathrm{GoldPrice}_{j,1930}} \right) + \epsilon_j \tag{6}$$

where the dependent variable is the change in the average real interest rate in country j between 1930 and 1935 and the independent variable is the average gold price of country j's currency in 1935 relative to that in 1930. As instruments in the IV regressions, we use the change in average inflation between the year before a country returned to gold and the year afterwards, and the change in output in the year after a country returned to gold.[21] The idea is that countries which saw larger disinflation/deflation and improvements in output after returning to gold in the 1920s would have been more reluctant to abandon gold in the 1930s.

	OLS	2SLS	GMM
Constant	-19.71	-18.78	-20.21
	(4.73)	(5.09)	(4.83)
$\frac{\mathrm{GoldPrice}_{j,1935}}{\mathrm{GoldPrice}_{j,1930}}$	0.18	0.17	0.20
	(0.06)	(0.07)	(0.07)
R^2	0.399	0.397	
N	11	11	11

Table III: Instrumental variables regressions. Dependent variable is change in real interest rate, 1930 to 1935. Heteroscedasticity-robust standard errors (HC1) in parentheses.

[21] The dates on which countries returned to gold are taken from Bernanke and James (1991). The first was Sweden in April 1924, while the last was Italy which completed its return to gold in December 1927.

The results are shown in Table III. The 2SLS and GMM IV estimates indicate that devaluations 'caused' lower real interest rates in the sample countries, with the similarity of the OLS and IV estimates reinforcing claims that endogeneity is unlikely to be a major issue.[22] The first stage of the 2SLS regression rejects the joint exclusion restriction test on the instruments, and the individual coefficients on the average change in inflation and output in the first stage are significant and of the expected sign, consistent with our conjecture that these are valid instruments.[23] A coefficient of the order of 0.2 on the relative gold price of a currency implies that a 30% depreciation on leaving the gold standard (which is close to the average fall in the gold value of currencies that had left by 1935) lowered the ex ante real interest rate by $0.2 \times 30 = 6$, i.e. 600 basis points. This is consistent with Table II. Our results come with caveats: the sample size is small, the parameter estimates are only significant at the 5 percent level, and one can think of reasons why the instruments might be correlated with other relevant policy actions, given that the dependent variable in the regression (the change in the real interest rate) is not defined narrowly around departures from gold.

9.2 Diff-in-diff

The apparent exogeneity of early leavers' decisions to come off gold suggests a diff-in-diff regression comparing the experiences of early and later leavers. The treatment is leaving gold early and the control group is all countries that left later. The treated group consists of all those countries that unambiguously left the gold standard early, between September and December 1931 (British India, Denmark, Finland, Japan, New Zealand, Sweden, and the UK)[24]; the control group is countries that unambiguously left after March 1933 (Bel-

[22]The Hausman test suggests that the OLS estimates are consistent against 2SLS, providing no evidence that endogeneity is an issue. The Sargan test for 2SLS does not reject the null that all instruments are valid, although it is unlikely that there is conditional homoskedasticity in our cross-country panel. Finally, the J test does not reject the null that the GMM model is valid. Test statistics and associated p-values are in the online replication files.

[23]The coefficients on the average change in inflation and output in the first stage of the 2SLS regression are -0.98 and 0.97 respectively, with heteroskedasticity-robust standard errors 0.23 and 0.13. The R^2 is 0.72 and the F-statistic is 40.04.

[24]The only early-leaving country not in our treatment group is Australia, because its departure from the gold standard is not unambiguously dated as occurring between September and December 1931. Adding it as a country that left gold in September 1931 (one of its candidate departure dates) has only minimal impact

gium, Czechoslovakia, Dutch East Indies, Estonia, France, Italy, the Netherlands, Poland, Switzerland, and the US). Our decision to impose December 1931 as the cut-off for early departure gives a reasonably balanced specification, with 7 countries in the treatment group and 10 in the control group, offering what is likely to be the cleanest possible identification. We consider average real interest rates in two periods p, the first before September 1931 and the second after December 1931. The diff-in-diff specification is:

$$(i_{j,p} - \pi^e_{j,p}) = \mathrm{c}_0 + c_1 I_j^{\text{EarlyLeaver}} + \mathrm{c}_2 I_p^{\text{AfterDec1931}} + \mathrm{c}_3 I_j^{\text{EarlyLeaver}} \times I_p^{\text{AfterDec1931}} + \epsilon_{j,p} \qquad (7)$$

where the dependent variable of the regression is the average real interest rate in country j and period p. The first independent variable is an indicator, $I_j^{\text{EarlyLeaver}}$, that takes the value one for countries in the treatment group and zero for countries in the control group; the second indicator, $I_p^{\text{AfterDec1931}}$, is one for observations of the dependent variable (average real interest rate) after December 1931 and zero for observations before September 1931. The interaction term $I_j^{\text{EarlyLeaver}} \times I_p^{\text{AfterDec1931}}$ is therefore the diff-in-diff treatment effect of a country leaving the gold standard early. It captures how much more real interest rates changed after December 1931 in the treatment group relative to the control group. We report two sets of results, depending on the window over which real interest rates are averaged before and after leaving. In each case we consider the average real interest rate before September 1931 and after December 1931, but in the first case we average over a 6-month window and in the second over a 12-month window.

For diff-in-diff to work well, the treatment and control groups should have parallel trends prior to going off gold. This is arguably reasonable in our case, given the Bernanke and James (1991) assertion that macroeconomic conditions in countries leaving gold in 1931 were not materially different from those in countries that still remained. Figure XII confirms that the treatment and control groups in our dataset had parallel real interest rate trends before September 1931.[25] The assumption of parallel trends is relaxed in Section 9.3 when we explicitly construct synthetic control units that satisfy parallel trends. In an ideal world,

on our diff-in-diff estimation results.

[25]Trends in inflation and the gold value of currency were also close to parallel before the first country left the gold standard. Although these trends have no impact on the diff-in-diff estimates, they are presented for completeness in Appendix I.1.

we would also estimate a staggered diff-in-diff specification (Callaway and Sant'Anna, 2021) to differentiate between the experiences of early, late and even later leavers. Unfortunately, the departures of leavers between 1932 and 1935 are spread out, making the effective sample size too small to infer staggered effects reliably.

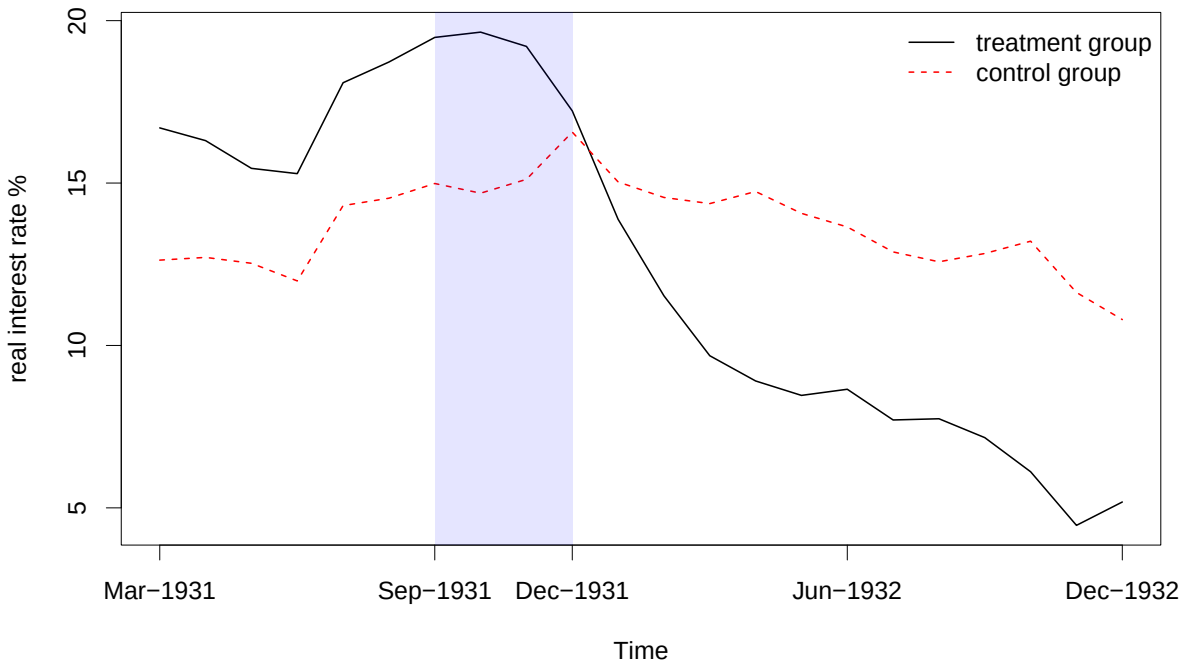

Figure XII: Average real interest rates in treatment (early leavers) and control groups.

The diff-in-diff regression results are in Table IV. There are $N = 34$ observations in each regression because we measure the average real interest rate in all 17 countries both before September 1931 and after December 1931. The second column shows that the average real interest rate in control group countries was 13.12% in the 6 months before September 1931. By contrast, the average in early-leaving countries over the same period was $13.12 + 3.64 = 16.76\%$, higher although not significantly so in such a small sample. In the 6 months after December 1931, the average real interest rate in control group countries rose to $13.12 + 1.29 = 14.41\%$, while in the early-leavers it fell to $13.12 + 3.64 + 1.29 - 7.86 = 10.19\%$. The results show that leaving gold had a statistically significant effect, lowering real interest rates by at least 7.86 percentage points, consistent with the findings from the IV regressions in Table

III.

	6-month window	12-month window
Constant	13.12	11.84
	(2.50)	(2.11)
$I_j^{\text{EarlyLeaver}}$	3.64	3.95
	(3.05)	(2.49)
$I_p^{\text{AfterDec1931}}$	1.29	1.52
	(0.96)	(1.15)
$I_j^{\text{EarlyLeaver}} \times I_p^{\text{AfterDec1931}}$	-7.86	-9.02
	(2.09)	(2.00)
R^2	0.12	0.22
N	34	34

Table IV: Diff-in-diff regressions. Dependent variable is real interest rate, before and after early leavers left gold. Robust standard errors clustered by country in parentheses.

9.3 Five synthetic control matching counterfactuals

The synthetic control matching method begins as the diff-in-diff regression by dividing countries into two groups, those in the treatment group that left the gold standard early and those in a control group that did not. However, rather than comparing averages between groups, each country in the treatment group is matched to a synthetic counterpart, constructed by taking a suitably weighted average of the pool of countries in the control group. The weights are chosen so that economic conditions in the synthetic counterpart reflect those in the treatment country in the period *before* it is treated. The behaviour of a country's synthetic counterpart in the period *after* treatment acts as our counterfactual.[26]

In our case, the treatment group is all the countries that unambiguously left the gold standard between September and December 1931 (British India, Denmark, Finland, Japan, New Zealand, Sweden, and the UK) and the control group is those countries that were still

[26]The method is similar in spirit to Choudhri and Kochin (1980), whose comparative study of European countries during the Great Depression uses Spain as a control because it did not join the gold standard after World War I. The synthetic control matching method is more general because it allows all untreated countries to act as potential controls; see Abadie (2021)

unambiguously on the gold standard in March 1933 (Belgium, Czechoslovakia, Dutch East Indies, France, Italy, Netherlands, Poland, Switzerland, and the US). The treatment group is thus the same as in the previous section, while the control group is as before except that we drop Estonia for which data on prewar economic conditions are incomplete. The economic conditions in the treated countries that the synthetic counterparts are constructed to reproduce are population size, GDP per capita in 1930, and the behaviour of either the *ex ante* real interest rate or inflation on specific dates before the country left the gold standard.[27] Minimising the quadratic distance from these variables defines the weights with which control countries are combined to produce the synthetic counterparts.

Following the notation in Abadie and Gardeazabal (2003), weights $W^* = (w_1^*, ..., w_J^*)'$ solve the constrained optimisation problem:

$$W^* = \underset{W}{\operatorname{argmin}}(X_1 - X_0 W)' V (X_1 - X_0 W), \tag{8}$$

such that $w_j^* \geq 0 \ \forall j$ and $\Sigma w_j^* = 1$. X_1 is a $K \times 1$ vector of economic conditions in the treated country before leaving the gold standard, to be matched by a weighted average of the columns in X_0, a $K \times J$ matrix of corresponding economic conditions in J control countries. V is a diagonal matrix that reflects the relative importance of matching economic conditions when making predictions for the outcome variable, which in our case is either the *ex ante* real interest rate or inflation. It is optimised to give weights $W^*(V)$ and a synthetic counterpart that predicts the outcome variable as well as possible before the country leaves gold.[28] Given $W^*(V)$ and the outcome variable Y_0 in control countries before and after the treated country leaves the gold standard, the counterfactual evolution of the synthetic counterpart is $Y_1^* = Y_0 W^*(V)$, to be compared to the actual pre- and post-departure outcome variable in the treated country, Y_1.

The decision to restrict our analysis to countries that left the gold standard before December 1931 or after March 1933 facilitates a clean dichotomy between the treatment and

[27] Data on population size and GDP per capita are taken from the Maddison Project Database at the Groningen Growth and Development Centre: https://www.rug.nl/ggdc/historicaldevelopment/maddison/. We obtain almost identical results using the Broadberry and Klein (2012) estimates of population size and GDP per capita that account for changes in national boundaries in Europe.

[28] See Appendix I.2 for additional information, including on how V is optimised.

control groups. It puts clear blue water between the departure dates of early and late leavers, and is designed to minimise the likelihood that our estimates are contaminated by anticipatory effects that might occur if the early departure of treatment group countries raised expectations of control group countries also leaving the gold standard. We see no evidence of such effects in our control group countries, which all maintained a strong commitment to the gold standard until at least early 1933. In any event any anticipatory effect would likely bias our estimates downwards, in the same way as would spillover or general equilibrium effects, by understating the impact that leaving had on the treatment countries relative to their synthetic counterparts.

The method produces synthetic counterparts for Denmark, Finland, New Zealand, Sweden, and the UK that match population and GDP per capita in 1930, and have small root mean square errors (RMSE) when fitting the country's real interest rate or inflation before leaving gold. The R^2 coefficients of determination between actual and synthetic counterparts before departure are in the range $0.64 - 0.98$, indicating that synthetic counterparts track actual pre-departure outcomes in each country (Appendix Tables I.2 - I.6). The good fit in the pre-departure period could be by construction, since it may just be the mechanical result of picking the synthetic control weights. To address this concern, we therefore re-ran the synthetic control analysis but pretending that the treatment happened six months or a year before it actually did. The results from this "backdating" exercise, presented in Appendix I.7, show as hoped that the synthetic and actual series continue to track each other until the "actual" intervention, which also verifies that our estimates are not overly influenced by observations in the periods immediately preceding a country's departure from the gold standard. For other countries in the treatment group, there is no weighted average of control group countries that comes close to reproducing the economic conditions that prevailed before leaving gold. Table V presents the weights assigned to control group countries when constructing the synthetic counterparts for real interest rates in our five countries. Reading the second column, we see that Denmark's synthetic counterpart is a weighted average of the Dutch East Indies, Italy and the Netherlands. The weight on all other control group countries is negligible.

	Denmark	Finland	New Zealand	Sweden	UK
Belgium			0.05		
Czechoslovakia			0.71		
Dutch East Indies	0.12		0.24		0.06
Italy	0.03	0.40		0.46	
Netherlands	0.85	0.20		0.54	0.72
Poland		0.40			
Switzerland					0.22

Table V: Weights used in synthetic counterparts for real interest rates

The results are in Figure XIII. In each case the solid blue line indicates the country of interest and the dashed red line its synthetic counterpart. Our success in constructing appropriate synthetic counterparts is apparent in the proximity of the blue and red lines in the period before leaving the gold standard, which is marked as before with a green vertical dotted line. The closeness of the solid blue and red dashed lines is by design: we relinquished other countries in the treatment group precisely because we were unable to construct synthetic counterparts that matched the behaviour of real interest rates before leaving. Our counterfactuals begin after the green vertical line marking when the countries left the gold standard. These tell a consistent story about what would have happened to real interest rates and inflation if the five countries had not left the gold standard when they did. Real interest rates would have remained elevated for at least 12 months and inflation would have picked up by less than it did. Leaving the gold standard caused a fall in real interest rates and a turnaround in inflation in these countries.

In Denmark, Finland, Sweden and the UK there is a short-lived rise in the real interest rate on leaving gold, as policymakers used nominal rates to first defend their currencies and then adapt to the new regime. The exception is New Zealand, which maintained a constant nominal rate on leaving gold. The jump in the real rate for New Zealand in July 1931 occurs before it left gold, as its estimated model is updated and forecast dynamics catch up with rapidly falling prices. If the model is updated more than semiannually then the jump is

smoothed across several months, but the narrative on leaving stays the same.

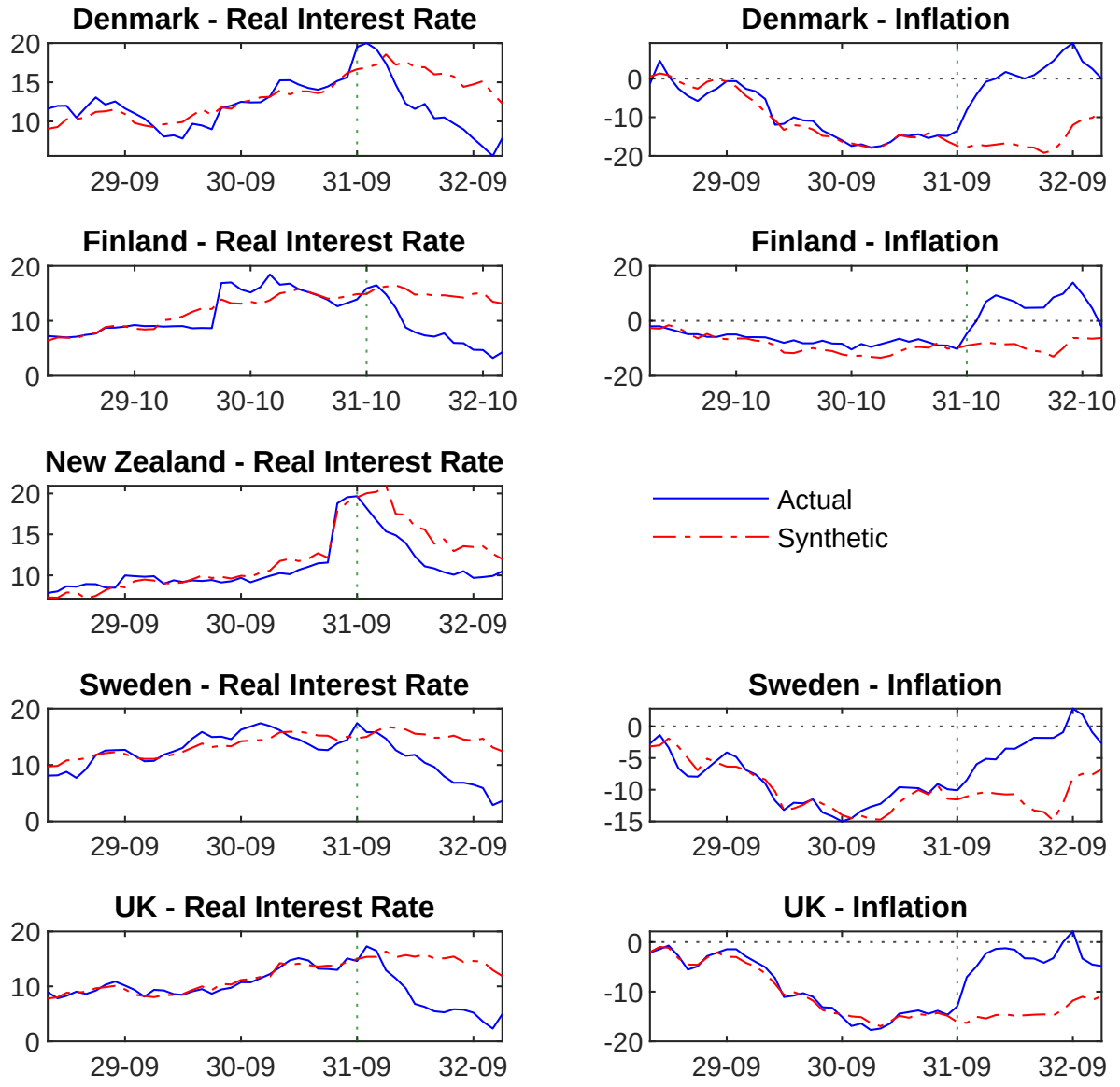

Figure XIII: Actual and counterfactual (synthetic) real interest rates and inflation in five early leavers.

10 Conclusions

Fifteen of our twenty-seven countries unambiguously left the gold standard on clearly defined dates. Our results confirm that in all fifteen leaving gold was associated with an increase in inflationary expectations and a decline in real interest rates. In eight of the fifteen leaving gold was associated with a turning point in expectations, a vindication of our argument. Although the timing is less clear, leaving gold seems to have had similar effects in several other countries, including Argentina, Australia, Austria, Estonia, Italy, and the United States – the country about which the argument was first made.

Abandoning the institution that had helped to stabilise inflationary expectations in the 1920s was thus an important precursor to recovery in many countries in the 1930s. But leaving the gold standard was not the only thing that countries did during this period, and inflationary expectations may have increased for different reasons as well. In Germany, for example, the suspension of reparations and Hitler's ascension to power seem to have been the crucial watersheds. We hope that future research will deal more comprehensively with the causes and consequences of such shifts in expectations during the 1930s.

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A Preferred measures of key variables

Country	Nominal interest rate	Prices	Output
Argentina	Discount rate of Banco de la Nacion	Wholesale price index - total (1926 = 100)	-
Australia	Discount rate of Commonwealth Bank	Wholesale price index - total (1911 = 100)	-
Austria	Monthly money rate	Wholesale price index - total (first half of 1914 = 100)	Index of general business (1923 - 1931 = 100)
Belgium	Private discount rate	Wholesale price index - total (April 1914 = 100)	Production - total (1923 - 1925 = 100)
British India	Discount rate of central bank	Wholesale price index - total (in Bombay) (July 1914 = 100)	-
Bulgaria	Average market discount rate	Cost of living - total 1914 = 100 from 1925 to 1934 1926 = 100 from 1933 to 1936 rebased to 1914 = 100	Production - total (1934 - 1935 = 100) available only after 1935
Canada	-	Wholesale price index - total (1926 = 100)	Production - total (1926 = 100)
Czechoslovakia	Market discount rate	Wholesale price index - total (July 1914 = 100)	Production - total (1929 = 100)
Denmark	Discount rate of central bank	Wholesale price index - total 1913 = 100 from 1925 to 1934 1931 = 100 from 1932 to 1936 only first half used	Production - total (1931 = 100) available only after 1934
Dutch East Indies	Discount rate of central bank	Wholesale price index - total (1913 = 100)	Production - hard coal (1000 tons)
Estonia	Discount rate of central bank	Wholesale price index - total (1913 = 100)	Production - oil shale (1000 tons)
Finland	Discount rate of central bank	Wholesale price index - total (1926 = 100)	Production - export industries (1926 = 100) Production - total (1926 = 100) available only after 1932
France	Private prime paper rate	Wholesale price index - total (July 1914 = 100)	Production - total (1913 = 100)
Germany	Prime banker's acceptance rate	Wholesale price index - total (1913 = 100)	Production - total (1928 = 100)
Hungary	Prime commercial paper rate	Wholesale price index - total (1913 = 100)	Production - total (1927 = 100) available only after 1927
Italy	Market discount rate	Wholesale price index - total 1913 = 100 from 1927 to 1934 1928 = 100 from 1934 to 1936 rebased to 1913 = 100	Production - crude steel (1000 tons) Production - total (1928 = 100) available only after 1929

Japan	Market discount rate	Wholesale price index - total (in Tokyo) (July 1914 = 100)	Production - textile industry (1930 = 100) Production - Total 1928 = 100 from 1926 to 1934 1930 = 100 from 1932 to 1936 only first half used
Lithuania	Discount rate of central bank	Wholesale price index - total (1913 = 100)	-
Netherlands	Private discount rate	Wholesale price index - total (1913 = 100)	Production - coal (1000 Tons)
New Zealand	Bank discount rate	Wholesale price index - total (1909 - 1913 = 100)	-
Peru	Discount rate of central bank	Wholesale price index - total (1913 = 100)	-
Poland	Discount rate of joint-stock banks	Wholesale price index - total (1928 = 100)	Production - total (1928 = 100)
South Africa	Discount rate of central bank	Cost of living - total (1910 = 100)	Production - hard coal (1000 Tons)
Spain	Discount rate of central bank	Wholesale price index - total (in Barcelona) (1913 = 100)	Production - iron ore (1000 Tons)
Sweden	Discount rate of central bank	Wholesale price index - total (1913 = 100)	Production - crude steel (1000 Tons) Production - total 1925 - 1930 = 100 from 1925 to 1934 1935 = 100 from 1934 to 1936 only first half used
Switzerland	Private discount rate	Wholesale price index - total July 1914 = 100 from 1926 to 1934 1926 - 27 = 100 from 1932 to 1936 rebased to July 1914 = 100	Hallmarking of watch cases (1000 pieces)
UK	Three month rate	Wholesale price index - total 1913 = 100 from 1919 to 1930 1924 = 100 from 1931 to 1936 rebased to 1924 = 100	Index of business activity (1924 = 100)
US	Prime commercial paper rate	Wholesale price index - total (1926 = 100)	Production - total (1923 - 25 = 100)

B Specification of estimated models

This appendix describes the separate dynamic factor models we estimate for each country. Where possible we follow the Bok et al. (2018) specification of the New York Fed nowcasting model, which assigns different categories of variables to latent factors according to Table B.2 A global factor affects all variables that are observed, whereas three additional factors are specific to variables observed in real, financial and labour markets respectively.[29] We do not have a separate factor specific to nominal variables, which means that inflation expectations are exclusively accounted for by the global factor. For a few countries we do not have enough data to identify a separate labour market factor, in which case we estimate a model with three latent factors and allow the labour market data we do have to be affected by the real and global factors.

Category	Global Factor	Real Factor	Financial Factor	Labour Factor
Housing and Construction	x	x		
International Trade	x	x		
Labour	x			x
Money, Banking, and Finance	x		x	
Prices	x			
Production	x	x		
Retail and Consumption	x	x		
Transport	x	x		

Table B.2: Specification of latent factors.

The datasets used in estimation of each country's dynamic factor model follow in Appendices B.1-B.28, where sources are abbreviated using the convention in Table B.3 and release delays are consistent with the *Federal Reserve Bulletin*.

[29] The labelling of the factor that affects all variables as "global" is taken from Bok et al. (2018), although for our purposes it is not necessary to attach labels to the latent factors. For the avoidance of doubt, we reiterate that that we estimate a separate dynamic factor model for each country. Our global factor is "global" in the sense of affecting all the variables within a country, but is not global in the sense of being estimated from developments in the global economy.

Source		Editors
FRB	Federal Reserve Bulletin (FRASER)	
IA	International Abstract of Economic Statistics (two volumes)	J. Tinbergen (volume 1), J.B.D. Derksen (volume 2)
SHW	Statistisches Handbuch Der Weltwirtschaft (two volumes)	
NBER	NBER Macrohistory Database	

Table B.3: Data sources

B.1 Argentina

Series Name	Category	Release Delay (in Month)	Source
Building Permits (in Buenos Aires)	Housing and Construction	2	SHW
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
All Banks - Advances	Money, Banking, and Finance	2	SHW
All Banks - Balances of Receivables and Liabilities vis-a-vis Foreign Countries	Money, Banking, and Finance	2	SHW
All Banks - Deposits	Money, Banking, and Finance	2	SHW
All Banks - Bills of Exchange	Money, Banking, and Finance	2	SHW
All Banks - Savings	Money, Banking, and Finance	2	SHW
All Banks - Securities	Money, Banking, and Finance	2	SHW
Banco de la Nacion - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Banco de la Nacion - Deposits	Money, Banking, and Finance	2	SHW
Notes in Circulation	Money, Banking, and Finance	2	SHW
Clearings	Money, Banking, and Finance	2	SHW
Stock Exchange - Share Turnover	Money, Banking, and Finance	2	SHW
Stock Exchange - Turnover of Fixed-income Securities	Money, Banking, and Finance	2	SHW
Bankruptcies	Money, Banking, and Finance	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Agricultural and Forestry Products	Prices	2	SHW
Wholesale Price Index - Non-agricultural Products	Prices	2	SHW
Wholesale Price Index - Skins	Prices	2	SHW
Wholesale Price Index - Wool	Prices	2	SHW
Wholesale Price Index - Meat	Prices	2	SHW
Cattle Slaughtering	Production	3	SHW
Turnover of Land Sales (in Buenos Aires)	Retail and Consumption	2	SHW
Turnover in Department Stores (in Buenos Aires)	Retail and Consumption	2	SHW
Railways - Freights Carried	Transport	2	SHW

B.2 Australia

Series Name	Category	Release Delay (in Month)	Source
Construction Activity in Sydney (Without City) - Approved Buildings	Housing and Construction	2	SHW
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Unemployed Union Members - Number	Labour	3	SHW
Unemployed Union Members - Percent	Labour	3	SHW
Weekly Average Wages (in 12 Industries)	Labour	2	SHW
Commonwealth Bank of Australia - Notes in Circulation	Money, Banking, and Finance	2	SHW
Clearings	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Agricultural Products	Prices	2	SHW
Wholesale Price Index - Dairy Products	Prices	2	SHW
Wholesale Price Index - Meat	Prices	2	SHW
Wholesale Price Index - Wool	Prices	2	SHW
Production - Butter	Production	3	SHW
Observable Wheat Stocks	Production	3	SHW
Maritime Shipping - Inbound Traffic	Transport	2	SHW
State Railways - Freights Carried	Transport	2	SHW

B.3 Austria

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Unemployed - Registered	Labour	3	SHW
Number of Unemployed Relieved - Austria	Labour	3	IA
Labour Exchange - Vacancies Filled	Labour	3	IA
Austrian National Bank - Notes in Circulation and Demand Deposits	Money, Banking, and Finance	2	IA
Austrian National Bank - Foreign Exchange	Money, Banking, and Finance	2	IA
Monthly Money Rate	Money, Banking, and Finance	0	SHW
Stock Exchange - Stock Prices	Money, Banking, and Finance	0	SHW
Stock Exchange - Total Value of Turnover	Money, Banking, and Finance	2	IA
Payment Difficulties - Initiated Compensation Procedures	Money, Banking, and Finance	2	SHW
Payment Difficulties - Opened Bankruptcies	Money, Banking, and Finance	2	SHW
Cost of Living - Total (Vienna)	Prices	2	SHW
Retail Prices - Total	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	IA
Wholesale Price Index - Food	Prices	2	IA

Wholesale Price Index - Industrial Goods	Prices	2	IA
Order Backlog - Cotton-spinning Mills	Retail and Consumption	2	SHW
Order Backlog - Iron Industry	Retail and Consumption	2	SHW
Turnovers - Production Goods	Retail and Consumption	2	SHW
Turnovers - Consumption Goods	Retail and Consumption	2	SHW
Index of General Business	Production	3	SHW
Production - Crude Steel	Production	3	NAI
Production - Electricity	Production	3	SHW
Production - Coal	Production	3	IA
Railways - Freight Car Provision	Transport	2	SHW

B.4 Belgium

Series Name	Category	Release Delay (in Month)	Source
Exports Value	International Trade	3	IA
Imports Value	International Trade	3	IA
Wholly Unemployed	Labour	3	IA
Unemployment on Part Time	Labour	3	IA
Days Lost by Insured Workers	Labour	3	IA
Proportion of Applicants to Vacancies	Labour	3	IA
CGER Savings	Money, Banking, and Finance	2	SHW
Call Money Rate	Money, Banking, and Finance	0	SHW
Private Discount Rate (Commercial Paper)	Money, Banking, and Finance	0	IA
Issues - Shares of Belgian Stock Companies	Money, Banking, and Finance	2	SHW
National Bank of Belgium - Notes in Circulation	Money, Banking, and Finance	2	IA
National Bank of Belgium - Gold	Money, Banking, and Finance	2	IA
Mortgages Registered	Money, Banking, and Finance	2	IA
Postal Cheques Total Turnover	Money, Banking, and Finance	2	IA
Stock Exchange - Share Prices	Money, Banking, and Finance	0	SHW
Bankruptcies	Money, Banking, and Finance	2	SHW
Unpaid Bills of Exchange	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	IA
Cost of Living - Food	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	IA
Retail Prices - Total	Prices	2	IA
Sensitive Goods Price Index	Prices	2	SHW
Tax Receipts Total	Retail and Consumption	2	IA
Production - Total	Production	3	SHW
Railways - Freights Carried	Transport	2	SHW

B.5 British India

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Gold Value of the Currency	Money, Banking, and Finance	0	SHW
Notes in Circulation	Money, Banking, and Finance	2	SHW
Issues - Securities	Money, Banking, and Finance	2	SHW
Stock Exchange - Value of Five Indian Railway Bonds (in London)	Money, Banking, and Finance	0	SHW
Cost of Living - Total (in Bombay)	Prices	2	SHW
Cost of Living - Clothing (in Bombay)	Prices	2	SHW
Cost of Living - Food (in Bombay)	Prices	2	SHW
Wholesale Price Index - Total (in Bombay)	Prices	2	SHW
Production - Cotton Fabrics	Production	3	SHW
Production - Cotton Yarn	Production	3	SHW
Sea Freight Index	Transport	2	SHW

B.6 Bulgaria

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Employed Workers and Employees	Labour	3	SHW
Bulgarian National Bank - Notes in Circulation	Money, Banking, and Finance	2	SHW
Bulgarian National Bank - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Bulgarian National Bank - Deposits	Money, Banking, and Finance	2	SHW
Bulgarian National Bank - Foreign Exchange	Money, Banking, and Finance	2	SHW
Clearings	Money, Banking, and Finance	2	SHW
Protested Bills of Exchange	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Corn	Prices	2	SHW
Wholesale Price Index - Wheat	Prices	2	SHW
Production - Coal	Production	3	SHW
Shipping - Inbound	Transport	2	SHW

B.7 Canada

Series Name	Category	Release Delay (in Month)	Source
Construction Contracts Awarded	Housing and Construction	2	IA
Building Permits	Housing and Construction	2	IA
Production - Construction Industry	Housing and Construction	2	SHW
Total Exports	International Trade	3	IA
Total Imports	International Trade	3	IA
Index of Employment	Labour	3	IA
Unemployment in Trade Unions	Labour	3	IA
Employment - Applications	Labour	3	IA
Employment - Placements	Labour	3	IA
Employment - Vacancies	Labour	3	IA
Strikes - Days Lost	Labour	3	IA
Strikes - Disputes in Existence	Labour	3	IA
Strikes - Number of Employees	Labour	3	IA
Bank Debits	Money, Banking, and Finance	2	IA
Chartered Banks - Commercial Loans	Money, Banking, and Finance	2	IA
Chartered Banks - Call Loans - Canada	Money, Banking, and Finance	2	IA
Chartered Banks - Call Loans - Elsewhere	Money, Banking, and Finance	2	IA
Chartered Banks - Short-term Deposits	Money, Banking, and Finance	2	IA
Chartered Banks - Long-term Deposits	Money, Banking, and Finance	2	IA
Chartered Banks - Total Securities	Money, Banking, and Finance	2	IA
Clearings	Money, Banking, and Finance	2	SHW
Notes in Circulation	Money, Banking, and Finance	2	SHW
Stock Exchange - Number of Shares Sold	Money, Banking, and Finance	2	IA
Stock Exchange - Share Prices - Common Stocks	Money, Banking, and Finance	0	IA
Stock Exchange - Share Prices - Preferred Stocks	Money, Banking, and Finance	0	IA
Stock Exchange - Share Prices - Banking	Money, Banking, and Finance	0	IA
Stock Exchange - Share Prices - Industrial	Money, Banking, and Finance	0	IA
Stock Exchange - Share Prices - Mining	Money, Banking, and Finance	0	SHW
Stock Exchange - Share Prices - Iron and Steel	Money, Banking, and Finance	0	IA
Stock Exchange - Share Prices - Utilities	Money, Banking, and Finance	0	IA
Stock Exchange - Share Turnover	Money, Banking, and Finance	2	SHW
Bankruptcies - Number	Money, Banking, and Finance	2	IA
Bankruptcies - Liabilities	Money, Banking, and Finance	2	IA
Retail Cost Per Week of Family Budget - Cost of Living	Prices	2	IA
Wholesale Price Index - Total	Prices	2	IA
Wholesale Price Index - Raw Materials	Prices	2	IA
Wholesale Price Index - Finished Goods	Prices	2	IA
Wholesale Price Index - Non-ferrous Metals	Prices	2	IA
Wholesale Price Index - Food and Tobacco	Prices	2	IA
Sales of Agricultural Products - Cattle	Retail and Consumption	2	SHW
Sales of Agricultural Products - Grain	Retail and Consumption	2	SHW
Production - Total	Production	3	SHW

Production - Steel Ingots and Castings	Production	3	IA
Production - Newsprint	Production	3	IA
Production - Pig Iron	Production	3	IA
Production - Coal	Production	3	IA
Railways - Car Loadings	Transport	2	IA
Railways - Freight Ton Miles	Transport	2	IA
Railways - Operating Revenues	Transport	2	IA

B.8 Czechoslovakia

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	IA
Total Imports	International Trade	3	IA
Average Hourly Wage Rates of Industry	Labour	2	SHW
Unemployed Jobseekers	Labour	3	SHW
Czechoslovak National Bank - Notes in Circulation	Money, Banking, and Finance	2	SHW
Czechoslovak National Bank - Deposits	Money, Banking, and Finance	2	SHW
Czechoslovak National Bank - Gold	Money, Banking, and Finance	2	SHW
Market Discount Rate	Money, Banking, and Finance	0	SHW
Clearings	Money, Banking, and Finance	2	SHW
Giro Turnover	Money, Banking, and Finance	2	SHW
Turnover of the Postal Savings Bank	Money, Banking, and Finance	2	IA + SHW
Stock Exchange - Bond Prices	Money, Banking, and Finance	0	SHW
Stock Exchange - Share Prices - Industrial and Transportation	Money, Banking, and Finance	0	SHW
Liquidations	Money, Banking, and Finance	2	IA
Bankruptcies	Money, Banking, and Finance	2	IA
Wholesale Price Index - Total	Prices	2	IA
Wholesale Price Index - Food and Fodder	Prices	2	IA
Wholesale Price Index - Industrial Goods	Prices	2	IA
Production - Total	Production	3	SHW
Production - Coke	Production	3	SHW
Railways - Car Loadings in International Traffic	Transport	2	IA

B.9 Denmark

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Hourly Earnings of Workers	Labour	3	SHW
Unemployed Union Members - Number	Labour	3	SHW
Unemployed Union Members - Percent	Labour	3	SHW
Central Bank of Denmark - Notes in Circulation	Money, Banking, and Finance	2	SHW
Central Bank of Denmark - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Credit Banks - Advances	Money, Banking, and Finance	2	SHW
Credit Banks - Bills of Exchange	Money, Banking, and Finance	2	SHW
Clearings	Money, Banking, and Finance	2	SHW
Stock Exchange - Bond Prices	Money, Banking, and Finance	0	SHW
Stock Exchange - Share Prices	Money, Banking, and Finance	0	SHW
Total Foreclosures	Money, Banking, and Finance	2	SHW
Agriculture Foreclosures	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Cost of Living - Clothing	Prices	2	SHW
Cost of Living - Food	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Import Goods	Prices	2	SHW
Wholesale Price Index - Animal Feed	Prices	2	SHW
Wholesale Price Index - Fertiliser	Prices	2	SHW
Wholesale Price Index - Butter	Prices	2	SHW
Wholesale Price Index - Heifers and Oxen	Prices	2	SHW
Pig Slaughtering	Production	3	SHW
Sea Freight Rate	Transport	2	SHW

B.10 Dutch East Indies

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Java Bank - Notes in Circulation	Money, Banking, and Finance	2	SHW
Java Bank - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Java Bank - Deposits	Money, Banking, and Finance	2	SHW
Java Bank - Foreign Exchange	Money, Banking, and Finance	2	SHW
Java Bank - Gold	Money, Banking, and Finance	2	SHW
Mortgage Institutions - Loans	Money, Banking, and Finance	2	SHW
Mortgage Institutions - Repayments	Money, Banking, and Finance	2	SHW
Clearings	Money, Banking, and Finance	2	SHW
Post Office Savings - Payments	Money, Banking, and Finance	2	SHW

Post Office Savings - Proceeds	Money, Banking, and Finance	2	SHW
Stock Exchange - Share Prices	Money, Banking, and Finance	0	SHW
Cost of Living - Total	Prices	2	SHW
Cost of Living - Food for Non-Europeans	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Export Goods	Prices	2	SHW
Wholesale Price Index - Import Goods	Prices	2	SHW
Production - Hard Coal	Production	3	SHW
Shipping - With Europe	Transport	2	SHW
Shipping - With US	Transport	2	SHW
Railways - Freight Revenue	Transport	2	SHW

B.11 Estonia

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Employed Workers	Labour	3	SHW
Unemployed	Labour	3	SHW
Bank of Estonia - Notes in Circulation	Money, Banking, and Finance	2	SHW
Bank of Estonia - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Cost of Living - Total (in Tallinn)	Prices	2	SHW
Cost of Living - Food (in Tallinn)	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Export Goods	Prices	2	SHW
Wholesale Price Index - Import Goods	Prices	2	SHW
Production - Oil Shale	Production	3	SHW
Railways - Freights Carried	Transport	2	SHW

B.12 Finland

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Unemployed - Partial Disclosure	Labour	3	SHW
Bank of Finland - Notes in Circulation	Money, Banking, and Finance	2	SHW
Bank of Finland - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Credit Banks - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Clearings	Money, Banking, and Finance	2	SHW
Stock Exchange - Share Prices (in Helsinki)	Money, Banking, and Finance	0	SHW
Stock Exchange - Share Turnover (in Helsinki)	Money, Banking, and Finance	2	SHW
Bankruptcies - Total	Money, Banking, and Finance	2	SHW
Protested Bills of Exchange - Value	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Cost of Living - Food	Prices	2	SHW
Cost of Living - Clothing	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Export Goods	Prices	2	SHW
Wholesale Price Index - Import Goods	Prices	2	SHW
Production - Export Industries	Production	3	SHW
Wholesale Turnover	Retail and Consumption	2	SHW
Maritime Shipping	Transport	2	SHW
State Railways - Freights Carried	Transport	2	SHW

B.13 France

Series Name	Category	Release Delay (in Month)	Source
Activity in Building Construction	Housing and Construction	2	IA
Total Exports (Quantity)	International Trade	3	IA
Total Exports (Value)	International Trade	3	IA
Total Imports (Quantity)	International Trade	3	IA
Total Imports (Value)	International Trade	3	IA
Unemployed on Benefits	Labour	3	SHW
Coefficient of Placement Index	Labour	3	NBER
Unsettled Job Applications	Labour	3	SHW
Bank of France - Advances to the State	Money, Banking, and Finance	2	SHW
Bank of France - Notes in Circulation	Money, Banking, and Finance	2	IA
Bank of France - Discounts	Money, Banking, and Finance	2	IA
Commercial Banks - Acceptances	Money, Banking, and Finance	2	SHW
Commercial Banks - Advances	Money, Banking, and Finance	2	SHW
Commercial Banks - Credits	Money, Banking, and Finance	2	SHW

Commercial Banks - Cash	Money, Banking, and Finance	2	SHW
4 Banking Institutions Deposits	Money, Banking, and Finance	2	IA
Commercial Banks - Bills of Exchange Discounted	Money, Banking, and Finance	2	SHW
Deposits of Private Banks at Caisse des Depots	Money, Banking, and Finance	2	IA
Private Discount Rate	Money, Banking, and Finance	0	SHW
Private Prime Paper Rate	Money, Banking, and Finance	0	IA
Collateral Loan Rate	Money, Banking, and Finance	0	IA
Returns of Paris Bankers Clearing House	Money, Banking, and Finance	2	IA
Bankruptcies	Money, Banking, and Finance	2	SHW
Stock Exchange - Price of Banking Stocks (4 Commercial Banks)	Money, Banking, and Finance	0	IA
Stock Exchange - Price of Variable Dividend Stocks (300 Domestic)	Money, Banking, and Finance	0	IA
Stock Exchange - Price of Metallurgical Stocks (13 Companies)	Money, Banking, and Finance	0	IA
Taxable Exchange Operations	Money, Banking, and Finance	2	IA
Capital Issuances - Variable Dividend Existing	Money, Banking, and Finance	2	IA
Capital Issuances - Variable Dividend New	Money, Banking, and Finance	2	IA
Cost of Living (Paris)	Prices	2	IA
Retail Price (Paris)	Prices	2	IA
Wholesale Price Index - Food	Prices	2	IA
Wholesale Price Index - Industrial Materials	Prices	2	IA
Wholesale Price Index - Total	Prices	2	IA
Receipts of Post Telegraphs and Telephones	Retail and Consumption	2	IA
Orders - Cotton Spinning	Retail and Consumption	2	IA
Orders - Cotton Weaving (Pieces Per Loom)	Retail and Consumption	2	IA
Yield of Entertainment Tax (Paris)	Retail and Consumption	2	IA
Turnover of Internal Commerce	Retail and Consumption	2	IA
Production - Coal	Production	3	IA
Production - Pig Iron	Production	3	IA
Production - Steel	Production	3	IA
Production - Total	Production	3	IA
Railways - Daily Carloads	Transport	2	IA
Railways - Weekly Receipts	Transport	2	IA
Shipping - Tonnage Cleared	Transport	2	IA

B.14 Germany

Series Name	Category	Release Delay (in Month)	Source
Urban Construction Activity	Housing and Construction	2	SHW
Total Exports	International Trade	3	IA
Total Imports	International Trade	3	IA
Unemployed - Main Beneficiary in Unemployment Insurance	Labour	3	SHW
Male Applicants Per Hundred Positions	Labour	3	NBER
Hourly Wages	Labour	2	SHW
Major Banks - Acceptances	Money, Banking, and Finance	3	SHW
Major Banks - Accounts Payable	Money, Banking, and Finance	3	SHW
Major Banks - Accounts Receivable	Money, Banking, and Finance	3	SHW
Major Banks - Cash and Bank Balance	Money, Banking, and Finance	3	SHW
Major Banks - Bills of Exchange	Money, Banking, and Finance	3	SHW
Major Banks - Advances on Goods	Money, Banking, and Finance	3	SHW
Major Banks - Reports and Lombards	Money, Banking, and Finance	3	SHW
Major Banks - Securities and Syndicate Participations	Money, Banking, and Finance	3	SHW
Reichsbank - Gold and Foreign Exchange Holding	Money, Banking, and Finance	2	IA
Merchandise Bill Rate	Money, Banking, and Finance	0	SHW
Prime Banker's Acceptance Rate	Money, Banking, and Finance	0	SHW
Issues - Domestic Fixed-income Securities	Money, Banking, and Finance	2	SHW
Issues - Domestic Shares	Money, Banking, and Finance	2	SHW
Reichsbank - Clearings	Money, Banking, and Finance	2	IA
Reichsbank - Transfers	Money, Banking, and Finance	2	IA
Reichsbank - Giro Transactions	Money, Banking, and Finance	2	SHW
Money in Circulation	Money, Banking, and Finance	2	IA
Postal Cheque Payments	Money, Banking, and Finance	2	IA
Stock Prices - Mining and Heavy Industries	Money, Banking, and Finance	0	IA
Stock Prices - Trade and Transport	Money, Banking, and Finance	0	IA
Bankruptcies	Money, Banking, and Finance	2	SHW
Composition Proceedings	Money, Banking, and Finance	2	SHW
Number of New Firms Established	Money, Banking, and Finance	2	NBER
Cost of Living - Food	Prices	2	SHW
Cost of Living - Total	Prices	2	IA
Wholesale Price Index - Total	Prices	2	IA
Wholesale Price Index - Agricultural	Prices	2	IA
Retail Sales - Total	Retail and Consumption	2	SHW
Production - Total	Production	3	SHW
Tonnage of Vessels under Construction	Production	3	NBER
Freight Rates - River	Transport	2	SHW
Freight Rates - Maritime	Transport	2	SHW
Railways - Waggon Loadings (Per Working Day)	Transport	2	IA
Railways - Revenue Ton-Kilometres	Transport	2	NBER

B.15 Hungary

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	IA
Total Imports	International Trade	3	IA
Job Seekers	Labour	3	SHW
Unemployed Union Members - Number	Labour	3	SHW
Unemployed Union Members - Percent	Labour	3	SHW
Hungarian National Bank - Notes in Circulation	Money, Banking, and Finance	2	SHW
Hungarian National Bank - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Hungarian National Bank - Foreign Exchange	Money, Banking, and Finance	2	SHW
Prime Commercial Paper Rate	Money, Banking, and Finance	0	IA
Day to Day Rate	Money, Banking, and Finance	0	IA
Clearings	Money, Banking, and Finance	2	SHW
Stock Exchange - Share Prices	Money, Banking, and Finance	0	SHW
Bankruptcies - Number	Money, Banking, and Finance	2	IA
Compositions - Number	Money, Banking, and Finance	2	IA
Cost of Living - Total	Prices	2	SHW
Cost of Living - Clothing	Prices	2	SHW
Cost of Living - Food	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	IA
Wholesale Price Index - Agricultural and Food Products	Prices	2	SHW
Wholesale Price Index - Industrial Materials and Products	Prices	2	SHW
Production - Total	Production	3	SHW
Production - Cotton Goods and Finish	Production	3	SHW
Postage - Letters	Retail and Consumption	2	IA
Postage - Telephone Calls	Retail and Consumption	2	IA
State Railways - Freights Carried	Transport	2	IA

B.16 Italy

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Unemployed - Total	Labour	3	SHW
Unemployed - Insured	Labour	3	SHW
Short-time Workers	Labour	3	SHW
Bank of Italy - Notes in Circulation	Money, Banking, and Finance	2	SHW
Bank of Italy - Foreign Exchange	Money, Banking, and Finance	2	SHW
Market Discount Rate in Milan	Money, Banking, and Finance	0	SHW
Stock Exchange - Share Prices	Money, Banking, and Finance	0	SHW
Stock Exchange - Share Sales	Money, Banking, and Finance	2	SHW
Bankruptcies	Money, Banking, and Finance	2	SHW
Protested Bills of Exchange	Money, Banking, and Finance	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Finished Goods	Prices	2	SHW
Wholesale Price Index - Semi-finished Goods	Prices	2	SHW
Electricity Industry - Power Consumption	Retail and Consumption	3	SHW
Production - Crude Steel	Production	3	SHW
Production - Pig Iron	Production	3	SHW
Railways - Freights Carried	Transport	2	SHW
Shipping - Sea Freight - Incoming Goods	Transport	2	SHW
Shipping - Sea Freight - Outgoing Goods	Transport	2	SHW

B.17 Japan

Series Name	Category	Release Delay (in Month)	Source
Total Exports - Including Colonies	International Trade	3	IA
Total Imports - Including Colonies	International Trade	3	IA
Wage Rates - Industrial Workers	Labour	2	SHW
Employment - Industrial	Labour	3	SHW
Bank of Japan - Notes in Circulation (Daily Average)	Money, Banking, and Finance	2	IA
Bank of Japan - Advances (Daily Average)	Money, Banking, and Finance	2	IA
Call Money Rate	Money, Banking, and Finance	0	SHW
Market Discount Rate (Average of Lowest, Tokyo)	Money, Banking, and Finance	0	IA
Stock Exchange - Average Price of 50 Industrial Shares	Money, Banking, and Finance	0	IA
Clearing Banks - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Commercial Banks - Advances	Money, Banking, and Finance	2	IA
Clearings	Money, Banking, and Finance	2	SHW

Cost of Living - Total (in Tokyo)	Prices	2	SHW
Cost of Living - Clothing (in Tokyo)	Prices	2	SHW
Cost of Living - Food (in Tokyo)	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Cotton Yarn	Prices	2	SHW
Wholesale Price Index - Raw Silk (in Tokyo)	Prices	2	SHW
Inventory - Raw Silk Warehouse	Retail and Consumption	2	SHW
Production - Total	Production	3	SHW
Production - Textile Industry - Total	Production	3	SHW
Production - Cotton Fabrics	Production	3	SHW
Production - Cotton Yarn	Production	3	SHW
Production - Raw Silk	Production	3	SHW
Railways - Freights Carried	Transport	2	SHW

B.18 Lithuania

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Bank of Lithuania - Notes in Circulation	Money, Banking, and Finance	2	SHW
Bank of Lithuania - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Bank of Lithuania - Gold	Money, Banking, and Finance	2	SHW
Gold Value of the Currency	Money, Banking, and Finance	0	SHW
Protested Bills of Exchange	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Flax	Prices	2	SHW
Railways - Freights Carried	Transport	2	SHW

B.19 Netherlands

Series Name	Category	Release Delay (in Month)	Source
Construction Activity - Completion	Housing and Construction	2	SHW
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Unemployment - Total Job Seekers	Labour	3	SHW
Unemployment - Insured Workers	Labour	3	SHW
Unemployment - Lost Workdays	Labour	3	SHW
Netherlands Bank - Notes in Circulation	Money, Banking, and Finance	2	SHW
Netherlands Bank - Foreign Currency	Money, Banking, and Finance	2	SHW
Netherlands Bank - Gold	Money, Banking, and Finance	2	SHW
Private Discount Rate	Money, Banking, and Finance	0	SHW
Collateral Loan Rate	Money, Banking, and Finance	0	SHW
Issues - Domestic Shares	Money, Banking, and Finance	2	SHW
Stock Exchange - Domestic Share Prices	Money, Banking, and Finance	0	SHW
Bankruptcies	Money, Banking, and Finance	2	SHW
Cost of Living - Total (Amsterdam)	Prices	2	IA
Cost of Living - Food (Amsterdam)	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	IA + SHW
Wholesale Price Index - Food	Prices	2	IA + SHW
Production - Coal	Production	3	IA

B.20 New Zealand

Series Name	Category	Release Delay (in Month)	Source
Construction Activity - Building Permits	Housing and Construction	2	SHW
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Weekly Wages - Total	Labour	3	SHW
Unemployed	Labour	3	SHW
Notes in Circulation	Money, Banking, and Finance	2	SHW
Credit Banks - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Credit Banks - Gold	Money, Banking, and Finance	2	SHW
Stock Exchange - Share Prices	Money, Banking, and Finance	0	SHW
Bankruptcies	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Cost of Living - Food	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Exporting Goods Total	Prices	2	SHW
Wholesale Price Index - Exporting Dairy Products	Prices	2	SHW

Wholesale Price Index - Exporting Meat	Prices	2	SHW
Wholesale Price Index - Exporting Wool	Prices	2	SHW
Wholesale Price Index - Importing Goods Total	Prices	2	SHW
Butter - Consignments	Retail and Consumption	2	SHW
Butter - Stocks	Retail and Consumption	2	SHW
Cheese - Consignments	Retail and Consumption	2	SHW
Cheese - Stocks	Retail and Consumption	2	SHW
Maritime Shipping - Inbound Traffic	Transport	2	SHW

B.21 Peru

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Central Bank - Notes in Circulation	Money, Banking, and Finance	2	SHW
Central Bank - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Central Bank - Deposits	Money, Banking, and Finance	2	SHW
Central Bank - Gold and Foreign Exchange	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Building Materials	Prices	2	SHW
Wholesale Price Index - Import Goods	Prices	2	SHW
Wholesale Price Index - Food	Prices	2	SHW
Wholesale Price Index - Metals	Prices	2	SHW
Wholesale Price Index - Textiles	Prices	2	SHW

B.22 Poland

Series Name	Category	Release Delay (in Month)	Source
Construction	Housing and Construction	2	SHW
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Registered Unemployed	Labour	3	SHW
Employed Workers	Labour	3	SHW
Bank of Poland - Notes in Circulation	Money, Banking, and Finance	2	SHW
Bank of Poland - Foreign Exchange	Money, Banking, and Finance	2	SHW
Discount Rate of Joint-Stock Banks	Money, Banking, and Finance	0	SHW
Clearings	Money, Banking, and Finance	2	SHW
Postal Check Turnover	Money, Banking, and Finance	2	SHW
Savings - Deposits	Money, Banking, and Finance	2	SHW
Stock Exchange - Share Prices	Money, Banking, and Finance	0	SHW
Issues - New Stocks	Money, Banking, and Finance	2	IA
Bankruptcies	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Cost of Living - Food	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Agricultural Products	Prices	2	SHW
Production - Total	Production	3	SHW
Production - Chemical Industry	Production	3	SHW
Production - Hard Coal	Production	3	SHW
Production - Consumer Goods	Production	3	SHW
Railways - Freight Car Traffic	Transport	2	SHW

B.23 South Africa

Series Name	Category	Release Delay (in Month)	Source
Construction Activity - Residential Buildings Commenced	Housing and Construction	2	SHW
Total Exports Including Gold Bullions and Coins	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Employed in Mining - Gold Mining, Indigenous and Other Coloured	Labour	3	SHW
Employed in Mining - Total Mining, Indigenous and Other Coloured	Labour	3	SHW
Agricultural Credit Banks - Advances	Money, Banking, and Finance	2	SHW
Credit Banks - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Credit Banks - Long-term Deposits	Money, Banking, and Finance	2	SHW
Clearings	Money, Banking, and Finance	2	SHW
Postal Savings Banks - Deposits	Money, Banking, and Finance	2	SHW

South African Reserve Bank - Notes in Circulation	Money, Banking, and Finance	2	SHW
South African Reserve Bank - Gold	Money, Banking, and Finance	2	SHW
Bankruptcies	Money, Banking, and Finance	2	SHW
Cost of Living - Total	Prices	2	SHW
Cost of Living - Food	Prices	2	SHW
Production - Hard Coal	Production	3	SHW
Production - Gold	Production	3	SHW
Railways - Freights Carried - Total Excluding Coal	Transport	2	SHW
Railways - Freights Carried - Coal	Transport	2	SHW

B.24 Spain

Series Name	Category	Release Delay (in Month)	Source
Bank of Spain - Notes in Circulation	Money, Banking, and Finance	2	SHW
Bank of Spain - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Bank of Spain - Deposits	Money, Banking, and Finance	2	SHW
Bank of Spain - Foreign Exchange	Money, Banking, and Finance	2	SHW
Bank of Spain - Gold	Money, Banking, and Finance	2	SHW
Gold Value of the Currency	Money, Banking, and Finance	0	SHW
Clearings	Money, Banking, and Finance	2	SHW
Stock Exchange - Fixed Interest Security Prices (in Barcelona)	Money, Banking, and Finance	0	IA
Stock Exchange - Stock Prices	Money, Banking, and Finance	0	IA
Cost of Living - Total (in Madrid)	Prices	2	SHW
Wholesale Price Index - Total (in Barcelona)	Prices	2	IA + SHW
Wholesale Price Index - Food	Prices	2	SHW
Wholesale Price Index - Industrial Materials	Prices	2	SHW
Production - Coal and Lignite	Production	3	IA
Production - Copper Ore	Production	3	IA
Production - Iron Ore	Production	3	IA
Production - Lead Ore	Production	3	IA
Production - Pig Iron	Production	3	IA
Production - Steel	Production	3	IA

B.25 Sweden

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	IA
Total Imports	International Trade	3	IA
Unemployed - Support Seekers	Labour	3	SHW
Unemployed - Union Members - Number	Labour	3	SHW
Unemployed - Union Members - Percent	Labour	3	IA
Credit Banks - Domestic Bills of Exchange	Money, Banking, and Finance	2	SHW
Credit Banks - Advances	Money, Banking, and Finance	2	IA
Yield on Inconvertible State Bonds	Money, Banking, and Finance	0	IA
Riksbank - Clearings	Money, Banking, and Finance	2	SHW
Riksbank - Notes in Circulation	Money, Banking, and Finance	2	IA
Riksbank - Bills of Exchange and Advances	Money, Banking, and Finance	2	SHW
Riksbank - Foreign Exchange	Money, Banking, and Finance	2	SHW
Stock Exchange - Share Prices - All Shares	Money, Banking, and Finance	0	IA
Stock Exchange - Turnover - Total	Money, Banking, and Finance	2	IA
Bankruptcies	Money, Banking, and Finance	2	IA + SHW
Cost of Living - Total	Prices	2	IA
Wholesale Price Index - Total (Board of Trade)	Prices	2	IA
Wholesale Price Index - Raw Materials	Prices	2	IA
Wholesale Price Index - Semi-finished Goods	Prices	2	IA
Wholesale Price Index - Finished Goods	Prices	2	IA
Wholesale Price Index - Consumer Goods	Prices	2	SHW
Wholesale Price Index - Production Goods	Prices	2	SHW
Production - Total	Production	3	SHW
Production - Production Goods Industries	Production	3	SHW
Production - Consumer Goods Industries	Production	3	SHW
Production - Crude Steel	Production	3	SHW
Production - Rolling Mill Products	Production	3	SHW
Production - Pig Iron	Production	3	SHW
Shipping - Inbound	Transport	2	IA
Shipping - Outbound	Transport	2	IA
Railways - Freights Carried	Transport	2	SHW

B.26 Switzerland

Series Name	Category	Release Delay (in Month)	Source
Total Exports	International Trade	3	SHW
Total Imports	International Trade	3	SHW
Average Employment Level	Labour	3	SHW
Short-time Workers	Labour	3	SHW
Unemployed	Labour	3	SHW
Cantonal Banks - Current Accounts Payable	Money, Banking, and Finance	2	SHW
Stock Exchange - Share Prices	Money, Banking, and Finance	0	SHW
Swiss National Bank - Notes in Circulation	Money, Banking, and Finance	2	SHW
Swiss National Bank - Gold Currency	Money, Banking, and Finance	2	SHW
Swiss National Bank - Gold	Money, Banking, and Finance	2	SHW
Composition Agreements	Money, Banking, and Finance	2	SHW
Cost of Living - Food	Prices	2	SHW
Cost of Living - Total	Prices	2	SHW
Wholesale Price Index - Feed and Fertilisers	Prices	2	SHW
Wholesale Price Index - Food	Prices	2	SHW
Wholesale Price Index - Total	Prices	2	SHW
Wholesale Price Index - Raw and Auxiliary Materials	Prices	2	SHW
Hallmarking of Watch Cases	Production	3	SHW

B.27 United Kingdom

Series Name	Category	Release Delay (in Month)	Source
Estimated Cost of Buildings for Which Plans Were Passed - 146 Cities	Housing and Construction	2	IA
Total Imports (Including Miscellaneous)	International Trade	3	IA
Total Exports (Including Miscellaneous)	International Trade	3	IA
Total Insured Persons Unemployed - Male	Labour	3	IA
Total Insured Persons Unemployed - Female	Labour	3	IA
Percentage of Insured Persons Unemployed - Male and Female	Labour	3	IA
Security Price Index - London	Money, Banking, and Finance	0	NBER
British Railway Common Shares Index	Money, Banking, and Finance	0	NBER
Three Months Rate	Money, Banking, and Finance	0	IA
Day to Day Rate	Money, Banking, and Finance	0	IA
Yield on Consols	Money, Banking, and Finance	0	NBER
Outstanding Treasury Bills	Money, Banking, and Finance	2	IA
Nine Clearing Banks - Advances	Money, Banking, and Finance	2	IA
Nine Clearing Banks - Deposits	Money, Banking, and Finance	2	IA
Nine Clearing Banks - Discounts	Money, Banking, and Finance	2	IA
Nine Clearing Banks - Investments	Money, Banking, and Finance	2	IA
Nine Clearing Banks - Cash to Deposits	Money, Banking, and Finance	2	IA

Bank Clearings - London (London Bankers Clearing House)	Money, Banking, and Finance	2	IA
Bank of England - Notes in Circulation	Money, Banking, and Finance	2	IA
Bank of England - Gold	Money, Banking, and Finance	2	SHW
Bank of England - Other Securities	Money, Banking, and Finance	2	SHW
New Capital Issues	Money, Banking, and Finance	2	IA
Bankruptcies	Money, Banking, and Finance	2	SHW
Retail Prices - Cost of Living (Ministry of Labour)	Prices	2	IA
Retail Prices - Food (Ministry of Labour)	Prices	2	IA
Wholesale Price Index - Total (Board of Trade)	Prices	2	IA
Wholesale Price Index - Food (Board of Trade)	Prices	2	IA
Production - Coal	Production	3	IA
Shipbuilding - Tonnage Commenced	Production	3	IA
Index of Consumption of Raw Cotton	Retail and Consumption	2	IA
Railways - Receipts - All Goods	Transport	2	IA
Railways - Weight of Freight Transported - General Merchandise	Transport	2	IA
Railways - Weight of Freight Transported - Fuel	Transport	2	IA
Shipping - Entered	Transport	2	IA
Shipping - Cleared	Transport	2	IA
Shipping - Index of Time Chartered Rates	Transport	2	IA
Shipping - Index of Freight Rates	Transport	2	IA

B.28 United States

Series Name	Category	Release Delay (in Month)	Source
Construction Contracts	Housing and Construction	2	IA
Building Permits	Housing and Construction	2	IA
Merchandise Imports	International Trade	3	IA
Merchandise Exports	International Trade	3	IA
Employment Index 1929 Revision*	Labour	3	FRB
Employment Index 1934 Revision	Labour	3	FRB
Employment Index 1936 Revision	Labour	3	FRB
Payroll Index 1929 Revision*	Labour	3	FRB
Payroll Index 1934 Revision	Labour	3	FRB
Payroll Index 1936 Revision	Labour	3	FRB
Prime Commercial Paper Rate	Money, Banking, and Finance	0	IA
Bank Rate on Customer Loans - Leading Cities	Money, Banking, and Finance	0	NBER
Banker's Acceptance Rate for New York	Money, Banking, and Finance	0	NBER
Yield on Long-term US Bonds	Money, Banking, and Finance	1	NBER
Gold Stock	Money, Banking, and Finance	2	IA
Money in Circulation	Money, Banking, and Finance	2	IA

Federal Reserve System Reporting Member Banks - Loans on Securities	Money, Banking, and Finance	2	IA
Federal Reserve System Reporting Member Banks - All Other Loans	Money, Banking, and Finance	2	IA
Federal Reserve System Reporting Member Banks - Investments	Money, Banking, and Finance	2	IA
Combined Federal Reserve Banks - Bills Discounted	Money, Banking, and Finance	2	IA
Combined Federal Reserve Banks - Bills Bought in Open Market	Money, Banking, and Finance	2	IA
Volume of Commercial Paper Outstanding	Money, Banking, and Finance	2	IA
Business Failures	Money, Banking, and Finance	2	IA
Average Stock Price - Industrials	Money, Banking, and Finance	0	NBER
Average Stock Price - Railroads	Money, Banking, and Finance	0	NBER
Wholesale Price Index (PPI)	Prices	2	IA
Raw Materials Price Index	Prices	2	IA
Semi Manufactured Goods Price Index	Prices	2	IA
Finished Goods Price Index	Prices	2	IA
Industrial Production	Production	3	FRB
Department Store Sales	Retail and Consumption	2	IA
Total Freight Car Loadings	Transport	2	IA
Revenue Per Freight Ton-Mile	Transport	2	NBER

* The labour variables from the 1929 revision are used for estimation. Using other editions of the variables instead does not alter the results.

C Evidence from commodity futures markets

It is not immediately obvious how to extract inflation expectations from Figure II.[30] Hamilton (1987) stresses arbitrage opportunities to claim that futures prices are predictors of future spot prices. One strategy a speculator could follow is to buy a futures contract at t for delivery at $t+1$ at an agreed price F_t, but with no money changing hands at t. At $t+1$ the speculator pays the agreed price for delivery of one physical unit, which they can then sell on the spot market at price S_{t+1}. The difference $F_t - S_{t+1}$ is their net cash flow, positive or negative. Under risk neutrality it must be that $E_t(F_t - S_{t+1}) = 0$ because if not, for example if the expectation was negative, a risk-neutral speculator would want to buy an infinite number of futures contracts, forcing up F_t until the condition holds. The condition can equivalently be written in terms of the spread:

$$F_t - S_t = E_t(S_{t+1}) - S_t \tag{C.1}$$

Through the lens of Hamilton (1987) and equation (C.1), traders must have been expecting raw cotton prices to fall in early 1929, to rise through the Great Depression, and to fall again from late 1934. If raw cotton prices are positively correlated with the wholesale price index then expectations of inflation also turned positive at the start of the Great Depression and negative at its end. This is not consistent with estimates of US inflation expectations from our dynamic factor model.

A second strategy a trader could follow is to sell a futures contract at price F_t that promises to deliver the commodity at $t+1$. The trader buys the commodity from the spot market at t by borrowing at the nominal interest rate i_t. Thus, next period the trader will owe $(1+i_t)S_t$ to repay the loan, plus storage costs u_t, and may enjoy a convenience yield c_t, which is the benefit to traders or users of the commodity from having inventory in hand. In this strategy, the cash flow is again zero in t and $F_t - (1+i_t)S_t - u_t + c_t$ in $t+1$. If u_t and c_t are known at t then this is a risk-free strategy, so net cash flow in $t+1$ must also be zero in equilibrium. In other words, it must be that:

$$F_t - S_t = i_t S_t + u_t - c_t \tag{C.2}$$

This is the storage theory of Working (1949), Telser (1958) and Fama and French (1987). In the literature $(c_t - u_t)/S_t$ is referred to as the net convenience yield. Equation (C.2) implies that the ratio of futures to the spot price is equal to $1 + i_t$ minus the net convenience yield, so as the latter falls, futures prices rise relative to spot prices. From the data on spot and future prices and an appropriate risk-free interest rate, we can estimate the net convenience yield for any of the commodities in the five countries with futures markets.

The relationship between the net convenience yield and inflation is the subject of Saleuddin and Coffman (2018), who stress the over-supply of raw cotton in the 1920s and 1930s (Enfield, 1931; Howell, 1939) and propose that over-supply increases storage costs and reduces convenience yields. The more pessimistic agents are about the future, the more they expect

[30] We are extremely grateful to an anonymous referee for clarifying our thinking on this issue. The discussion below is largely based on his feedback to us.

that commodities will end up in storage at higher storage costs and lower convenience yields, which leads to futures prices being higher relative to spot prices.

Additional backing for the storage theory is provided by Gospodinov and Ng (2013), who explicitly analyse the empirical relationship between net convenience yields and expected inflation over the period March 1983 to July 2008. They find that the first two principal components of panels of net convenience yields have strong predictive power for forecasting inflation in the US, Canada, Japan, France, Germany, Italy, and the UK. Furthermore, the empirical estimates describe a positive relationship between inflation expectations and the net convenience yield for many commodities, consistent with the theory of storage.

The solid line in Figure C.1 plots inflation expectations as estimated by our dynamic factor model of the US. Superimposed as a series of dots is the net convenience yield at the beginning of each month, extracted from commodity market futures data and averaged across the different maturities of future contracts traded at the time. The co-movement between the dynamic factor model estimates and the net convenience yield is striking. The correlation between expected inflation and the net convenience yield is positive, in accordance with the Saleuddin and Coffman (2018) interpretation of the theory of storage.

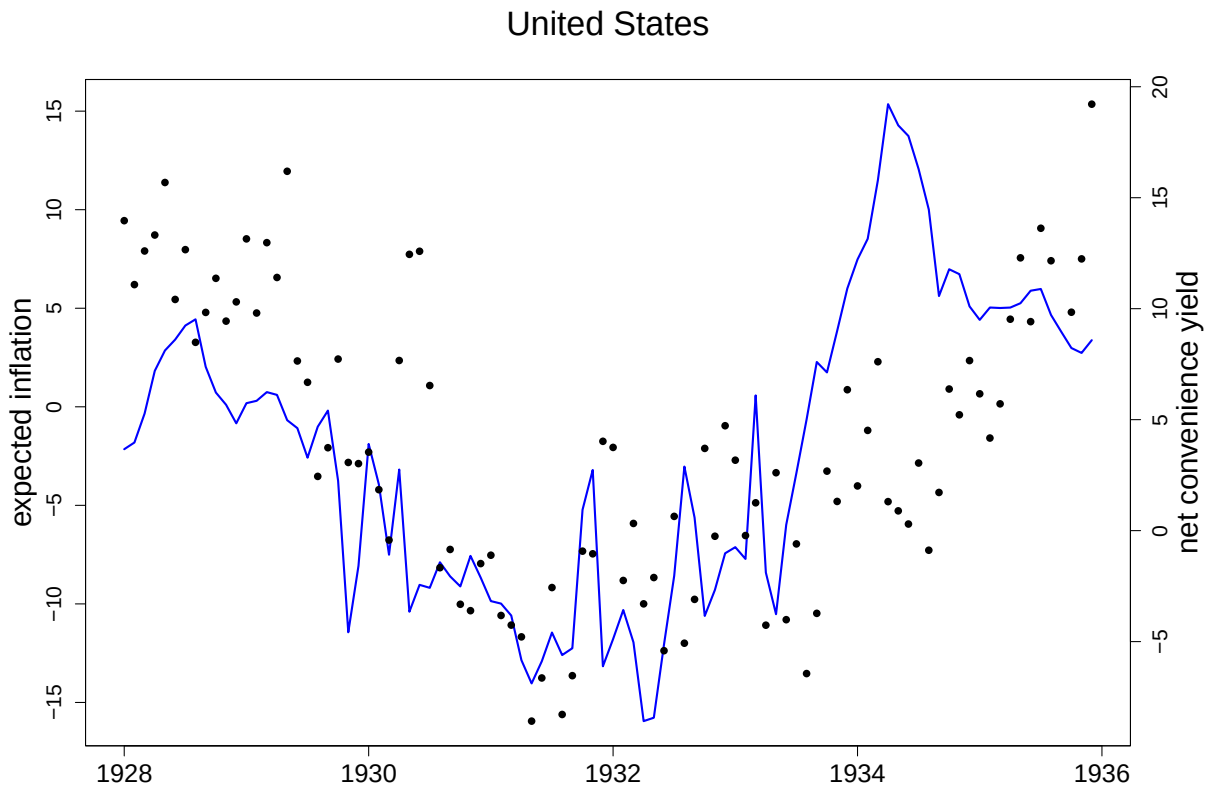


Figure C.1: Expected inflation from the United States dynamic factor model (blue line, left y-axis) and the net convenience yield on cotton futures on the New York Cotton Exchange (black dots, right y-axis).

The strong co-movement in Figure C.1 supports the estimate of inflation expectations from our dynamic factor model. Both measures point towards a turnaround in expectations in late 1931 or early 1932, and where the series do deviate can be explained by known idiosyncrasies of the US cotton market, for example in the 1930s when the Dust Bowl drought emptied storage and increased the net convenience yield.

We also collected prices for other commodities traded in US futures markets, most notably wheat, corn, oats, and rye on the Chicago Board of Trade, from the *New York Times* and the *Wall Street Journal* and cross-checked with *The Baltimore Sun*, *The Boston Daily Globe*, *The Cincinnati Enquirer*, *The Gazette* (Montreal), *The Globe* (Toronto), *The Indianapolis Star*, *The Minneapolis Tribune*, and *The New York Herald Tribune*.[31] These grains competed with cotton for storage, so their net convenience yields should pick up the same positive relationship with expected inflation that we observed for cotton. This is indeed the case, although the plots are noisier and the co-movement is less clear-cut. If we follow Gospodinov and Ng (2013) and extract principal components from the net convenience yields of cotton and other commodities such as grains, then the first principal component co-moves with the inflation expectations from our dynamic factor model, see Figure C.2.

[31] Our data on grain futures prices in Chicago were cross-checked with Iorgulescu et al. (2022).

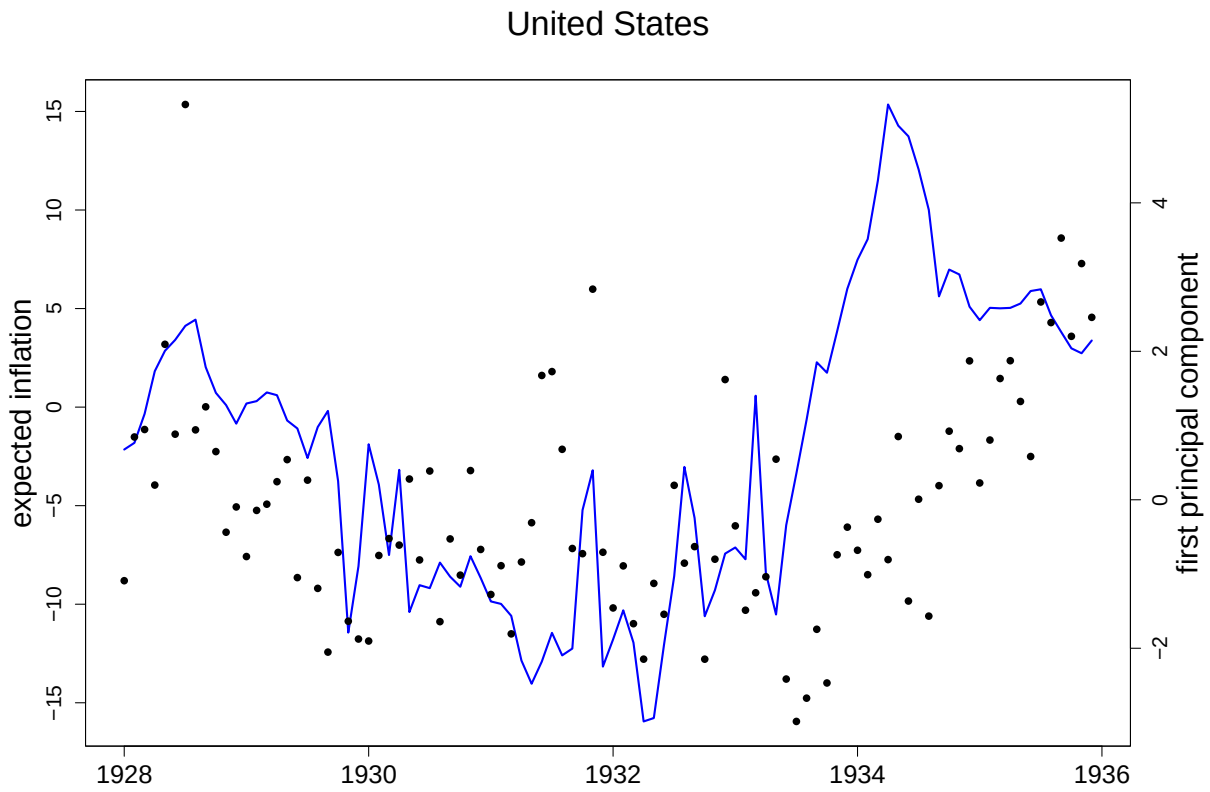


Figure C.2: Expected inflation from the United States dynamic factor model (blue line, left y-axis) and the first principal component of cotton futures on the New York Cotton Exchange and commodity futures on the Chicago Board of Trade (black dots, right y-axis).

For the other countries with commodity futures markets, we transcribed monthly prices from archives of national and financial newspapers. The *Manchester Guardian* and *The Scotsman* were our sources for a variety of contracts on the Liverpool Cotton Exchange and the London Metal Exchange, with some UK prices verified using *The Times* and Lennard et al. (2021). French prices of cotton, coffee and peppers at the Le Havre Futures Market are from *L'Écho de Paris*, while German prices at the Bremen Cotton Exchange are from *Karlsruher Tagblatt*, *Deutsche Allgemeine Zeitung*, *Berliner Tageblatt und Handels-Zeitung*, *Berliner Börsen-Zeitung*, *Badische Presse*, *Hamburger Fremdenblatt* and *Vossische Zeitung*. A peculiarity of the Bremen Cotton Exchange is that prices were quoted in US dollars.[32]. For Japan, cotton yarn prices on the Osaka Sampin Exchange and silk prices on the Kobe Raw Silk Exchange were taken from *China Press* (Shanghai) and *The Times of India*. Taken together with the US data, our newly-transcribed dataset of spot and futures prices includes

[32]Only US cotton was traded on the Bremen Cotton Exchange, and futures being priced in dollars was a response to earlier hyperinflations. Dollar-denominated pricing raises complications for the calculation of net convenience yields, as they mix elements of expected inflation in the US and Germany. Whilst interest rates in US dollars seem to be the relevant ones, storage costs and convenience yields were denominated in German Reichsmark, so expectations of inflation in Germany should also be relevant.

31,512 observations of 636 different contracts across 22 broad categories of commodities.

The relationship between net convenience yields on cotton futures and the dynamic factor model estimates of expected inflation for the UK, France, Germany and Japan is plotted in Figure C.3. The series for the UK and France again co-move strongly, with the factor model estimates and net convenience yields both indicating that inflation expectations bottomed out about one year earlier in the UK than in France. The futures market data for the UK and France offer further corroborating evidence in support of our estimates, the exceptions being around the US Dust Bowl drought of the 1930s and during 1934 when our measure of inflation expectations in the UK rises faster than net convenience yields. The support from futures markets in Germany and Japan is less compelling, although the experience in Germany after 1933 and the establishment of a supervisor board for cotton trade in 1934 make it difficult to draw firm conclusions.[33] In Japan, the futures market data from late 1930 to the middle of 1931 are contaminated by tensions between spinners and weavers that led to severe cuts in production and a high premium on having cotton yarn at hand.

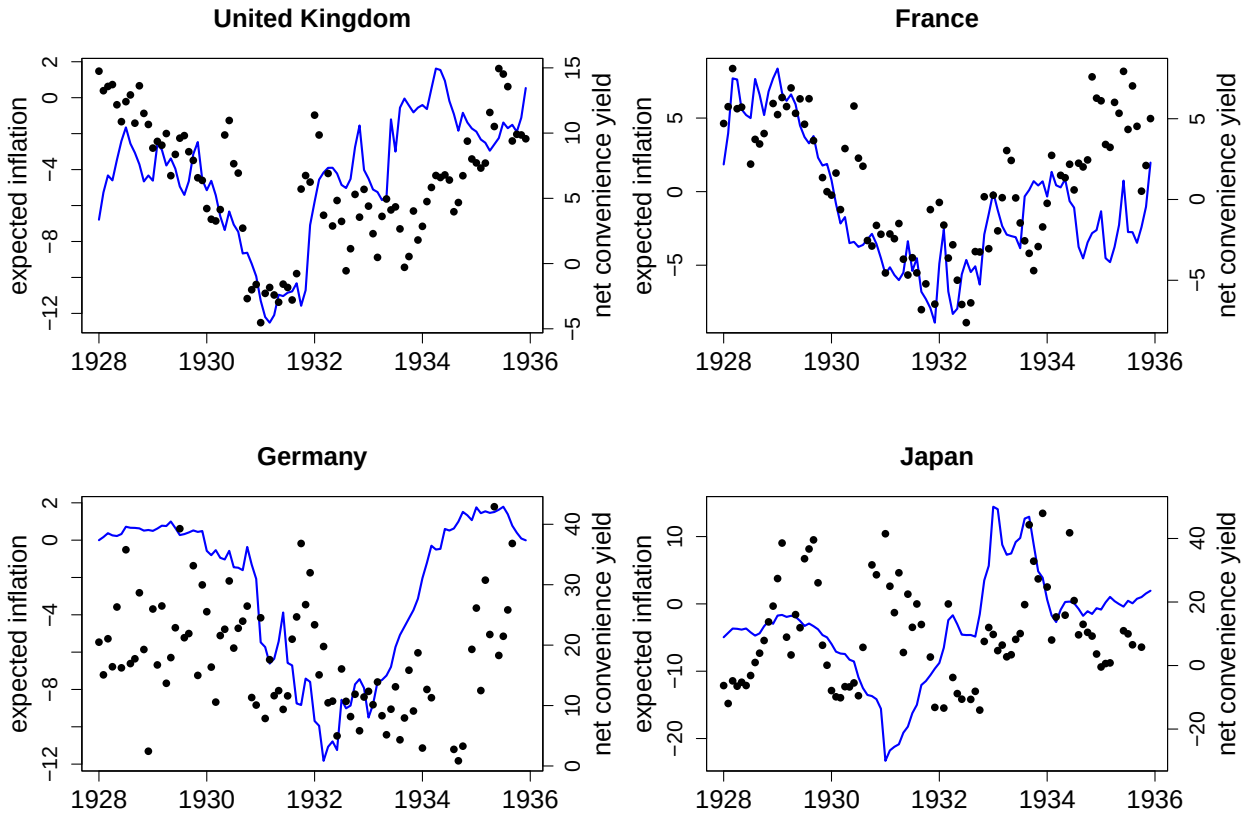


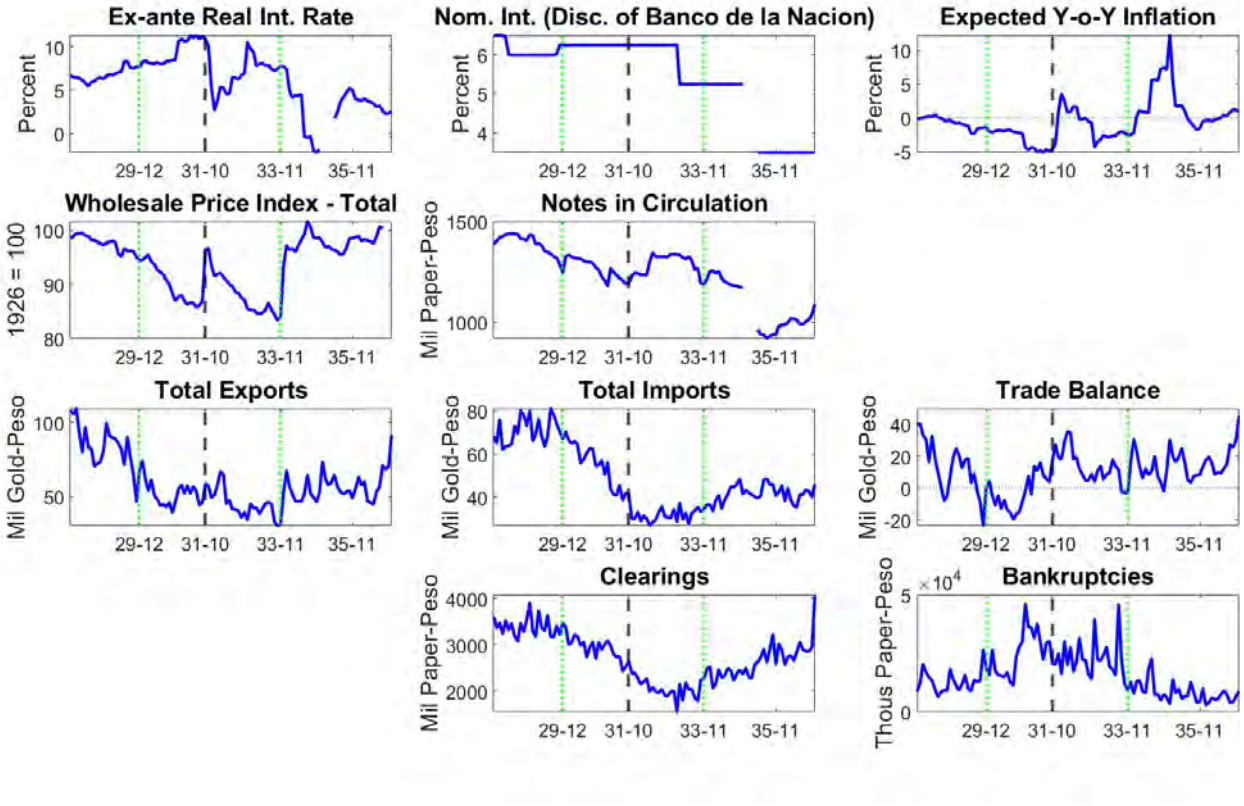
Figure C.3: Expected inflation from the dynamic factor models (blue lines, left y-axes) and the net convenience yield on cotton futures on the Liverpool, Le Havre, Bremen and Osaka Sampin Cotton Exchanges (black dots, right y-axes).

[33]The history of the Bremen Cotton Exchange (Bremer Baumwollbörse) is discussed in Garside (1935) and Linne (2003).

In conclusion, the relationship between commodity futures prices and expected inflation is theoretically ambiguous. If the futures data are interpreted in line with equation C.2, then they are broadly consistent with the inflation expectations generated by our dynamic factor models. If, on the other hand, they are interpreted in line with equation C.1 then they are inconsistent with those estimated expectations. Since both arbitrage conditions should hold in equilibrium, the futures data cannot unambiguously confirm, or rule out, our estimates of inflation expectations. One possible resolution is to acknowledge that investors may not have been risk-neutral, as assumed by equation C.1. As noted in the text of the paper (footnote 11), increases in uncertainty or risk aversion may provide additional reasons why forward premia may have risen during the Great Depression, at a time when traders expected continuing deflation.

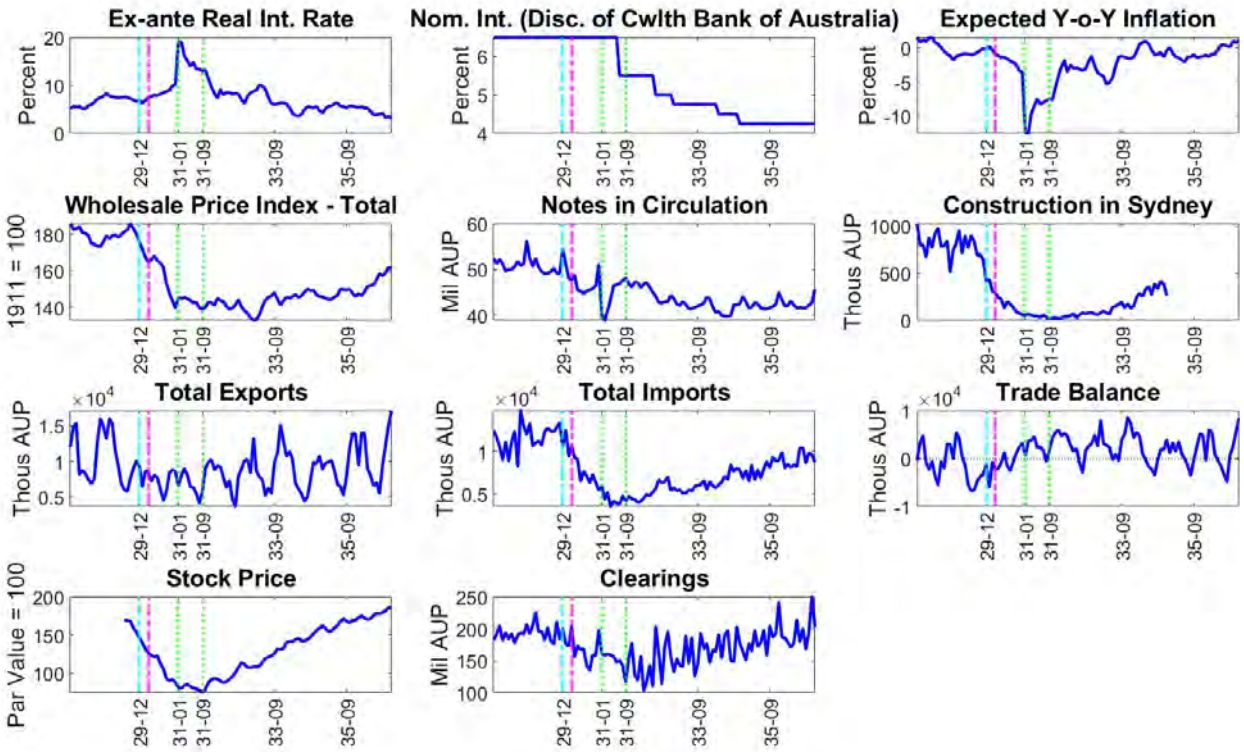
D Illustration of key variables by country

D.1 Argentina



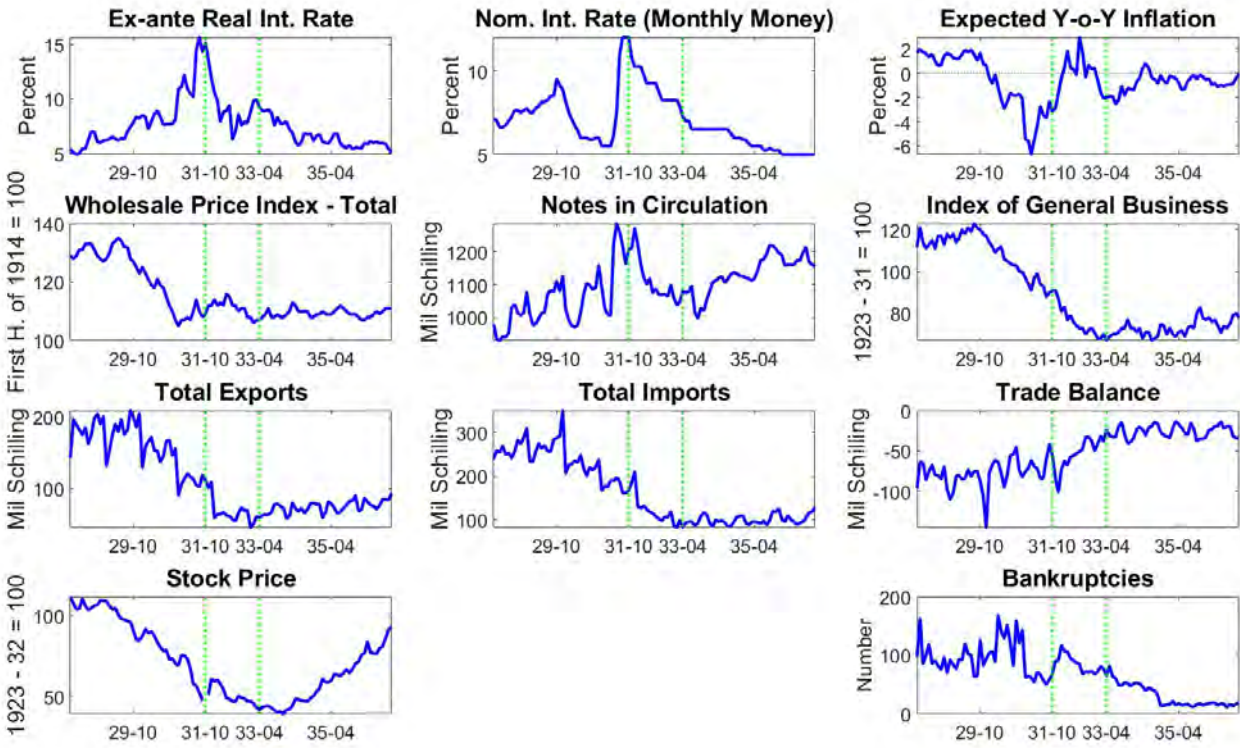
December 1929: suspension of currency board
October 1931: exchange control
November 1933: devaluation and currency reforms

D.2 Australia



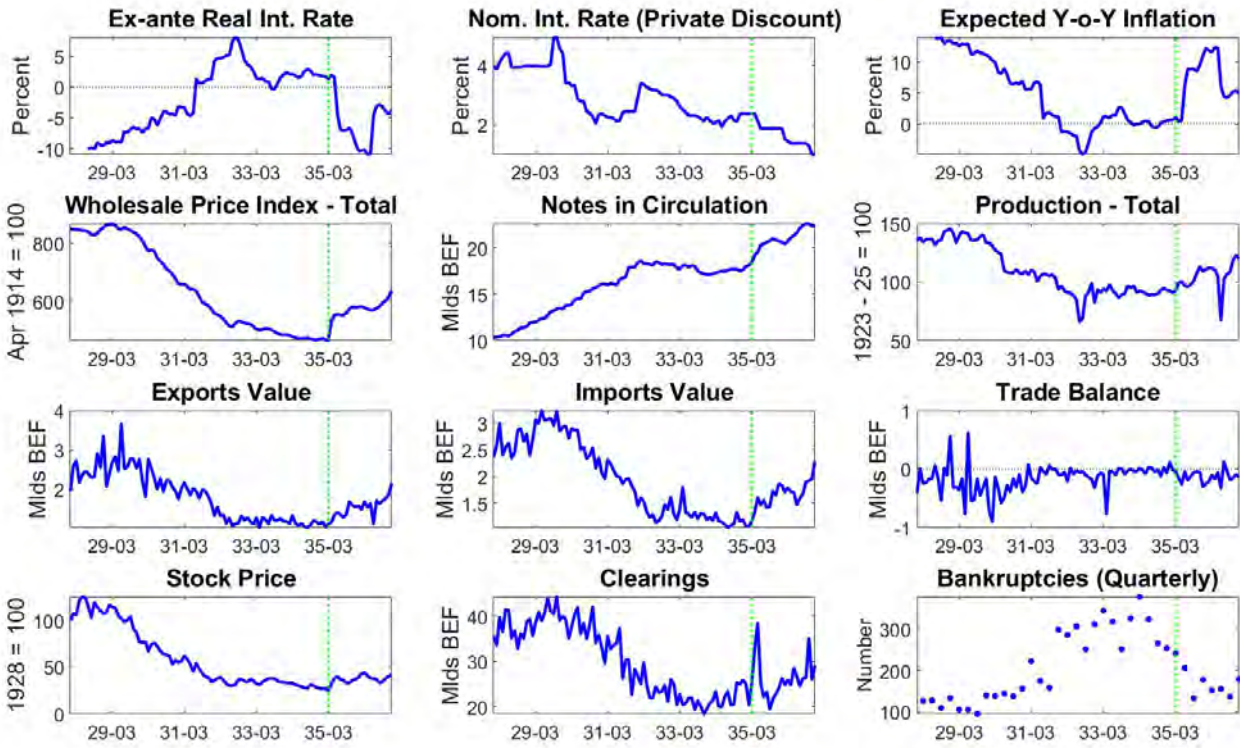
December 1929: official suspension of gold standard
March 1930: devaluation (magenta vertical dash-dotted line)
January 1931: devaluation
September 1931: UK suspension of gold standard

D.3 Austria



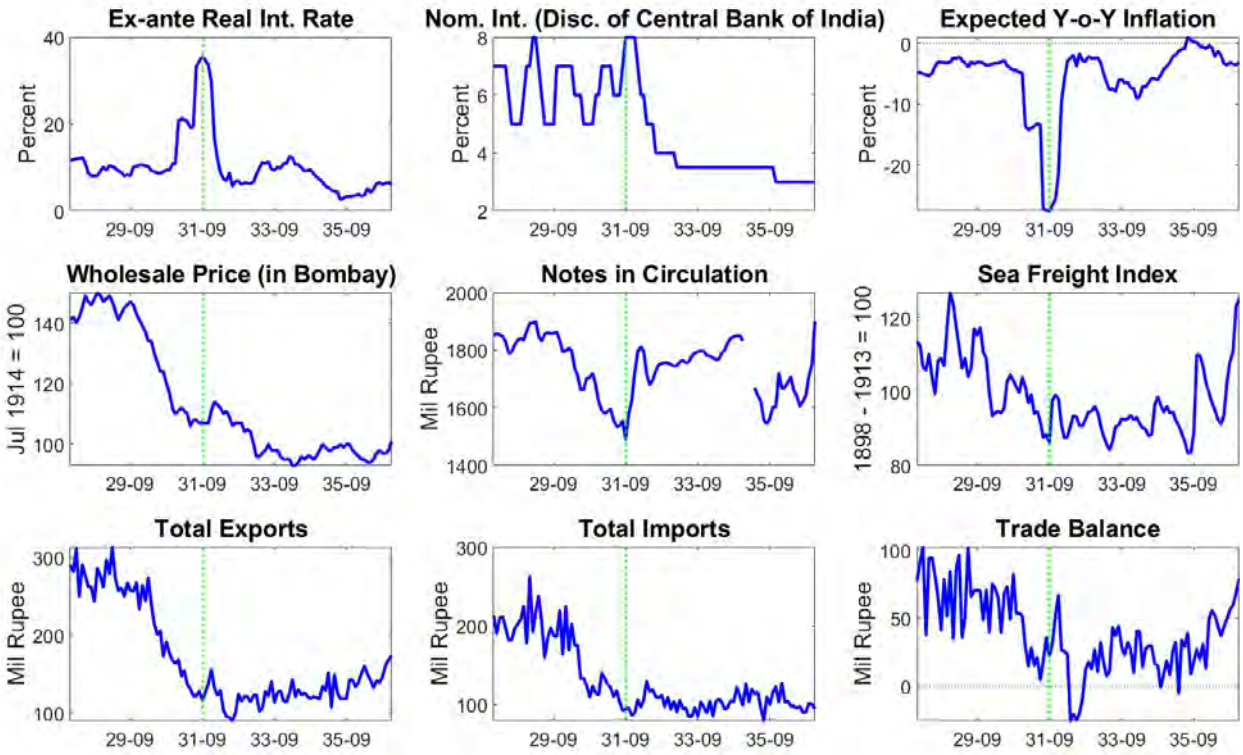
October 1931: devaluation
April 1933: devaluation

D.4 Belgium



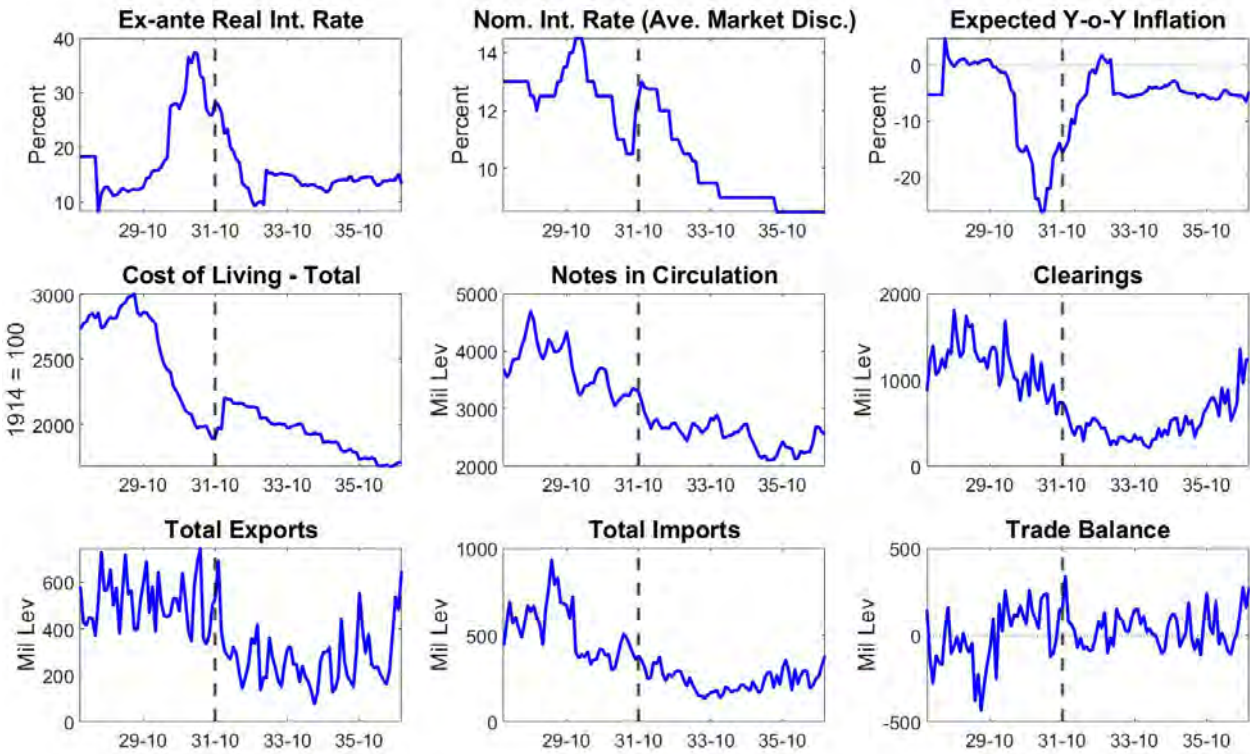
March 1935: official suspension of gold standard, devaluation, and exchange control

D.5 British India



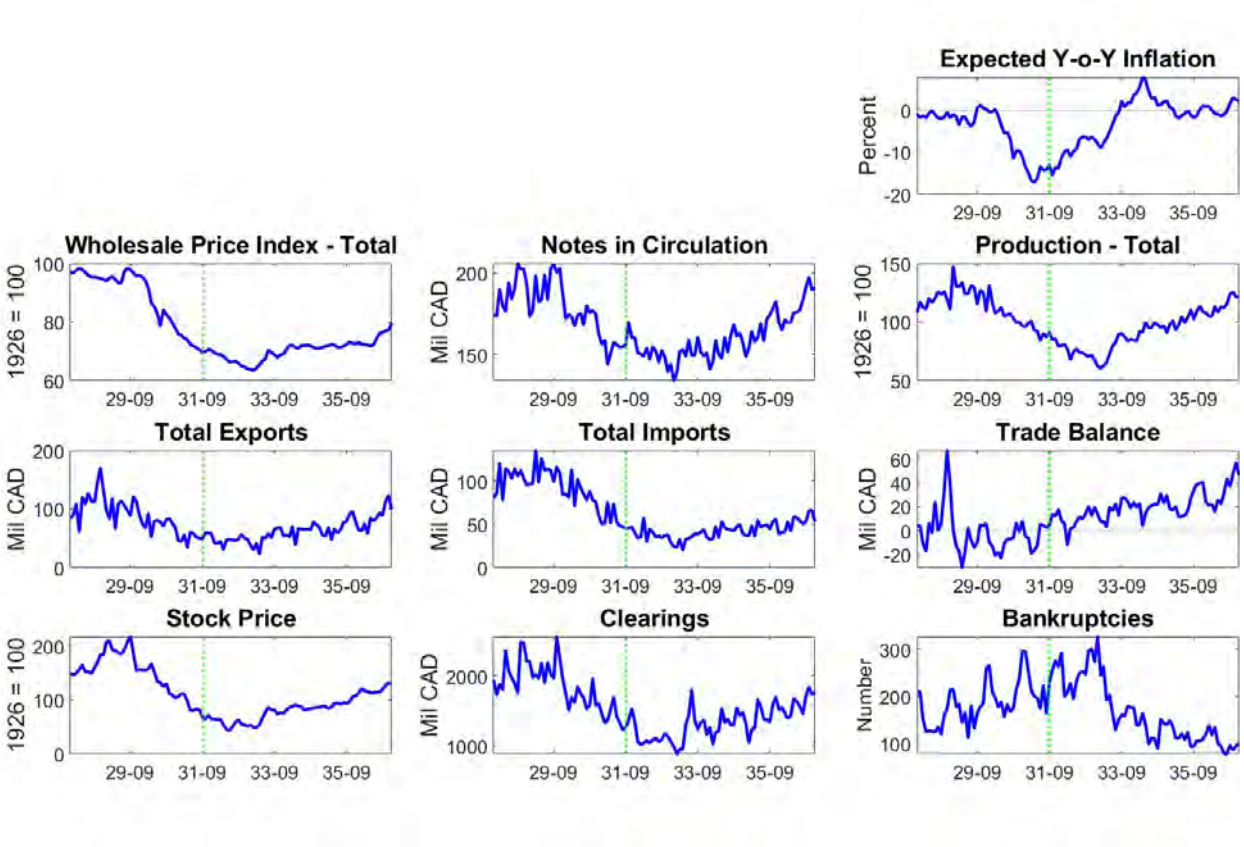
September 1931: UK suspension of gold standard and devaluation

D.6 Bulgaria



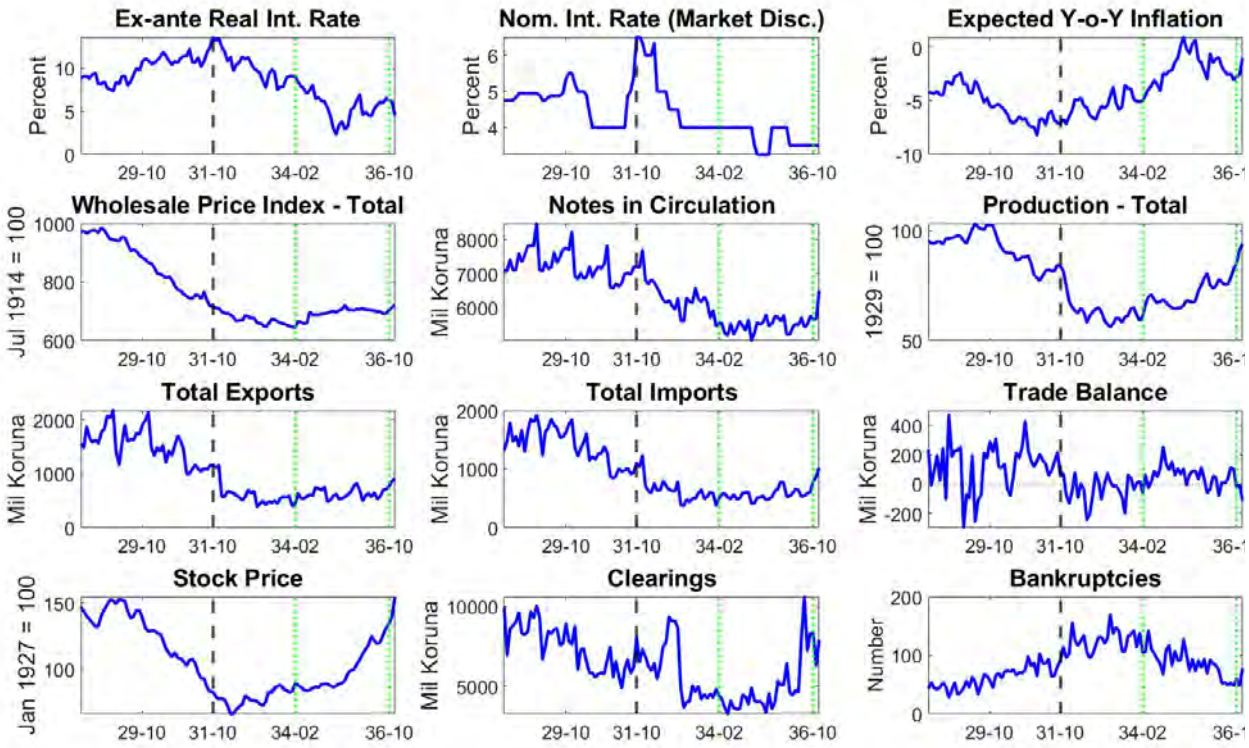
October 1931: exchange control

D.7 Canada



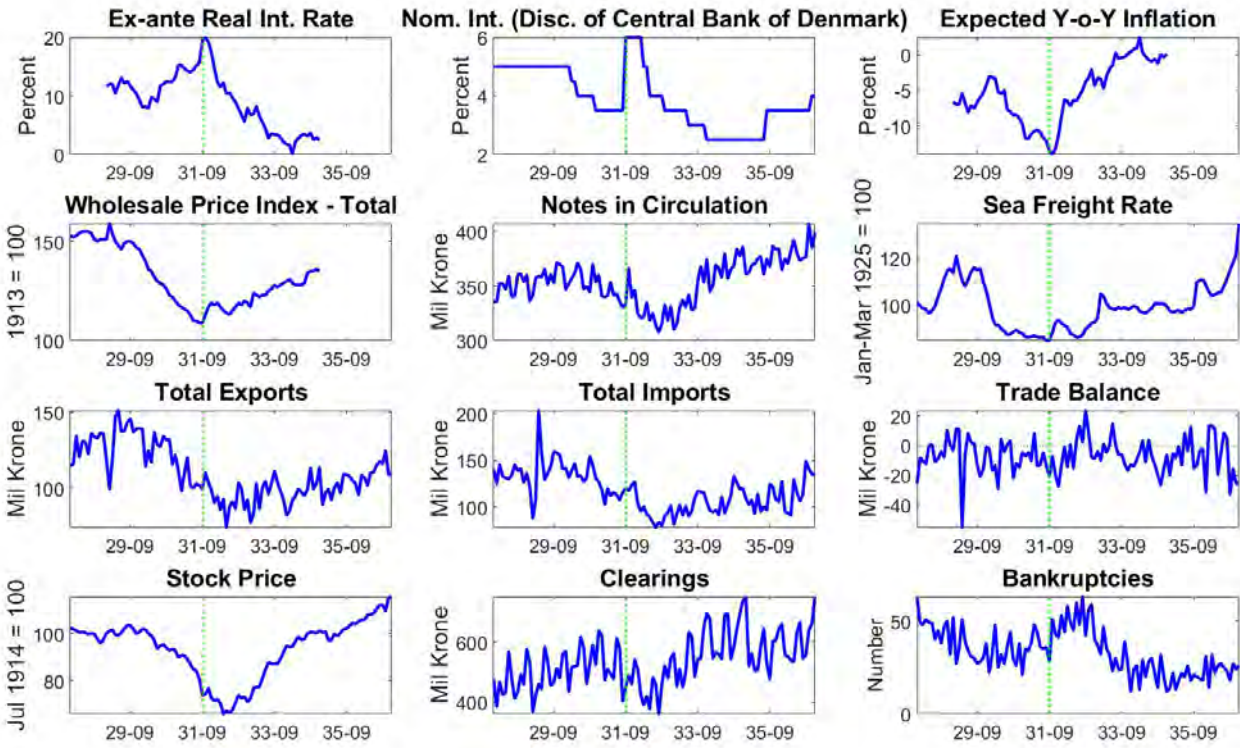
September 1931: devaluation

D.8 Czechoslovakia



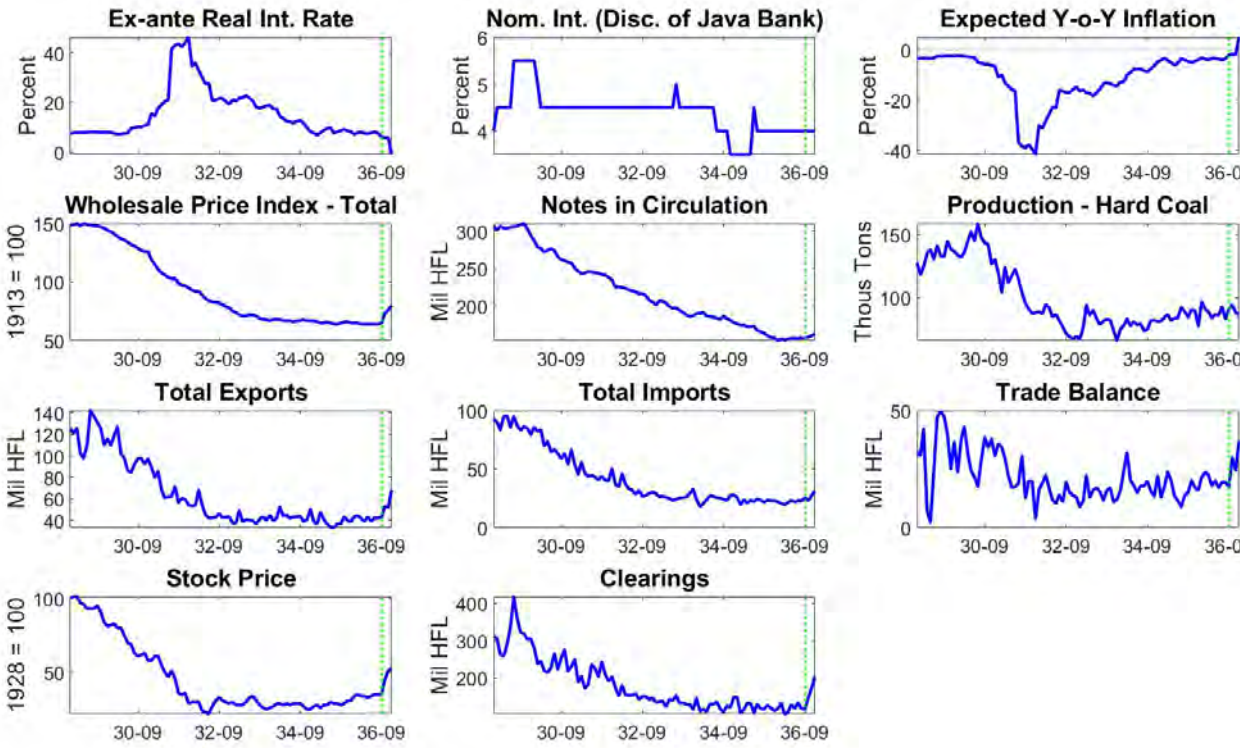
October 1931: exchange control
February 1934: devaluation
October 1936: devaluation

D.9 Denmark



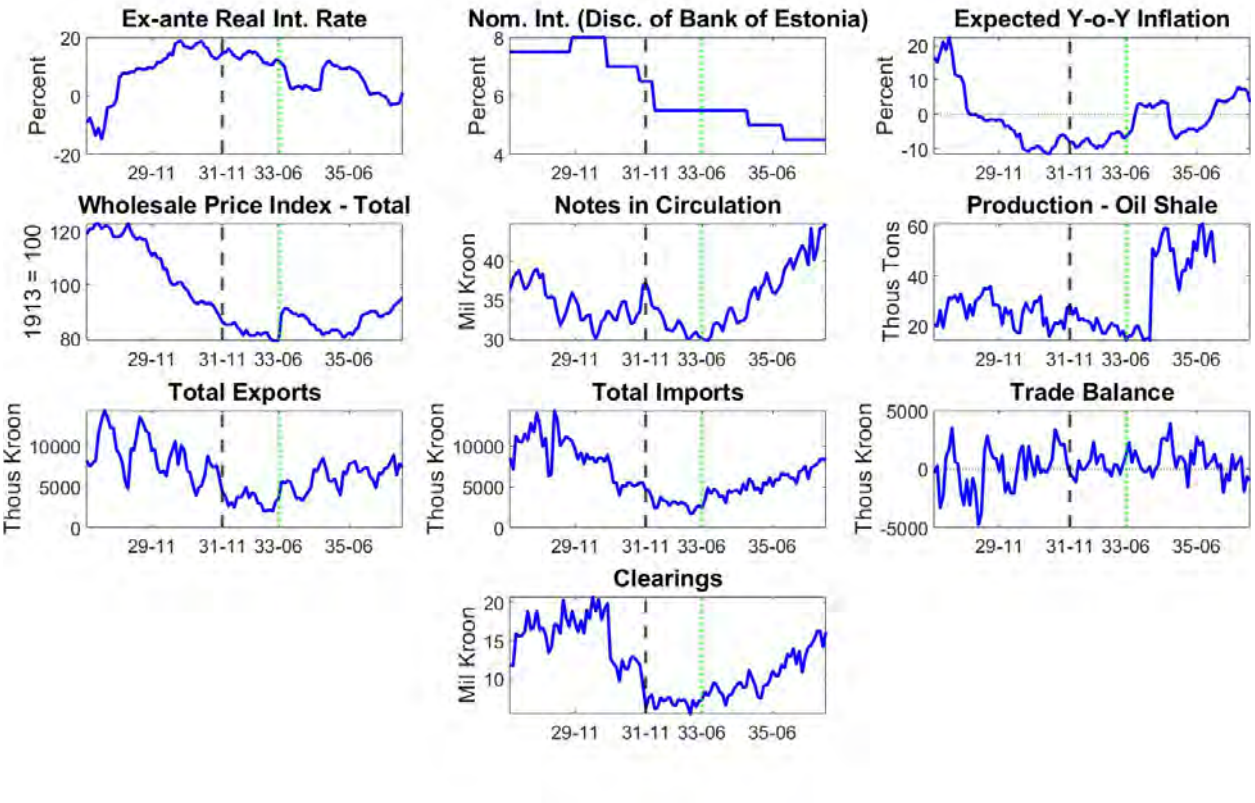
September 1931: official suspension of gold standard and devaluation

D.10 Dutch East Indies



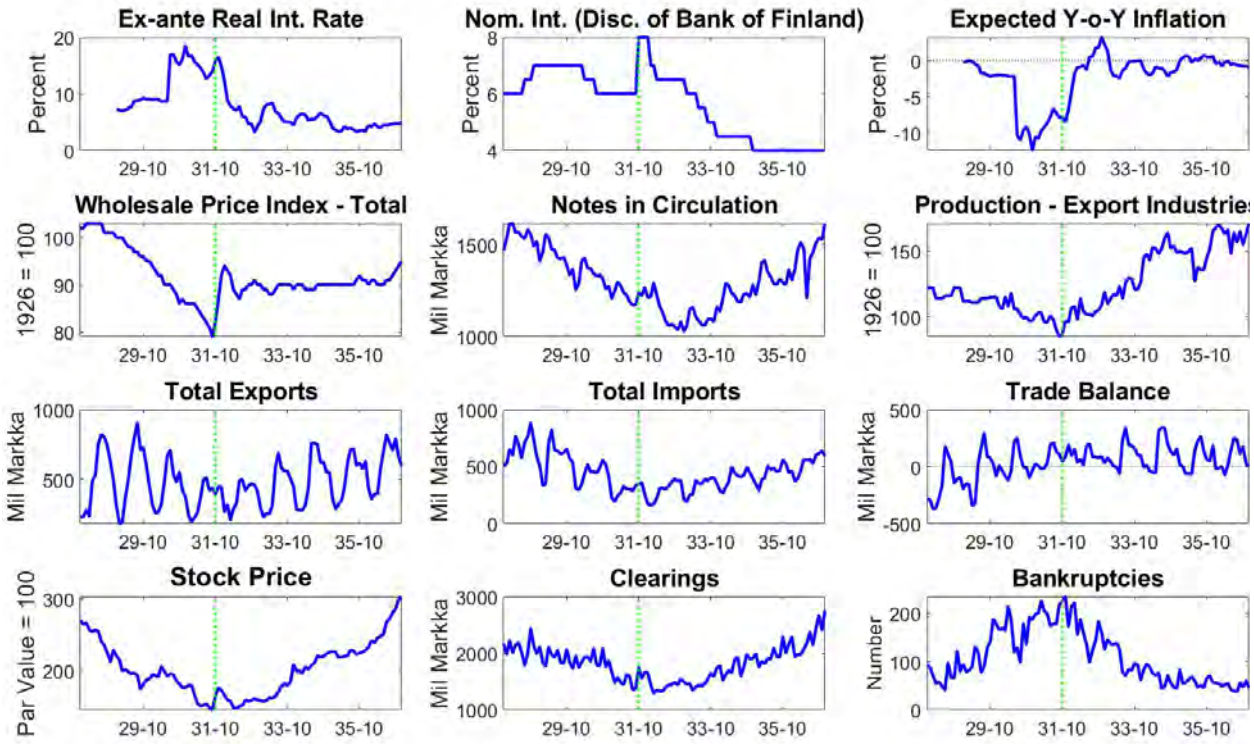
September 1936: Dutch suspension of gold standard

D.11 Estonia



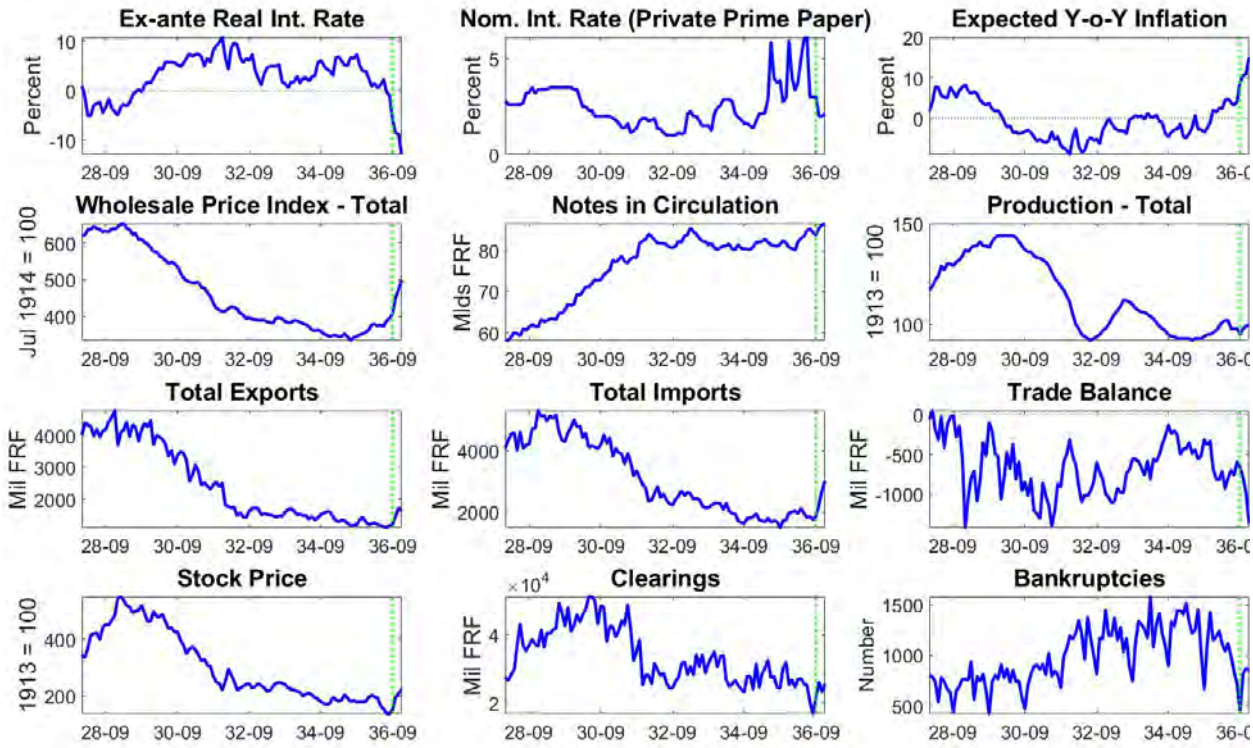
November 1931: exchange control
June 1933: official suspension of gold standard and devaluation

D.12 Finland



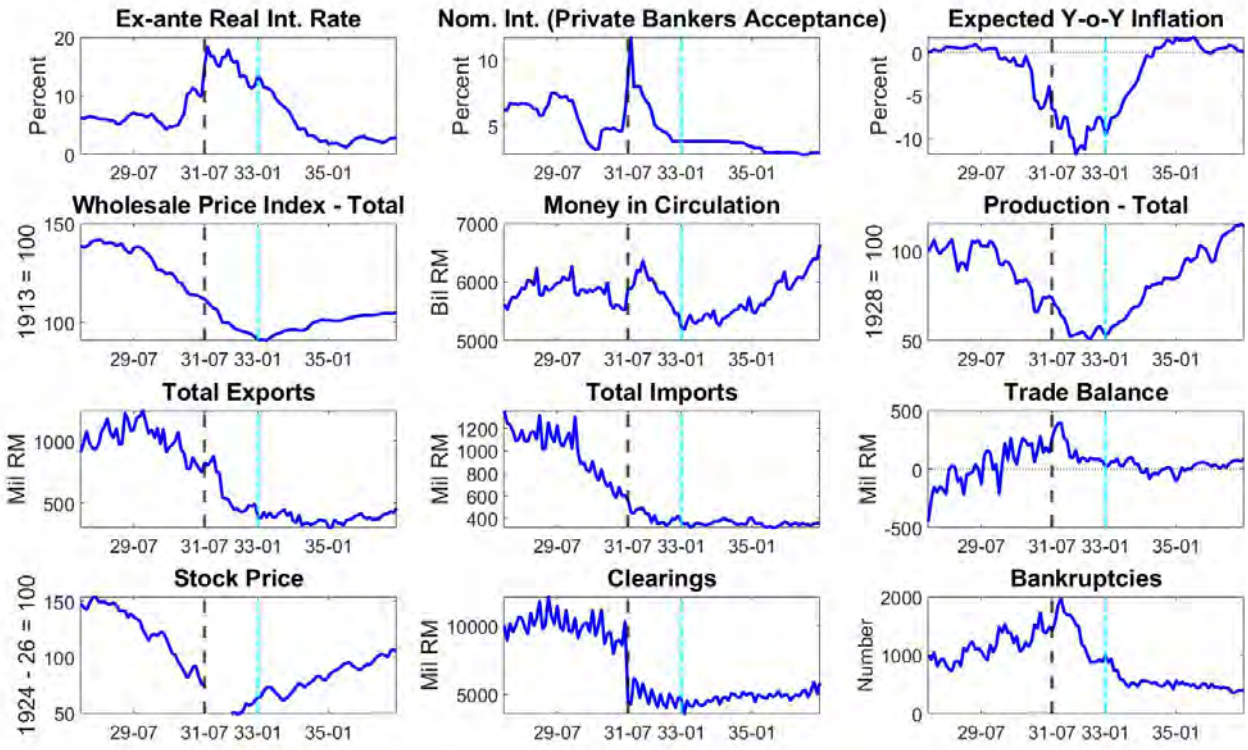
October 1931: official suspension of gold standard and devaluation

D.13 France



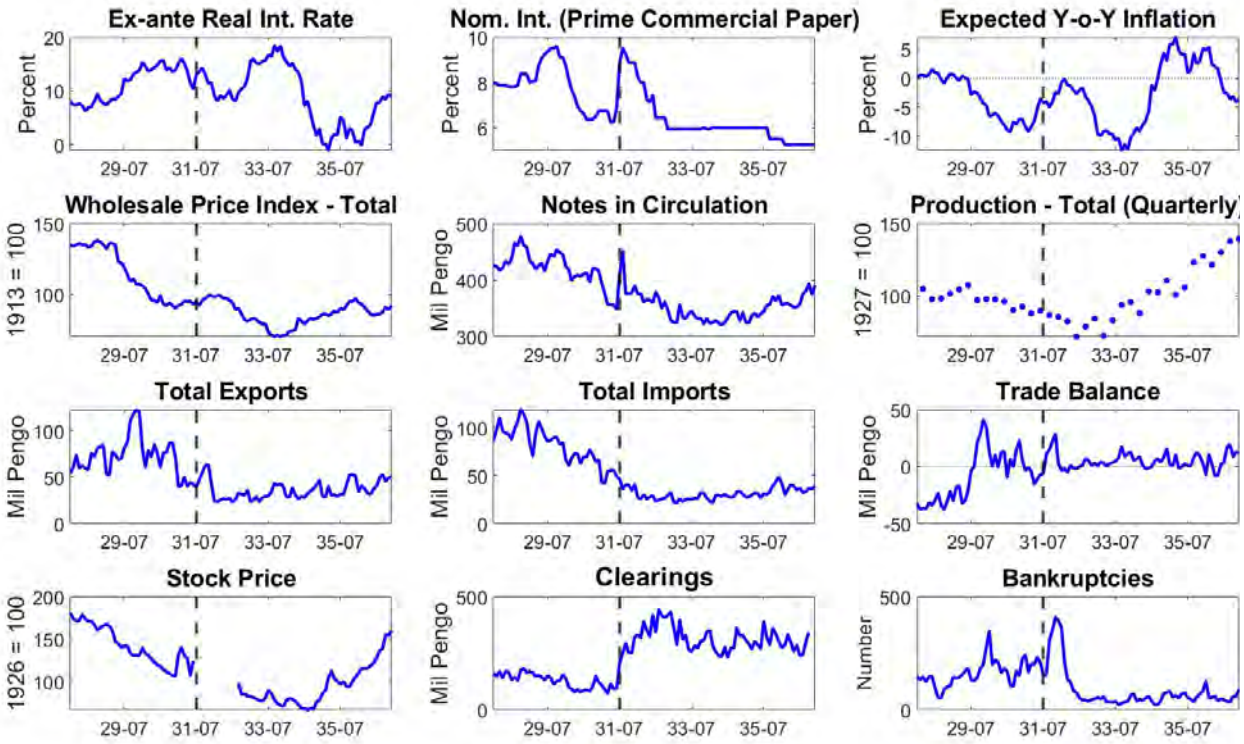
September 1936: devaluation

D.14 Germany



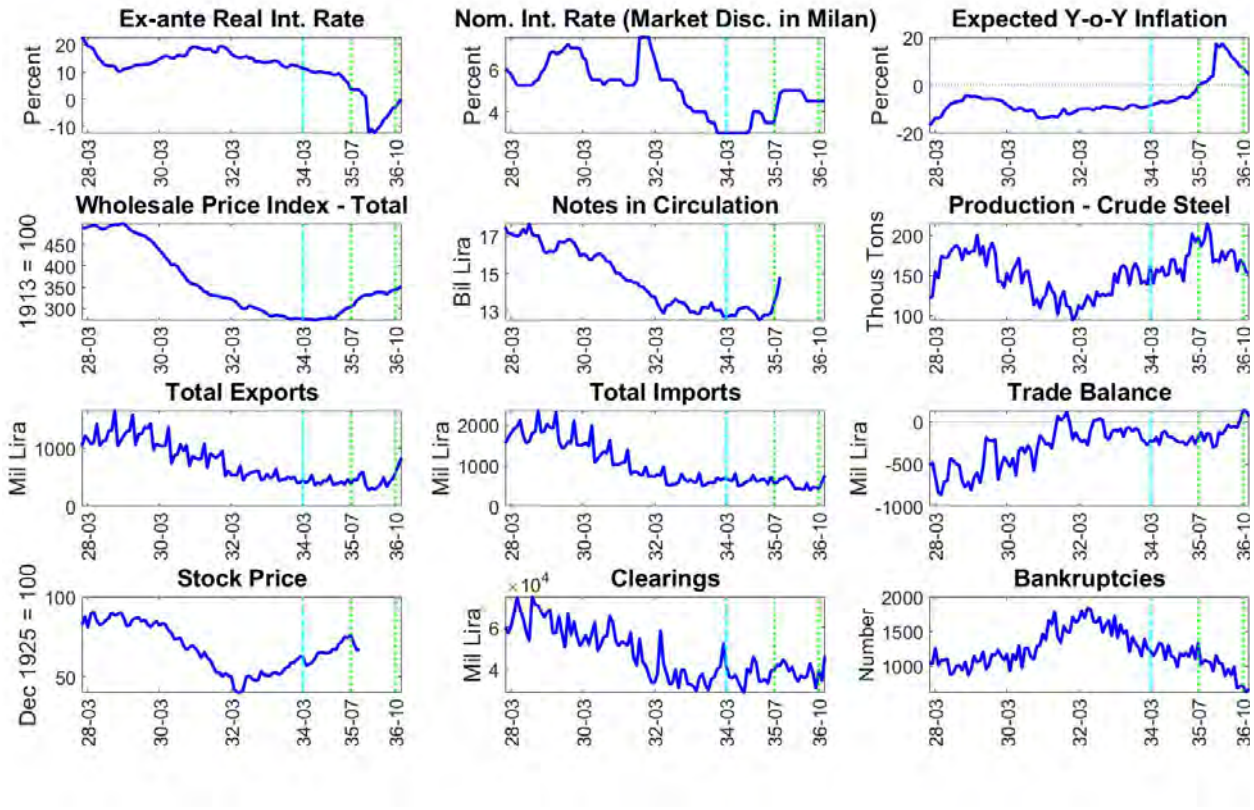
July 1931: exchange control
January 1933: Adolf Hitler's rise to power

D.15 Hungary



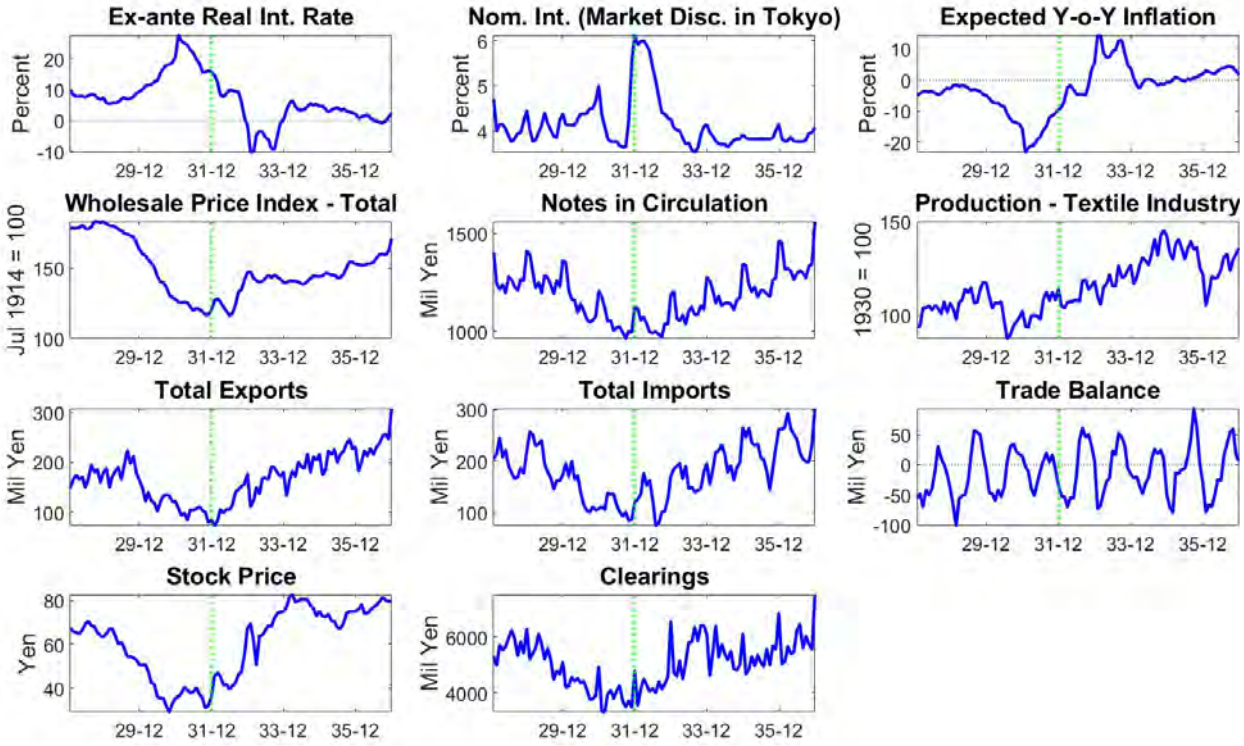
July 1931: exchange control

D.16 Italy



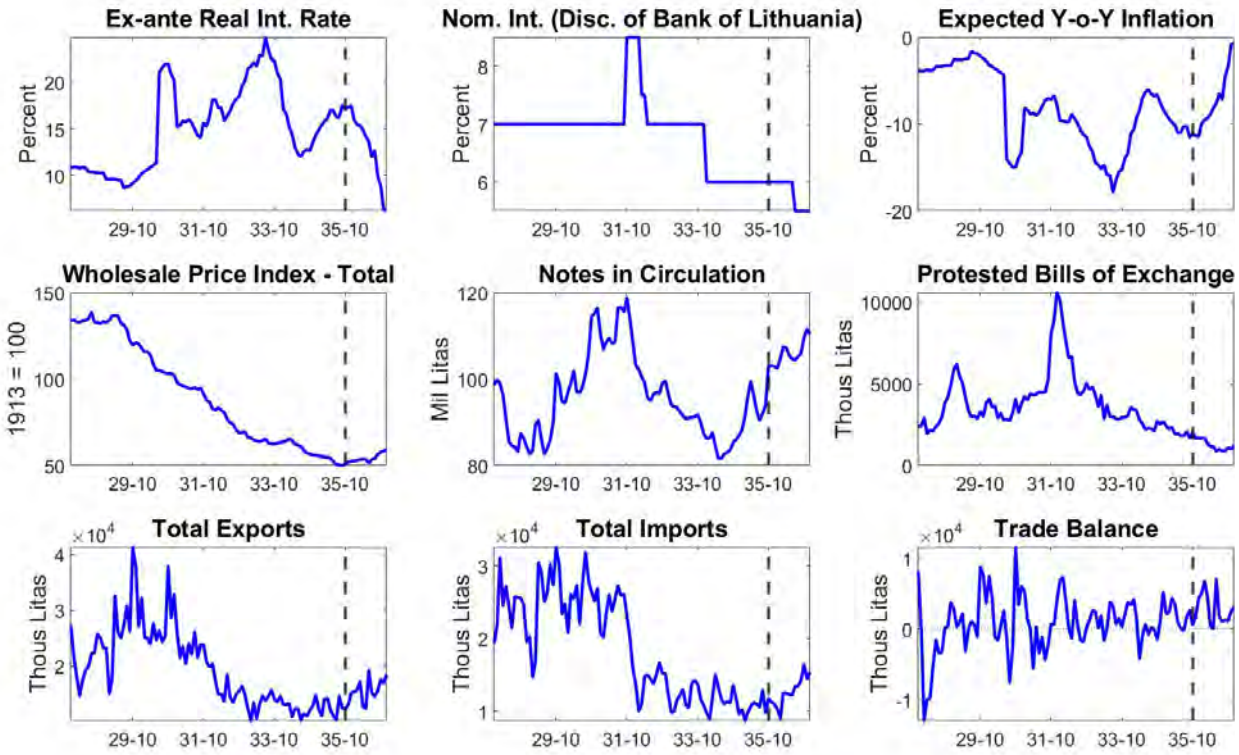
March 1934: devaluation
July 1935: abolition of 40% reserve requirement for paper money
October 1936: devaluation

D.17 Japan



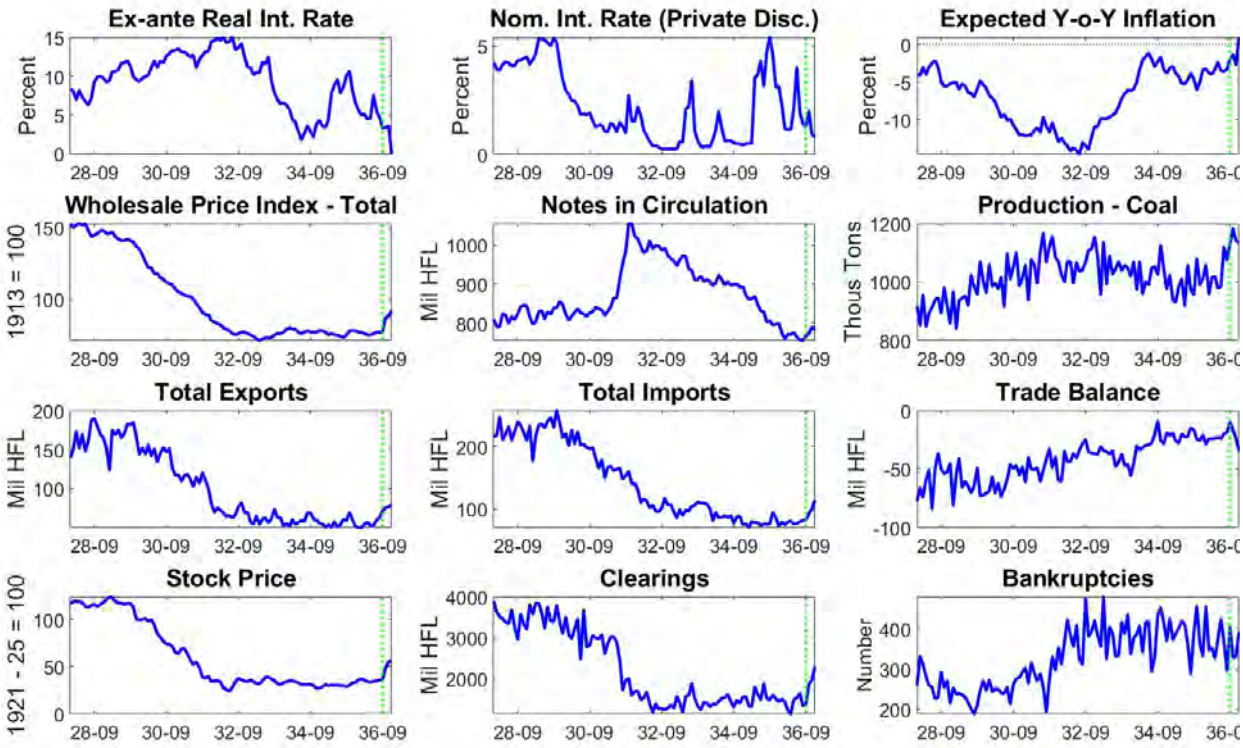
December 1931: official suspension of gold standard and devaluation

D.18 Lithuania



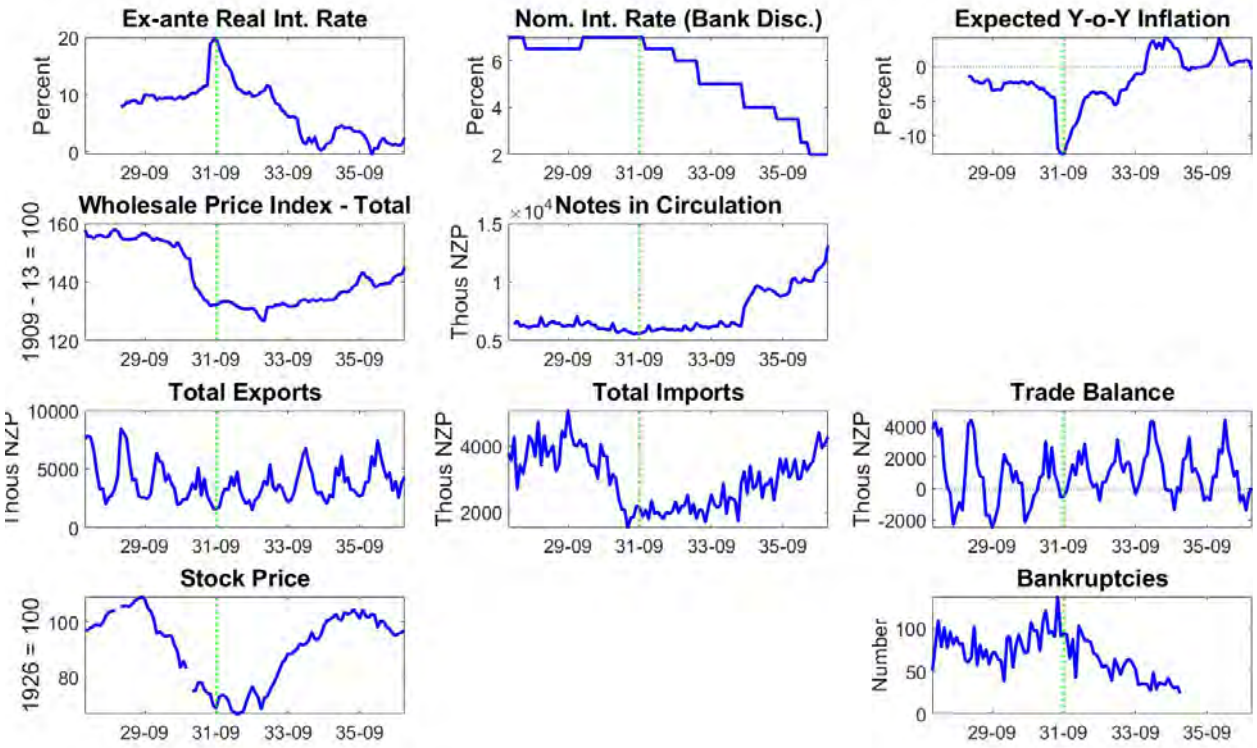
October 1935: exchange control

D.19 Netherlands



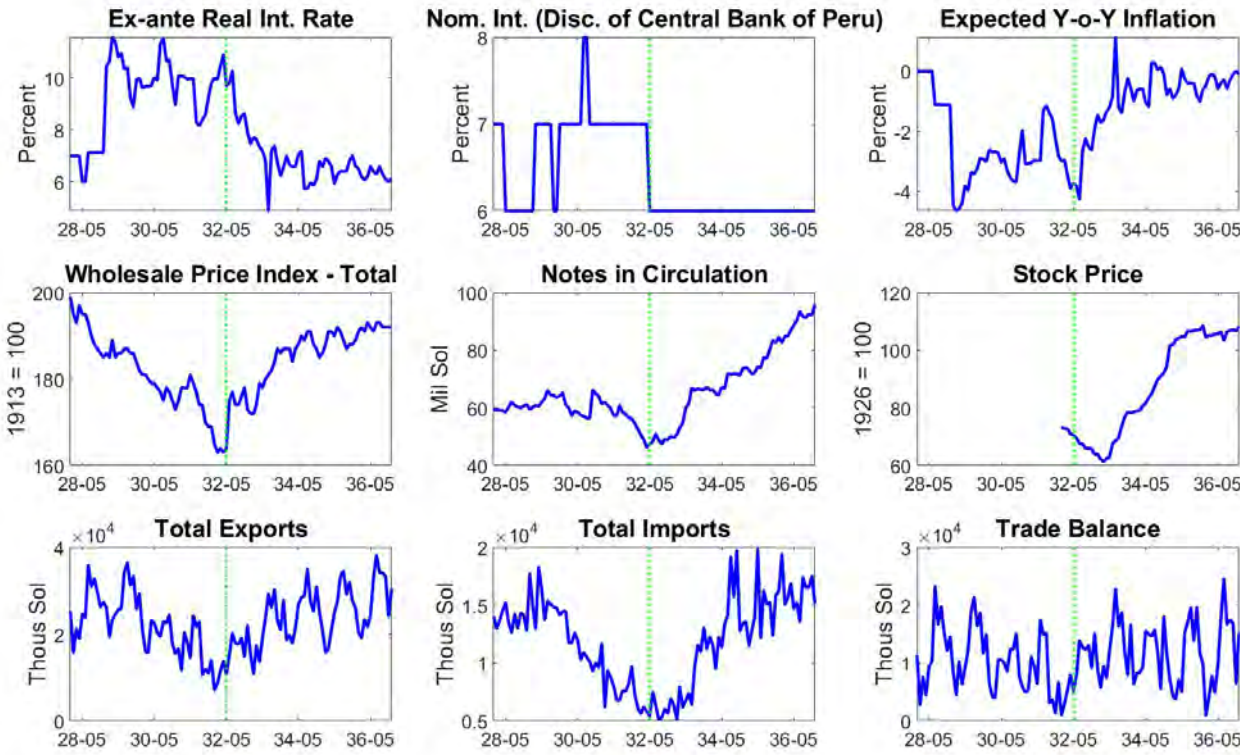
September 1936: official suspension of gold standard and devaluation

D.20 New Zealand



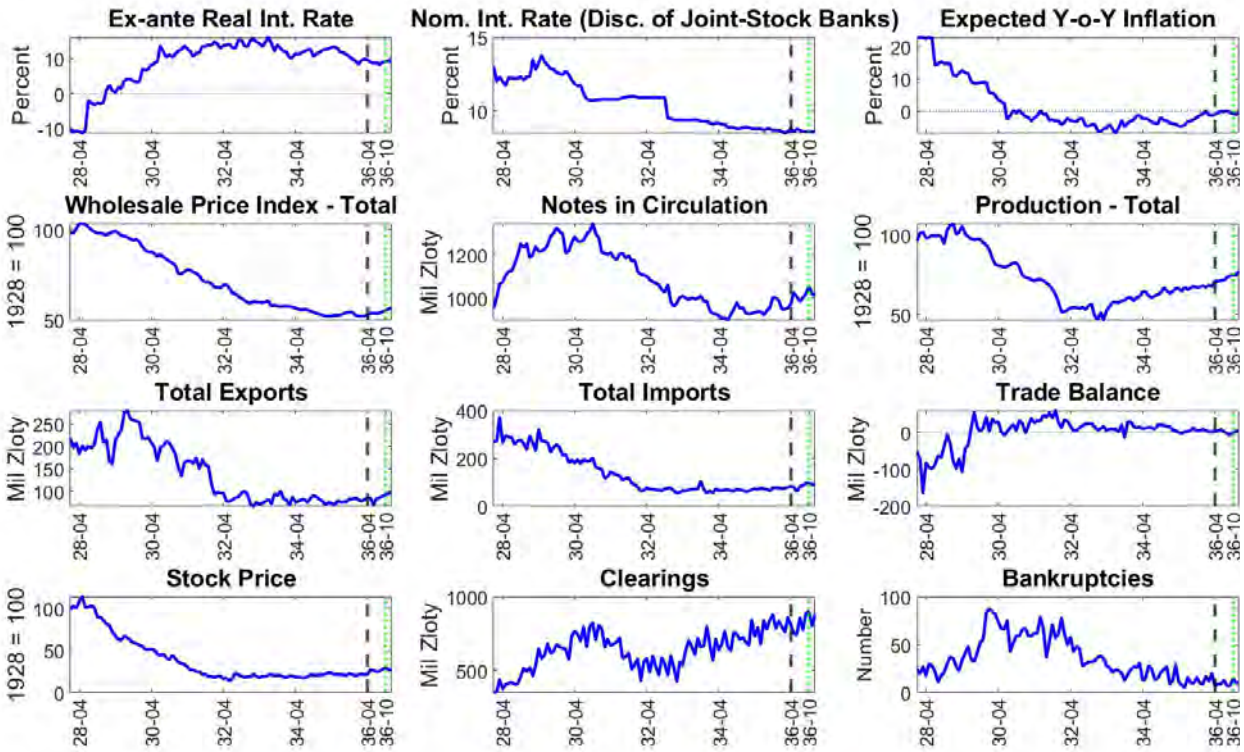
September 1931: official suspension of gold standard

D.21 Peru



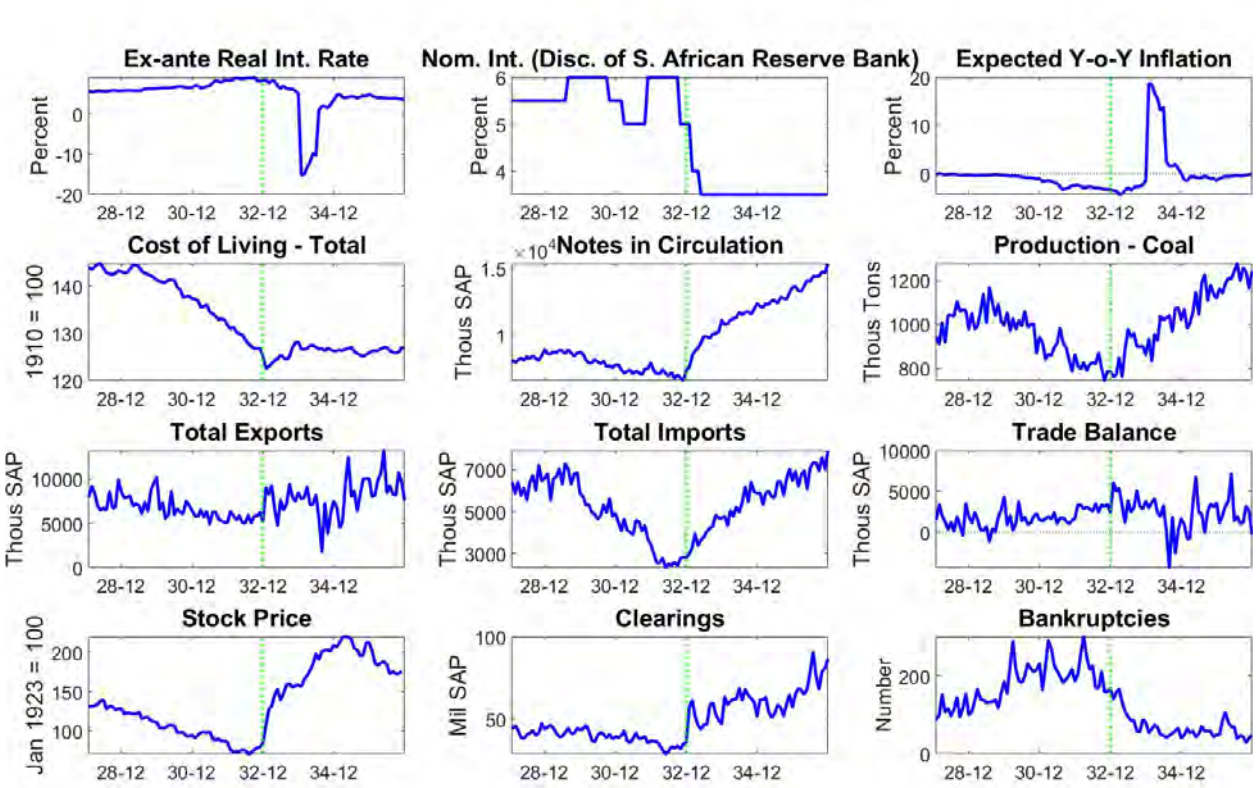
May 1932: official suspension of gold standard and devaluation

D.22 Poland



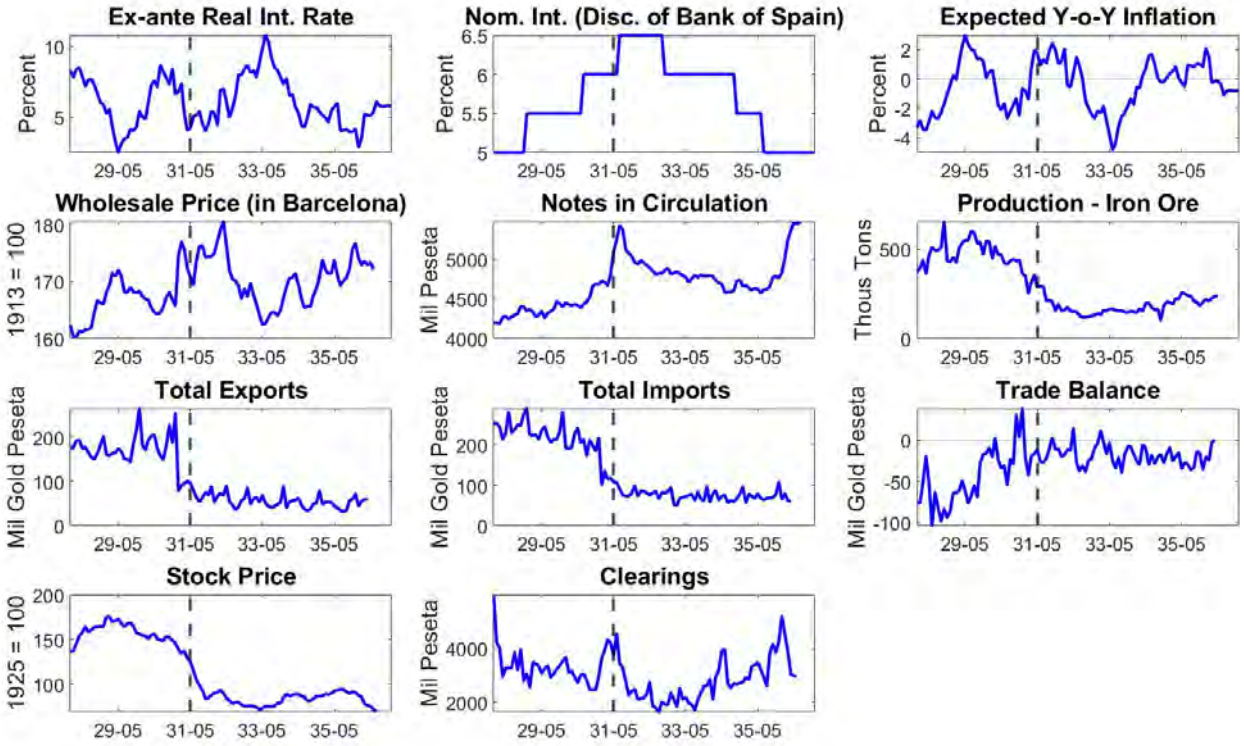
April 1936: exchange control
October 1936: devaluation

D.23 South Africa



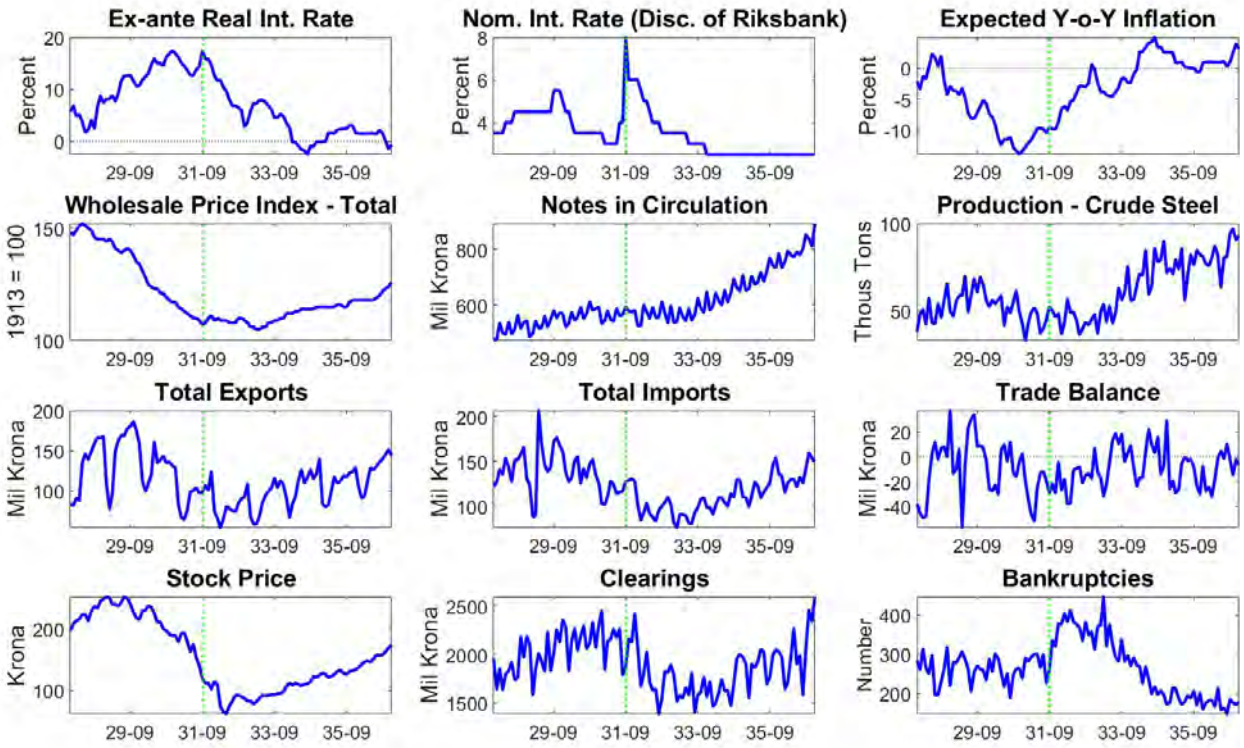
December 1932: official suspension of gold standard

D.24 Spain



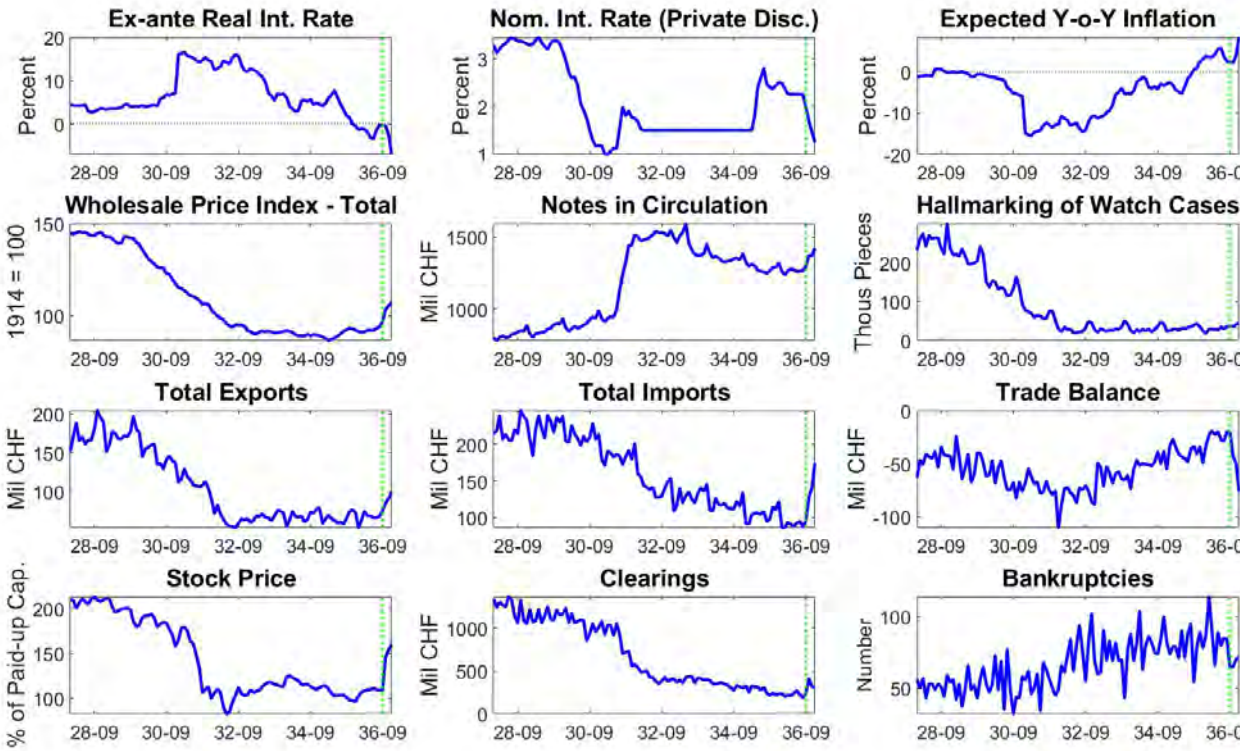
May 1931: exchange control
Spain did not return to gold standard after World War I.
Data are incomplete due to civil war that started in July 1936.

D.25 Sweden



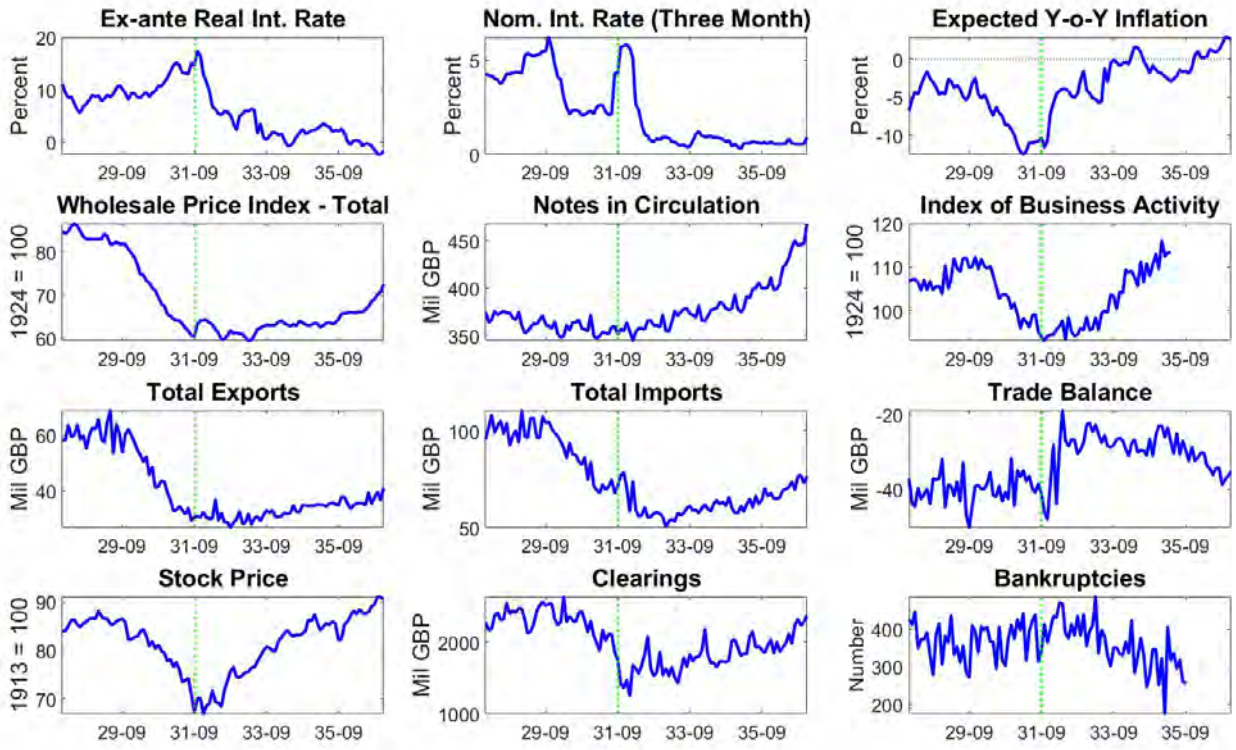
September 1931: official suspension of gold standard and devaluation

D.26 Switzerland



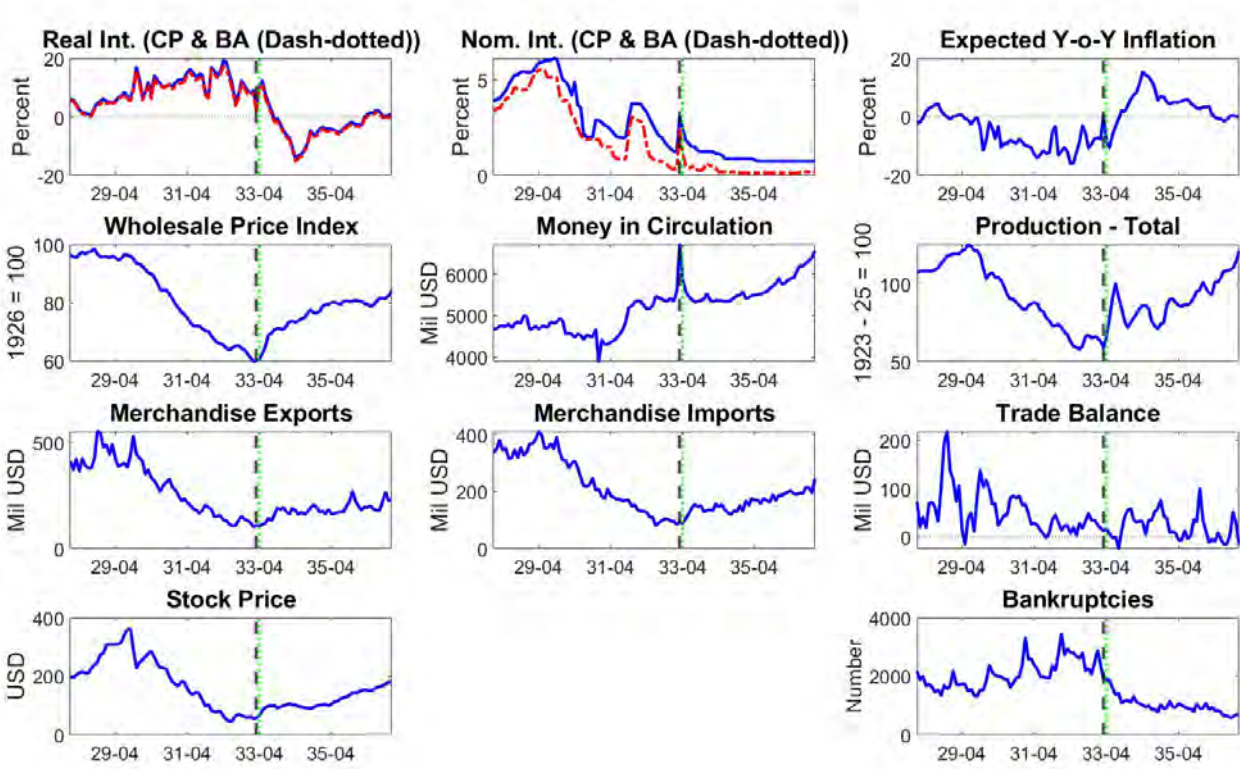
September 1936: devaluation

D.27 United Kingdom



September 1931: official suspension of gold standard and devaluation

D.28 United States



CP: prime commercial paper rate (blue solid)
BA: New York banker's acceptance rate (red dash-dotted)
March 1933: exchange control (black vertical dashed line)
April 1933: official suspension of gold standard and devaluation

E Dating departures for New Zealand and Group C

In Australia and New Zealand private banks managed the exchange rate, which was quoted as a premium or a discount vis à vis sterling; Drummond (1981, p. 100) comments that people in the two countries tended to assume that a pound was a pound wherever it had been issued, and that while prior to 1925 "the premiums and discounts had sometimes been sizable", "this had appeared unnatural." Faced with chronic balance of payments problems, in December 1929 the Australian government introduced legislation allowing it, operating in conjunction with the Commonwealth Bank, to require that other banks disclose their gold holdings; to require that gold be exchanged for Australian notes; and to ban the export of gold. The League of Nations (1937, p. 16) regarded this as an official suspension of the gold standard, but that was not how the government viewed it. The following month, faced with further gold losses, the Bank exercised its right to requisition gold holdings, and Schedvin (1988, p. 125) writes that "There is little doubt that the gold standard was, in fact, abandoned" then – but the authorities had chosen this option, rather than the alternative of banning gold exports, precisely because the latter would have been seen as unequivocally abandoning the gold peg. Schedvin argues that trying to keep the "myth" of gold standard adherence alive made sense, and that the myth persisted until mid-1930 (p. 126).

The Australian pound had been slipping in value relative to sterling since October 1929 but as mentioned earlier there was nothing unusual about this. By April 1930 it was 6% below par and there was a further modest devaluation in October to 9% below par. But it was the abrupt movement to 30% below par in January 1931 (Figure E.1) that in the eyes of most commentators marked the real devaluation (Eichengreen, 1992, pp. 235-6; Schedvin, 1988, pp. 164-8). Writing on January 10, The Economist commented approvingly that "now that a more nearly "true" exchange rate has been established, the normal economic forces should come into play."[34] It seems reasonable to date Australia's departure to this date, although it should be noted that the exchange rate remained pegged against sterling at a new lower rate for the best part of a year. Indeed, in February the newly elected Premier of New South Wales urged "the abandonment of the gold standard", a course of action that was opposed by the Chairman of the Commonwealth Bank in the following month (Brown, 1940, pp. 877-8). One could therefore also argue that it was sterling's departure from gold in September that marked the real rupture in the Australian case: Table I lists both January and September 1931 as potential departure dates.

[34]"Australian Exchange Developments." *Economist*, 10 Jan. 1931, p. 59+.

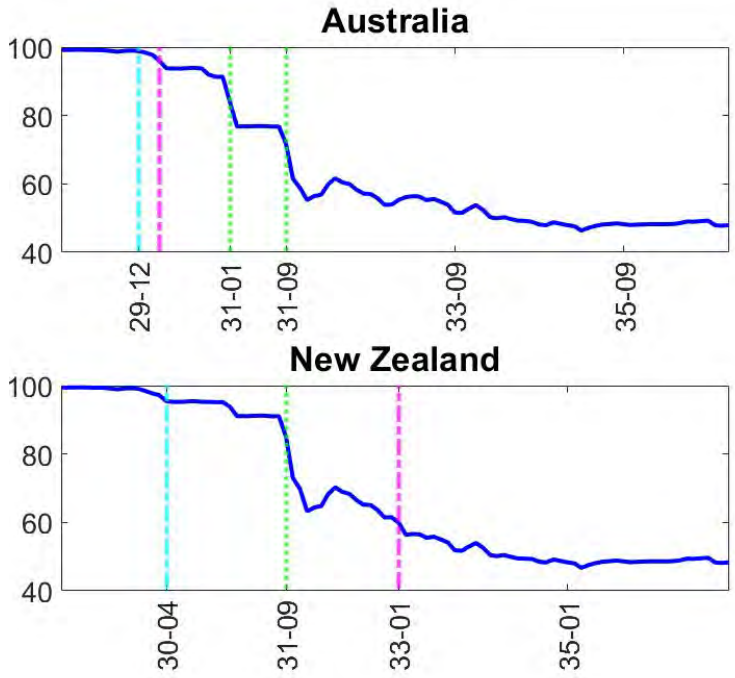


Figure E.1: Currencies' gold value (percentage of parity)

Turning to New Zealand, the country's pound gradually slipped against sterling in the early years of the depression, reaching a rate of £NZ110 to £stg100 by early 1931. The League of Nations lists a devaluation or depreciation as occurring in April 1930, and both Brown, and Obstfeld and Taylor, date New Zealand's departure to that month. But the depreciation was viewed by the banks as undesirable and, hopefully, temporary: it was also relatively minor as Figure E.1 indicates. During 1932 there were growing calls for devaluation against sterling, however, and the government finally acceded to these calls in January 1933 (Fleming, 1997; Singleton, 2003). By that time, however, sterling itself had abandoned gold: we therefore favour dating New Zealand's departure to September 1931, when the UK left, and Figure E.1 strongly suggests that this did indeed mark the real break with gold.[35]

When Austria imposed exchange controls in October 1931 the schilling was trading at a 10-15% discount on informal markets; by November the discount had risen to over 34%, a dramatic shift. By this stage, according to the official history of the Austrian Central Bank, "Policy makers did not, in actual fact, truly consider reinstating the gold parity of the schilling." When in March 1933 the government decreed that "all liabilities in gold or foreign exchange had to be settled at the intrinsic value prevailing at the contract date," this was merely an acknowledgment "that the schilling had been devalued" (Jobst and Kernbauer, 2016, pp. 180, 183; Eichengreen, 1992, p. 269). It thus seems reasonable to date Austria's

[35]September 1931 is also when the League of Nations considered New Zealand to have officially suspended the link with gold, and Kemmerer (1954) also favours a 1931 departure.

departure to October 1931, as do both Brown, and Obstfeld and Taylor, although a case could also be made for the September 1931 date favoured by Wolf (2008), by which time black market rates were already diverging from parity.

On the other hand, at the end of October 1931 the Economist was reporting that the Austrian government regarded the schilling as being "perfectly stable" and that it was therefore refusing to prohibit "gold clauses" in commercial invoicing (specifying that payments be made in terms of gold) since in any event such clauses were "of purely theoretical significance."[36] In April 1933, however, the Central Bank permitted the sale in private clearing of "all incoming foreign currencies (not only those derived from the export trade, as heretofore)". The Economist commented that "The foreign exchange regulations, in fact, in so far as they apply to the compulsory exchange rate of the schilling, have been withdrawn, and it is now publicly known that the schilling has dropped by 30 to 32 per cent." The Austrian public, it noted, was following these developments "with anxiety."[37] The League of Nations (1937) dated Austria's official suspension of the gold standard to this month, and it seems that the official recognition of what had become de facto reality, combined with the abandonment of the remaining legislative props to the gold standard, may have mattered for expectations. We therefore consider two potential departure dates for Austria: October 1931 and April 1933.

Czechoslovakia imposed exchange controls in October 1931, and then devalued against gold in both February 1934 and October 1936. We consider both of these dates, although Eichengreen notes that the first devaluation "was not used as an occasion to expand domestic credit" (Eichengreen, 1992, p. 365). Finally, Italy is listed by the League of Nations as having depreciated or devalued in March 1934, and two months later exchange controls were introduced. In May 1935 the *Sovrintendenza allo scambio delle valute* was created, for the purpose of managing foreign exchange.[38] A greater turning point, in terms of what matters to us, arguably came in July 1935 when the 40% reserve requirement regarding paper money was abolished, allowing the government to monetise a greater portion of its budget deficits. In Luigi Einaudi's view the shift meant that the future of the lira would no longer be determined by gold reserves, since these could now be replaced by government paper, but by the supply of and demand for the currency. The lira remained overvalued, however, and the gold standard was definitively abandoned in October 1936 (Toniolo, 1980, pp. 290, 293–5; Fratianni and Spinelli, 1997, pp. 153-4). We consider both July 1935 and October 1936 as candidate dates.

[36]"Austria." *Economist*, 31 Oct. 1931, p. 807+.
[37]"Austria." *Economist*, 22 Apr. 1933, p. 862+.
[38]We are grateful to Gianni Toniolo for pointing this out to us.

F Yield curve evidence from the US and UK

The travails of President Roosevelt in 1933 place the United States in our Group B of countries that abandoned the gold standard in stages.[39] Our estimated dynamic factor model nevertheless identifies a clear takeoff in expected inflation in early 1933.[40] In this appendix we fact-check this result against evidence from US bond markets. It is well-known that bond term premia have predictive power for future economic activity, so if expectations of future inflation were really revised upwards in 1933 then we would expect to see that also reflected in bond term premia.[41] The results are shown in Figure F.1. We measure the bond term premium as the difference between the yield to maturity on 10 and 3-year zero coupon government bonds, as estimated for the US by Hall and Sargent (2011).

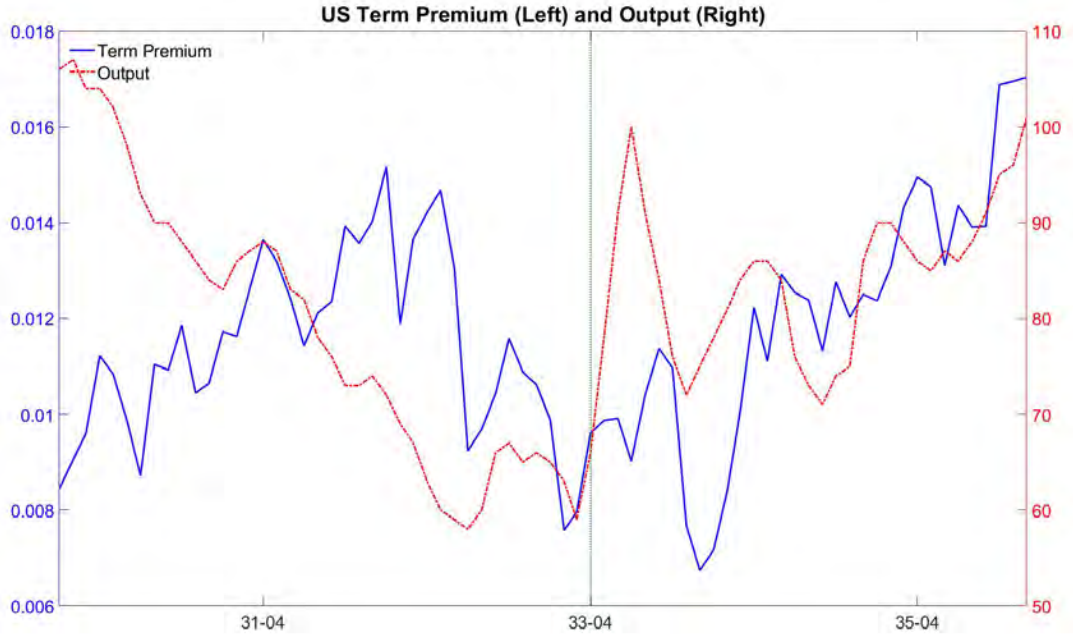


Figure F.1: Term premium and output in the US

The trends in the US bond term premium in Figure F.1 are consistent with our dynamic factor model estimates and our narrative that leaving the gold standard was instrumental in shifting expectations. The term premium narrowed with the deflationary expectations of 1932 and early 1933, only starting to widen from April 1933 onwards as bond markets priced

[39] Edwards (2018) provides an entertaining narrative account of events at this time.

[40] See Figure VIII.

[41] Bond term premia have predictive power for future economic activity under the expectations hypothesis of the term structure of interest rates, where long rates are a function of current and future expected short rates. If expectations of future inflation and output are revised upwards then the term premia on long bonds should increase, as bond market participants expect that the yield on short bonds will rise in the future as the monetary authority responds to inflationary pressures. See Estrella and Mishkin (1997) for more.

in increased expectations of future inflation. There is a temporary reversal in the bond term premium at the beginning of 1934, but the broad picture that emerges is one of a V-shaped evolution in both the bond term premium and output, with the bottom of the V occurring around the time the US left the gold standard.

The corresponding analysis for the UK is in Figure F.2, which plots the term premium implied by estimates of the yields on 3 and 10-year zero coupon government bonds from Ellison and Scott (2020). The bond term premium narrowed in the run up to the UK leaving the gold standard in September 1931, as it did in the US before their departure in April 1933. However, the post-departure experience of the UK was notably different. The term premium remained relatively compressed until the Lausanne Conference in July 1932 and the cancellation of the Young Plan in August 1932, at which point it widened dramatically.[42] The evidence from the term premium therefore departs from our dynamic factor model estimates in Figure III, which describe a pronounced increase in expected inflation late in 1931. Our dynamic factor model suggests that leaving the gold standard had a more immediate and unambiguous impact on UK expectations than appears to be the case from bond market evidence.

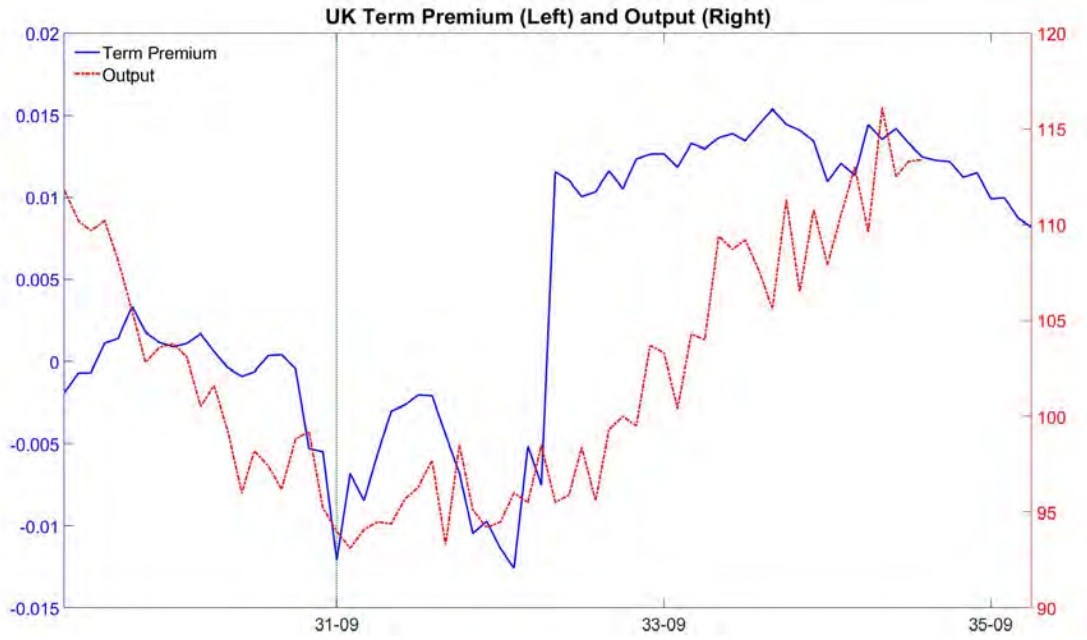


Figure F.2: Term premium and output in the UK

[42] Ellison et al. (2019) discuss the Lausanne Conference and the Young Plan from a UK perspective.

G Further results by country

G.1 UK

The fixed target date is September 1932, one year after leaving the gold standard. The nominal interest rate in the 12 months to September 1932 is known as of September 1931, so there is no distinction between the forecast and realised values of the nominal rate from September 1931 onward. The expected inflation in the 12 months to September 1932, hence real interest rate, continues to evolve until November 1932 due to the two-month delay in the price data release.

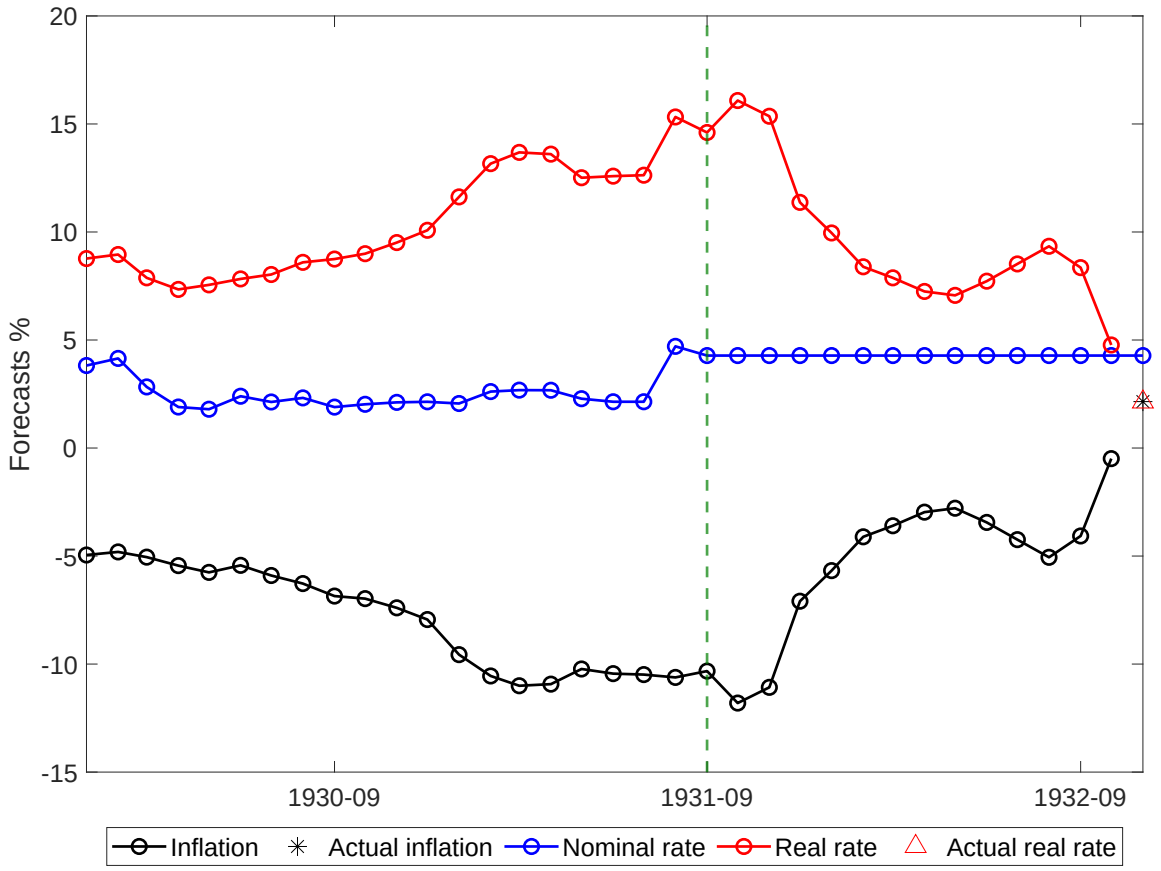


Figure G.1: Real-time forecasts of UK inflation, nominal interest rate and real interest rate in the 12 months to September 1932.

G.2 US

The fixed target date is April 1934, one year after leaving the gold standard. The nominal interest rate in the 12 months to April 1934 is known as of April 1933, so there is no distinction between the forecast and realised values of the nominal rate from April 1933 onward. The expected inflation in the 12 months to April 1934, hence real interest rate, continues to evolve until June 1934 due to the two-month delay in the price data release.

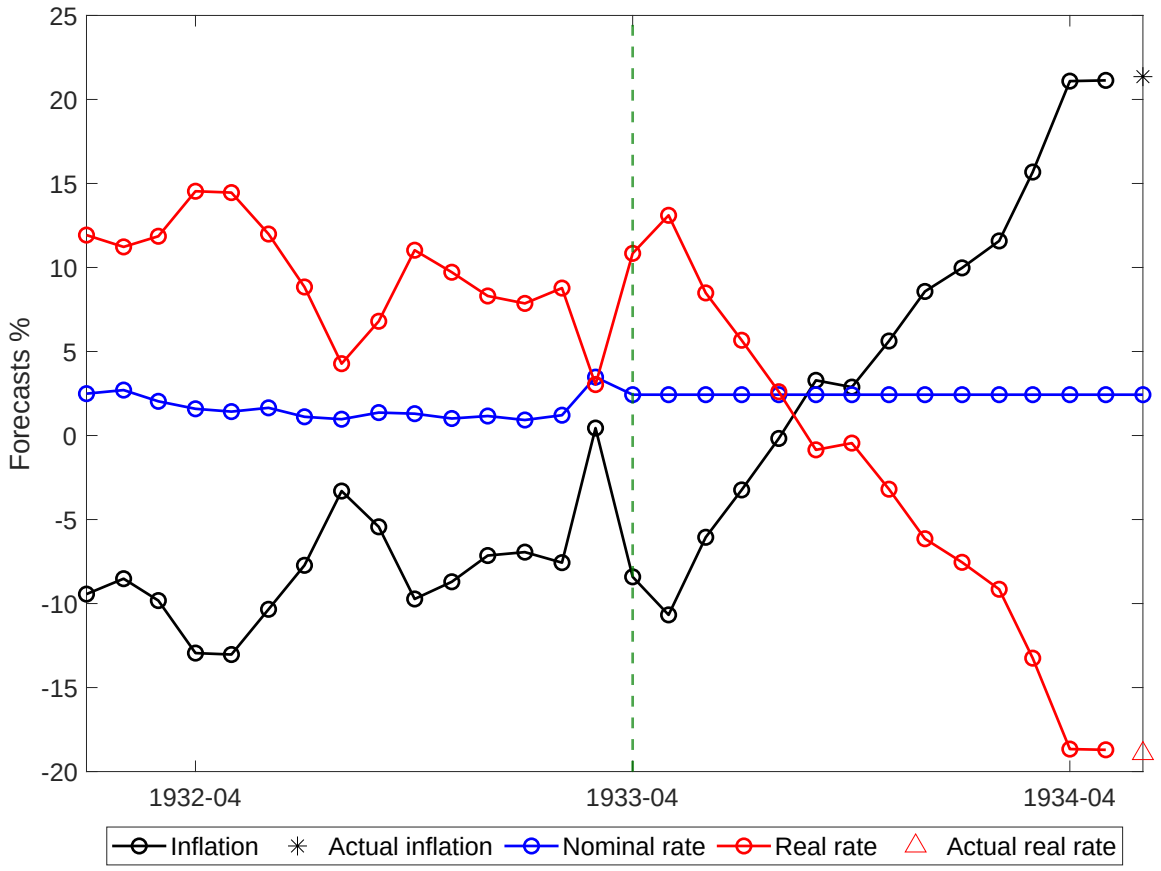


Figure G.2: Real-time forecasts of US inflation, nominal interest rate and real interest rate in the 12 months to April 1934.

G.3 Germany

The fixed target date is January 1934, one year after Hitler's accession to power. The nominal interest rate in the 12 months to January 1934 is known as of January 1933, so there is no distinction between the forecast and realised values of the nominal rate from January 1933 onward. The expected inflation in the 12 months to January 1934, hence real interest rate, continues to evolve until March 1934 due to the two-month delay in the price data release.

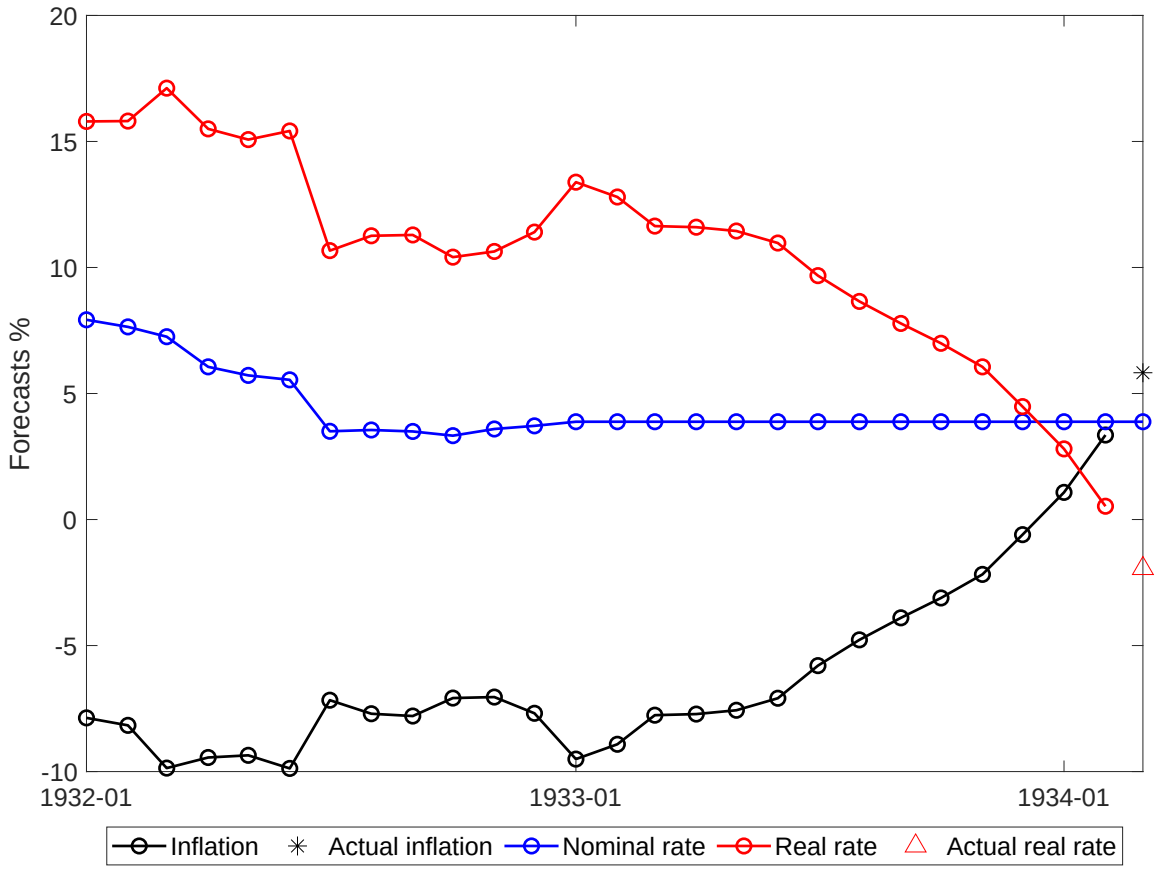


Figure G.3: Real-time forecasts of Germany inflation, nominal interest rate and real interest rate in the 12 months to January 1934.

H Further cross-country comparisons

H.1 Simple tests

The simple tests ask whether the change in a variable after a country left gold is significantly different from zero. For a cross-section of countries, we conduct hypothesis tests at different horizons under the null hypothesis of no change in a variable relative to its average in the three months prior to leaving. The results are in Table H.1, where each row reports a separate test for n months after leaving, with n varying from 6 months before to 12 months after. The columns of each row report the mean change in 12-month ahead expected inflation $\Delta\pi^e$, nominal interest rate Δi, real interest rate $\Delta(i-\pi^e)$, prices $100\Delta\log P$ and output $100\Delta\log Y$ relative to their average values in the three months before departure, with p-values derived from the appropriate student's t-distribution. The final row gives the number of countries for which data are available for each variable. For example, expected inflation after three months was on average 2.53 percentage points higher than it was over the three months before leaving in the 12 countries for which data are available, with a p-value of 0.01.

The text in Section 8 highlights a significant rise in the real interest rate on departure and after one month (1.62 and 1.72 respectively in Table H.1, both with p-values less than 0.05) but a significant fall after three months all the way out to 12 months (-2.07 at three months and even more negative in all subsequent rows, all with p-values less than 0.01).

Months after	$\Delta\pi^e$		Δi		$\Delta(i-\pi^e)$		$100\Delta\log P$		$100\Delta\log Y$	
departure	*mean*	p	*mean*	p	*mean*	p	*mean*	p	*mean*	p
-6	-1.29	0.20	-0.14	0.24	1.01	0.32	3.47	0.00	3.02	0.28
-5	-0.75	0.37	-0.17	0.20	0.35	0.66	3.11	0.00	2.73	0.06
-4	-0.20	0.76	-0.19	0.18	-0.18	0.77	1.94	0.00	3.30	0.12
-3	0.42	0.40	-0.21	0.17	-0.62	0.24	0.65	0.00	0.41	0.75
-2	-0.42	0.19	-0.14	0.15	0.28	0.37	0.01	0.94	0.62	0.53
-1	0.00	0.99	0.35	0.09	0.34	0.52	-0.66	0.00	-1.03	0.32
0	-0.52	0.29	0.97	0.07	1.62	0.02	-0.46	0.28	1.79	0.18
$+1$	-0.93	0.13	0.84	0.07	1.72	0.03	4.08	0.02	3.43	0.37
$+2$	0.21	0.67	0.68	0.18	0.49	0.46	6.28	0.00	7.06	0.24
$+3$	2.53	0.01	0.67	0.19	-2.07	0.05	6.90	0.00	9.60	0.21
$+4$	4.29	0.00	0.56	0.24	-3.88	0.00	6.27	0.01	5.79	0.35
$+5$	5.10	0.00	0.39	0.40	-4.81	0.00	6.10	0.01	7.30	0.16
$+6$	5.04	0.00	-0.05	0.87	-5.14	0.00	5.62	0.02	8.26	0.12
$+7$	5.24	0.00	-0.09	0.77	-5.54	0.00	4.99	0.05	4.00	0.52
$+8$	5.84	0.00	-0.31	0.24	-6.31	0.00	5.14	0.05	6.94	0.25
$+9$	6.24	0.00	-0.45	0.10	-6.82	0.00	5.48	0.06	5.83	0.34
$+10$	7.11	0.00	-0.46	0.10	-7.57	0.00	6.04	0.04	4.76	0.53
$+11$	7.99	0.00	-0.53	0.08	-8.56	0.00	6.98	0.03	6.77	0.36
$+12$	8.77	0.00	-0.65	0.03	-9.53	0.00	7.53	0.02	7.64	0.32
N	12		11		11		12		7	

Table H.1: The average change after leaving the gold standard for a cross-section of countries, at different horizons. *mean* and p are average change and p-value (two-sided), respectively.

H.2 Nonparametric tests

The simple tests may be susceptible to outliers, for example according to Romer (1993) the US recovery was exceptional. To address this, we abstract from the magnitude of changes and take a nonparametric approach that instead tests whether variables rise or fall before and after a country leaves the gold standard. To perform the test, we simply count the number of countries for which a variable is higher n months after leaving. Under the null hypothesis that a variable is independently and equally likely to rise or fall in each country, the count statistic has a binomial distribution with the success probability of 0.5, and we can calculate its p-value. The results are in Table H.2, with each row as before presenting results for n months after departure. Reading across the $+3$ row for the change after two months relative to the average in the three months before leaving, in 11 out 12 countries expected inflation was higher, in 5 out 11 the nominal interest rate was higher, in 2 out of 11 the real interest rate was higher, in 10 out of 12 prices were higher and in 5 out of 7 output was higher. The associated p-values are 0.00, 0.23, 0.03, 0.02 and 0.16.

Section 8 notes that it is highly unlikely to see the real interest rate falling after leaving in all 11 countries, if rising and falling are independently equally likely. It is based on the counts $\#$ in the $\Delta(i - \pi^e)$ column of Table H.2 being zero from $+4$ onward, with p-values < 0.01.

Months after	$\Delta\pi^e$		Δi		$\Delta(i-\pi^e)$		$100\Delta\log P$		$100\Delta\log Y$	
departure	#	p	#	p	#	p	#	p	#	p
-6	4	0.12	1	0.01	8	0.08	12	0.00	4	0.27
-5	5	0.19	1	0.01	7	0.16	11	0.00	5	0.16
-4	5	0.19	1	0.01	6	0.23	11	0.00	5	0.16
-3	8	0.12	2	0.03	3	0.08	9	0.05	5	0.16
-2	5	0.19	1	0.01	5	0.23	7	0.19	5	0.16
-1	4	0.12	4	0.16	8	0.08	0	0.00	2	0.16
0	5	0.19	6	0.23	7	0.16	4	0.12	6	0.05
$+1$	3	0.05	5	0.23	7	0.16	9	0.05	4	0.27
$+2$	6	0.23	5	0.23	6	0.23	10	0.02	4	0.27
$+3$	11	0.00	5	0.23	2	0.03	10	0.02	5	0.16
$+4$	11	0.00	5	0.23	0	0.00	9	0.05	4	0.27
$+5$	11	0.00	5	0.23	0	0.00	10	0.02	5	0.16
$+6$	12	0.00	4	0.16	0	0.00	7	0.19	5	0.16
$+7$	11	0.00	4	0.16	0	0.00	7	0.19	4	0.27
$+8$	12	0.00	4	0.16	0	0.00	7	0.19	4	0.27
$+9$	12	0.00	3	0.08	0	0.00	7	0.19	5	0.16
$+10$	12	0.00	3	0.08	0	0.00	8	0.12	4	0.27
$+11$	12	0.00	3	0.08	0	0.00	8	0.12	4	0.27
$+12$	12	0.00	2	0.03	0	0.00	10	0.02	4	0.27
N	12		11		11		12		7	

Table H.2: Number of countries # with inflation expectations, nominal interest rate, real interest rate, prices or output higher than average of three months before leaving the gold standard, at different horizons. p is probability of observing each outcome under the null that higher or lower values are independently equally likely.

H.3 Placebo tests

The simple and nonparametric tests are potentially sensitive to the presence of aggregate trends and/or shocks. If variables are rising throughout the sample period, then it is not surprising to find significant effects when comparing variables before and after leaving the gold standard. That would be true of changes after n months starting in any month, not just the months after leaving. Placebo tests speak to this by asking whether the dates on which countries left the gold standard are in some way special. We do this by (i) assigning random departure dates to each country, (ii) counting for how many countries each variable rises after their assigned departure date, and (iii) comparing the distribution of counts with the random dates to the counts with the actual dates (i.e., our dating in Table I).

The results for the real interest rate are in Figure H.1, where the random departure dates are independently drawn from a uniform distribution with support from January 1930 to December 1935, the sample period considered in Section 9.1. The histograms show the distribution of counts using the random dates; the red dots the counts with the actual dates from the $\Delta(i - \pi^e)$ column in Table H.2. The figure strongly suggests there is something special about the actual departure dates for the behaviour of the real interest rate, as many of the red dots are deep in the tails of the distributions. There are virtually no random draws of departure dates that see the real interest rate falling in all 11 countries +4 months and more after leaving, which happened after the actual departure dates.

The corresponding placebo test for prices is in Figure H.2, the red dots being counts with actual dates from the $100\Delta \log P$ column in Table H.2. The evidence for the actual dates being special is not as definitive as for the real interest rate, but the dots are still often well in the right tails of the distributions before and after departure (especially at -6, -5, -4, and +1 to +5 months). Furthermore, we can use the random placebo draws to calculate how likely it is that we would by chance observe prices falling then rising around the time of leaving gold, as they do in 8 of our 12 countries. If we interpret such a turnaround as prices at both -4 and +4 months being higher than the three-month average prior to departure (so prices fall and rise), then in only 3 of the 10,000 random draws did 8 or more countries exhibit a pattern turnaround in prices on leaving. This strengthens the claim that the actual departure dates are special also for price behaviour.

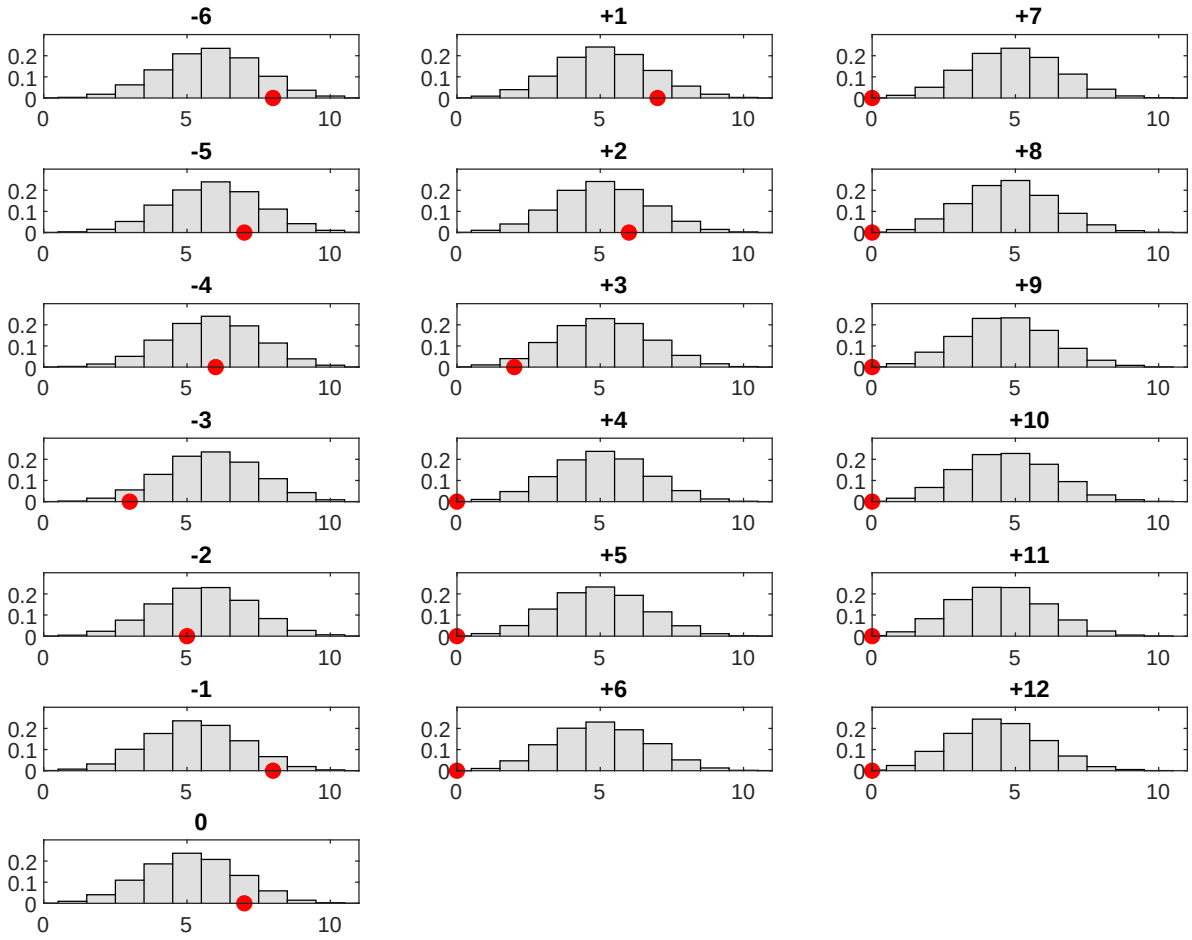


Figure H.1: Placebo test results for the real interest rate, at different horizons. Histograms are the distribution of counts of the real interest rate rising using the random departure dates; red dots are counts with the actual dates.

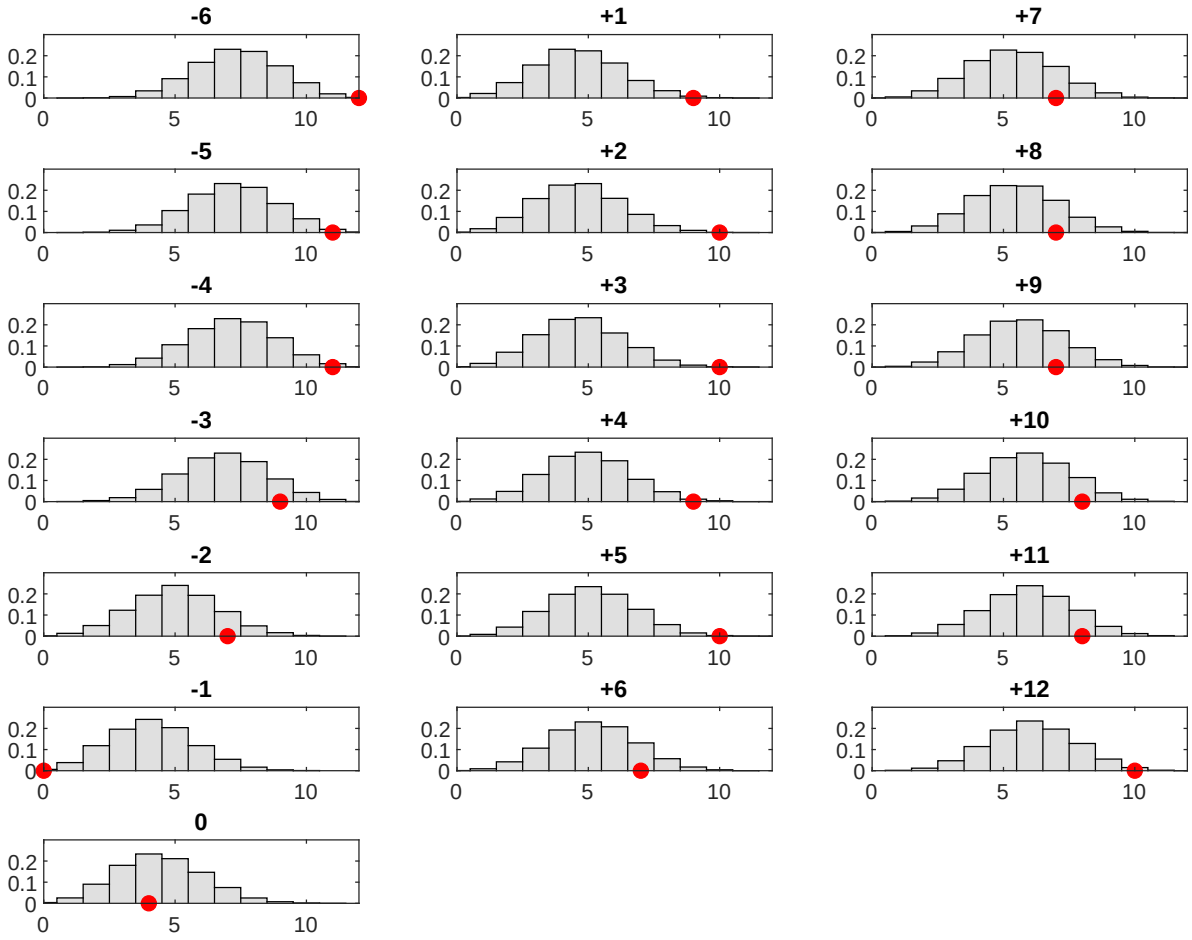


Figure H.2: Placebo test results for prices, at different horizons. Histograms are the distribution of counts of the price level rising using the random departure dates; red dots are counts with the actual dates.

I Further results on causality

I.1 Pre-departure trends

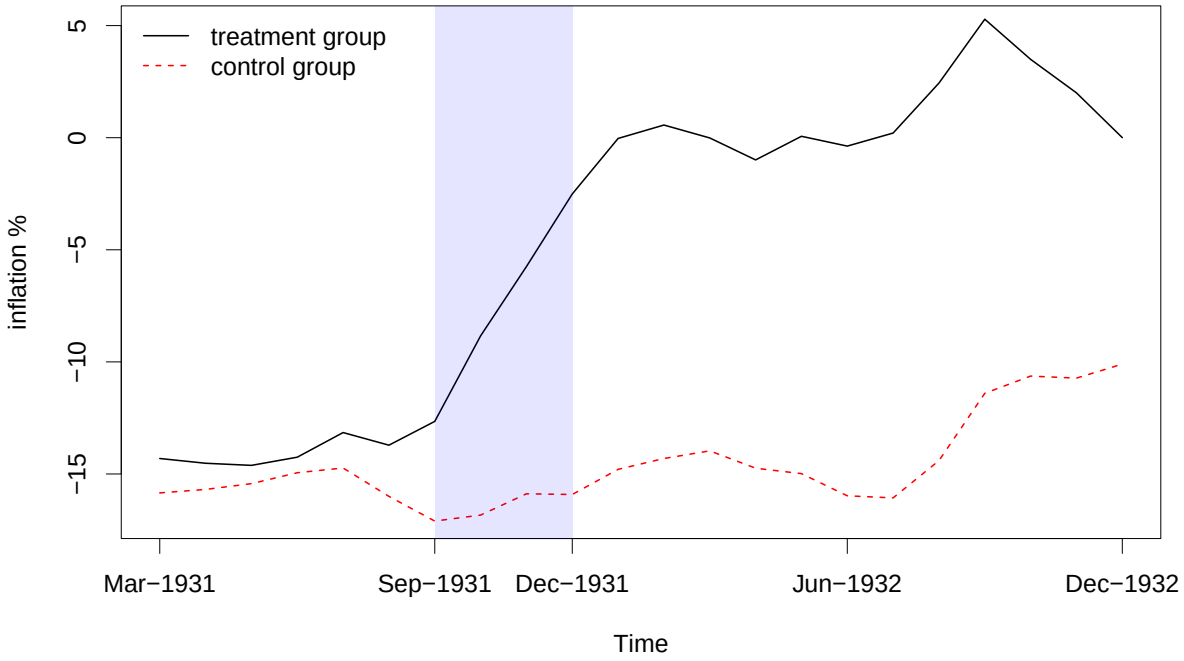


Figure I.1: Average inflation in treatment and control groups. Treatment group unambiguously left the gold standard between September 1931 and December 1931 (British India, Denmark, Finland, Japan, New Zealand, Sweden, UK). Control group unambiguously left after March 1933 (Belgium, Czechoslovakia, Dutch East Indies, Estonia, France, Italy, the Netherlands, Poland, Switzerland, US). Inflation is 12-month change in price level.

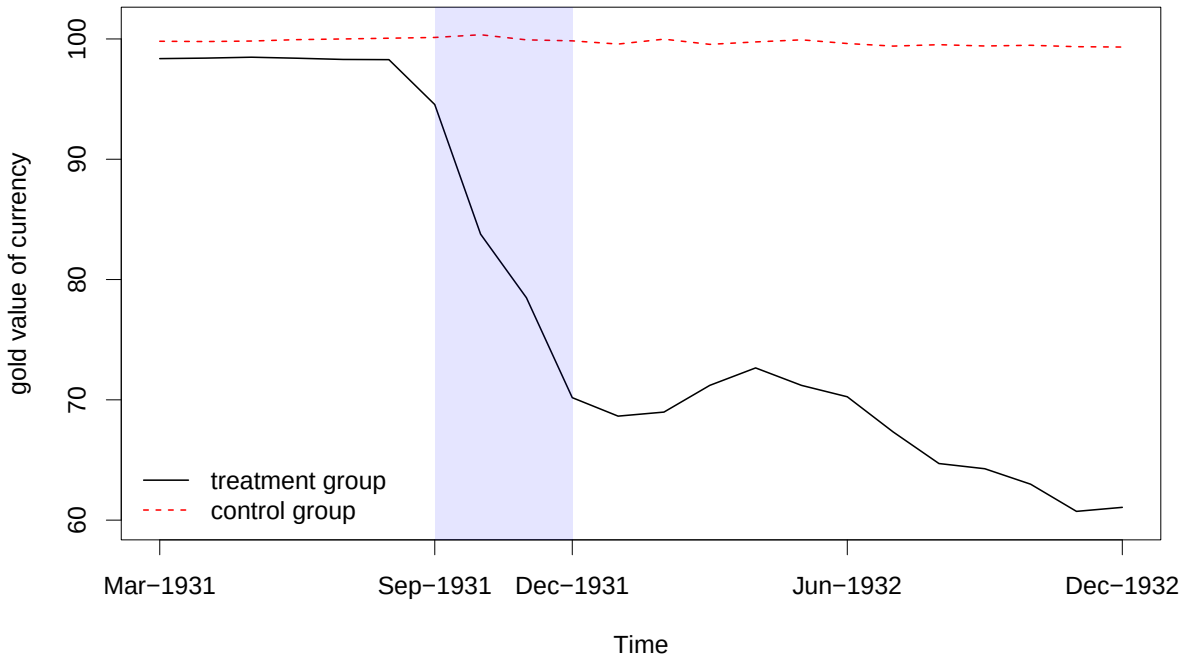


Figure I.2: Average gold price of currency in treatment and control groups. Treatment group unambiguously left the gold standard between September 1931 and December 1931 (British India, Denmark, Finland, Japan, New Zealand, Sweden, UK). Control group unambiguously left after March 1933 (Belgium, Czechoslovakia, Dutch East Indies, Estonia, France, Italy, the Netherlands, Poland, Switzerland, US). Gold value of currency is normalised to 100 for each country at its level when the country went back on gold after World War I.

I.2 Specification for estimation of synthetic controls

As explained in Section 9.3, the synthetic control estimate of the counterfactual treatment country is based on

$$W^*(V) = \underset{W}{\operatorname{argmin}}(X_1 - X_0 W)' V (X_1 - X_0 W),$$

where the weights $W^*(V) = (w_1^*, ..., w_J^*)'$ are such that $w_j^* \geq 0 \; \forall j$ and $\Sigma w_j^* = 1$. The treatment is the departure from the gold standard in 1931. X_1 is a $K \times 1$ vector of economic conditions in the treated country before leaving the gold standard, to be matched by a weighted average of the columns in X_0, a $K \times J$ matrix of corresponding economic conditions in J control countries. As shown in the tables in this section and Appendix I.5, we use log population size, log GDP per capita in 1930, and four pre-departure values of the outcome variable, *ex-ante* real interest rate or realised inflation, as the economic conditions to be matched. Therefore, $K = 6$. Because we employ only the countries that were still unambiguously on the gold standard in March 1933 as control countries, $J = 9$. As the optimisation problem above indicates, W^* depends on V which reflects the relative importance of the variables in X_1 and X_0. We follow the standard practice and select the diagonal matrix V that solves

$$V^* = \underset{V}{\operatorname{argmin}}(Z_1 - Z_0 W^*(V))' (Z_1 - Z_0 W^*(V)),$$

where Z_1 is a vector of the outcome variable for the treatment country up until the departure from the gold standard and Z_0 is a matrix that contains the same outcome variables for the J control countries. V is restricted to be a non-negative diagonal matrix. Iterating on the optimisation problem for V, conditional on W satisfying its own optimisation problem, gives V^* and W^*. Abadie (2021, p. 396-397) provides a detailed exposition on the selection procedures for V. They result in two sets of weights: W^*, applied to the control countries to construct the synthetic counterpart to the treatment country that serves as the counterfactual without the treatment (hence being our main concern); and V^*, that determines the relative importance of the economic conditions being matched for predicting the outcome variable in the period before the treatment. Because only the pre-departure values of the economic conditions and the outcome variable are used for matching, it is possible to identify the effect of the departure from gold on the outcome variable.

With $W^* = W^*(V^*)$ that solves the optimisation problems above, the synthetic counterpart that reproduces X_1 is constructed as $X_1^* = X_0 W^*$. Applying W^* to the columns of Y_0 containing the outcome variables for the control countries for the entire sample period (i.e., both pre- and post-departure periods), the synthetic outcome variable for the treatment country is constructed as $Y_1^* = Y_0 W^*$, to be compared to the actual outcome variable for the treated country Y_1 also spanning the entire sample period.

W^* for real interest rates is reported in Table V, and W^* for inflation is reported in Appendix Table I.4. X_1 and X_1^* are given under "Actual" and "Synthetic" in Appendix Tables I.2 and I.5. Y_1 and Y_1^* are plotted in Figure XIII using the same legends.

Denmark			Finland		
Control	Actual	Synthetic	Control	Actual	Synthetic
Log pop 1930	6.55	7.03	Log pop 1930	6.54	7.40
Log GDP 1930	3.73	3.65	Log GDP 1930	3.43	3.46
Real rate 03-29	11.99	10.27	Real rate 01-30	8.96	10.12
Real rate 06-30	8.99	10.82	Real rate 08-30	16.99	13.21
Real rate 12-30	13.20	13.15	Real rate 12-30	18.44	13.76
Real rate 06-31	14.46	13.91	Real rate 06-31	13.82	14.04
New Zealand			Sweden		
Control	Actual	Synthetic	Control	Actual	Synthetic
Log pop 1930	6.17	7.31	Log pop 1930	6.79	7.22
Log GDP 1930	3.70	3.38	Log GDP 1930	3.63	3.62
Real rate 02-29	8.05	7.27	Real rate 01-30	11.83	11.45
Real rate 01-30	8.98	9.04	Real rate 05-30	15.87	13.81
Real rate 01-31	10.27	11.75	Real rate 09-30	16.26	14.20
Real rate 07-31	18.79	17.86	Real rate 07-31	13.81	14.40
UK					
Control	Actual	Synthetic			
Log pop 1930	7.66	6.88			
Log GDP 1930	3.74	3.72			
Real rate 06-29	9.23	9.65			
Real rate 06-30	8.66	9.33			
Real rate 12-30	12.23	11.78			
Real rate 06-31	13.16	13.78			

Table I.2: Match of synthetic counterparts for real interest rate.

I.3 Goodness of fit of synthetic counterparts for real interest rate

Denmark	RMSE	R^2	Finland	RMSE	R^2
Before leaving	1.27	0.68	Before leaving	1.89	0.76
After leaving	5.24	0.54	After leaving	7.13	0.46
After/before ratio	4.11		After/before ratio	3.78	
New Zealand	RMSE	R^2	Sweden	RMSE	R^2
Before leaving	0.87	0.89	Before leaving	1.62	0.64
After leaving	3.35	0.84	After leaving	6.19	0.49
After/before ratio	3.87		After/before ratio	3.81	
UK	RMSE	R^2			
Before leaving	0.66	0.91			
After leaving	7.74	0.24			
After/before ratio	11.75				

I.4 Weights used in synthetic counterparts for inflation

	Denmark	Finland	Sweden	UK
Belgium	0.47			
Czechoslovakia		0.75	0.65	
France	0.24			
Netherlands	0.29		0.23	0.29
Poland				0.26
Switzerland		0.25	0.12	
US				0.45

I.5 Match of synthetic counterparts for inflation

Denmark			Finland		
Control	Actual	Synthetic	Control	Actual	Synthetic
Log pop 1930	6.55	7.07	Log pop 1930	6.54	7.03
Log GDP 1930	3.73	3.70	Log GDP 1930	3.43	3.55
Inflation 02-29	4.61	1.34	Inflation 03-29	-2.91	-1.58
Inflation 10-29	-0.67	-2.08	Inflation 10-29	-4.95	-6.45
Inflation 02-30	-11.95	-10.78	Inflation 03-30	-8.00	-11.57
Inflation 02-31	-16.43	-16.47	Inflation 02-31	-7.53	-12.65
Sweden			UK		
Control	Actual	Synthetic	Control	Actual	Synthetic
Log pop 1930	6.79	7.04	Log pop 1930	7.66	7.57
Log GDP 1930	3.63	3.57	Log GDP 1930	3.74	3.65
Inflation 05-29	-7.89	-5.05	Inflation 06-29	-4.89	-4.59
Inflation 10-29	-4.83	-6.37	Inflation 06-30	-11.03	-11.80
Inflation 03-30	-13.19	-13.20	Inflation 12-30	-17.73	-16.31
Inflation 10-30	-14.49	-14.49	Inflation 06-31	-14.45	-14.72

I.6 Goodness of fit of synthetic counterparts for inflation

Denmark	RMSE	R^2	Finland	RMSE	R^2
Before leaving	1.74	0.94	Before leaving	2.66	0.80
After leaving	17.04	0.10	After leaving	14.84	0.01
After/before ratio	9.77		After/before ratio	5.58	
Sweden	RMSE	R^2	UK	RMSE	R^2
Before leaving	1.49	0.85	Before leaving	0.89	0.98
After leaving	8.35	0.07	After leaving	10.98	0.13
After/before ratio	5.59		After/before ratio	12.29	

I.7 Backdated synthetic counterparts

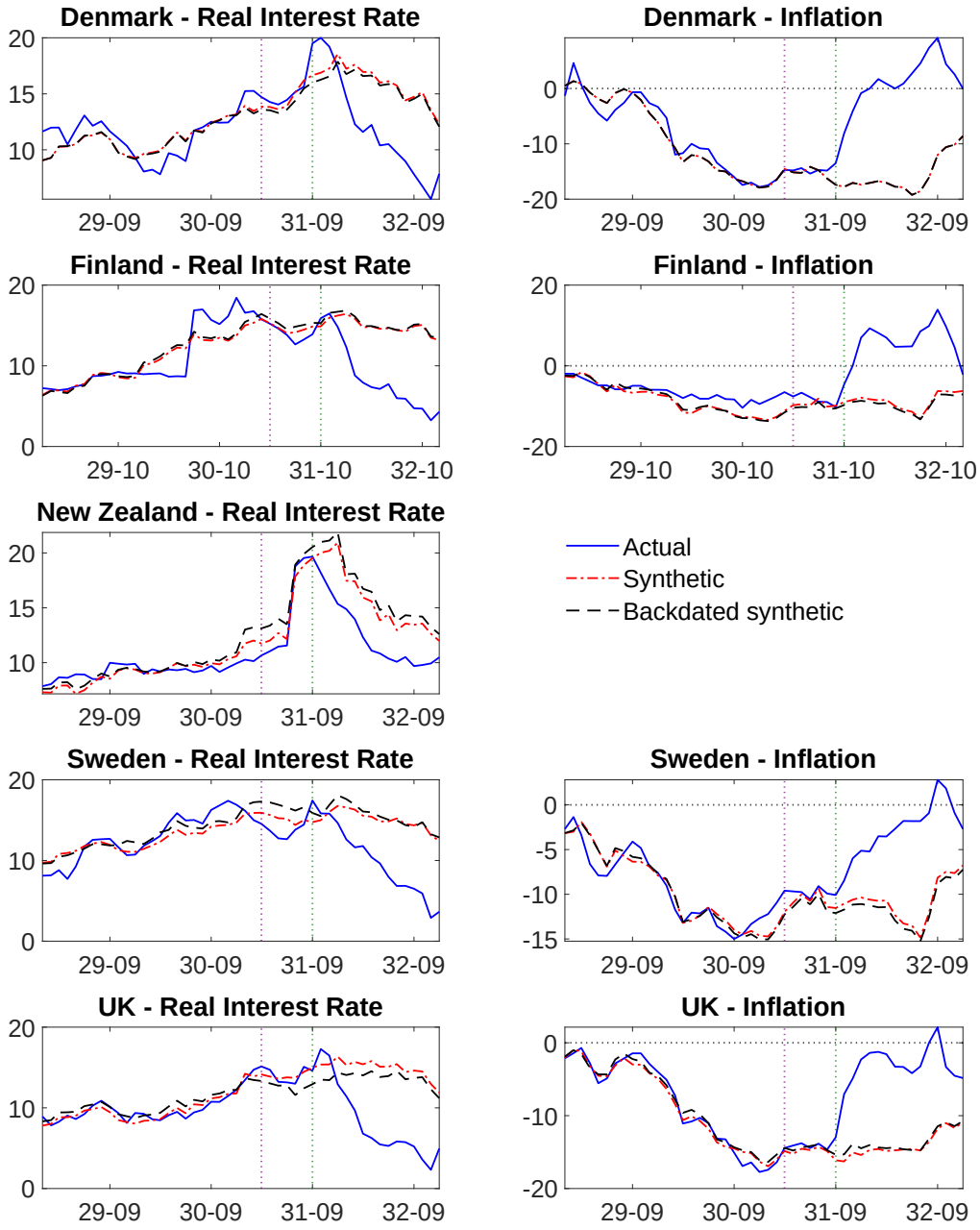


Figure I.3: Actual and counterfactual (synthetic) real interest rates and inflation in five early leavers. Synthetic counterparts for backdated counterfactuals constructed using data only available at least 6 months before leaving gold.

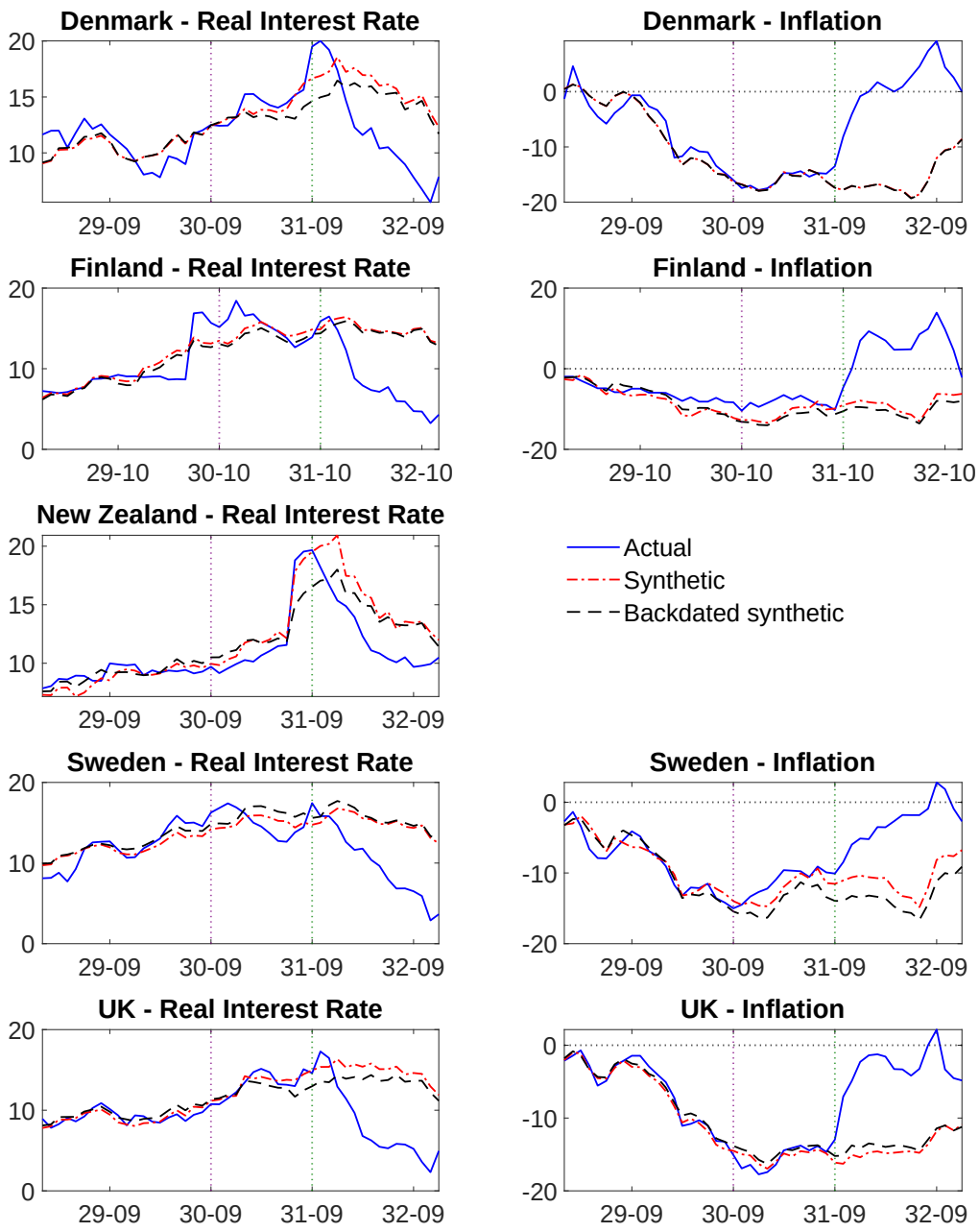


Figure I.4: Actual and counterfactual (synthetic) real interest rates and inflation in five early leavers. Synthetic counterparts for backdated counterfactuals constructed using data only available at least 12 months before leaving gold.

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