The Ends of 30 Big Depressions

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What we do

What does it take to end a long, deep, deflationary recession or depression?

Our Q: How did countries recover from the Great Depression?

Our approach:

- A new dataset: 30+ countries, 1,500+ variables, 230,000+ monthly and quarterly observations
- Modern nowcasting methods (NY-Fed model) for estimating real-time inflation expectations
- Leaving the gold standard $\rightarrow \pi^e \uparrow$ and $r \downarrow$
- For five countries we can claim that the relationship is “causal”
  - Counterfactual analysis using synthetic control matching techniques

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Golden fetters and inflation expectations

- Eichengreen and Sachs (1985) - leaving the gold standard was a prerequisite for recovery
- Sargent (1982) - going back on gold after WWI replaced expectations of hyperinflation with stable prices
- We argue that going off gold replaced expectations of deflation with stable or increasing prices

A collapse in ex ante real interest rate

↓

A rebound in interest-rate-sensitive expenditures

↓

Economic recovery
Related literature: Temin and Wigmore

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

- Extensive literature on historical inflationary expectations, largely focussed on whether Great Depression deflation was anticipated
  - Shibamoto and Shizume (2014) and Chouliarakis and Gwiazdowski (2016) make Temin/Wigmore-style arguments for Japan & UK
- We offer the most comprehensive study to date on the topic
  - Country coverage (30+)
  - Methods
  - Dorval and Smith (2015), Hamilton et al. (2016), Albers (2018), and especially Daniel and Steege (2020) closest to our work
Principal sources:

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

- Complementary sources:
  - Federal Reserve Bulletin
  - NBER Macrohistory Database
  - Statistical Yearbook of the League of Nations
  - Individual countries’ statistical authorities

- The availability of many datasets enables thorough cross-checks
Key variables

- **Nominal interest rate**
  - Following Romer (1992), three to six month market interest rates wherever possible
  - Central bank discount rates otherwise

- **Aggregate price index**
  - Wholesale price index wherever possible
  - Cost of living index or wholesale price of a key product/commodity otherwise

- **Aggregate output**
  - Total production index or its variant wherever possible
  - Quantity of a key product/commodity otherwise
Methodology

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

\[ r = i - \pi^e \]

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

- Country index \( j = 1, 2, \ldots, J \); variable index \( i = 1, 2, \ldots, N_j \); factor index \( k = 1, 2, \ldots, r_j \); time index \( t = 1, 2, \ldots, T_j \) (months)

- The large set of variables for each country \( (y_{i,t}^j) \) is related to a small number of latent factors \( (f_{k,t}^j) \) and an idiosyncratic component \( (e_{i,t}^j) \)

\[
y_{i,t}^j = \mu_{i,t}^j + \sum_{k=1}^{r_j} \lambda_{i,k}^j f_{k,t}^j + e_{i,t}^j
\]

\[
f_{k,t}^j = \alpha_k^j f_{k,t-1}^j + u_{k,t}^j
\]

\[
e_{i,t}^j = \rho_i^j e_{i,t-1}^j + \varepsilon_{i,t}^j
\]

- The parameters \( \mu_{i,t}^j, \lambda_{i,k}^j, \alpha_k^j, \rho_i^j \) and the latent factors \( f_{k,t}^j \) are estimated using the Kalman filter and maximum-likelihood methods
Dynamic factor model

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

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

Transformed and Standardised Data

Factors

Global, Real, Financial, Labour

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Real-time inflation expectations

Object: US Y-o-Y Inflation Rate (%); Target: March 1934; Realised Inflation in Red Dot

Data Flow (Mar 1933)

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

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Dating departures from the gold standard

- Surprisingly tricky
- Different references disagree
- Candidates: official suspension, devaluation, exchange controls
- Q: What constituted a regime change sufficient to change inflation expectations?
- We privilege official suspension and devaluation over exchange controls
“If one regards the guarantee of convertibility for capital transactions as an essential feature of the gold standard, then Germany left the gold standard in July 1931. On the other hand, for contemporaries we have to notice that only leaving the parity against gold seemed to be the real breaking of the rules of the gold standard. At least this is the way our sources regard it. Till long after July 1931, and thus after the introduction of the “Devisenbewirtschaftung” the question was asked, whether Germany would or should leave the gold standard. This could only mean leaving the parity in favour of floating.” (Borchart 1984)
Dating departures from the gold standard

- **Group A** – unambiguous dates for suspension or devaluation
  - Belgium, British India, Canada, Denmark, the Dutch East Indies, Finland, France, Japan, the Netherlands, New Zealand, Peru, South Africa, Sweden, Switzerland, and the UK

- **Group B** – exchange controls
  - Bulgaria, Germany, Hungary, Lithuania

- **Group C** – exchange controls followed by suspension or devaluation
  - Chile, Estonia, Poland, Romania, the US

- **Group D** – ambiguous departure dates
  - Argentina, Australia, Austria, Brazil, Czechoslovakia, Italy
Private banks had managed the exchange rate: while the Australian pound fluctuated against sterling “this had appeared unnatural”

December 1929: legislation allows government & Commonwealth Bank to require that banks exchange gold for notes & ban gold exports
  - League of Nations views this as suspending gold standard, government disagrees

January 1930 CB exercises right to requisition banks’ gold
  - Schedvin says this was the end of the gold standard but the decision was made instead of banning gold exports (which government feared would be seen as abandoning gold)
Example: Australia

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

Figure 3. Currencies’ gold value (percentage of parity)

In New Zealand too the 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 3 indicates. During 1932 there were growing calls for

<table>
<thead>
<tr>
<th>Country</th>
<th>Official suspension of gold</th>
<th>Exchange control</th>
<th>Depreciation or devaluation in relation to gold</th>
<th>Introduction of a new gold parity</th>
<th>Departure from gold</th>
<th>Group</th>
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<td>1933</td>
<td>C</td>
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</table>
Expected inflation and real interest rate (Group A)

- Belgium
- British India
- Canada
- Denmark
- Dutch Indies
- Finland
Expected inflation and real interest rate (Group A)

- France
- Netherlands
- Japan
- New Zealand
- Peru
- South Africa
Expected inflation and real interest rate (Group A)
Expected inflation and real interest rate (Group B)
Expected inflation and real interest rate (Group C)

Chile

Poland

Estonia

Romania

US

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Expected inflation and real interest rate (Group D)

Argentina

Australia

Austria

Brazil

Czechoslovakia

Italy
Case study - Japan

Real Int. (Left) & Exp. Inf. (Dash-dotted; Right)

Wholesale Price & Cost of Living (Dash-dotted)

Textile Industry Production

Market Disc., Call (Dash-dotted), BOJ Disc. (Dashed)

Gold Value of the Currency

Industrial Employment

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Case study – South Africa

Real Int. (Left) & Exp. Inf. (Dash-dotted; Right)

Cost of Living - Total & - Food (Dash-dotted)

Coal (Left) & Construction (Dash-dotted; Right)

Disc. Rate of S. African Reserve Bank

Gold Value of the Currency

Employment in Mining

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The Ends of 30 Big Depressions
The country group figures and the case studies suggest that leaving the gold standard was an important pre-condition for recovery.

However, difficult to generalise to all 30 countries.

So, we take a conservative approach and focus on our Group A countries where timing is unambiguous:
- Ex ante real interest rate, real output, and total trade (exports + imports)
- The first troughs in real interest rates after leaving gold are dated using the Bry-Boschan method (Harding and Pagan, 2002)
  - The results align with the visual evidence.
## Real interest rates

<table>
<thead>
<tr>
<th>Country</th>
<th>Departure from gold standard</th>
<th>Departure</th>
<th>One quarter</th>
<th>Two quarters</th>
<th>One year</th>
<th>Two years</th>
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<td>1.2</td>
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<td><strong>Average</strong></td>
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<td><strong>-2.9</strong></td>
<td><strong>-2.3</strong></td>
<td><strong>-5.1</strong></td>
<td><strong>-5.1</strong></td>
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</table>
Cross-country comparisons

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

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of months to trough</th>
<th>Change in real interest rate</th>
<th>Change in nominal interest rate</th>
<th>Change in expected inflation</th>
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Martin Ellison, Sang Seok Lee, Kevin Hjortshøj O'Rourke

The Ends of 30 Big Depressions
<table>
<thead>
<tr>
<th>Country</th>
<th>Departure from gold standard</th>
<th>Cumulative change in real output upon or after:</th>
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<tr>
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<td>departure</td>
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<td>4.2</td>
</tr>
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<td>Oct-31</td>
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<tr>
<td><strong>Average</strong></td>
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## Total trade

Cumulative change in total trade upon or after departure from gold standard

<table>
<thead>
<tr>
<th>Country</th>
<th>Departure from gold standard</th>
<th>Departure</th>
<th>One quarter</th>
<th>Two quarters</th>
<th>One year</th>
<th>Two years</th>
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<td>France</td>
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<tr>
<td>UK</td>
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<td>0.3</td>
<td>-13.1</td>
<td>-18.2</td>
<td>-8.4</td>
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<tr>
<td><strong>Average</strong></td>
<td></td>
<td><strong>0.6</strong></td>
<td><strong>26.8</strong></td>
<td><strong>4.4</strong></td>
<td><strong>16.6</strong></td>
<td><strong>30.5</strong></td>
</tr>
</tbody>
</table>
The results so far do not identify the causal effect of leaving
- A shortcoming shared by much of the existing literature

Q: What would have happened if these countries had not left the gold standard at the time they did?

**Synthetic control matching methods of Abadie and Gardeazabal (2003)**
- Treatment group: all the countries that had unambiguously left by Dec 1931
- Control group: the countries that were still unambiguously on the gold standard in the middle of 1932
- ‘Matching’ variables: population size, GDP per capita in 1930, average inflation between Jan 1929 and Aug 1931, and the behaviour of the ex ante real interest rate before the country left the gold standard
Control group index \( j = 1, 2, \ldots, J \)

For each treated country we construct a 'synthetic' counterpart which is a weighted average of the control group countries, with weights defined by \( W^* = (w_1, w_2, \ldots, w_J) \), a \( J \times 1 \) vector

We choose the weights so that the synthetic country resembles the treated country, \textit{before it was treated}, as much as possible

\( Y_1 \) is a \( T \times 1 \) vector of an outcome variable (e.g. the \textit{ex ante} real interest rate) for a treated country in \( T \) post-treatment periods, and \( Y_0 \) is a \( T \times J \) matrix of the outcome variable for control group countries in the post-treatment periods

The synthetic or counterfactual outcome is estimated by \( Y_1^* = Y_0 W^* \)
<table>
<thead>
<tr>
<th>Country</th>
<th>Australia</th>
<th>Denmark</th>
<th>Finland</th>
<th>New Zealand</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czechoslovakia</td>
<td>0.029</td>
<td></td>
<td>0.196</td>
<td>0.239</td>
<td>0.032</td>
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<tr>
<td>Italy</td>
<td></td>
<td></td>
<td>0.349</td>
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<td>0.218</td>
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<tr>
<td>Netherlands</td>
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<td>Romania</td>
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<td>0.327</td>
<td>0.064</td>
<td>0.103</td>
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<td>0.442</td>
<td>0.572</td>
<td>0.343</td>
<td>0.417</td>
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</tbody>
</table>
We consider $X_1$, a $K \times 1$ vector of pre-treatment 'matching' variables, for the treated country, and $X_0$, a $K \times J$ matrix of the same variables for the control group. $W^*$ is chosen by solving

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

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

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

Denmark - Real Interest Rate

Finland - Real Interest Rate

Sweden - Real Interest Rate

Denmark - Realised Inflation

Finland - Realised Inflation

Sweden - Realised Inflation

The Ends of 30 Big Depressions
Australia and New Zealand

The Ends of 30 Big Depressions

Australia - Real Interest Rate
New Zealand - Real Interest Rate

Percent

Actual
Synthetic

29-09 30-09 31-09 32-09

29-09 30-09 31-09 32-09
Fifteen of our thirty countries unambiguously left the gold standard on clearly defined dates (Group A)

An increase in inflation expectations and a decrease in real interest rate for these countries as well as some others

We provide evidence that the relationship is causal for five countries

For the countries where the timing of departure is less clear, our results can help us to see what really mattered in turning around expectations

Overall strong support for the Sargent/Temin-Wigmore hypothesis