

# Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870–2008

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# Motivation

## New interest in role of credit in macroeconomy

- Money view versus irrelevance view versus credit view
- Are credit booms dangerous? or epiphenomena?
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## Importance of some new long-run evidence

- “Rare events” problem
  - Need a *lot* of data to say anything meaningful
- Advanced versus emerging
  - Not so different when it comes to *banking* crises?
- Shifting importance of money versus credit
  - Decreasing importance of broad money?

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Confronting theory with data (on a large scale) has been hard

# What's new?

## Contribution of this paper

- A massive new 140 × 14 annual panel database
- Key financial history variables for developed countries
- Many questions we could not answer without these data
- Better analyze the causes/consequences of “rare event” crises
- Major research area (e.g. Barro, Reinhart-Rogoff)

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## Future research agenda

- Develop, refine, and extend the dataset
- Apply to other enduring & important macro-finance questions
- Examples:
  - Which macroeconomic policies work best in a financial crisis?
  - Money versus credit as the cause of inflation?
  - Does credit drive recoveries? economic growth in general?



# Outline

## Descriptive: new annual bank credit data

- 1870-2008 for N=14 (+other macro aggregates)
- Trends: What has happened in the long run?
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- Trends: What has happened in the long run?
- Event study: what has happened in financial crises?

## Predictive: Do credit booms go bust?

- “Early warning?” Can credit data help us forecast financial crisis?
- Predictive ability testing
- Control for other potential causal factors

# Part 1: Descriptive

## A Very Large New Dataset

- Data: Standard macro variables plus our new data
  - **Bank loans** = Domestic currency lending by domestic banks to domestic households and non-financial corporations (excluding lending within the financial system). Banks are monetary financial institutions and include savings banks, postal banks, credit unions, mortgage associations, and building societies.
  - **Bank assets** = Sum of all balance sheet assets of banks with national residency (excluding foreign currency assets).
  - Sources & Methods

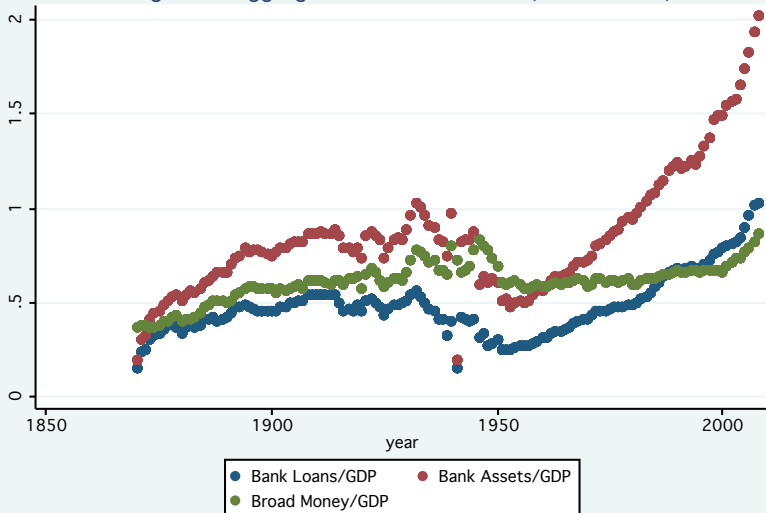
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  - Sources & Methods
- To summarize these data we construct “global trends”
  - For any  $X_{it}$  estimate country-fixed effects regression
$$X_{it} = a_i + b_t + e_{it}$$
then plot the estimated year effects  $b_t$  to show the average global level of  $X$  in year  $t$ .
  - Note: averaging masks cyclical variation

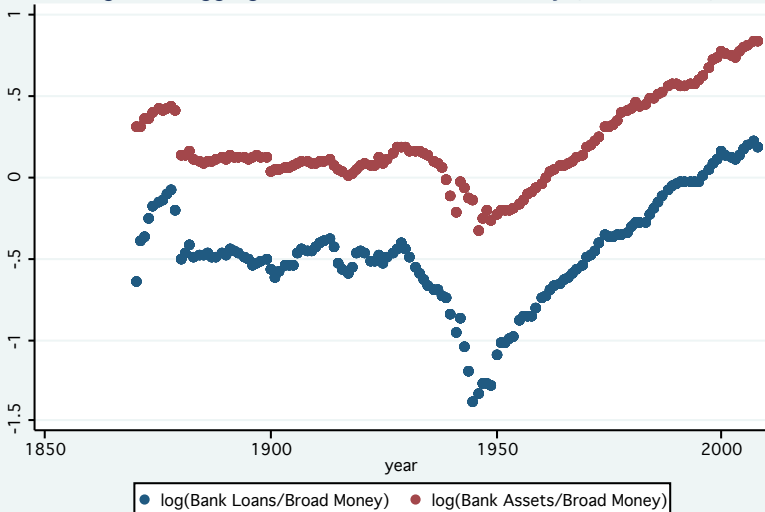
# Growth of Banking

Figure 1. Aggregates Relative to GDP (Year Effects)



# Growth of Funding Leverage

Figure 2. Aggregates Relative to Broad Money (Year Effects)



# Trends—Summary

- Age of Money (1870–1970s)
  - Money and credit were tightly linked and maintained a fairly stable relationship relative to GDP
  - Both aggregates collapsed in the Great Depression
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- Age of Credit (1970s–2008)
  - Continued and unprecedented rise of leverage and growth of non-monetary liabilities of banks
  - Decoupling of credit from money
  - Decline of safe/liquid assets on bank balance sheets



# Responses in Financial Crises

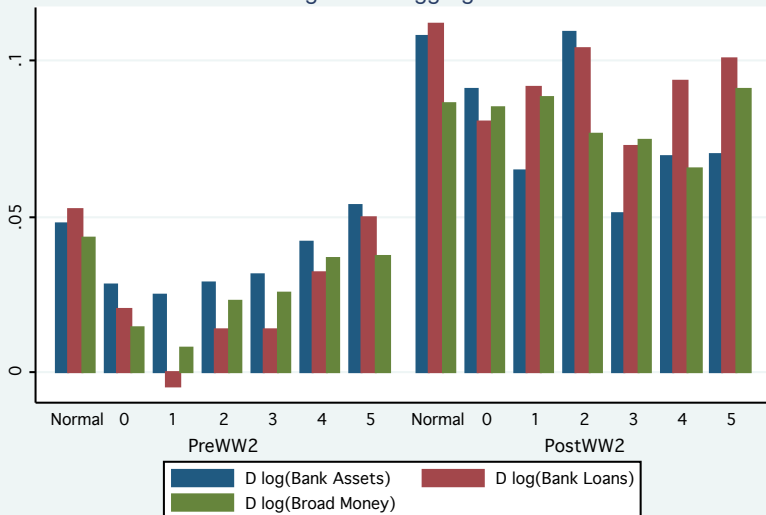
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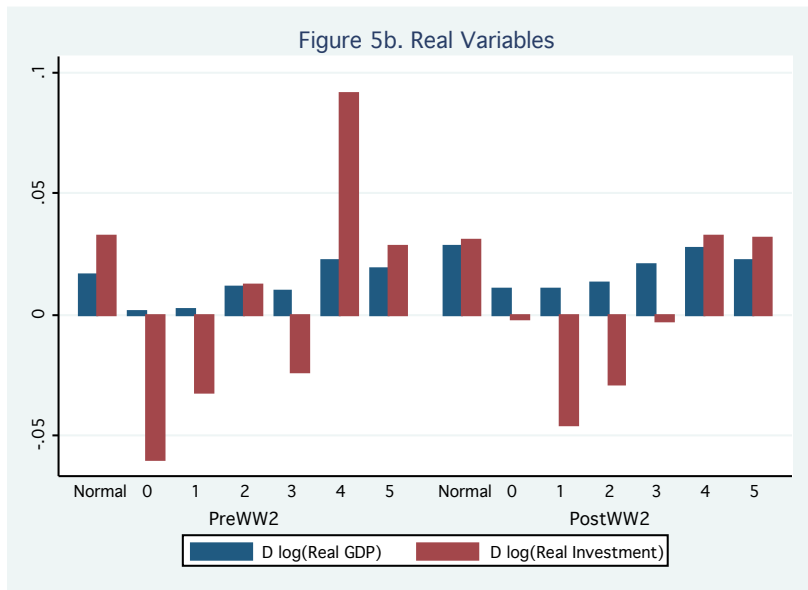
- Event analysis
  - Use Bordo et al. and Reinhart-Rogoff event definitions, although we make 1 or 2 minor adjustments
  - Track aggregates in years 0–5 after an event
- Compare the pre-WW2 and post-WW2 eras
  - Was there a watershed?
  - Look for evidence that changes in central bank policies after the Great Depression have made a difference

# Money & Credit in Financial Crises

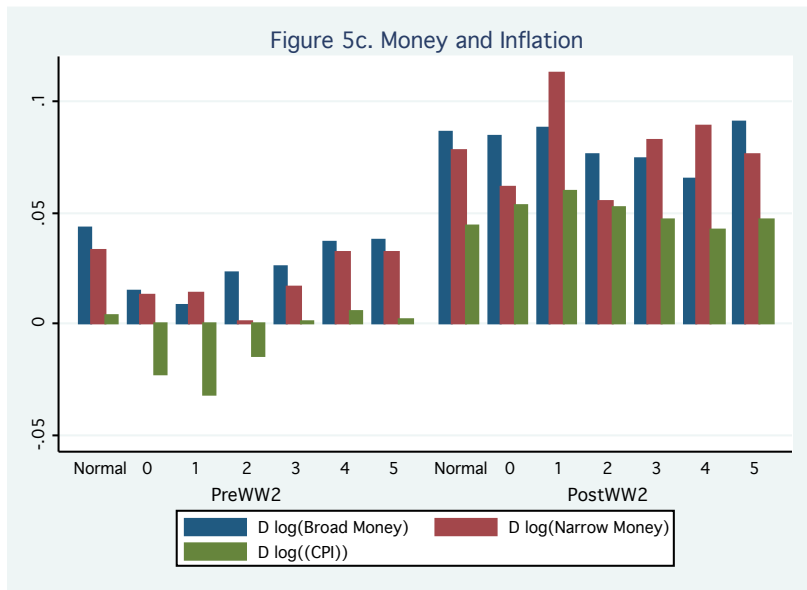
Figure 5a. Aggregates



# Real Variables in Financial Crises



# Nominal Variables in Financial Crises



# A Few Cross-Regime Comparisons

TABLE 2 CUMULATIVE EFFECTS AFTER FINANCIAL CRISES

Cumulative log level effect, after years 0–5 of crisis, versus noncrisis trend, for:	Pre–World War 2	Pre–World War 2, excluding 1930s	Post–World War 2
Log broad money	–0.141*** (0.027)	–0.103*** (0.029)	–0.062 (0.039)
Log bank loans	–0.236*** (0.044)	–0.179*** (0.048)	–0.148*** (0.053)
Log bank assets	–0.113*** (0.034)	–0.078** (0.037)	–0.239*** (0.048)
Log real GDP	–0.045** (0.020)	–0.018 (0.020)	–0.062*** (0.017)
Log real investment	–0.203** (0.094)	–0.114 (0.093)	–0.222*** (0.047)
Log price level	–0.084*** (0.025)	–0.047* (0.027)	+0.009 (0.028)

Notes: \*\*\* denotes significance at the 99% level, \*\* 95% level, and \* 90% level. Standard errors in parentheses.

# Interpretation of Results

- Lessons of the Great Depression — Have Been Learned?
  - Since WW2, central banks have strongly supported money and credit in the wake of financial crises
  - “Success” in preventing deleveraging of the financial sector and deflationary tendencies
  - But not in reducing output costs
  - Bailing out finance but failing to protect the real economy?

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  - But not in reducing output costs
  - Bailing out finance but failing to protect the real economy?
- Unintended consequences?
  - Policy intervention possibly created more of the very hazards it was intended to solve
  - More financialized economy may be harder to stabilize



## Part 2: Predictive

### Crisis Prediction Framework

- Economic conditions at  $t - 1, t - 2, \dots \rightarrow$  crisis at time  $t$

$$\text{logit}(p_{it}) = b_{0i} + b_1(L)\Delta\log\text{CREDIT}_{it} + b_2(L)X_{it} + e_{it}$$

where

$\text{logit}(p) = \ln\left(\frac{p}{1-p}\right)$  is the log odds ratio

$b_i(L)$  is a polynomial in the lag operator  $L$

- We have also tried a linear probability specification (and a variety of fixed effects), but the results are robust

# Baseline Model

TABLE 4 BASELINE MODEL AND ALTERNATIVE MEASURES OF MONEY AND CREDIT

Specification (Logit country effects)	(6) Baseline	(7) Replace loans with broad money	(8) Replace loans with narrow money
L.Dlog(loans/P)	-0.108 (2.05)	1.942 (2.94)	-0.890 (1.37)
L2.Dlog(loans/P)	7.215*** (1.99)	5.329** (2.52)	2.697 (1.68)
L3.Dlog(loans/P)	1.785 (1.83)	2.423 (2.63)	2.463 (1.77)
L4.Dlog(loans/P)	0.0517 (1.49)	-1.742 (2.51)	-2.244 (1.65)
L5.Dlog(loans/P)	1.073 (1.78)	4.275* (2.30)	1.210 (1.82)
Observations	1285	1361	1394
Groups	14	14	14
Avg. obs. per group	91.79	97.21	99.57
Sum of lag coefficients	10.02***	12.23***	3.235
se	3.235	3.544	3.129
Test for all lags = 0, $\chi^2$	17.22***	18.35***	5.705
p value	0.0041	0.0025	0.3360
Test for country effects = 0, $\chi^2$	7.789	9.333	8.627
p value	0.857	0.747	0.800
Pseudo $R^2$	0.0596	0.0481	0.0343

Notes: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Robust standard errors in parentheses.

# Predictive Ability Testing: ROC Curve and Diagnostics

Background, definition.

$d =$  outcome (binary),  $\hat{z} = \hat{\beta}X$  signal (continuous),  $c =$  threshold

$$TP(c) = P[\hat{z} \geq c | d = +1] \quad FP(c) = P[\hat{z} \geq c | d = -1]$$

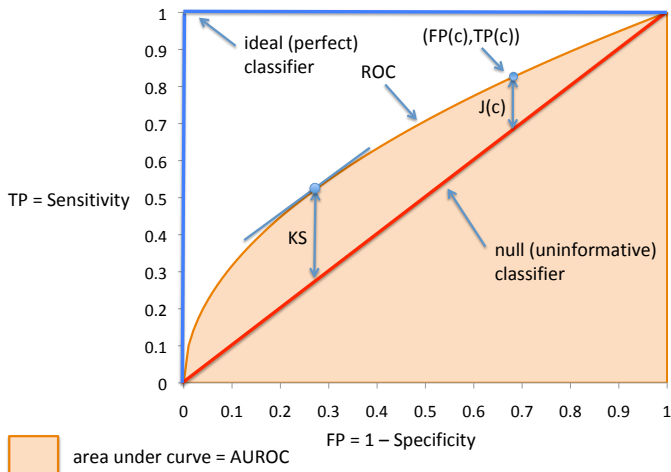
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## Digression: ROC, Expected Utility, and Optimality

Is there an economic metric for classification performance?

Yes. Suppose  $\pi$  is frequency of crisis events (positives). Expected utility is

$$U(c) = U_{TP}TP(c)\pi + U_{FN}(1 - TP(c))\pi + U_{FP}FP(c)(1 - \pi) + U_{TN}(1 - FP(c))(1 - \pi). \quad (1)$$

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Differentiate. Slope of ROC curve at optimum threshold ( $dU/dc = 0$ ) is

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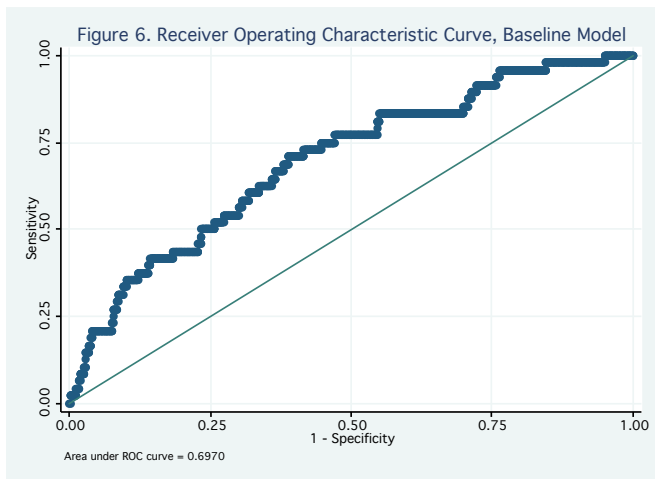
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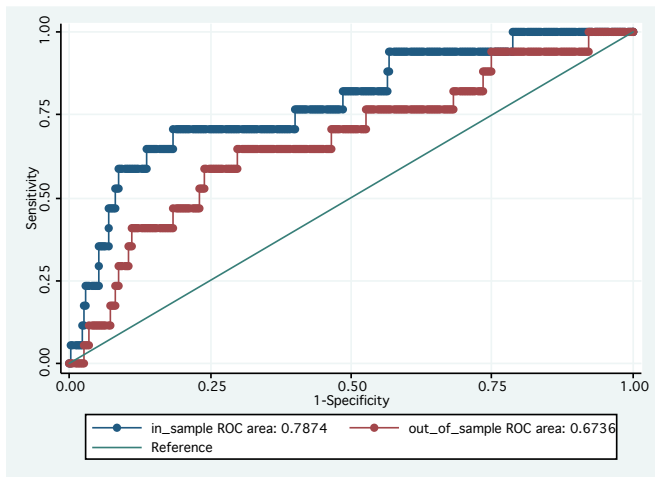
# Baseline Model - The ROC Curve



- What is a “high” AUROC? [Medical examples]

# In- and Out-of-Sample

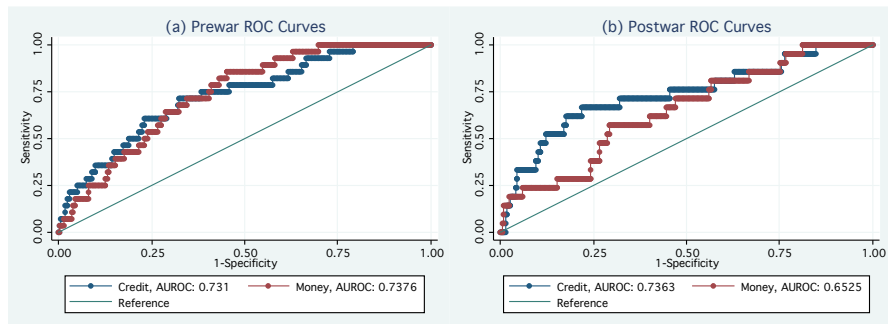
Out of sample period is 1984–2008



- The gold standard: out-of-sample predictive power
- “Who could have known?”

# Credit versus Money as Crisis Predictors

Pre-WW2 and Post-WW2



- Before WW2 credit and money models yield similar predictions
- After WW2 credit model predictions are far superior

# Robustness Checks

## Additional Control Variables

- Adding additional control variables does not lead to a statistically significant improvement in predictive ability (measured by AUROC)

<b>Add 5 lags of</b>	<b>Significant?</b>	<b>Credit significant?</b>	<b>AUROC</b>
<b>Real GDP growth</b>	<b>Y</b>	<b>Y</b>	<b>0.711</b>
<b>Inflation</b>	<b>Y</b>	<b>Y</b>	<b>0.756</b>
<b>Nominal interest rate</b>	<b>N</b>	<b>Y</b>	<b>0.712</b>
<b>Real interest rate</b>	<b>Y</b>	<b>Y</b>	<b>0.744</b>
<b>Investment/GDP ratio</b>	<b>Y</b>	<b>Y</b>	<b>0.737</b>
<b>BASELINE</b>	<b>—</b>	<b>Y</b>	<b>0.697</b>

# Conclusions

## Major findings

- Credit = Money?
  - In the distant past, yes. Not any more.
- Great moderation?
  - The real responses to financial crises are no better now than in the barbarous pre-WW2 era.
- Early warning?
  - Credit data contain predictive information about future financial crises.

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## Implications

- Policymakers ignored credit at their peril
  - “BIS view” versus “Old conventional wisdom.”
    - Borio/White/Rajan/et al. versus Greenspan & Co.
- Large future research agenda ahead
  - Study credit-growth-inflation linkages more carefully
  - Measure costs of crises more accurately (treatment-v-control)