# The End of the Great Depression: VAR Insight on the Roles of Monetary and Fiscal Policy

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# The Great Depression and World War II

☐ The Great Depression is the most important single event in the history of business cycle macroeconomics

☐ World War II is the single greatest event in human history (John Keegan)

☐ This paper combines thinking about how these two large historical events interacted.

# Three Big Questions about the Great Depression

☐ Why it happened at all?  1929-33

☐ Why it lasted so long, 1933-41

☐ Why it eventually ended, 1939-41

☐ This paper is about the third of these topics, with partial implications for the second topic

☐ The Obama Administration's top economists all have published positions: Summers, Bernanke, and C. Romer

# Our Paper Attempts to Replace Polemics by Science

- ☐ C. Romer (1992).  "Only money mattered" and fiscal policy had no role in ending the Great Depression
- ☐ Vernon (1994) "after 1940 only fiscal expansion mattered"
- ☐ Bernanke and Summers-deLong:  the economy recovered through mean-reversion.  A non-starter, why mean reversion in 1939-41 instead of 1933-35?

# The Existing Literature Includes Astonishing Lapses

- ☐ The Effect of WWII on the American Economy began with Pearl Harbor on 12/07/41 (C. Romer, deLong-Summers)

- ☐ One can measure recovery from recessions by annual growth rates of real GDP irrespective of the output gap (C. Romer, others)

  - ■ By this criterion the economy was doing great in 1934-35 because real GDP was growing at a 10 percent annual rate, despite 20% unemployment

# This Paper Makes These Contributions

- New quarterly (and monthly) data set for components on spending on real GDP, 1919-51
- New criterion for "end of Great Depression" based on a new estimate of potential real GDP for 1919-51
- Rejection of nonsensical "band pass filter" estimates of GDP trend for the interwar period. These methods imply that the trend smooths actual values only modestly
    - Headline result from Figure 3: Band-pass filter implies that potential (trend) real GDP growth collapsed from +9 percent per annum in 1924 to -8 percent per annum in 1930-31

# In Addition to New Data and Estimate of Potential Real GDP . .

- ☐ Review of contemporary media regarding
  - ■ The size and timing of the explosion of military spending between 1940:Q2 and 1941:Q4
  - ■ The pervasive impact of the explosion on output and employment
    - ☐ Details for industries
    - ☐ Details for cities
- ☐ A Literature Review:  How much about 1940-41 has been missed in previous papers on the end of the Great Depression

# The Econometric Results

- ☐ VAR methodology.
  - ■ Own-equation innovations (O) vs. full-model innovations (IA)
  - ■ Five variables, five lags
  - ■ Extensive robustness tests
    - ❑ Change in sample period start and end dates
    - ❑ Change in variable definitions
    - ❑ Change in variable dimensions, X/YN vs. LN(X)
    - ❑ Change in VAR ordering of variables
- ☐ Our baseline result of 61% fiscal, 36% monetary, and 3% "other" is surprisingly robust to the robustness tests

# New Data Available for Economic Research
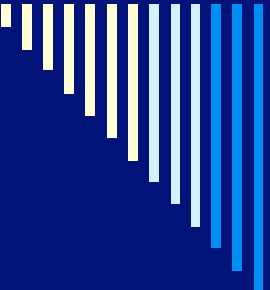
- ☐ Quarterly and monthly interpolated components of real GDP and for GDP deflator
- ☐ Interpolators – almost everything in the NBER electronic historical data bank
- ☐ More than twice as many monthly series as Gordon-Veitch (1986)
- ☐ Solving problem of non-additivity of chain-weighted GDP components, $1937 vs. $2000

# Why We Can't Use $2000 Real GDP to Assess 1939-41

Figure 1: $1937 vs. $2000 Comparison for GDP Residual / GDP and G / GDP: 1919-1951
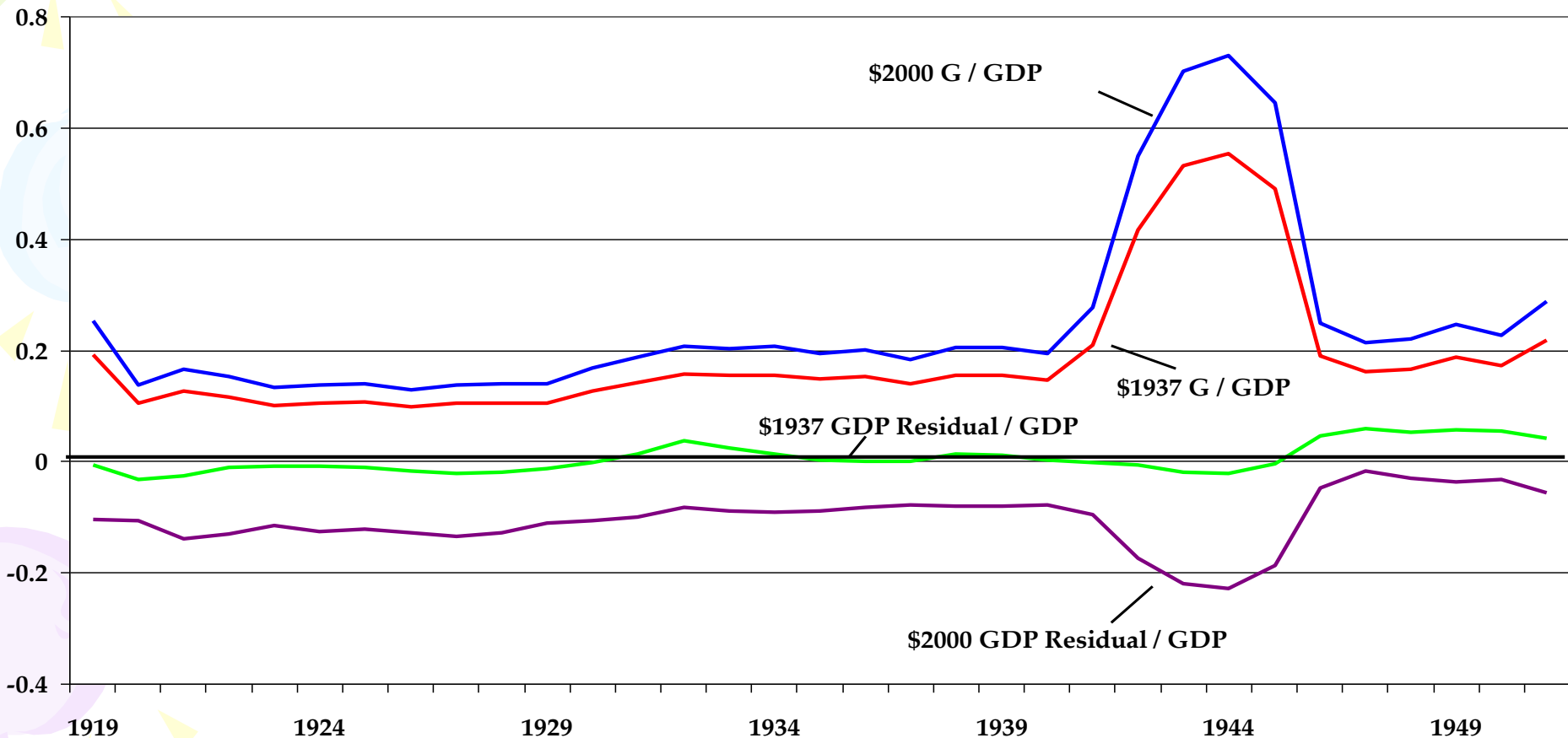
# A Dispute in the Literature: When Was the End?

- We define the end of the Great Depression as when actual real GDP returned to potential real GDP

  - Percent log output ratio = 0 as it was in 1928-29

- Thus we need to estimate potential real GDP

- Big point of this section – any statistical measure is flawed, we must use exponential trends through benchmark years
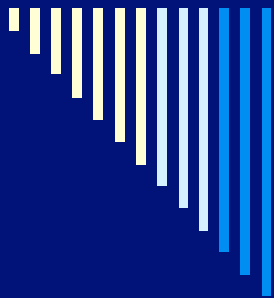
# The Current Favorite: The Band-pass Filter

- ☐ This is a mechanical method which excludes an arbitrary span of frequencies, most commonly 32 quarter or 8 years
- ☐ It delivers results similar to the H-P filter with a smoothing parameter of 1600
- ☐ The next few slides compare the assessment of the interwar period with our exponential trend vs. the BP filtered trend

# Population and Productivity were Growing, So Why Does BP Filter Register a Decline?

**Figure 2.   Real GDP in $1937, Actual and Two Trends,
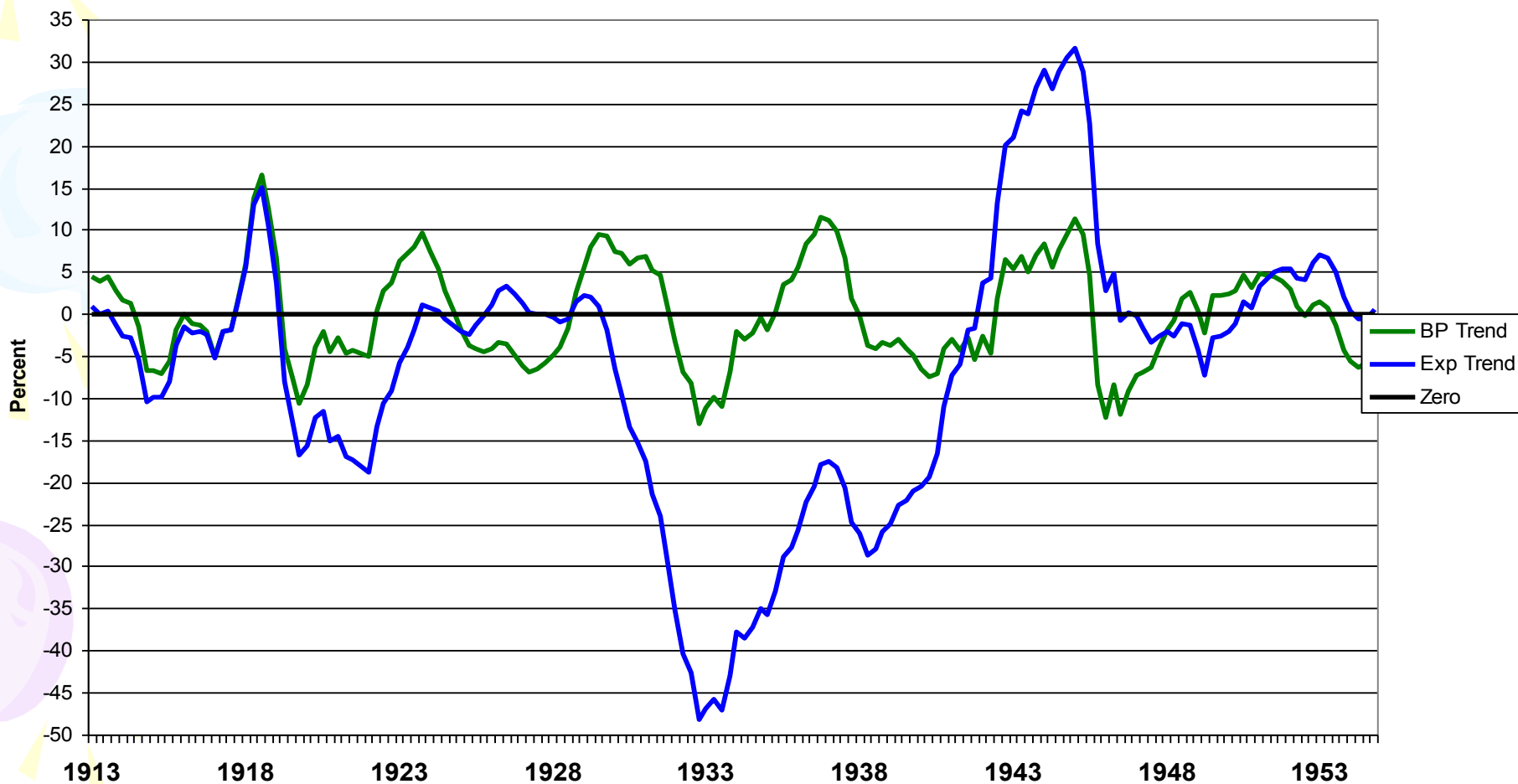Band-Pass Filtered and Exponential-through-Benchmarks, 1913-54**
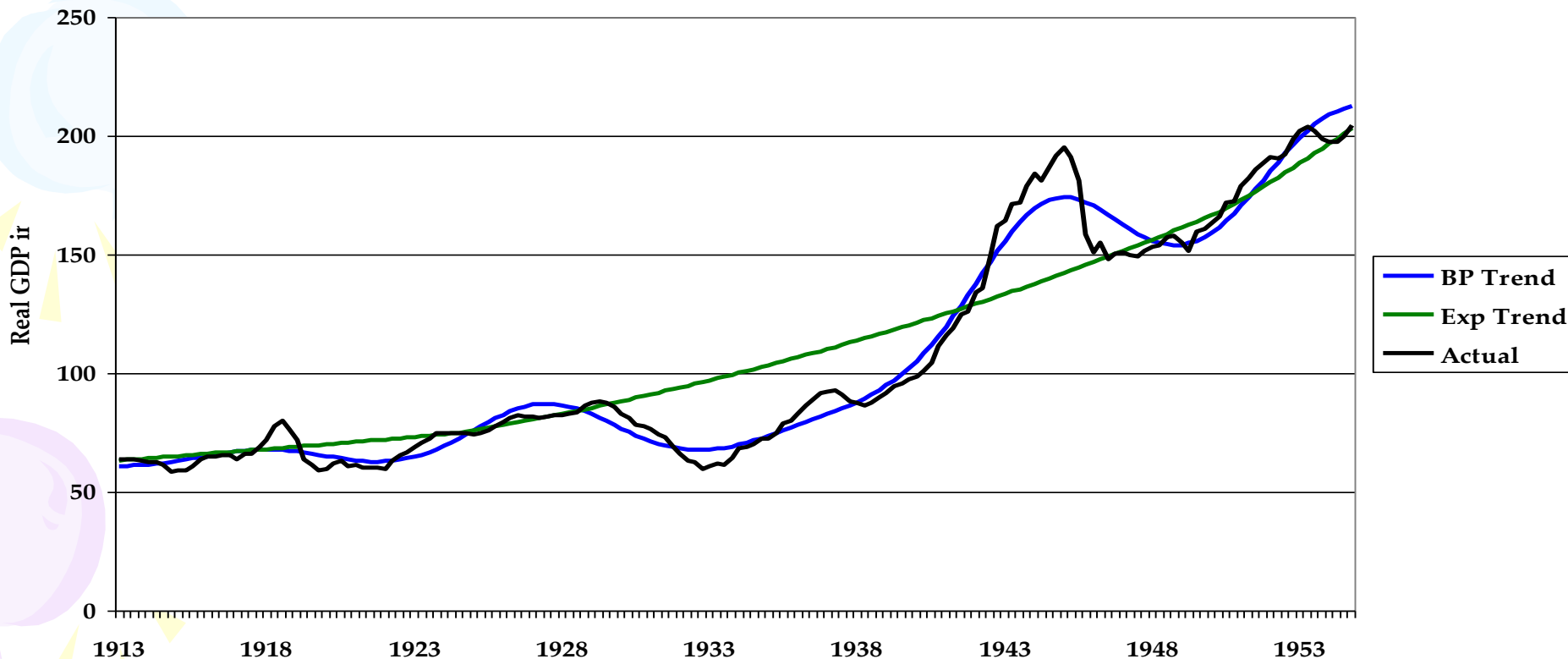
# BP Filter Implies Gyrations in Potential Real GDP Growth



Figure 3. Annual Rates of Change of Band-Pass Filtered and Exponential-through-Benchmarks Estimates of Real GDP, 1913-54
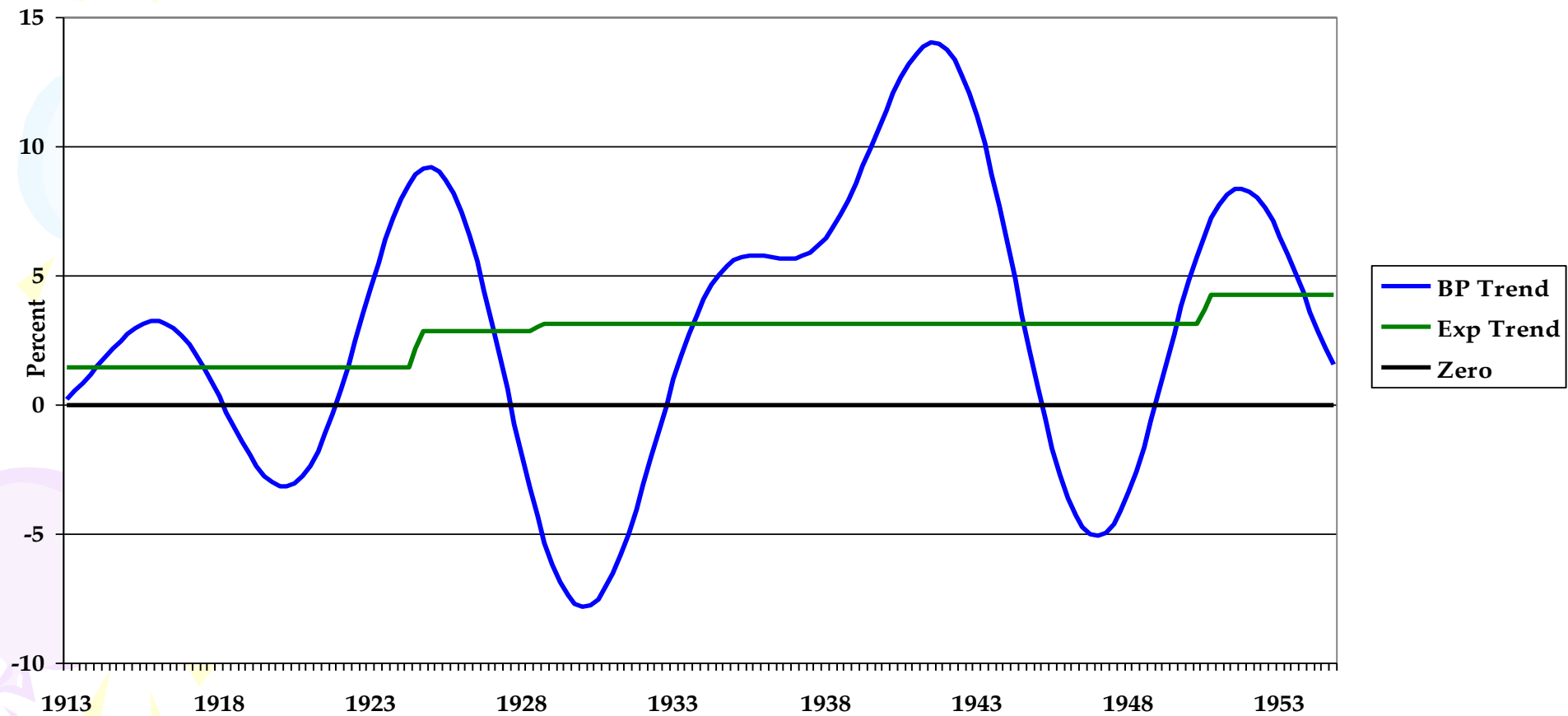
# According to BP Filter, the 1930s were just like the 1920s!

**Figure 4. Percent Log Ratio of Actual to Trend Real GDP,**
**Band-Pass Filtered and Exponential-through-Benchmarks, 1913-54**

# Compare with an pure piece of data:  Employment Population Ratio, 1913-1941

**Figure 5.  Percent Log Ratio of Actual to Trend Real GDP,**
**BP Filter and Exponential-through-Benchmarks,**
**and Twice the Percent Log of the Employment/Population Ratio (1929=1),**
**Annual, 1913-41**
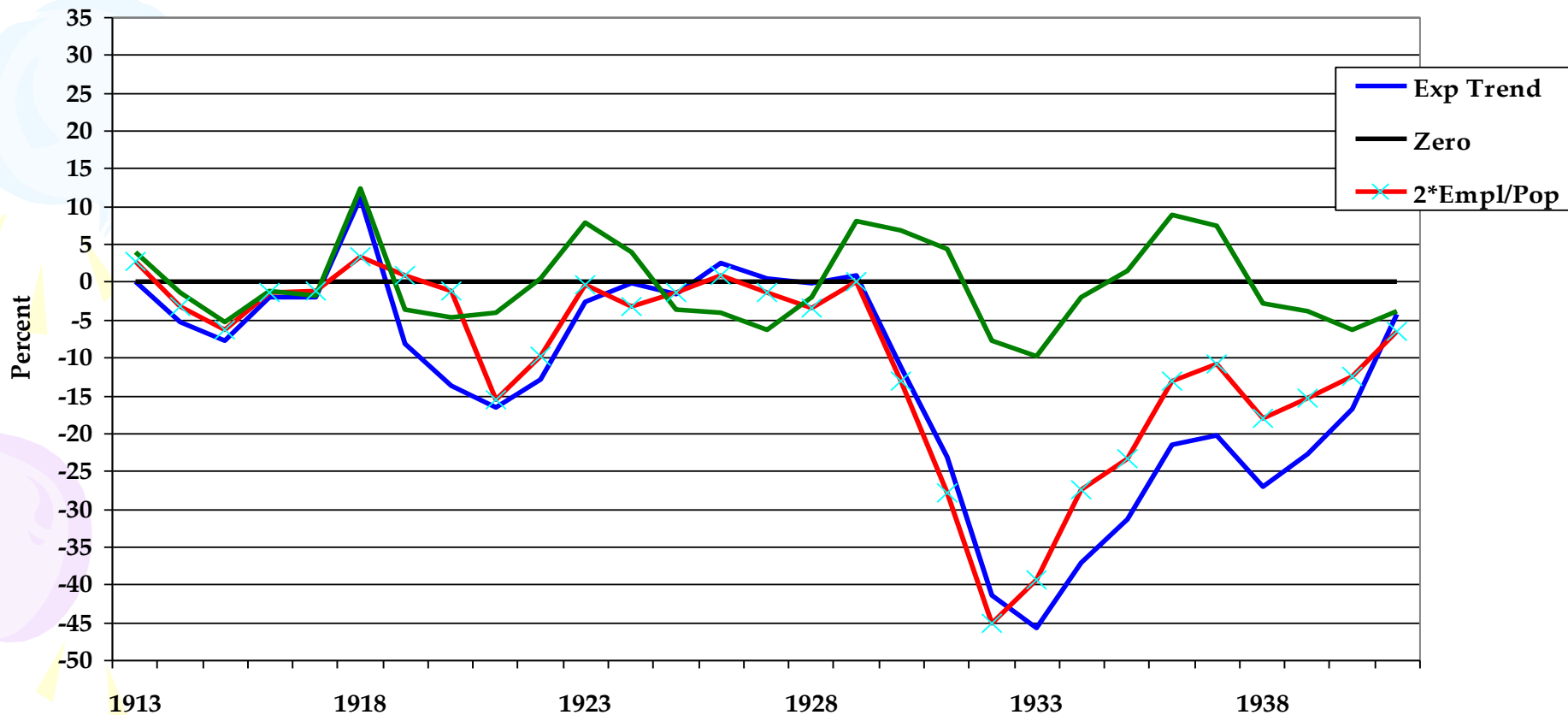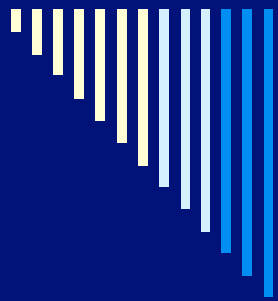
# A Theme of This Paper: Possible Error in Exponential Trend

- The exponential trend applies a constant log growth rate from 1928 to 1950.

- The reason is that we have no solid information on any benchmark year between 1928 and 1950

- 1941?  The paper weighs the evidence of tight markets in some parts of manufacturing vs. loose labor markets

- The paper raises the possibility that the 1928-50 trend overstates potential output in 1941

  - Our trend  is consistent with the possibility that the employment/pop ratio expresses loose labor markets compared to tight product markets

  - Decline in labor's share in 1939-41

# Dating the end of the Great Depression



Figure 6: Real GDP versus Potential Real GDP, 1913:Q1-1954:Q4, Billions of $1937 (Upper Frame) and Output Gap (Lower Frame)
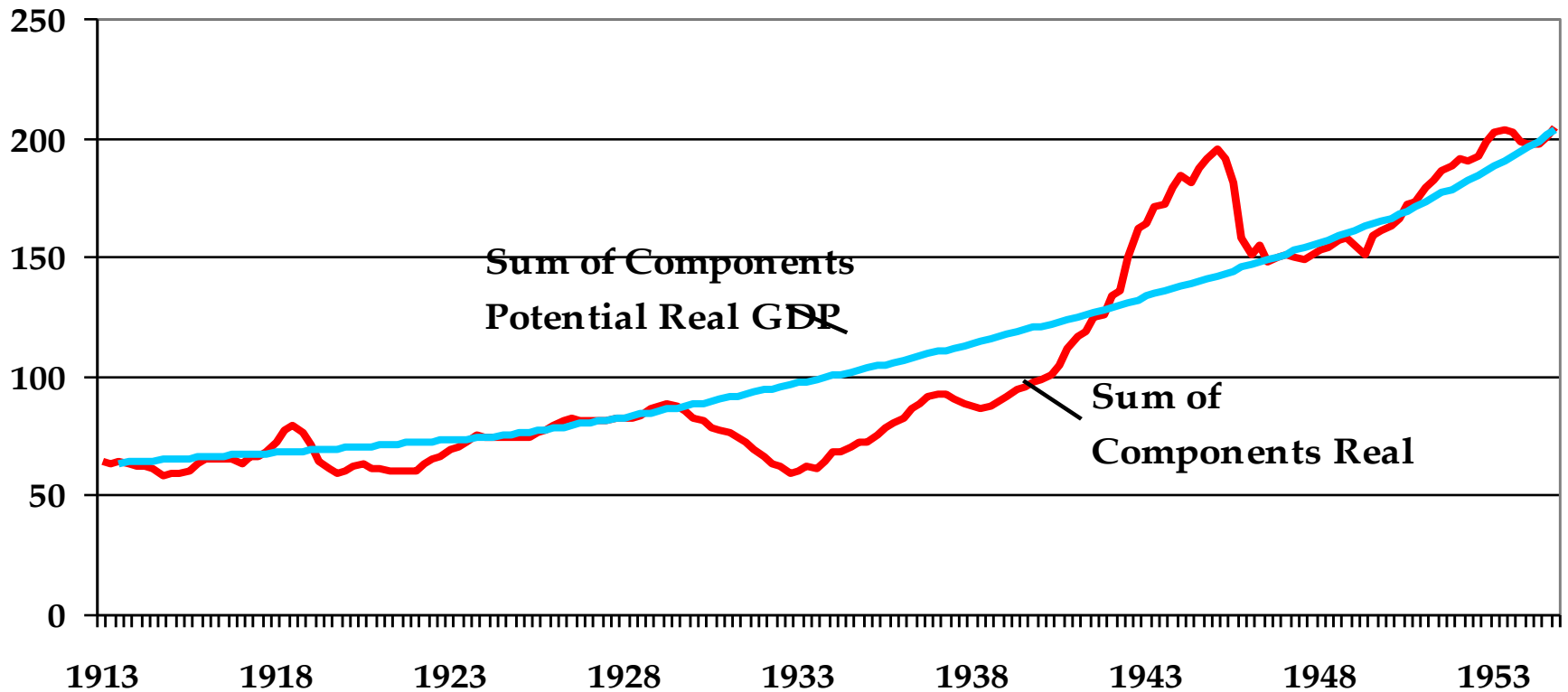
# The Log Output Ratio in Color, 1913-54



Output Gap = 100*LN(Y/YN)
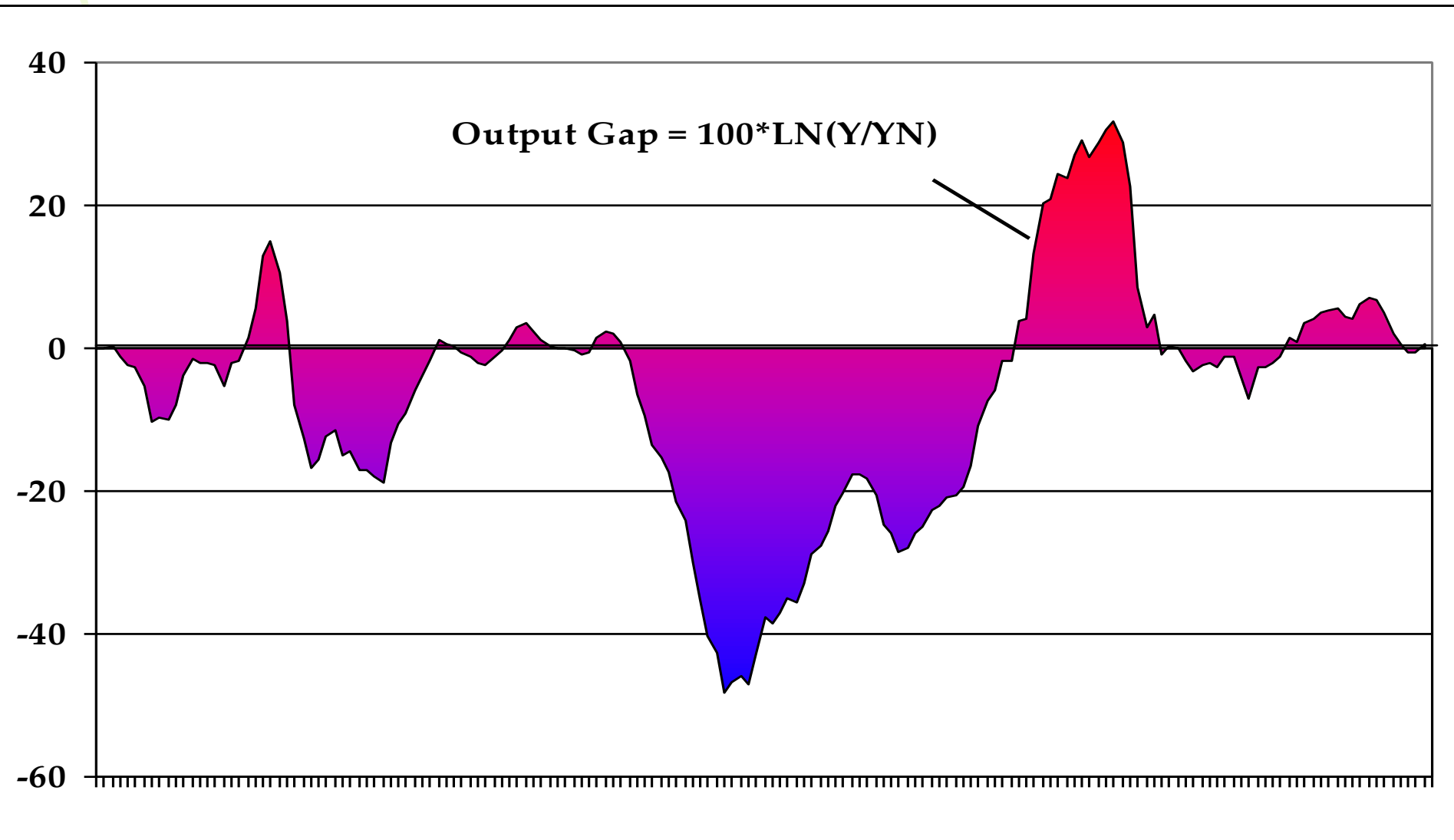
# Taking the Trend Potential GDP Estimate as Given, Let's Look at Components of Real GDP

- The numbers on these graphs are all of the form $X/Y^N$

- The charts show such concepts as C/YN, I/YN, G/YN, and NX/YN

- All data are expressed in the constant prices of 1937, which nearly eliminates the non-additivity problem of the chain-weighted NIPA

# Consumption and Government Spending

**Figure 7: Real GDP Components as Percentages of Sum of Components Potential Real GDP, 1919:Q1-1951:Q4**

100*(C/YN)

100*(G/YN)
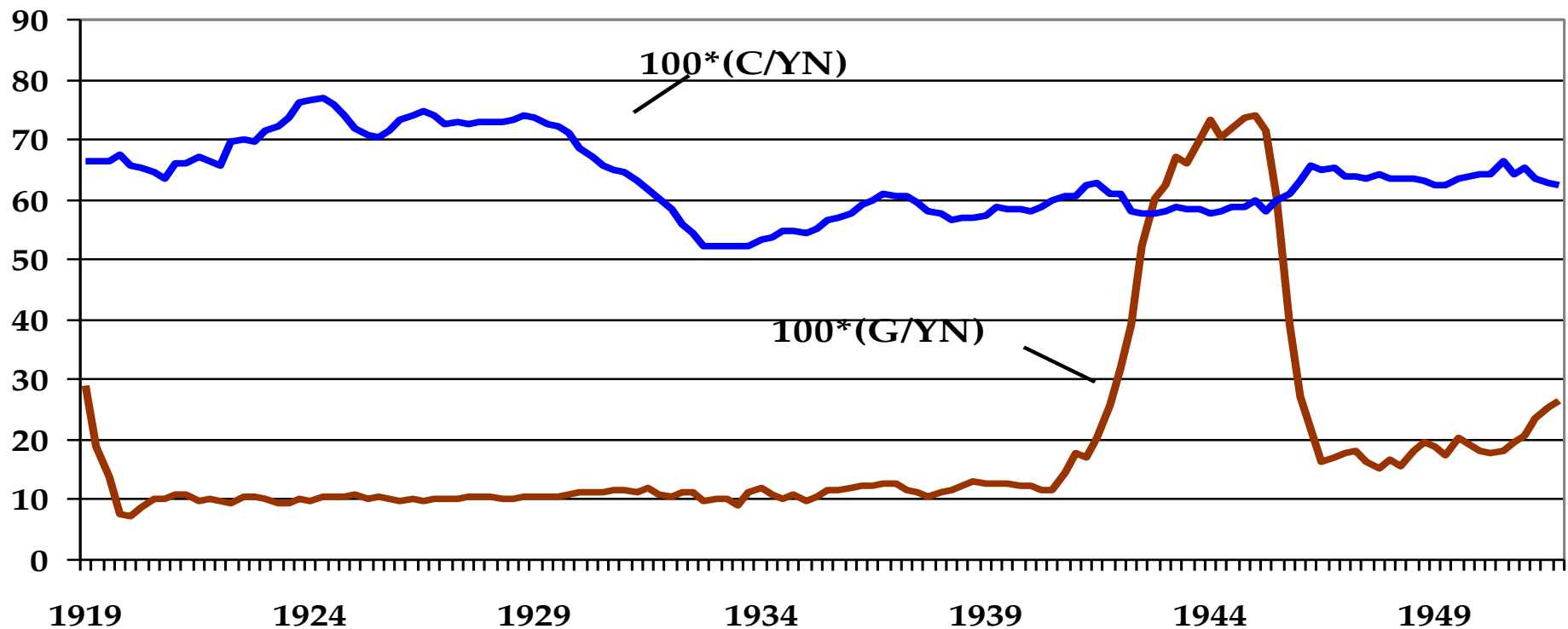
# Investment and Net Exports
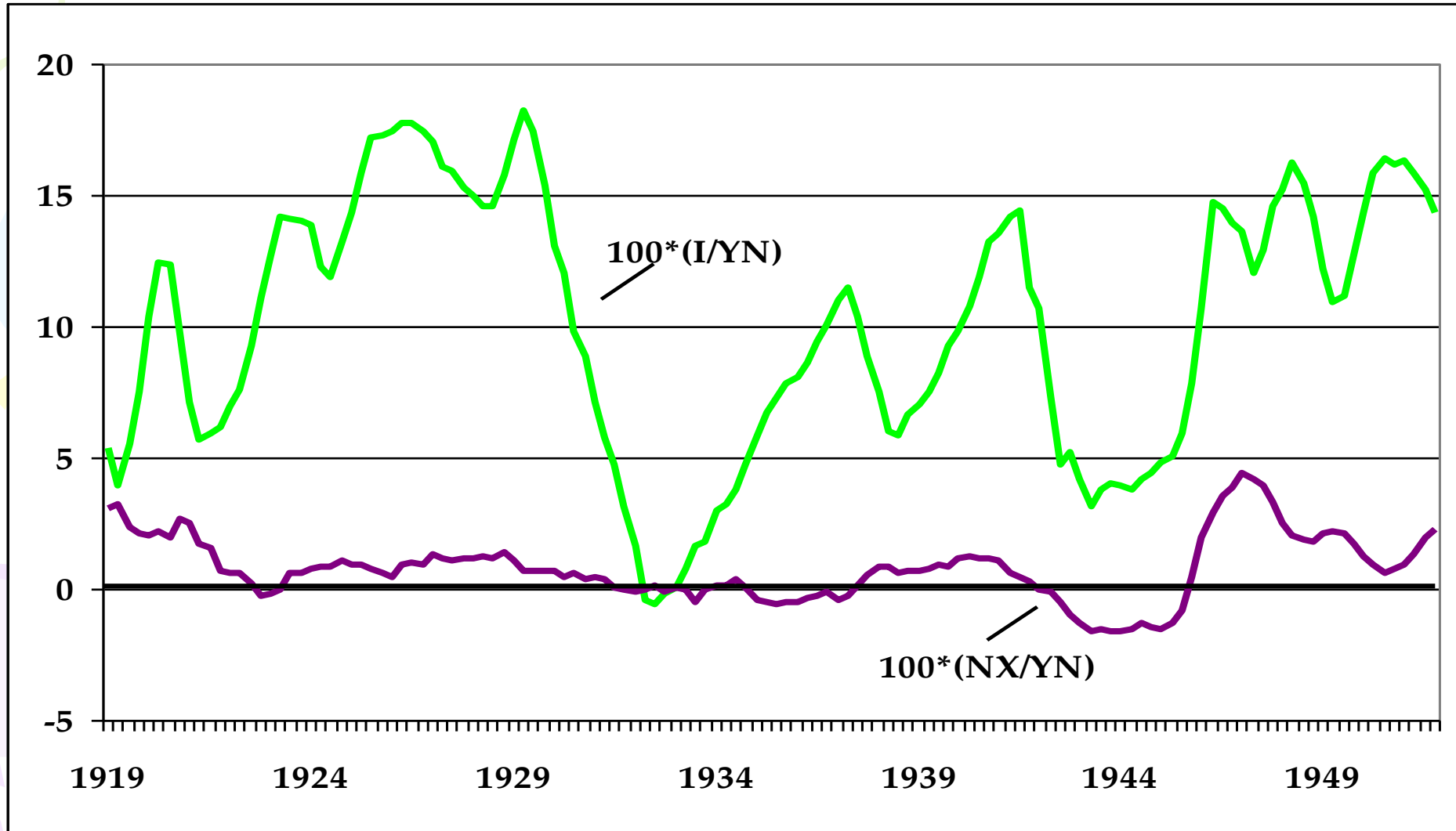
# A Possible Data Problem

- Consumption and Investment turn down in 1941:Q4 before Pearl Harbor
- Is this an artifact of interpolation?
  - Is 1942 downturn "smoothed" backwards into 1941:Q4 or even 1941:Q3?
  - Or is 1941:Q4 downturn "real" due to production constraints?
- Fortunately there is an independent data set on quarterly real GDP starting 1939

# Valerie Ramey's New Data

- ☐ She discovered a little known 1954 national income supplement that published quarterly NOMINAL GDP components back to 1939:Q1
- ☐ She the developed her own quarterly deflators from pieces of the CPI and WPI
- ☐ Her data are not complete – no inventories, exports, or imports
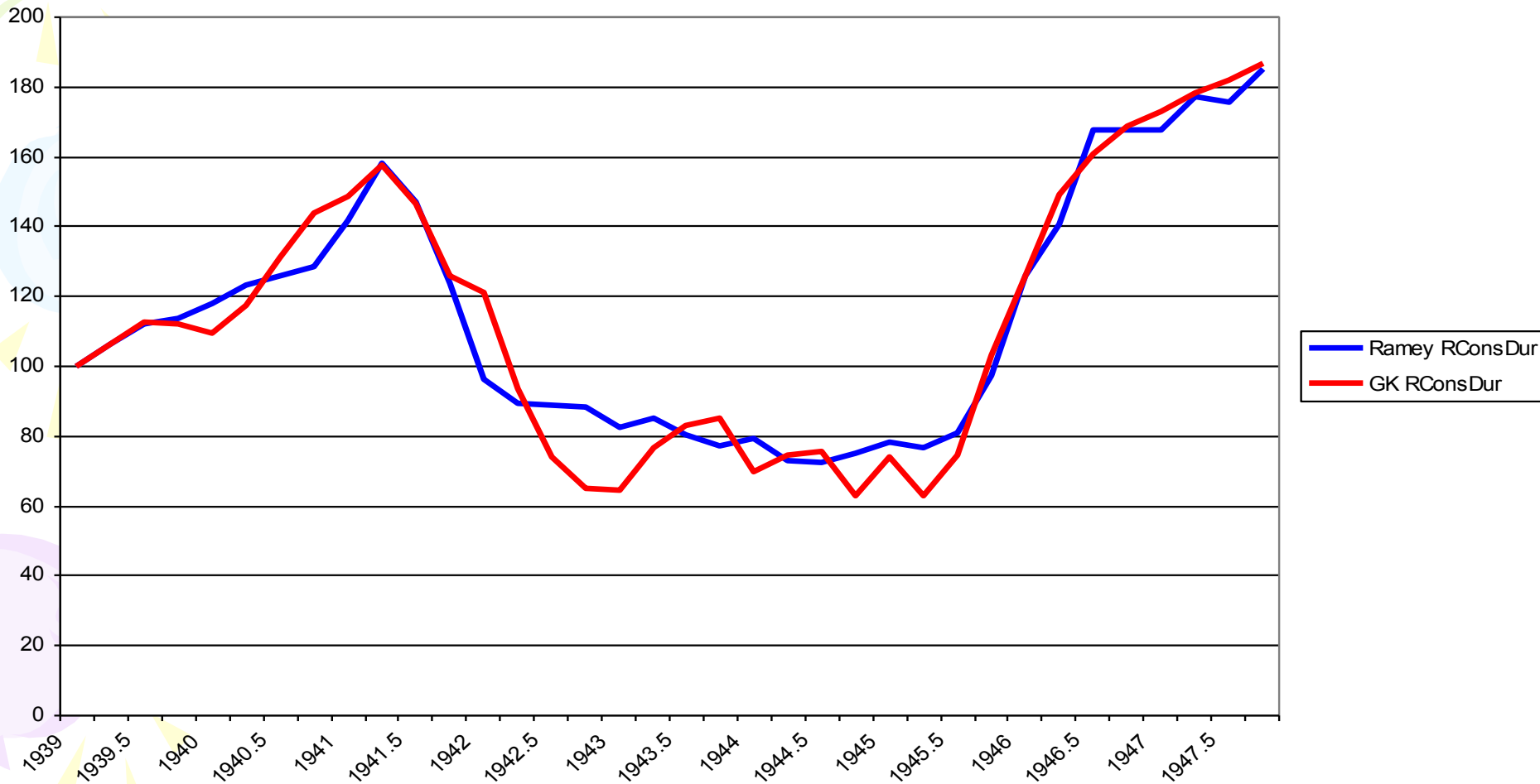- ☐ How do her data compare to ours?

# Total Real Consumption, 1939:Q1 = 100

**Ramey vs. Gordon-Krenn Real Consumption, 1939:Q1 = 100**
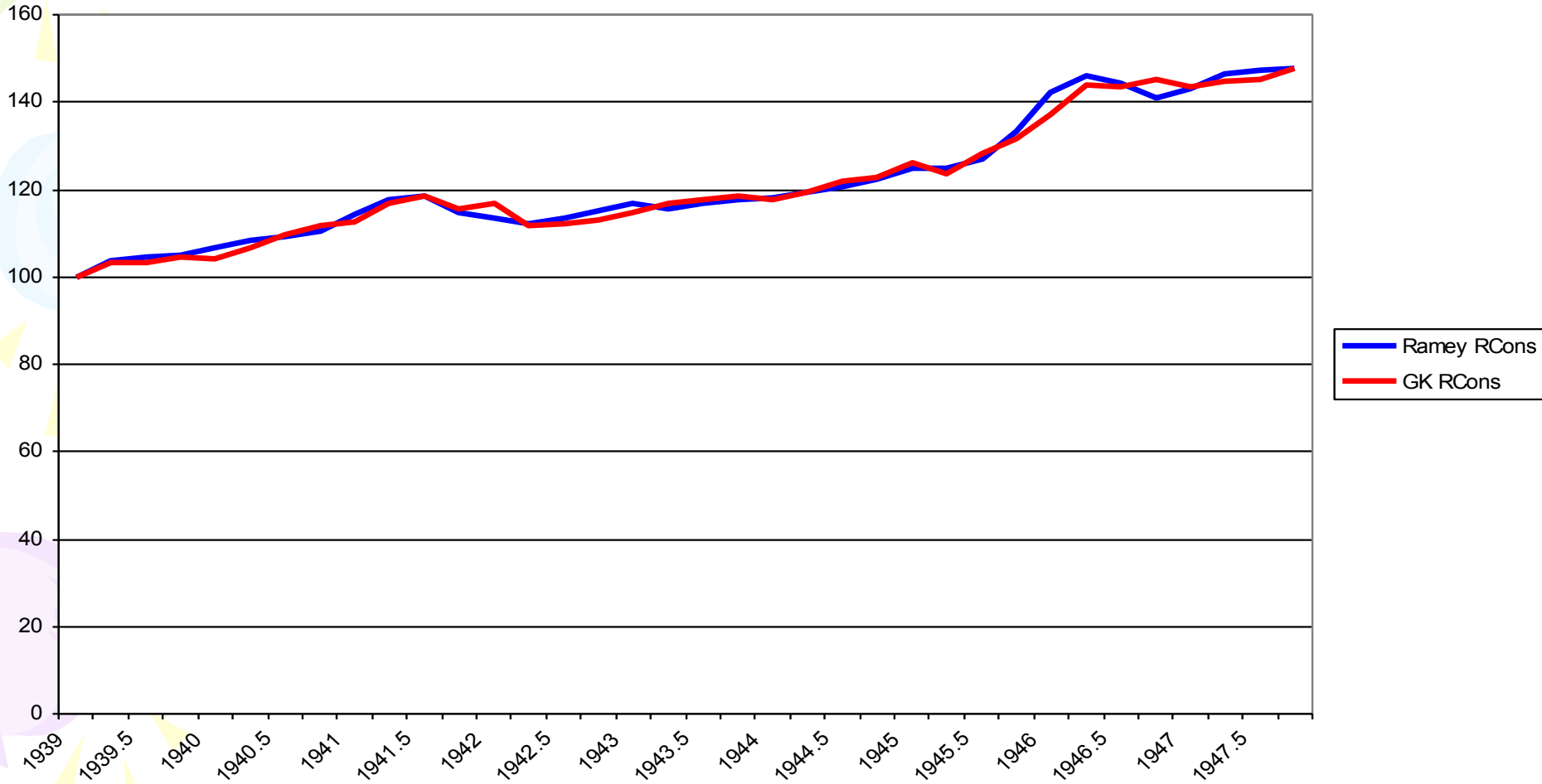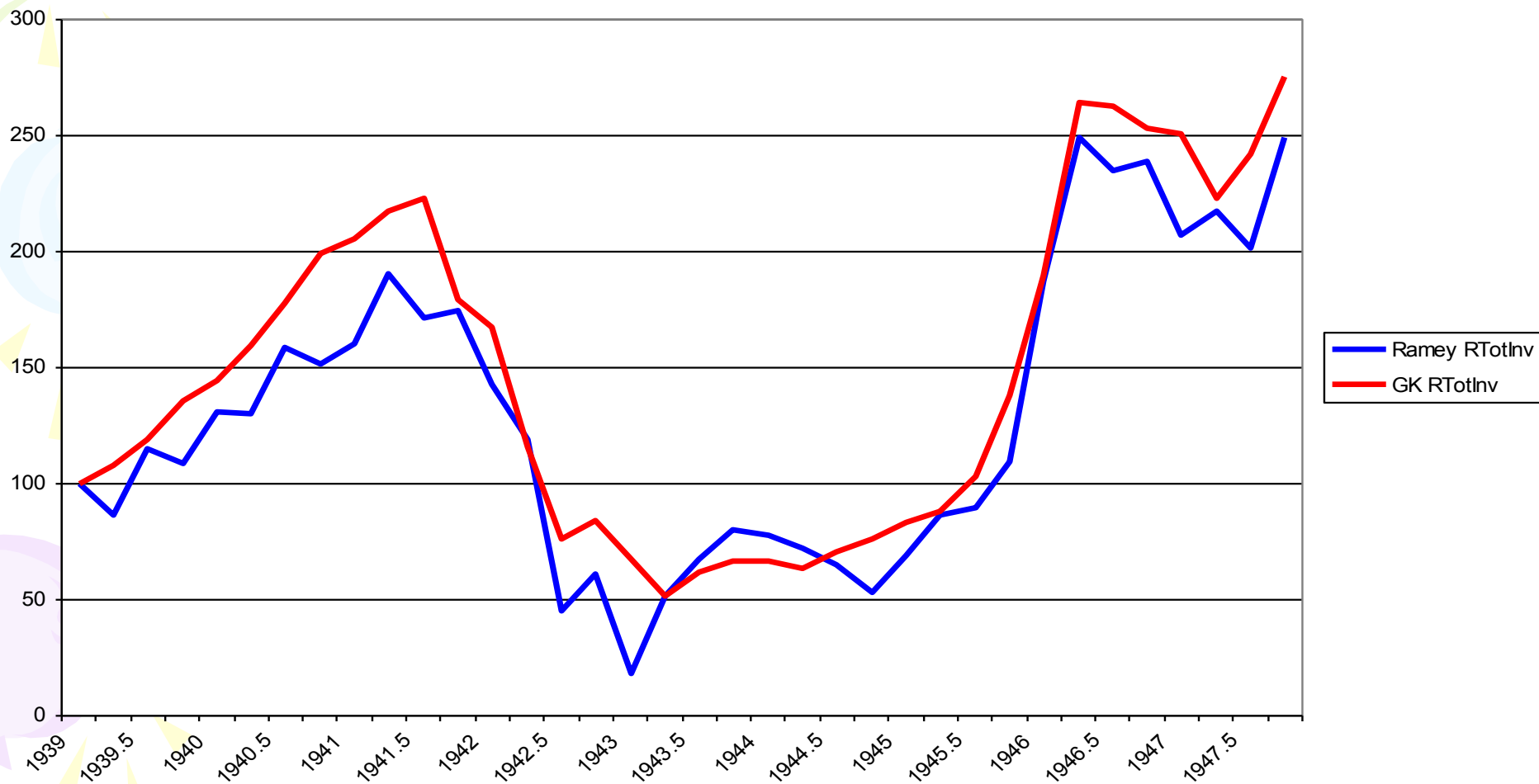
# Real Consumer Durables, 1939:Q1 = 100

**Ramey vs. Gordon-Krenn Real Consumer Durable Expenditures, 1939:Q1 = 100**

# Total Investment, 1939:Q1 = 100



Ramey vs. Gordon-Krenn Real Total Private Domestic Investment, 1939:Q1 = 100

# Summary of Comparison, 1941:Q2 – 1941:Q4
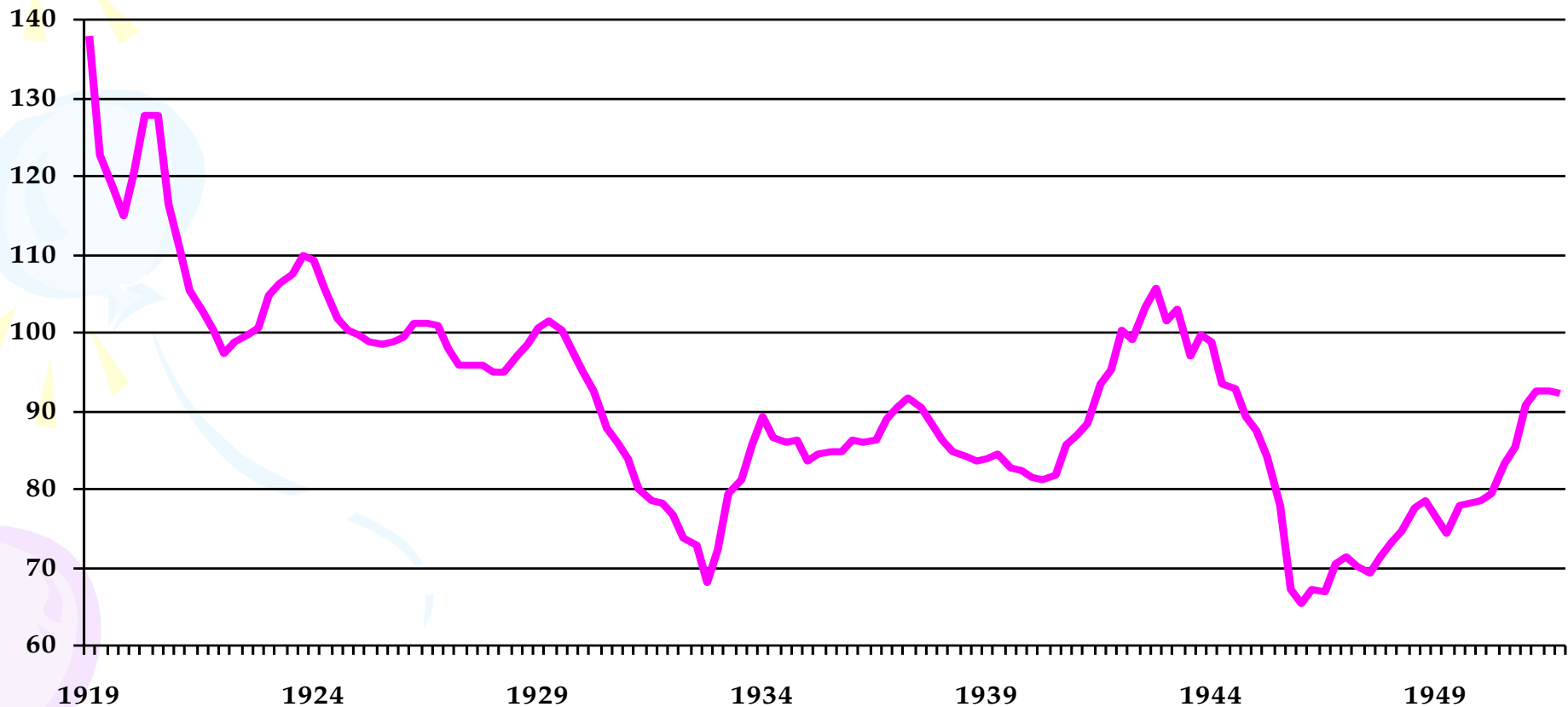
- Total Consumption
  - Ramey        -2.3 percent
  - G-K          -1.1 percent
- Total Investment
  - Ramey        - 8.5 percent
  - G-K          -17.6 percent
- Total Consumption + Investment
  - Ramey        -2.1 percent
  - G-K          -4.2 percent

# Velocity of M1 Works Against a Money-Only Interpretation

**Figure 10:  Velocity of M1, 1929 = 100, 1919:Q1 - 1951:Q4**

# What Was Happening in U. S. Economy, 1940-41?

- ❑ Sources: Ramey's compendium of quotes from *Business Week*
- ❑ Our own citations from *Fortune* and the *New York Times*
- ❑ Two sections:
  - Evidence on actual vs. potential GDP in 1941
  - Examples of how the increase in military spending impacted product and labor markets

# The GDP Gap in 1941?

☐ Our log output ratio is -4.1 percent for full-year 1941 and -1.7 percent for 1941:Q4

☐ Loose Labor markets:

- BLS/Lebergott Unemployment Rate 9.9

- Darby Unemployment Rate 6.0

- But Darby's workers were low-paid and available to work in private sector

# But Product Markets Were Tight in Parts of Manufacturing

- ☐ Utilization rate in steel industry
  - ■ 39.6% in 1938
  - ■ 82.1% in 1940
  - ■ 97.3% in 1941
- ☐ *BW* 5/31/41 "new cars are selling faster than auto companies can make them"
  - ■ Forecast of 50 percent drop in car production in 1942
- ☐ *Fortune* April 1940 machine tool industry "tearing along close to capacity" ("thrown out of office")
- ☐ GDP deflator rose 9.3 percent year ending 1941:Q4
  - ■ But labor's share fell, consistent with looser labor markets

# The Fire Was Ignited in 1940:Q2, *Not* on 12/7/41

- ☐ Even before 1940:Q2, January exports jumped to combatant nations jumped 50 percent or more Y-o-Y

- ☐ In June defense appropriations jumped by 1.5 percent of GDP

- ☐ June 22 "National Defense has become the dominant economic and social force in the U. S. today"

- ☐ June 10 "Stripping of the Arsenals" (read quotes)

# Summer and Fall of 1940

- August:  defense appropriations jumped by 5 percent of GDP
  - Plans for a two-ocean navy "by 1944"
  - 50,000 warplanes by June, 1942
- September:  Selective Service, 1.2 million to be drafted
- 400,000 construction jobs to build army training camps (1% of 1940 employment)
- Aircraft industry employment in Los Angeles County 12,000 in 10/38, projected at 100,000 by end 1941 (*Fortune,* March 1941)

# Literature Review

- ☐ DeLong and Summers
  - ■ "By the time WWII began, 5/6 of decline in output relative to trend had been made up."
- ☐ C. Romer's unambiguous verdict
  - ■ "Monetary developments were a crucial source of the recovery of the U. S. economy from the Great Depression.  Fiscal policy, in contrast, contributed almost nothing to the recovery before 1942"
  - ■ Problems with Romer
    - ☐ Ignores decline in velocity 1938-40
    - ☐ Treats real interest rates as a source of recovery, not recognizing that real interest rates are endogenous
- ☐ Bernanke and Parkinson (1989):  mean reversion

# Closest to Our Conclusions: Vernon JEH 1994

- ☐ Fiscal policy primarily responsible for expansion in 1941

- ☐ He concentrates on 1941 but recognizes a role for monetary policy in 1940 and earlier

- ☐ His fiscal multipliers are not based on interwar evidence but are calculated from the postwar MPS model

- ☐ Vernon can be viewed as a point of departure for this paper

# Section 5: VAR Methodology

☐ Purpose of the VAR:

■ To determine whether innovations in fiscal policy or innovations in monetary policy were the driving force behind the 1939:Q1-1941:Q4 recovery

■ To conduct the testing for this question with minimal restrictions and/or preconceived notions and in a way that takes into account the correlations between the variables

■ To be able to quantify the recovery into percentages attributable to innovations in fiscal policy, innovations in monetary policy, and an "other" category

# VAR Framework

$$y_t = c + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + ... + \Phi_p y_{t-p} + \varepsilon_t$$

- Each element is a ($n$ x 1) vector, where $n$ is the number of variables in the VAR
- $p$ is the number of lags included in the VAR
- This paper sets $n$ = 5 and $p$ = 5
- The variables used are:
    - (1) Real Government Spending on Goods and Services (G)
    - (2) Nominal M1 Money Supply (M1)
    - (3) M1 Money Multiplier (MM)
    - (4) Real GDP minus G (N)
    - (5) Federal Reserve Bank of New York Discount Rate (R)
- G is the fiscal policy variable, while M1, MM and R are the monetary policy variables
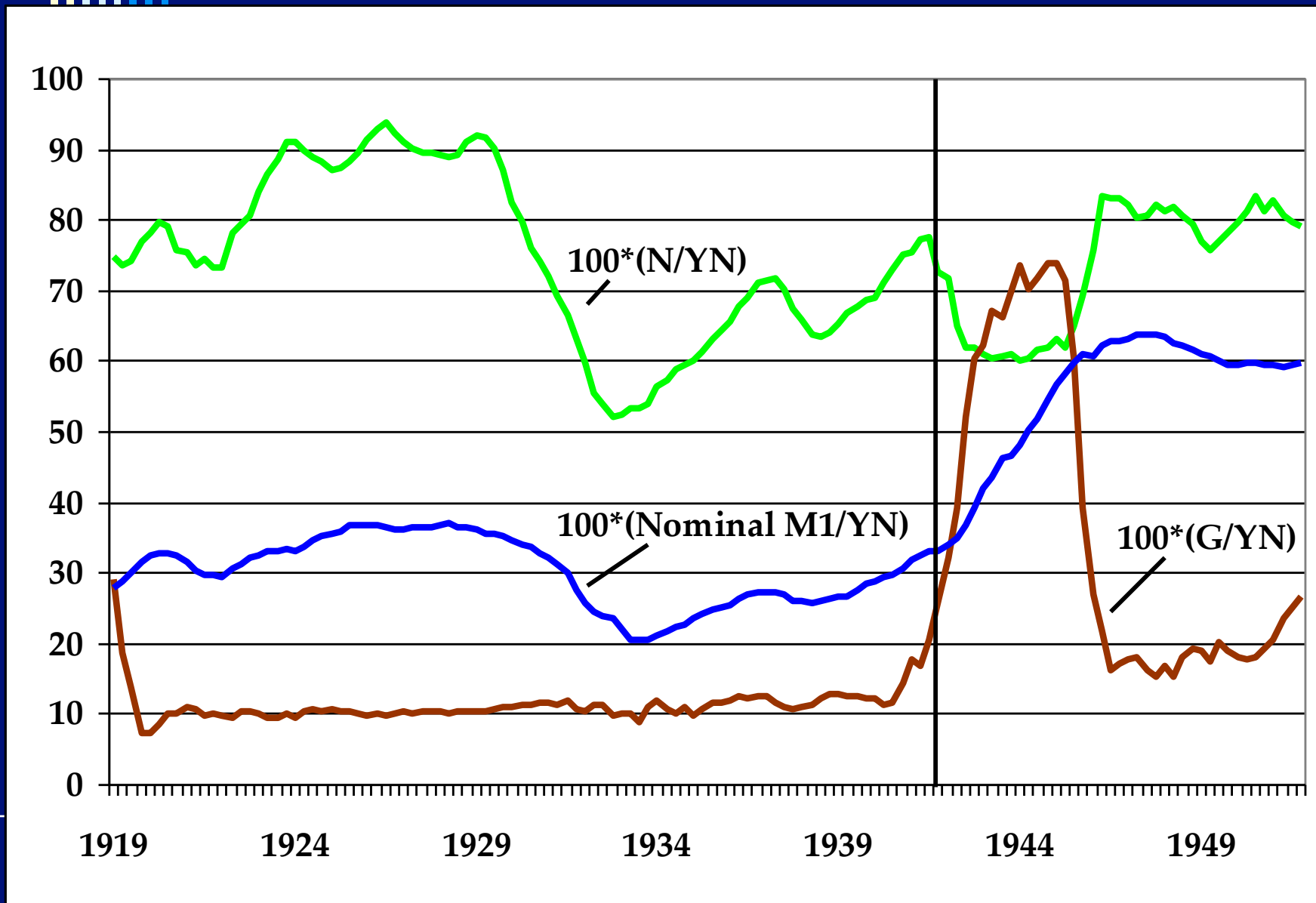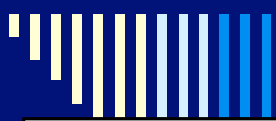
# VAR Time Period

☐ Benchmark time period: 1920:Q2-1941:Q2

- 1941:Q3-1941:Q4 are excluded from the VAR because the dramatic rise in G over that span (from 16.9% of YN in 1941:Q2 to 25.6% in 1941:Q4) leads to nonsensical results

- However, simulations are still run through 1941:Q4 using the VAR coefficients estimated through 1941:Q2

- This makes our results based off of those coefficients biased *against* innovations in fiscal policy explaining the recovery from the Great Depression
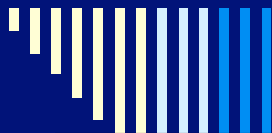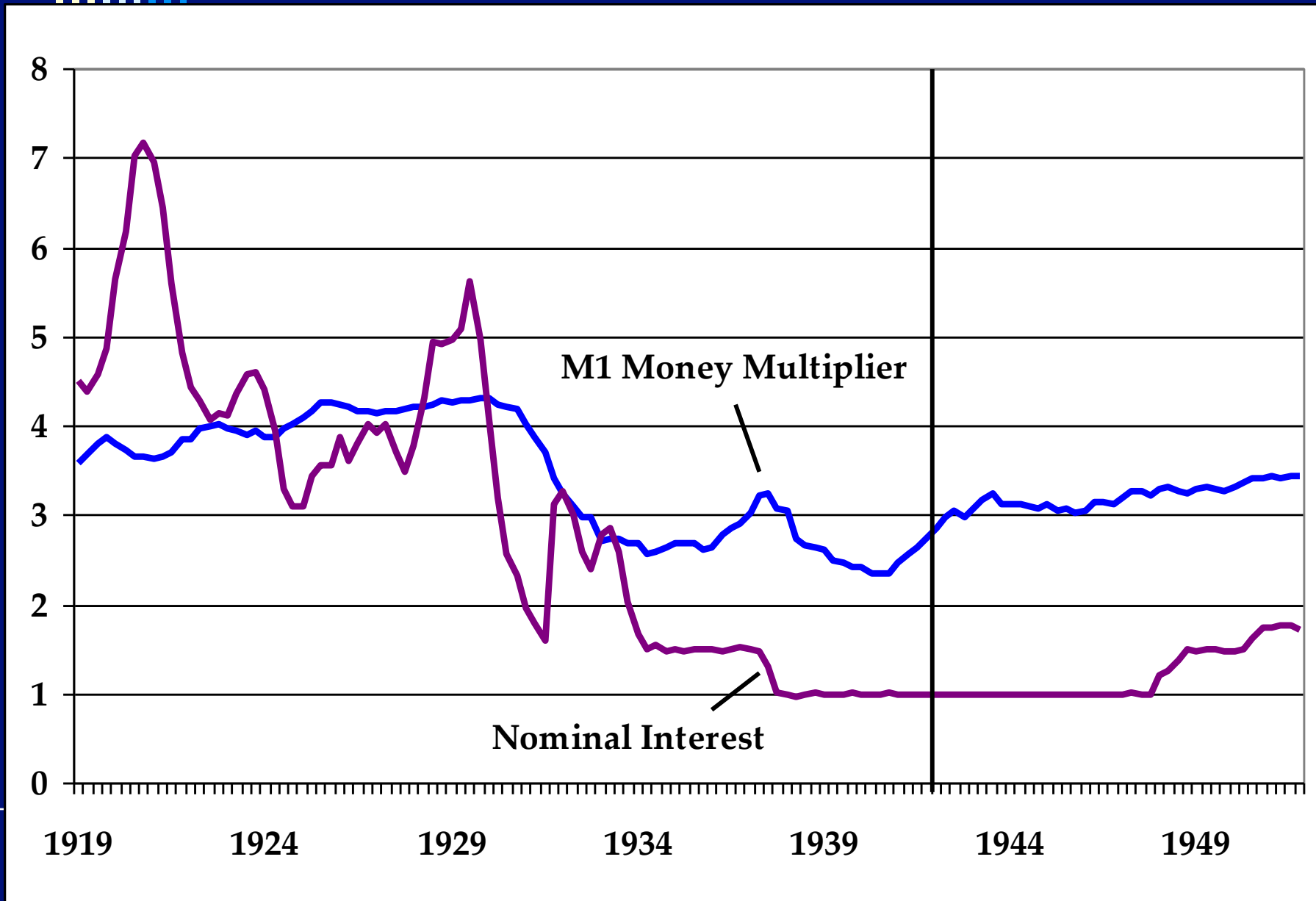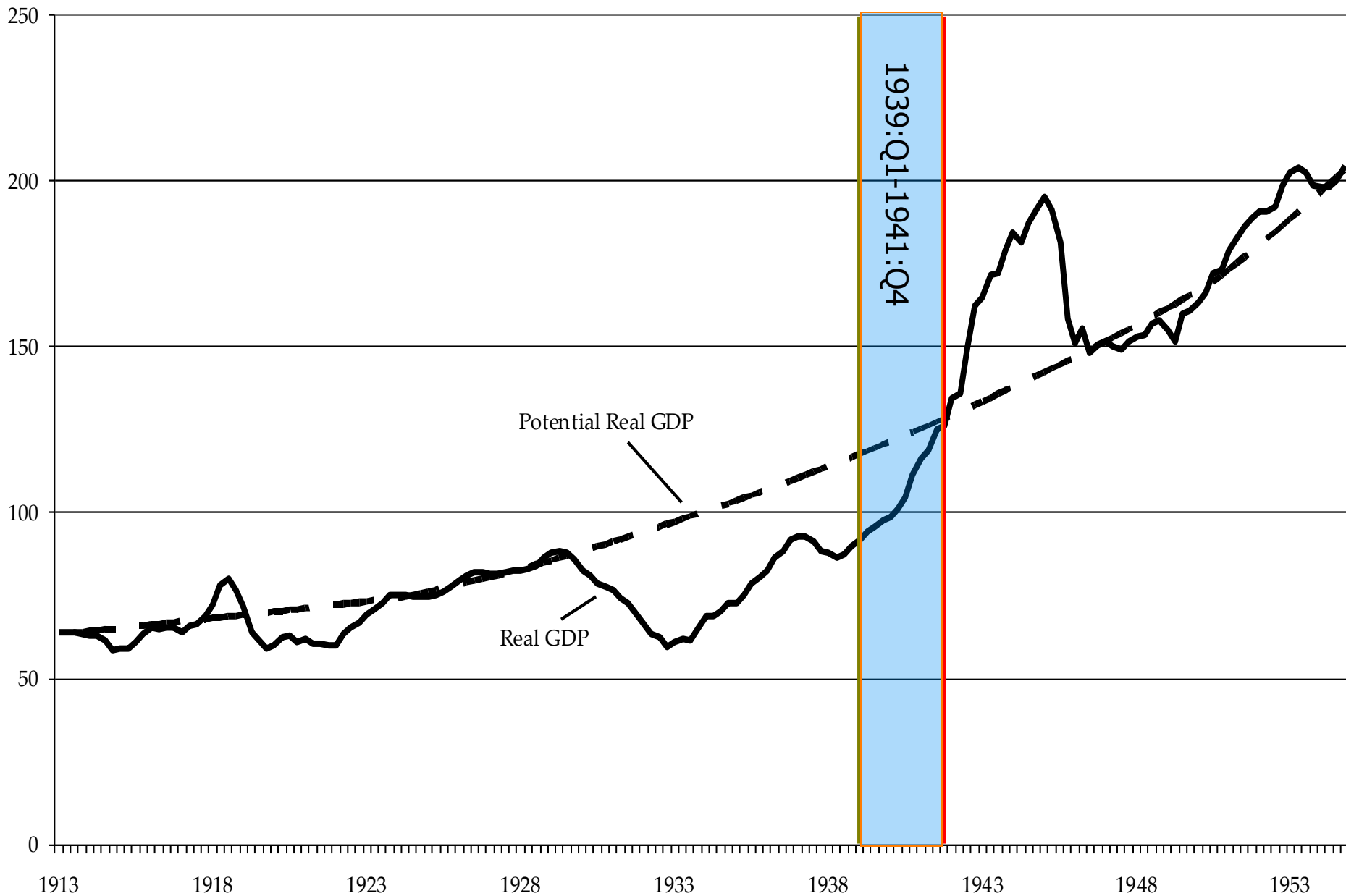
# VAR Variables: 1919:Q1-1951:Q4

# Real GDP versus Potential Real GDP, 1913:Q1-1954:Q4, Billions of Chained $1937



1939:Q1-1941:Q4

Potential Real GDP

Real GDP

# Dynamic VAR Forecasts and "Own-Innovations" in the Variables

$$\hat{y}_{1939:Q4} = c + \Phi_1 \hat{y}_{1939:Q3} + \Phi_2 \hat{y}_{1939:Q2} + \Phi_3 \hat{y}_{1939:Q1} + \Phi_4 y_{1938:Q4} + \Phi_5 y_{1938:Q3} + \varepsilon_{1939:Q4}$$

- Above is the equation for the VAR dynamic forecast values in 1939:Q4
- When there is a "hat" over $y_t$ it means that the number was estimated by the VAR forecast
  - Thus this is called a *dynamic* forecast because the previously forecasted values are used to forecast each subsequent value
- The (5 x 1) vector $\varepsilon_{1939:Q4}$ represents the "own-innovations" in each of the variables
  - It can be thought of as the changes in each variables' values from 1939:Q3 to 1939:Q4 not predicted by the VAR coefficients.

# Innovations: Unorthogonalized ("Own") versus Orthogonalized ("Interactive")

- Most papers using VARs conduct testing using orthogonalized innovations
- The main advantage of orthogonalizing is that contemporaneous correlations between the variables are taken into account when examining innovations in a single variable
- In the paper this leads us to give them the more intuitive name as "interactive" (IA) innovations, as compared to the simplified "own" (O) innovations described on the preceding slide

# More on "Own" vs. "Interactive"

☐ The orthogonalization process involves making identifying restrictions using assumptions based on prior knowledge, one example being structural VARs

☐ Stock and Watson (2001, p. 113) caution that these VAR's "structural implications are only as sound as their identification schemes," meaning that if the additional assumptions going into the identification restrictions are flawed, then the rest of the VAR results will be flawed as well.

# Choleski Factorization Method

- Instead of structural identifying assumptions, this paper uses a Choleski factorization method, which basically implies that variables ordered first in the VAR are contemporaneously unrelated to the variables ordered after them

- Thus for IA innovations, the ordering of the VAR matters, and we must explore several different ordering schemes in the robustness checks

- Our baseline ordering (G, M1, MM, N, R) is based off the exogeneity of G, with M1 and MM next to make their comparison with G innovations on more equal terms

# Stopping in 1941:Q2 vs. 1941:Q4

☐ Unfortunately, because we end our VAR in 1941:Q2, we are unable to compute IA innovations for 1941:Q3 or 1941:Q4

☐ Luckily, the simplified O innovations, which can be computed in post-sample simulations, produce very similar results to the IA innovations

☐ This allows us to confidently use O innovations to generate results in 1941:Q4

# Section 6: VAR Results

☐ We perform three main tests using VARs:  historical decompositions, dynamic forecasts and impulse response functions

# Historical Decompositions

- The purpose of the historical decomposition is to see which variables' innovations had the largest effect on the variable examined (either G or N, as G + N = Y).
- This is done using the same dynamic forecast technique described above, except now innovations in each variable are allowed to enter into the forecast, one variable at a time.
- The following figures display four lines:
  - Red: displays the actual path of the variable examined (as a percentage of YN)
  - Purple: displays the basic VAR dynamic forecast
  - Green: displays how IA innovations in each of the six variables influence the variable examined, setting all other up through 1941:Q2
  - Blue: displays the impact of O innovations through 1941:Q4.

Figure 11: Contribution of Model Variable Innovations to G: 1939:Q1 to 1941:Q4
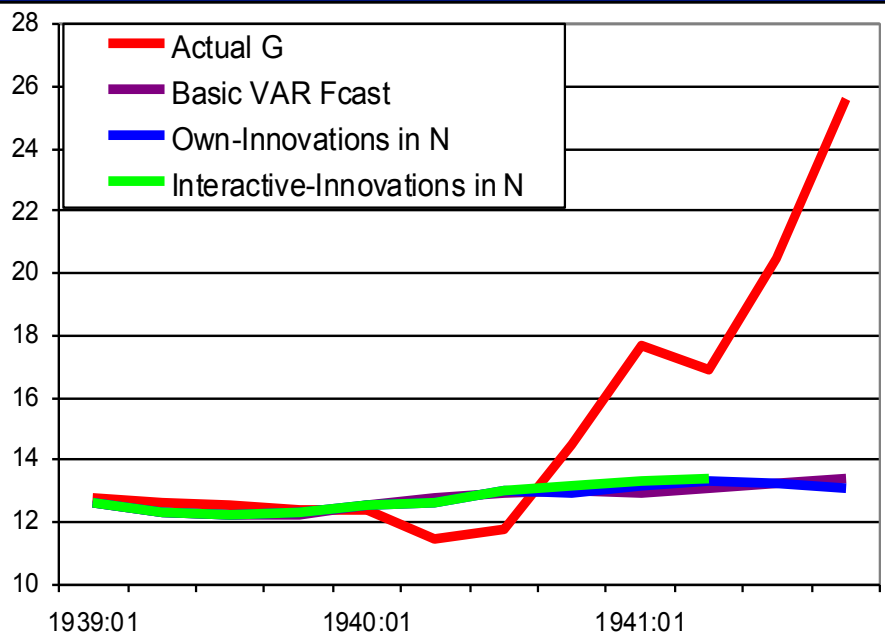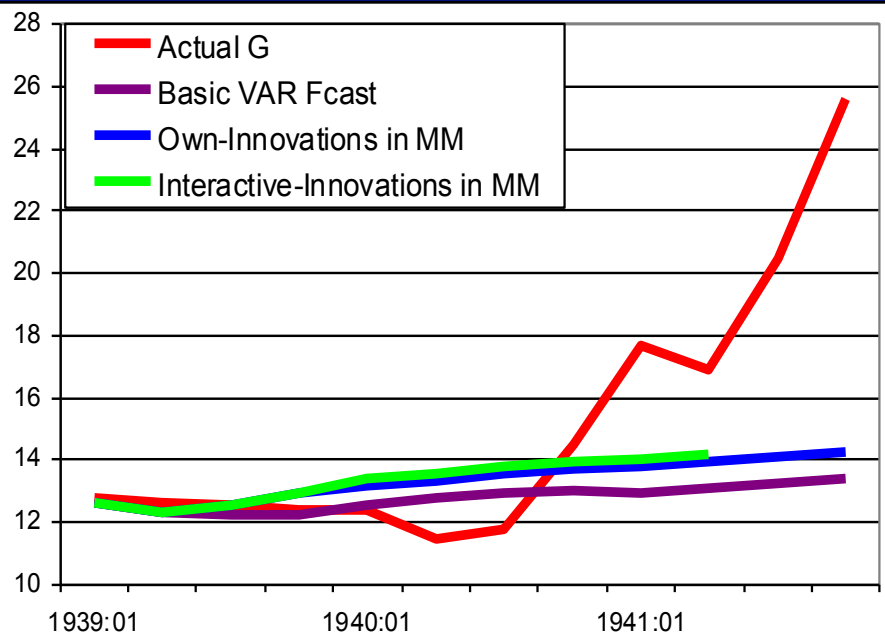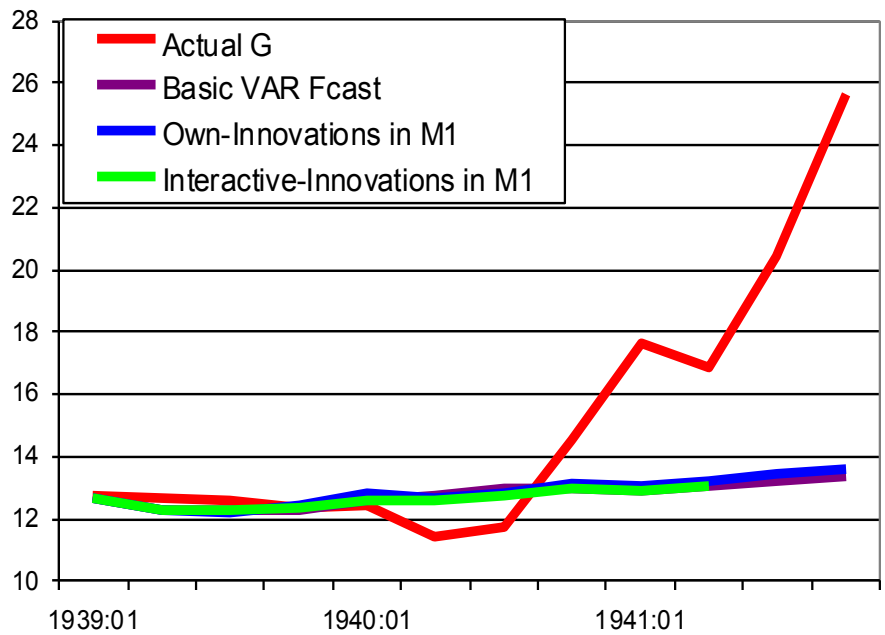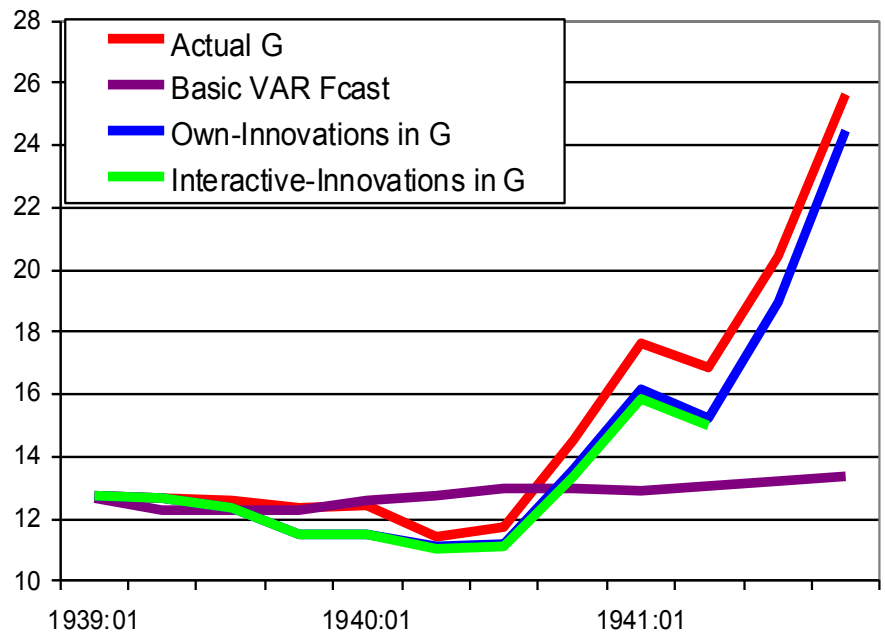
**Figure 12: Contribution of Model Variable Innovations to N: 1939:Q1 to 1941:Q4**
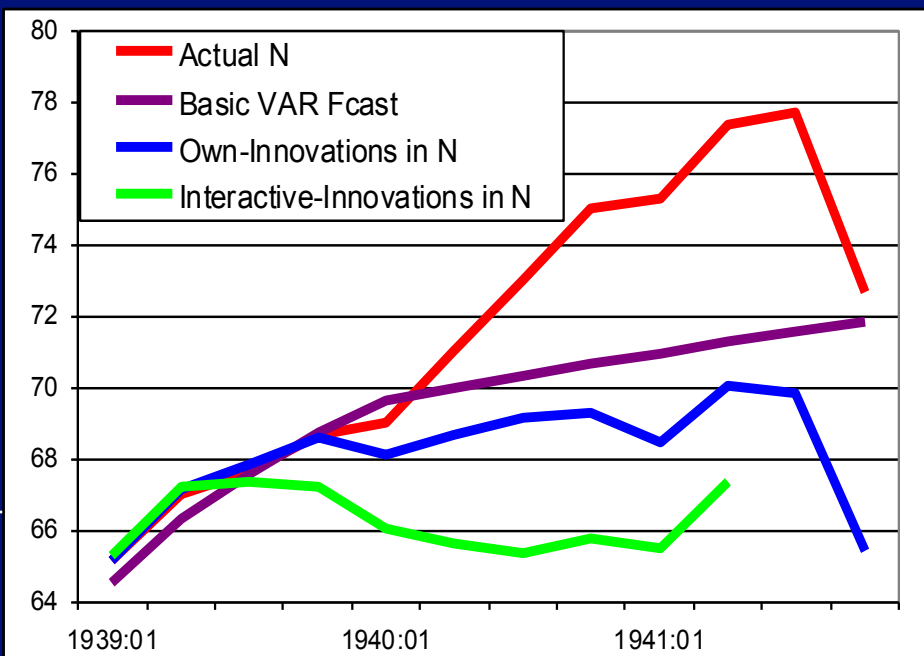
# Conditiional Forecasts

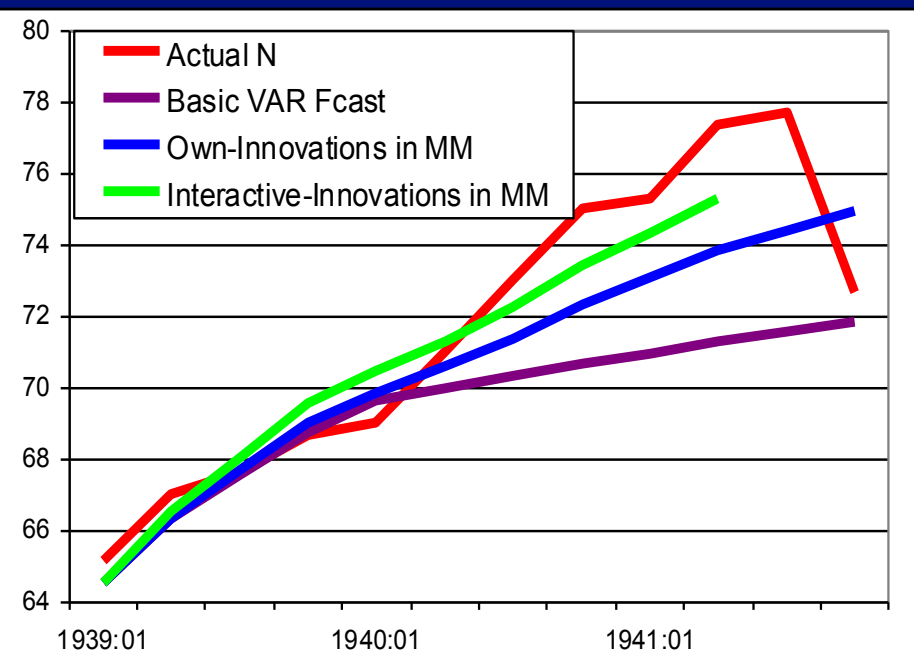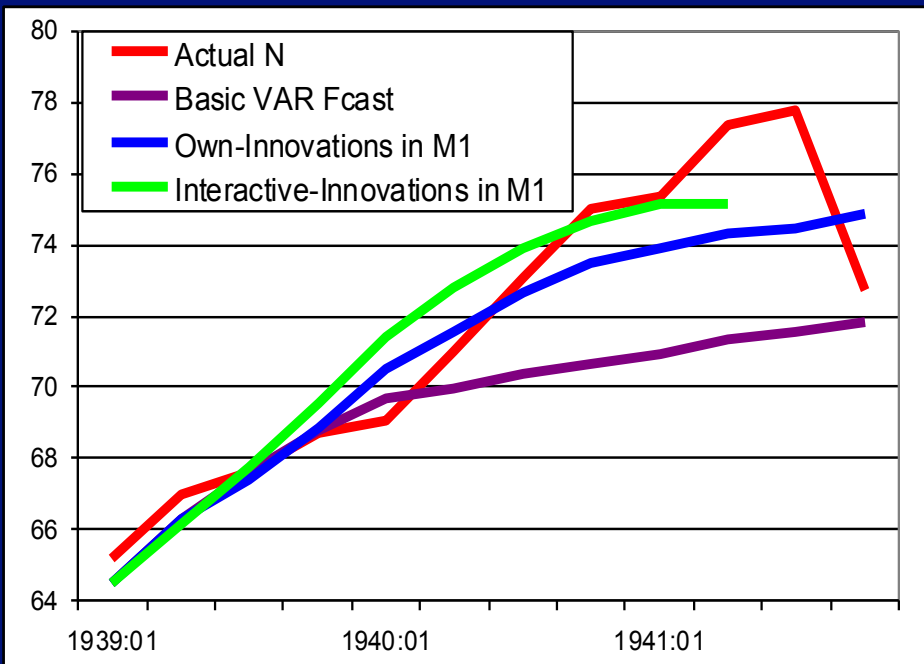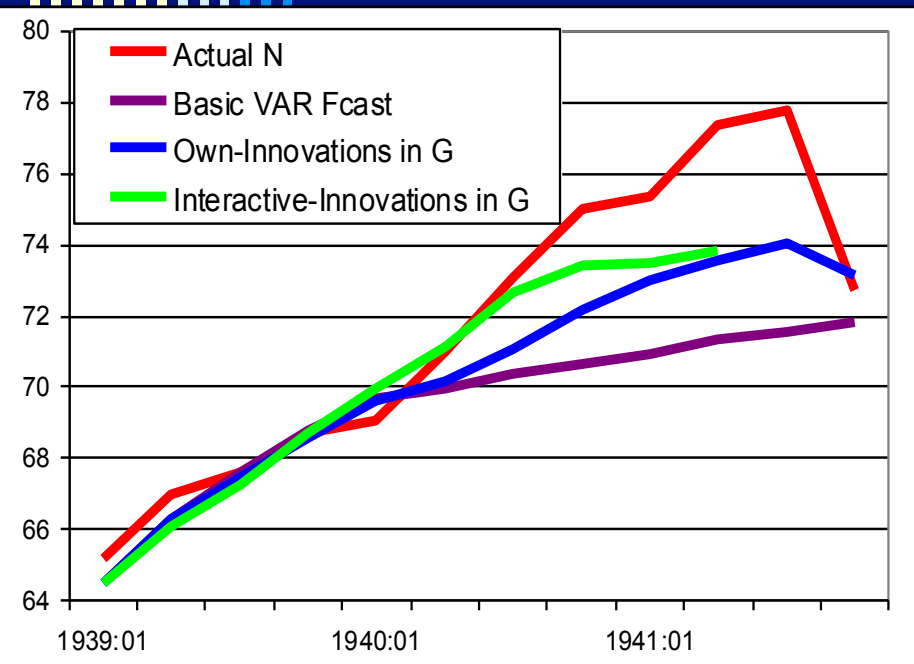**Figure 13: Actual Data vs. Conditional Forecasts\*: 1939:Q1 to 1941:Q4**



Government Expenditures (G)
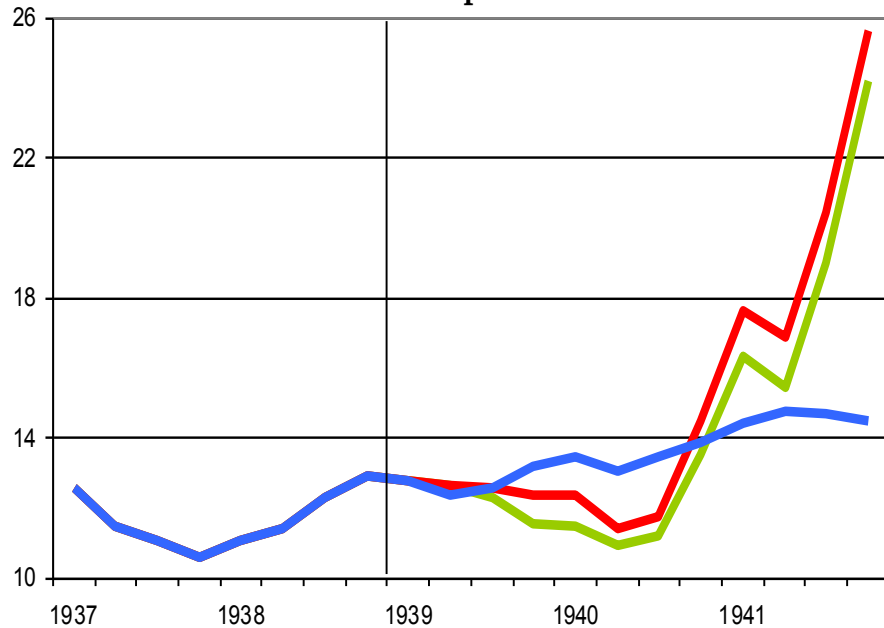
N = C + I + (X-IM)
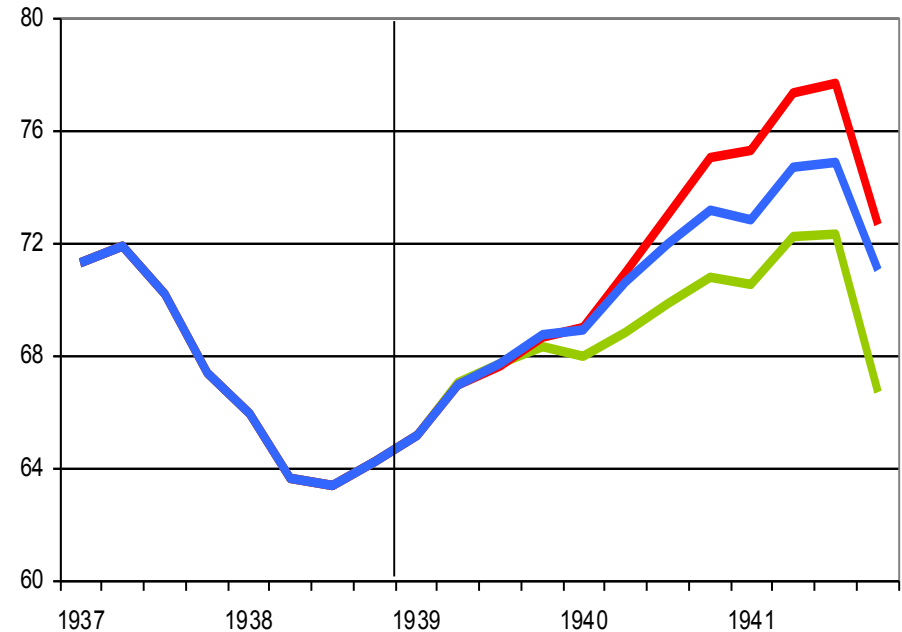
— Actual Data    — Fcast with Fiscal Innovations Suppressed    — Fcast with Monetary Innovations Suppressed

\* Conditional Forecasts:

Blue line = Fiscal (G) innovations are suppressed (set equal to 0) from 1939:Q1 onward, while innovations to the other variables remain

Green line = Monetary (M1, M, R) innovations are suppressed (set equal to 0) from 1939:Q1 onward, while innovations to the other variables remain

# Sum of Components Real GDP (Y), Actual Data vs. Conditional Forecasts*: 1939:Q1 to 1941:Q4

Legend:
— Actual Data    — Fcast with Fiscal Innovations Suppressed    — Fcast with Monetary Innovations Suppressed

* Conditional Forecasts:

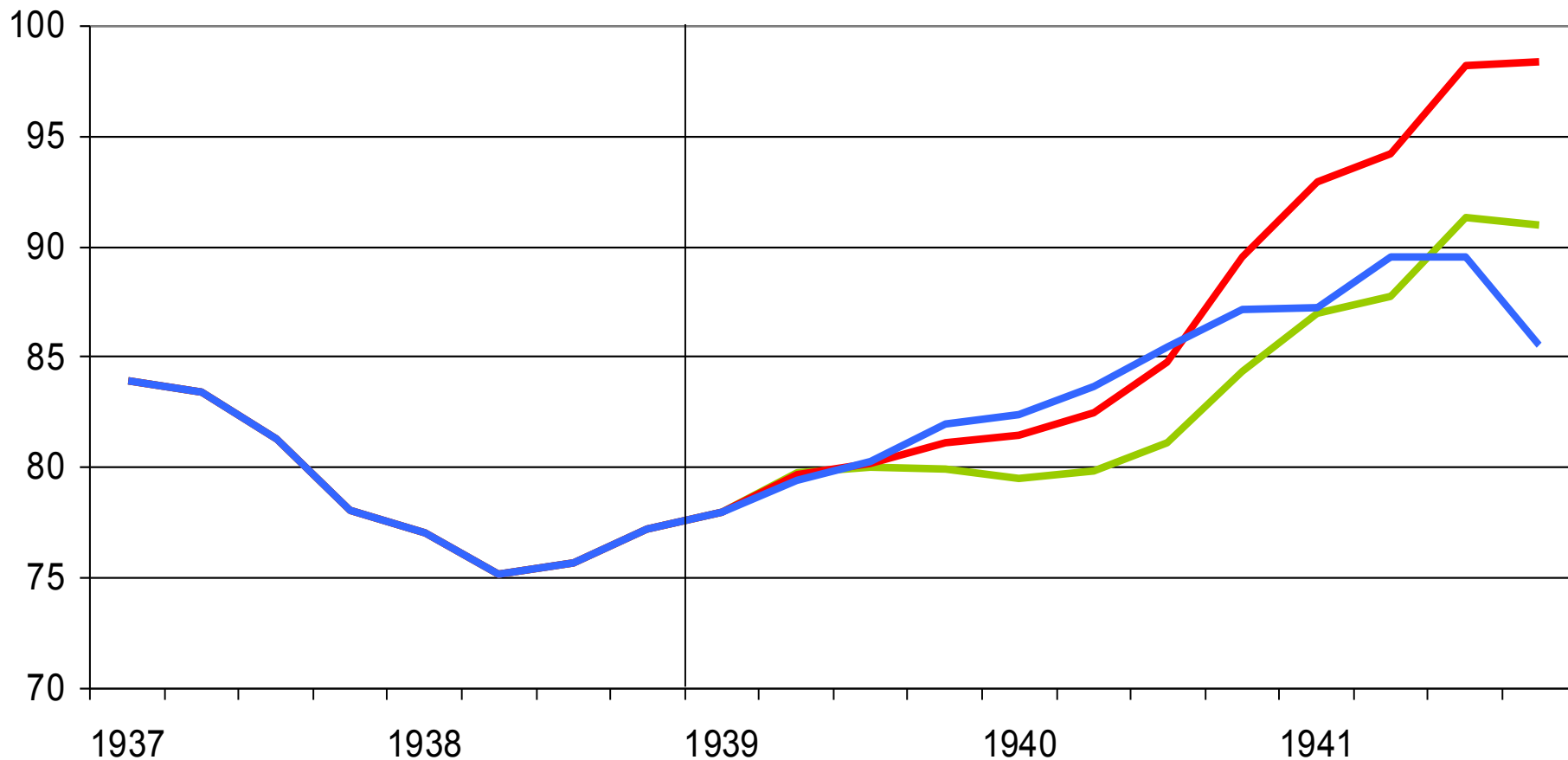Blue line = Fiscal (G) innovations are suppressed (set equal to 0) from 1939:Q1 onward, while innovations to the other variables remain

Green line = Monetary (M1, M, R) innovations are suppressed (set equal to 0) from 1939:Q1 onward, while innovations to the other variables remain

Figure 14: Interwar vs. Postwar Basic VAR Dynamic Forecasts: 1939:Q1 to 1941:Q4

# Figure 15: Interwar 16-Quarter Impulse Response Functions



Notes: (1) The graphs show the response of the variable in the row to a disturbance in the variable in that column

(2) The top and bottom lines in the graphs are the +/- 1 standard deviation bands or a roughly 68% confidence interval
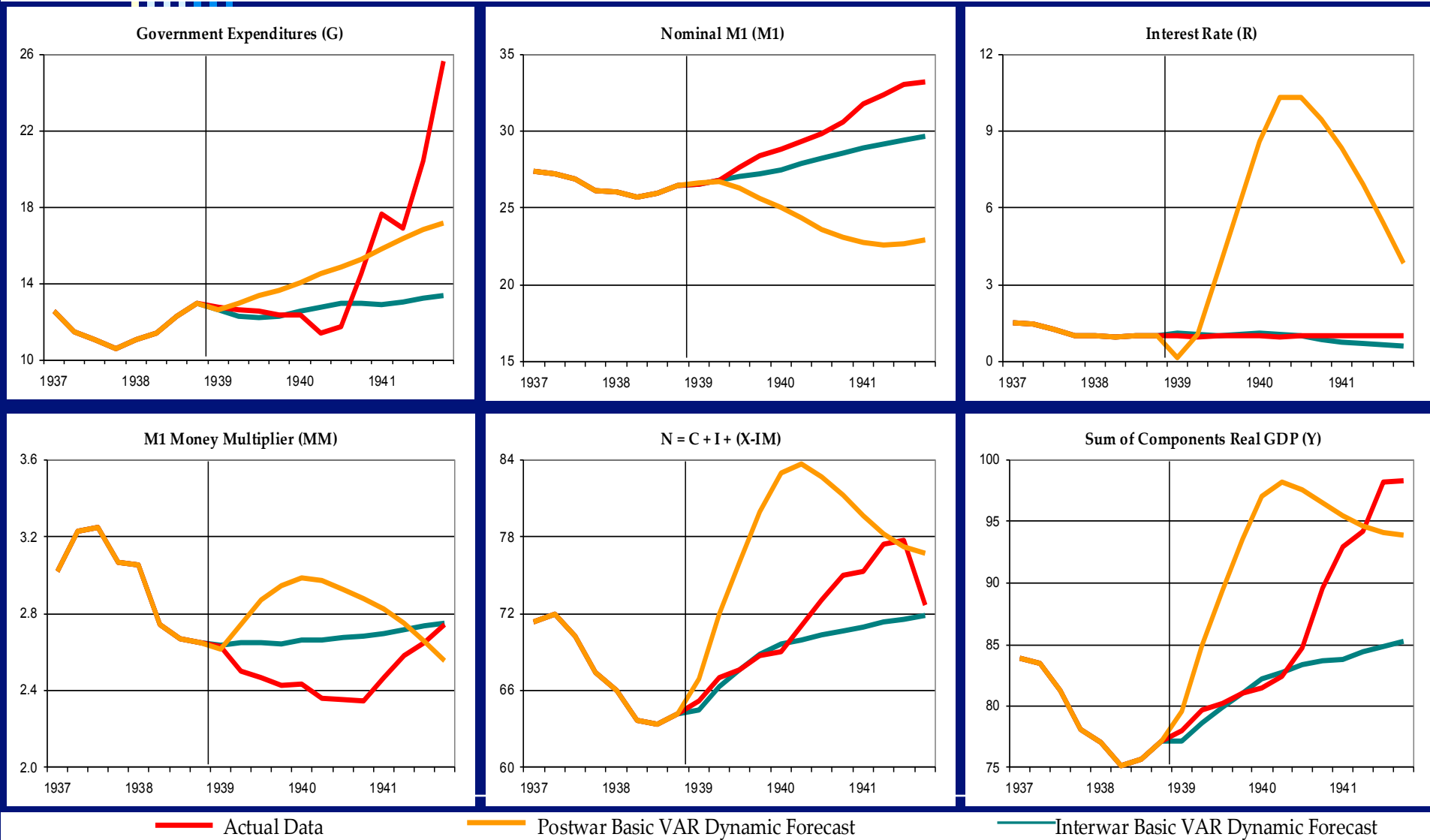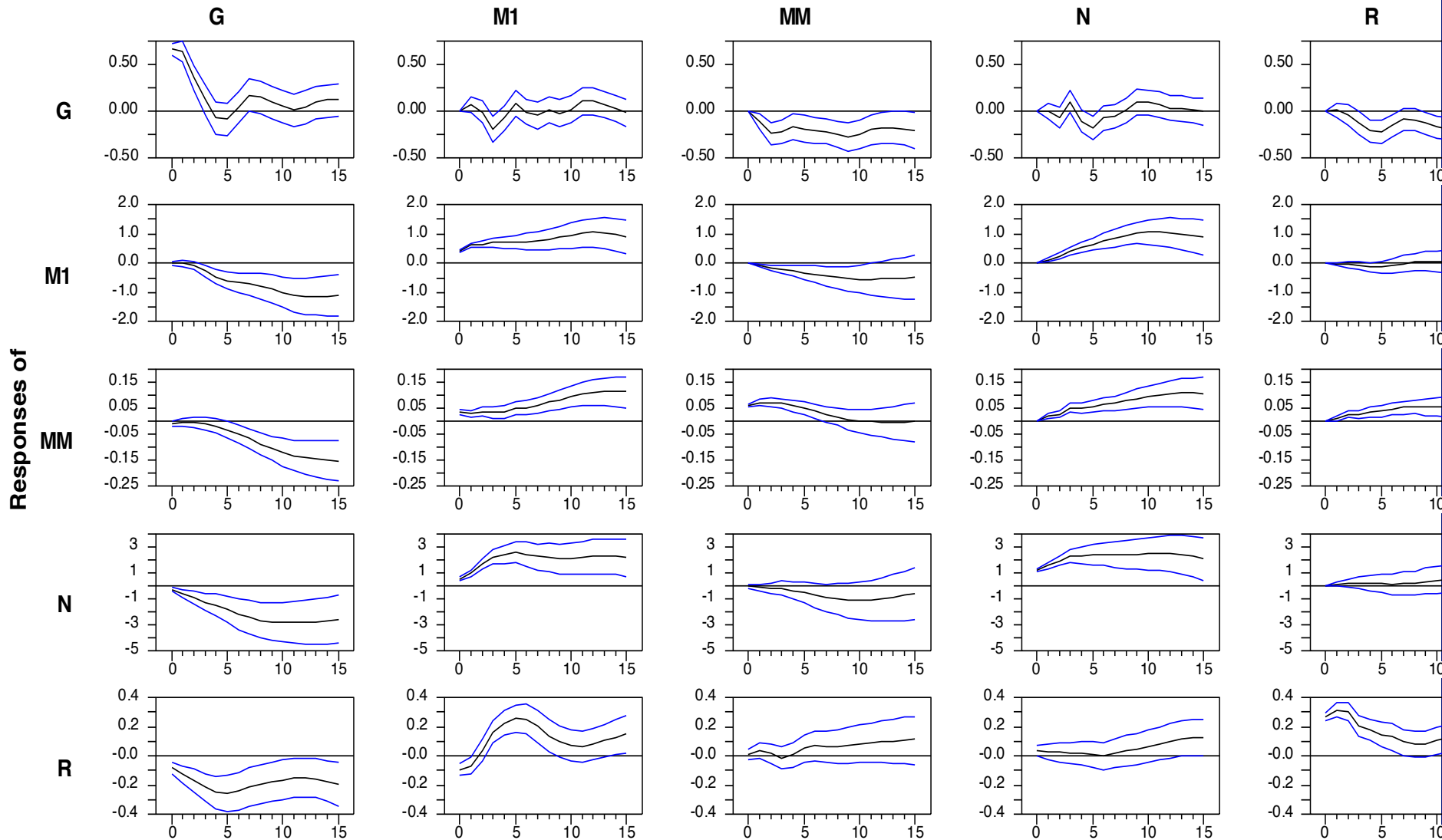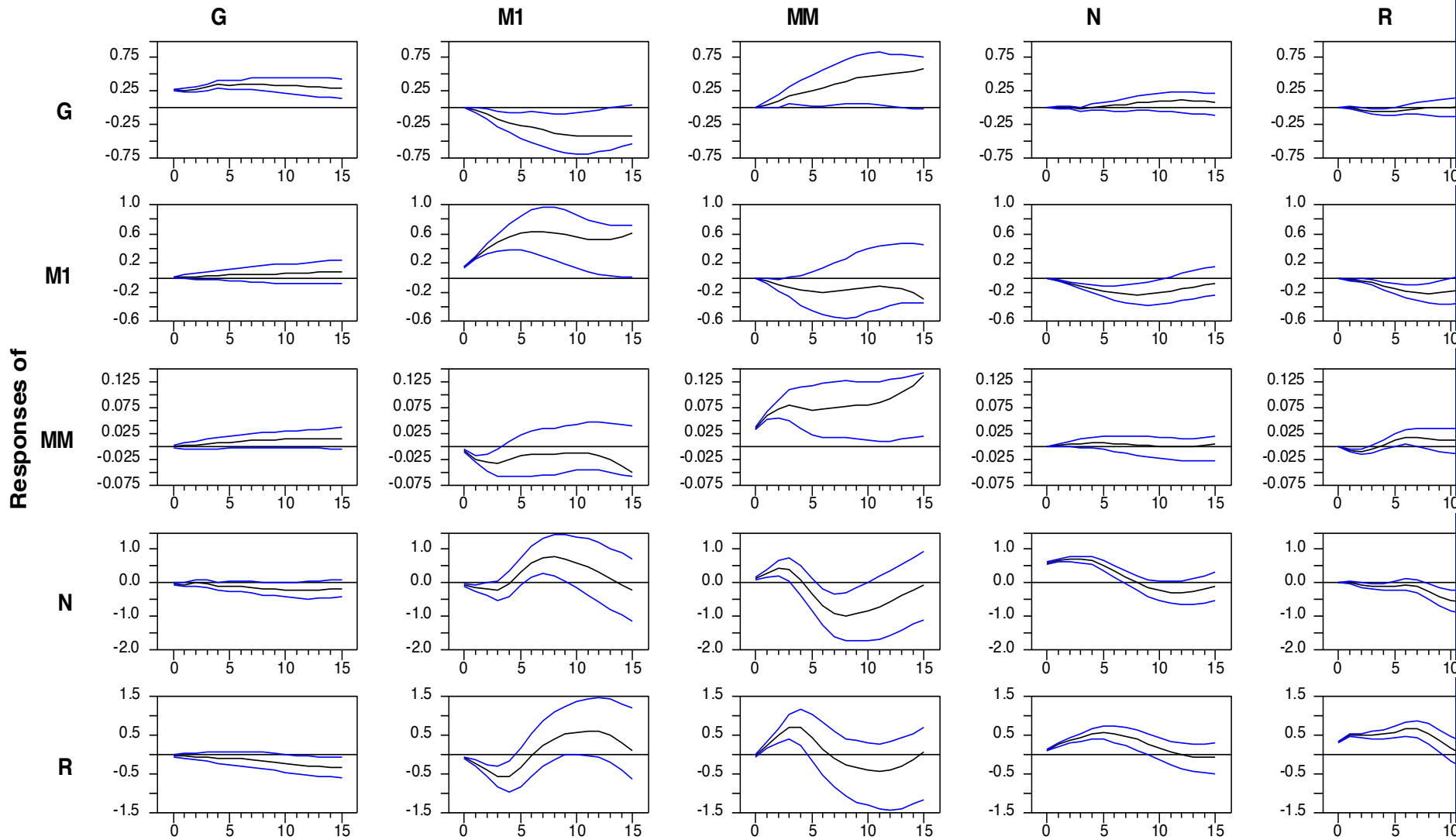
# Figure 16: Postwar 16-Quarter Impulse Response Functions



Notes: (1) The graphs show the response of the variable in the row to a disturbance in the variable in that column

(2) The top and bottom lines in the graphs are the +/- 1 standard deviation bands or a roughly 68% confidence interval

# Summary of VAR Robustness Checks

| VAR Time Period | VAR Ordering | Type of Innovation | Percentage of Recovery Explained[1] | | | |
| | | | Innovations in G | Innovations in MP[2] | Other[3] | Unexplained[4] |
|---|---|---|---|---|---|---|
| **Baseline Result** | | | | | | |
| 1920:Q2-1941:Q2 | G, M1, MM, N, R | Own-Innovations | 60.8 | 36.4 | 2.8 | 0.0 |
| **Change in VAR Period Start Date** | | | | | | |
| 1923:Q4-1941:Q2 | G, M1, MM, N, R | Own-Innovations | 75.0 | 35.7 | -10.7 | 0.0 |
| **Change in VAR Period End Date** | | | | | | |
| 1920:Q2-1941:Q3 | G, M1, MM, N, R | Own-Innovations | 102.8 | 24.6 | -27.5 | 0.0 |
| 1920:Q2-1941:Q1 | G, M1, MM, N, R | Own-Innovations | 57.0 | 15.1 | 17.9 | 0.0 |
| 1920:Q2-1940:Q4 | G, M1, MM, N, R | Own-Innovations | 34.1 | 28.0 | 38.0 | 0.0 |
| 1920:Q2-1940:Q3 | G, M1, MM, N, R | Own-Innovations | -3.5 | 42.9 | 60.6 | 0.0 |
| **Using Monetary Base in Place of M1** | | | | | | |
| 1920:Q2-1941:Q2 | G, MB, MM, N, R | Own-Innovations | 63.6 | 37.7 | -1.3 | 0.0 |
| **Adding GDP Deflator to the VAR Model** | | | | | | |
| 1920:Q2-1941:Q2 | G, MB, MM, N, R, YDEF | Own-Innovations | 58.2 | 26.1 | 15.7 | 0.0 |
| **Using Natural Logs in the VAR instead of Ratios to YN[4]** | | | | | | |
| 1920:Q2-1941:Q2 | G, M1, MM, N, R | Own-Innovations | 73.6 | 30.3 | -6.3 | 2.4 |
| 1920:Q2-1941:Q4 | G, M1, MM, N, R | Own-Innovations | 117.5 | 27.1 | -56.3 | 11.7 |
| **Interactive-Innovations Through 1941:Q4 (Using Natural Logs), Alternative Orderings [4]** | | | | | | |
| 1920:Q2-1941:Q4 | G, M1, MM, N, R | Interactive-Innovations | 116.3 | 42.0 | -69.2 | 10.9 |
| 1920:Q2-1941:Q4 | G, N, M1, MM, R | Interactive-Innovations | 116.3 | 34.1 | -61.6 | 11.2 |
| 1920:Q2-1941:Q4 | N, G, M1, MM, R | Interactive-Innovations | 98.7 | 34.1 | -48.1 | 15.3 |
| 1920:Q2-1941:Q4 | M1, MM, G, N, R | Interactive-Innovations | 135.1 | 27.7 | -69.2 | 6.4 |

[1] Totals may not add up to 100.0% due to rounding

[2] MP = Monetary Policy (Combined Effect of Own-Innovations in M1, MM and R)

[3] Other = Combined Effect of Basic VAR Dynamic Forecast and Own-Innovations in N

[4] Totals do not add up to 100.0% because of change from logs to percentages of YN, leaving a certain percentage unexplained

# Section 7: Conclusion

- This paper examines the recovery of the United States from the Great Depression of the 1930s, a topic that has been intensely debated by economists in recent decades.

- A newly created quarterly dataset of real GDP components, the GDP Deflator and potential real GDP allows the paper to take a fresh look at the issue of whether fiscal or monetary policy dominated the recovery.

- All testing in the paper is done within a 5 variable, 5 lag VAR framework that accounts for the correlations between the variables and presents a more realistic model for the recovery period than those used in previous studies.

# Main Results

- Of the recovery that occurred between 1939:Q1 and 1941:Q4:

  - 60.8% is explained by fiscal policy innovations
  - 36.4% is explained by monetary policy innovations
  - 2.8% is explained by the combined effect of the rise in the basic VAR dynamic forecast and innovations in N

- The majority of the recovery from the Great Depression can be attributed to fiscal policy innovations, with monetary policy innovations playing a supporting role
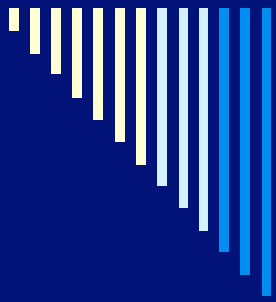
# Comparison to Other Paper's Findings

- ☐ Rejection of Romer (1992) and De Long and Summers (1988), who believe that fiscal policy did not meaningfully contribute to the recovery until 1942
  - ■ The new dataset shows that G as a percentage of YN started to rise dramatically in 1940:Q2, 7 quarters before the recovery was complete and 6 quarters before Pearl Harbor
- ☐ Confirmation of Vernon (1994) as we both find that the majority of the recovery up through 1940 can be explained by monetary policy innovations, but that after 1940 fiscal policy innovations completely dominated the recovery and were more impacting to the 1939:Q1 to 1941:Q4 recovery as a whole

# Applicability of Results to the Present Economic Recession

- 1939:Q1 vs. 2009:Q2:
  - Output Gap (1-Y/YN): 22.0% vs. 7.7%
  - Unemployment Rate: 17.4% (Apr. 1939) vs. 9.7% (Aug. 2009)
  - Over 8 years since Bank of the United States failed vs. 18 months since the collapse of Bear Stearns
- The Obama administration is acting in accordance with this paper's results, injecting billions of dollars into the economy via both fiscal and monetary policy
- The CBO predicts Obama's FY 2009 budget will raise fiscal outlays by 7.5% of GDP versus FY 2008
- Hopefully these measures will drive the U.S. economy back to its potential level as they did in 1939

# Questions?