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THE END OF THE GREAT DEPRESSION 1939-41: POLICY CONTRIBUTIONS AND FISCAL MULTIPLIERS

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ABSTRACT

This paper is about the size of fiscal multipliers and the sources of recovery from the Great Depression. Its baseline result is that 89.1 percent of the 1939:Q1-1941:Q4 recovery can be attributed to fiscal policy innovations, 34.1 percent to monetary policy innovations and the remaining -23.2 percent to the combined effect of the basic VAR dynamic forecast and innovations in non-government components of GDP.

Traditional Keynesian multipliers assume that there are no capacity constraints to impede a fiscal-driven expansion in aggregate demand. On the contrary, we find ample evidence of capacity constraints in 1941, particularly in the second half of that year. As a result our preferred government spending multiplier is 1.80 when the time period ends in 1941:Q2 but only 0.88 when the time period ends in supply-constrained 1941:Q4. Only the 1.80 multiplier is relevant to situations like 2009-10 when capacity constraints are absent across the economy.

Two sets of new insights emerge from a review of contemporary print media. We document that the American economy went to war starting in June 1940, fully 18 months before Pearl Harbor. We also detail the bifurcated nature of the 1941 economy, with excess capacity in its labor market but capacity constraints in many of the key manufacturing industries. By July 1941, the American economy was in a state of perceived national emergency.

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An online appendix is available at:
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1. Introduction

The worldwide economic crisis of 2008-10 has revived two longstanding controversies in macroeconomics, the size of fiscal multipliers and the sources of recovery from the Great Depression. This paper advances the understanding of both topics by providing new insights in several dimensions on the period 1939-41. We develop a new quarterly data set back to 1919, estimate a new VAR model for 1920-41 using those data, decompose the absolute and relative contributions of monetary and fiscal policy as explanations of the end of the Great Depression, and suggest a new framework for estimating fiscal multipliers for 1940-41. In addition, we provide new quarterly estimates of potential real GDP and of the output gap for the interwar period.

Our focus on the results of the new data and VAR model implies a critique of recent papers that estimate government spending multipliers by dividing the change in real GDP over some time interval by the change in government spending over the same period. Instead, we suggest that the numerator of the fiscal multiplier should be calculated as the estimate in the VAR model of the change in real GDP contributed by innovations in government expenditure minus the change in real GDP predicted by the VAR model in the absence of those innovations. Likewise, the denominator of the fiscal multiplier should be calculated as the change in government spending contributed by the innovations in government expenditures minus the change in government expenditures predicted by the VAR model in the absence of any innovations.

Beyond that, this paper makes a unique contribution by reviewing the contemporary print media for 1940-41. Two sets of new insights emerge that are highly relevant both to the previous literature on the causes of the end of the Great Depression, and to the more recent literature on fiscal multipliers. First, we document that the American economy went to war starting in June 1940, fully 18 months before Pearl Harbor, in contrast to the widespread assumption in the previous literature that Pearl Harbor marked the beginning of the war. We show that the share of government spending (including federal, state, and local) in potential GDP more than doubled between 1940:Q2 and 1941:Q4, i.e., prior to any impact of post-Pearl Harbor rearmament.

Second, we show that estimates of fiscal multipliers for 1940-41 are not relevant to situations like 2008-10 when there is ample excess capacity. The fiscal stimulus in 1940-41 was partly crowded-out not by any increase of interest rates, but rather by capacity constraints in critical areas of manufacturing that became increasingly acute in the second half of 1941. Previous studies of 1940-41 have been misled by the high 1941 unemployment rate into thinking that multipliers calculated from 1940-41 can be applied to 2008-10. We show to the contrary that the 1941 economy was bifurcated, with excess capacity in its labor market but capacity constraints in many of the key manufacturing industries. Because of these capacity constraints, our fiscal multipliers are radically different when we extend our calculations to 1941:Q4 instead of stopping them in 1941:Q2.

The media citations presented below by themselves constitute a fascinating rebuttal to anyone who believes that World War II for the American economy began on December 7, 1941. Fully one percent of the American labor force was at work in February 1941 building army training camps for 1.4 million new draftees. During the year 1941 employment in ship-building, both to expand the U. S. Navy and to supply Lend-Lease aid to Britain, accounted for another one percent of the labor force. We find evidence that supply constraints were predicted as early as June 1941 to cause a radical near-term cutback in automobile production. By July 1941, the American economy was in a state of perceived national emergency.

The point of departure for this paper is twofold, recent papers on fiscal multipliers and an earlier literature on the sources of the end of the Great Depression. The set of new papers by several prominent macroeconomists, including Barro and Redlick (2009), Eichenbaum, Christiano, and Rebelo (2009), Hall (2009), and Ramey (2009), estimates a widely varying set of fiscal multipliers, some of which cast doubt on whether the 2009-11 Obama fiscal stimulus program could possibly revive real GDP by any significant amount. Low estimates of fiscal multipliers would help to explain the length of the Great Depression, as they would imply that Roosevelt's New Deal programs were ineffective in boosting real GDP and reducing unemployment. In addition, low estimates of fiscal multipliers would bolster the claim by C. Romer (1992) that monetary forces were the only explanation of the recovery of the economy from the Great Depression prior to Pearl Harbor.

The second literature relevant to this paper concerns the sources of the end of the Great Depression, which retains its appeal as a perennial macroeconomic topic. "Why did the Great Depression last so long?" is perhaps the second most important topic in domestic macroeconomic history next to "Why did the Great Depression Happen?" A determination of what factor or combination of factors ended the Depression can be turned on its head to suggest which alternative policies could have ended the Depression in 1933-35 instead of 1939-41. Candidates for this list explaining the end, each with strong supporting voices in the literature, include monetary policy, military spending, and the economy's natural mean-reverting and recuperative properties.

Lessons from this period are more relevant than ever now because the worldwide economic crisis of 2008-10 raises some of the same issues. What is being held constant across differing estimates of fiscal multipliers? Is the crucial background variable determining the size of fiscal multipliers the level of interest rates, as implied by the current "zero lower bound" fiscal policy literature, or the extent of underutilized capacity? To what extent does the U. S. economy in 1939-41, prior to the outbreak of war, represent a valid analogy to the U. S. economy of 2009-10?

The core empirical results here are based on the VAR framework and incorporate several dimensions of novelty that contrast with past research. Unlike Romer (1992) who claimed that "only money mattered" or Vernon (1994) who countered that after 1940 "only fiscal expansion mattered," our specification of the VAR model in this paper is designed to allow both monetary and fiscal expansion to matter. We expect that money mattered more in the early quarters of the 1939-41 period, while military-driven fiscal expansion dominated the latter half and thus completed the recovery from the Great Depression. Our VAR results are presented not as a single outcome but as a multiplicity of robustness tests, so that the reader can assess the range of contributions of monetary policy, fiscal expansion, and other factors.

The paper utilizes a newly created database of quarterly variables for the 1919-51 time period. New quarterly series for the nine real GDP components and the GDP deflator were generated using the methodology outlined in Chow and Lin (1971) that transforms annual data into quarterly data by regressing on related monthly series. In addition to providing quarterly interpolated values of annual series, this paper also recognizes the distortion of levels and growth rates of real GDP and government spending that are nearly universal in current research on the interwar period. Because of changes in the relative price of government spending compared to total real GDP since the late 1930s, all estimates that use currently published estimates in $2005 of government expenditure multipliers and other aspects of the 1930s and early 1940s are distorted. We show that these errors can be eliminated by expressing the variables of interest in 1937 prices, and this substantially reduces the extent of the increase before and during World War II of the share of government spending in GDP.

This paper's results show that while both fiscal and monetary policy contributed to the recovery from the Great Depression, fiscal policy innovations were the dominant force, especially after 1940:Q2 when government expenditures as a percentage of potential real GDP started to explode. This conclusion remains consistent over several different tests and is robust to alterations in the VAR specification. The results of this paper therefore reject those of Romer (1992) and De Long and Summers (1988), who find that the recovery was already over before the impact of fiscal policy took effect. Instead, the results are supportive of Vernon's (1994) alternative analysis, as both find that the majority of the recovery up through 1940 can be explained by monetary policy innovations, while the larger part of the recovery that occurred after 1940 was almost completely due to fiscal policy innovations. Thus we find that while fiscal expansion was the single most important reasons why the Great Depression ended, monetary policy also played a nontrivial role, explaining between one-quarter and one-third of the recovery as we define it.

The paper is organized into eight parts including the introduction. Part 2 introduces the new data for quarterly components of real GDP and potential real GDP and describes important aspects of interwar macroeconomics with charts based on the new data. Part 3 reviews contemporary media that demonstrate the impact of the fiscal expansion on the economy of 1940-41, and it also provides substantial evidence of supply constraints, i.e., shortages, that became worse as 1941 progressed. Part 4 then reviews the previous academic literature from the perspective of the data of Part 2 and the contemporary media review of Part 3. We find a wide variety of flaws, from mixing up changes and gaps, to attributing causation to endogenous variables like the real interest rate, to a misunderstanding of when World War II began for the American economy. Part 5 contains the paper's VAR specification and Part 6 the results. Part 7 presents the fiscal multipliers based on the VAR model, for periods alternately ending in 1941:Q2 and 1941:Q4. Part 8 concludes.

2. New Data for Components of GDP and for Potential Real GDP: Methods and Findings

In order to analyze the causes of the end of the Great Depression using the VAR methodology, data at greater than the annual frequency are needed in order to provide more degrees of freedom in the regressions. This paper makes three new contributions to the development of the required data. First, as described in section 2.1, we avoid the non-additivity problem of the chain-weighted NIPA data by measuring all real spending variables in 1937 dollars, not 2005 dollars. Second, we create a new interpolated quarterly data set for each of the components of real GDP over the period 1919-51 (as well as for the GDP deflator). Third, we develop a new series for potential real GDP, i.e., the economy's capacity to produce under normal peacetime conditions. We demonstrate that standard statistical techniques are inherently incapable of creating a potential real GDP series for the 1929-50 period, and we propose a sensible alternative that produces a measure of the GDP gap consistent with independent raw data, the employment-population ratio.

2.1 The Use of 1937 Rather Than 2005 as the Base Year

Annual NIPA data for real GDP and its components are available in $2005 back to 1929. However, there are significant disparities between total real GDP and the sum of the underlying components of real GDP for years that are more than a decade away from the base year chosen for deflation. Divergences arise because each variable is deflated independently. Because the relative price of Government Expenditures (G) rose between 1937 and 2005, the size of real government spending in $2005 relative to real GDP in $2005 is always greater than the equivalent ratio expressed in contemporary nominal dollars.

Figure 1 shows the comparison between the $1937 and $2005 real GDP residuals as a percentage of real GDP, as well as the large difference created by the alternative base years in measures of G as a percentage of real GDP.[1] On average, the deflator used for G has risen faster than that used for real GDP; therefore, when the base year is changed from $1937 to $2005, G as a percentage of real GDP during the 1919-1951 period becomes larger. In fact, there is an old saying that "every time they move the base year later, World War II gets bigger." An easy solution to this problem created by chain-weighted measurement is to use the readily available $1937 measures of real GDP components. Figure 1 shows that in the critical year 1941, the sum of components of real GDP in $2005 is overstated by 7 percent, and the ratio of government

1. See NIPA Table 1.1.6 for components of real GDP in $2005 and Table 1.1.6A for the same components in $1937.

spending to real GDP (G/Y) in $2005 is overstated by more than 40 percent (30 percent in $2005 vs. 21 percent in $1937).

2.2 The New Set of Quarterly Interpolated Data

The full details of the data interpolation are provided in the Data Appendix, including the source of the annual data for 1919-28 before the annual NIPA data begin, and a description of the monthly interpolators.[2] The interpolation is achieved using the Chow-Lin (1971) process that converts each annual series into a monthly series while maintaining the annual sum by regressing on related monthly series. The related monthly series are obtained from the NBER's Historical Statistics Database and are chosen based on their perceived relevance to the variable in question.[3] More than twice as many monthly interpolators are used as in the previous attempt by Gordon and Veitch (1986) to create interwar quarterly data, and the Data Appendix describes in more detail other differences with that prior research.

Figure 2 compares the newly interpolated dataset by displaying its similarity to the independently created quarterly dataset of Ramey (2009) for the overlap period 1939:Q1-1941:Q4.[4] In particular, our series and the Ramey series both indicate that the ratio of government spending to potential real GDP (G/YN) more than doubled between 1940:Q2 and 1941:Q4. They also show that non-government spending components of GDP relative to potential real GDP (N/YN) declined in the last half of 1941.

2.3 Potential Real GDP and the Limitations of Statistical Trends for the Interwar Period

The distinguishing features of the Great Depression are that the unemployment rate remained so high for so long (whether measured by the standard Lebergott series or the more plausible Darby (1976) series), and the corollary that actual output remained below potential output for so long. Because of flaws in the unemployment rate as a measure of cyclical utilization (see among others Coen 1973), and because consistent monthly and quarterly employment data are not available during the interwar period, we prefer to limit our attention to utilization as measured by the ratio of actual to potential quarterly real GDP. But what is potential real GDP?

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2. The new data on the components of real GDP are available both monthly and quarterly, but only quarterly data are used in this paper.
3. Related monthly series were also chosen so that they could be made into a continuous monthly series from 1919:M1-1951:M12.
4. Ramey (2009) used a completely different method to arrive at her quarterly data for GDP and GDP components. Instead of using monthly interpolators, Ramey utilizes the 1954 National Income supplement of the predecessor agency of the BEA, which published quarterly nominal GDP and components measures back to 1939:Q1. Ramey=converted this into real terms by creatively deflating the nominal data by various mixes of CPI components. The fact that these two uniquely created datasets line up so well over the 1939:Q1 to 1941:Q4 period as shown in Figure 2 lends credibility to both approaches.

It has been universal in macroeconomics since the 1982 invention of the Hodrick-Prescott (H-P) filter for macroeconomic time-series research to use a statistical filter to distinguish actual from trend movements of variables. It has been previously noted that a real GDP trend created with the H-P filter using the usual quarterly parameter of λ=1600 responds too much to recessions, yielding implausible downward movements in the economy's capacity to produce. An alternative suggested by Hamilton (1994, Chapter 13) among others is the Kalman filter, which is capable of estimating the output trend subject to outside information on the cyclical component of output fluctuations taken from data sources other than real GDP, e.g., the unemployment rate or rate of capacity utilization.[5]

More recently empirical papers in macroeconomics have adopted the band-pass filter, which produces similar results to the H-P filter though is generally considered more sophisticated. Unlike the H-P filter parameter, which specifies arbitrarily the extent to which the trend will "bend" in response to a decline in output, the band-pass filter arbitrarily chooses to eliminate certain frequencies. For instance, it has become standard to create a band-pass filtered estimate of trend GDP by cutting out frequencies corresponding to periodicities below 32 quarters.

The implausibility of the application of the band-pass (BP) filter to interwar data with this standard filtering of periodicities is exhibited in Figures 3, 4, and 5.[6] Figure 3 exhibits the level of actual real GDP (as always in $1937) as shown by the solid line, which more than triples from the trough of the Great Depression to the peak of World War II production. The BP filter estimate of the real GDP trend also triples, doing little more than mimicking the main fluctuations of actual real GDP. We note in particular that the BP estimate of trend output declines between 1927 and 1932 by 25 percent, which is implausible in light of ongoing increases in the working-age population and the robust growth of output per person during the 1930s decade.

The 25 percent log decline in the BP estimate of trend output between mid-1927 and mid-1932, combined with five years of steady growth in the working age population, implies that trend output per person declined at an unprecedented rate of nearly seven percent per year. To justify this productivity collapse, one must show either a technological backwardation or widespread forgetfulness on the part of the American worker; however, in reality, this was one of the most technologically progressive periods in U. S. history (for details, see Field 2003).[7] To take just two evocative examples, the automobiles of 1940 featured the streamlined bodies of General Motors and the introduction of automatic transmission by Oldsmobile, and bore little

5. Gordon (2003) provides a comparison of the H-P and Kalman filters in providing estimates of the trend in output per hour.

6. We are grateful to Giorgio Primiceri for carrying out the estimation of the band-pass filtered trend for our real GDP data between 1919 and 1951. His technique follows standard practice of excluding all frequencies below 32 quarters. His cooperation does not imply any agreement with the interpretations in this section of the paper.

7. BP-filtered trend real GDP in $1937 was 87.5 billion in 1927:Q3 and 67.9 billion in 1932:Q3.

resemblance to the crude Model A Fords of 1928-29. Also, the epochal year of 1939 produced two movies in full color, "Gone With the Wind" and "The Wizard of Oz", which were light years ahead technologically of the crude initial talkies starting with the "Jazz Singer" in 1928.

Because the BP estimates of trend growth of the nation's capacity to produce are implausible, we instead estimate potential real GDP as an exponential trend that extends from the late 1920s to 1950, spanning the volatility of the 1930s and 1940s, as shown in Figure 3. Our chosen years in which the exponential trend is forced to equal actual real GDP include 1913, 1924, 1928, 1950, and 1954. We choose *not* to select 1941 as a benchmark year, in order not to prejudge a central issue for this paper, the extent of excess demand or supply during the year 1941.

Figure 4 exhibits the implausibly wild swings in the growth rate of the BP filtered trend from 1913 to 1954. Most notably, the BP trend output growth declines from a peak of 9.2 percent per year in 1924:Q3 to -7.8 percent per year in 1930:Q2. What aspect of labor force growth, output per hour, or technology caused this 17-point decline in the growth rate of the economy's capacity to produce in the 1924-30 period, most of which occurred in the famous "roaring twenties" of technological innovation and giddy optimism? What is happening here is that the BP filtered trend is not a trend at all, but just an attempt, like a dog chasing a bone, to mimic the growth rate of real GDP. The bizarre behavior of the BP filtered trend in the interwar period raises questions about its frequent application to postwar data in recent macroeconomic research.

Further evidence of the implausibility of the BP filtered trend is exhibited in Figure 5. Displayed are the log percent ratios of actual to trend real GDP ("the output gap") implied by the BP filter as contrasted with the exponential trend-through-benchmarks technique. Because the BP filter causes the real GDP trend to "bend" in response to any prolonged movement in real GDP, the output gap is a wiggly line between 1919 and 1954 suggesting that the economy experienced a regular set of fluctuations with a log percent output ratio varying between +10 and -10 percent. Most notably, *the output gap implied by the BP filter implies that there was no difference in the output gap in the 1920s vs. the 1930s or the 1940s!*

The plausibility of the exponential trends-through-benchmarks measure of potential or trend real GDP during the interwar period is supported by independent evidence. Annual employment data for this period can be compared with the alternative BP and exponential trend estimates of the GDP gap. Figure 6 displays the BP-filtered and exponential trend-based output gaps, copied from Figure 5 and converted to an annual series. The employment-population ratio can be examined directly without any need for detrending, as that ratio was stationary between 1900 and 1972.[8] We take the raw data for the employment-population ratio, express it as an index number with 1929=100, and then calculate the percent log of that index.

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8. Civilian employment and the population aged 14+ come from the *Millennial Edition of the Historical Statistics*, series Ba471 and Aa140, respectively.

However, in Figure 6 we do not plot the log index but rather twice the log index, reflecting the postwar fact that the employment-population ratio fluctuates with an elasticity to the output gap of about one-half. As is evident in Figure 6 the exponential trend version of the log output ratio tracks the employment-population ratio very closely while the BP-filtered output ratio does not. The decline in the employment-population ratio is a fact in the raw data which has nothing to do with technological forgetfulness and reinforces the interpretation that the volatility of output in the 1930s was driven by aggregate demand and not by productivity shocks.

2.4 Data Graphs Based on the Exponential Trend Concept of Potential Real GDP

The exponential trend version of potential real GDP and percentage log output gap are used for the remainder of this paper as an organizational and conceptual device to interpret the end of the Great Depression. In this section we examine the results of the data interpolation, with components of real GDP expressed as a percentage ratio of potential (exponential trend) real GDP. Figure 7 decomposes the fluctuations of the log output ratio into its four separate contributions of consumption, investment, government spending, and net exports, each expressed as a ratio to potential GDP (e.g., C/YN). These data provide important insights about the process by which increased military expenditure crowded out private spending during World War II and even in 1941, prior to Pearl Harbor. The most striking series in Figure 7 is the G/YN series, which more than doubles before Pearl Harbor (from 11.5 percent in 1940:Q2 to 25.6 percent in 1941:Q4).

To what extent was the consumption ratio (C/YN) depressed or stimulated by the government spending explosion over the same six-quarter period? The C/YN ratio was at 59.1 in 1940:Q2, rose slightly to a peak of 62.8 percent in 1941:Q3, and declined slightly in 1941:Q4. The total investment ratio (I/YN including inventory change) rose from 10.6 percent in 1940:Q2 to 14.4 percent in 1941:Q3 before dropping sharply to 12.7 percent in 1941:Q4. Net exports as a percent of potential GDP declined from 1.4 percent in 1940:Q2 to 0.4 percent in 1941:Q3, a result of crowding out from the fact of war rather than from U. S. military expenditures themselves. Many of the largest customers of U. S. exports became enemies in this period (Germany, Japan) and the flow of exports to other traditional customers of the U. S. such as continental Europe, China and southeast Asia, was greatly curtailed as well.

The top frame of Figure 8 displays the ratio to YN of non-government expenditures (N), which by definition is the sum of consumption, investment, and net exports. If the explosion of government expenditures caused a crowding out of N during 1940-41, this would show up as a decline in N as G increased. However, N/YN grows substantially from a value of 71.2 percent in 1940:Q2 to 77.6 percent in 1941:Q3. N/YN does drop by 1.9 percent in 1941:Q4, which could either indicate some crowding out via government expenditures or physical constraints on production of some consumer and investment goods as a result of pressure on available industrial capacity.

In addition to the components of real GDP, this paper examines the contribution of monetary policy variables to ending the Depression. The top frame of Figure 8 depicts the value of nominal M1 divided by potential real GDP, showing that the relative money supply fell from an initial value of 36.9 percent in 1928:Q1 to a trough of 20.4 percent in 1933:Q3, for a percent log decline of -59 percent. Another notable aspect of the behavior of M1 is the difference in its behavior in 1933-39 and after 1939. Ratios of nominal M1 to potential real GDP (YN) were 20.4 perceet in 1933:Q3, 26.6 percent in 1939:Q1, 29.3 percent in 1940:Q2, and 33.2 percent in 1941:Q4, still well below the 1928 value of 36.9 percent. This time path of the money supply, which exhibited relatively steady growth between 1939 and 1941, raises the question about why the economy expanded so slowly up to 1940:Q2 and so rapidly in the subsequent six quarters up to Pearl Harbor.

The bottom frame of Figure 8 displays the money multiplier and the Fed nominal discount rate. Both are clearly endogenous variables. The nominal interest rate increased from 3.5 percent in 1927:Q3 to 5.6 percent in 1929:Q3, as the Fed raised rates in response to the 1928-29 exuberance of the economy and of the stock market, and then declined to a trough of 1.6 percent in 1931:Q2. The discount rate was absolutely fixed at 1.0 percent between 1939:Q1 and 1941:Q4 (and beyond), thus rendering irrelevant any role for a crowding out effect operating through interest rates.

The money multiplier was particularly endogenous in the late 1930s, the era of "pushing on a string." Banks held massive amounts of excess reserves, and gold inflows that increased the monetary base did not directly translate into increases in M1. From its peak in 1937:Q2 of 3.25, the money multiplier drifted steadily lower until its trough of 2.35 reached equally in 1940:Q2-1940:Q4, followed by a modest increase to 2.74 in 1941:Q4. During World War II the money multiplier was extremely stable, varying only between 2.98 in 1942:Q1 and 3.24 in 1943:Q2. Overall the money multiplier provides evidence *against* the potency of monetary expansion, since its decline in 1938-40 offset much of the explosion of the monetary base due to the inflow of gold from Europe, a fact ignored in Romer's (1992) emphasis on that gold inflow as a primary source of the economy's recovery from the Great Depression.

Prior to developing our VAR model to examine the relative roles of monetary and fiscal policy, it is useful to examine the interwar time series of nominal GDP and M1 (top frame of Figure 9) and of the velocity of M1 (bottom frame). Traditional macroeconomic theory teaches that there is no reason for velocity to be constant or even to grow steadily. Velocity combines the influence of changes in money demand across asset classes, together with shifts in the "IS curve", that is, all of the changes in aggregate demand that alter consumption, investment, government spending, and net exports.

Those who are skeptical of the Friedman and Schwartz monetary interpretation of the Great Depression will find several interesting features of Figure 9. There is a clear lead of the decline of nominal GDP between 1929 and 1933 *in advance* of the decline in M1 that was touted by Friedman and Schwartz as the most important *cause* of the Great Depression. It has always been argued by skeptics of Friedman and Schwartz that the M1 money supply is endogenous and was directly impacted by the loss of income, jobs, as well as by bank failures, during the 1929-33 period.

What about 1939-41? Both nominal GDP and nominal M1 increased rapidly after our benchmark quarter of 1939:Q1. But let us look at the differences between the first five quarters (1939:Q1-1940:Q2) and the subsequent growth in both GDP and M1 during the six-quarter period 1940:Q2-1941:Q4. The respective annualized growth rates of GDP and of M1 in the initial five-quarter period were 8.3 and 11.0 percent, implying that velocity declined at an annual rate of 2.7 percent. Then the relationship was reversed in the six quarters following 1940:Q2, with respective annualized growth rates of GDP and of M1 of 22.2 percent and 11.5 percent, implying that velocity *increased* at an annual rate of 10.7 percent. This decline in velocity through 1940:Q2 followed by a major increase in velocity through 1941:Q4 stands as prima facie evidence that fiscal policy mattered in causing the output expansion of 1940-41. The bottom frame of Figure 9 shows separately the decline in the velocity of M1 from 83.9 percent of its 1929 value in 1939:Q1 to a trough of 81.1 percent in 1940:Q2, followed by a rapid increase to 95.1 percent in 1941:Q4.

2.5 Was It Really a Recovery?

Higgs (2009) has viewed the recovery generated by defense spending associated with World War II as non-existent, because in his view consumers were worse off during the war than they had been before the war. The first problem with Higgs' analysis is that he fails to distinguish between the period of concern in this paper, 1939-41, with the 1942-45 period of active combat when consumer spending was held down by the mandatory shutdown of most consumer durable production and by explicit rationing of some nondurable goods. Over our recovery time period, 1939:Q1-1941:Q4, real consumer spending increased by 15.7 percent. This recovery did not just consist of building planes and tanks; it was a broad-based economic recovery that reached every household in the country with a sharp increase in income that was in part consumed.

Somewhat surprisingly, our data show that Higgs is wrong even for the period of the war itself. Even though production of many consumer durables was prohibited during the war, total real consumption in the final quarter of the war 1945:Q3 was 10.9 percent higher than in the final prewar quarter 1941:Q4. Excluding consumer durables because of capacity constraints, personal consumption expenditures of nondurables and services were 16.6 percent higher in 1945:Q3 than in 1941:Q4 and 33.6 percent higher than in 1939:Q1. In fact real consumer expenditures on nondurables and services were *higher in every quarter of 1942-45 than they had been in 1941:Q4.* And this understates the increase in total consumption, since it excludes the food and clothing provided to the 10 percent of the population that served in the military, as these were counted as government rather than consumption expenditures.

But even these data greatly understate the benefit of World War II to consumer wealth and subsequent postwar spending. After the endless joblessness of the Great Depression, suddenly everyone had jobs. If they could not spend their newly surging incomes, they could save them. Granted, wartime saving took a haircut when a jump in the price level reduced real wealth as price controls were removed in mid-1946, but there was plenty of wartime saving to propel after 1945 a spending boom of historic proportions. Between the last combat quarter of 1945:Q3 and 1948:Q4, real consumer durable spending increased by 160 percent, and total real consumption spending increased by 17.1 percent.

The U. S. was unique in its geographical location. It did not suffer wartime damage. But so enormous was the amount of unused capital and labor in 1939 that the economy could and did produce an explosion of armaments with no reduction at all in consumption spending on nondurables and services. Constraints on the production of durables merely resulted in postponement of the replacement of cars and of the introduction of 1930s inventions like television. With full bank accounts, Americans as a result of wartime income were able nearly to triple their purchases of durable consumer goods between 1945 and 1948.

Overall, total real consumer spending increased between 1939:Q1 and 1948:Q3 by 50 percent overall and by 31 percent on a per-capita basis. This growth rate of per-capita real consumption spending was 2.7 percent per year, faster than any postwar decade but one.[9]

3. Contemporary Evidence on the Effects of Fiscal Expansion, 1940-41

The most surprising lapse in some of the previous literature, especially Romer (1992), De Long and Summers (1988), and others, is their explicitly stated assumption that World War II began for the American economy on December 7, 1941, with the Pearl Harbor attack. On the contrary, our estimates suggest that the pre-Pearl Harbor "preparedness" emergency caused the share of government spending (including state, local, and Federal) to increase from 11.5 percent in 1940:Q2 to 25.6 percent in 1941:Q4, and that *all* of this increase took the form of Federal government military expenditures that were exogenous to influence from the rest of the economy.

In section 3.1 we report contemporary evidence on the direct impact of government defense spending on the economy in 1940-41. Our new evidence comes from a close reading of the *New York Times* and of *Fortune* magazine, with additional details from Vatter (1985). We supplement our original research with several of Ramey's (2009) quotes from *Business Week* for the 1940-41 period. We also use this evidence in section 3.2 to address the growing importance of capacity constraints in 1941. Such capacity constraints taint estimates of fiscal multipliers in 1940-41. If there were any capacity constraints at all, then increased military spending crowded

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9. Decades are counted between census years. Real per-capita consumption grew during 1940-50 at 2.72 percent per year, second only to the 1960-70 growth rate of 3.03 percent.

out civilian spending. Our narrative in this section depicts one industry after another shifting during 1940-41 from a status of excess supply to excess demand.

3.1 The Effect of the Government Stimulus on People and Firms, 1940-41

The revival of the American economy due to the explosion of Federal defense expenditures began in 1940:Q2, the quarter in which France fell.[10] To calibrate the actual data for the economy of 1940-41, we note that nominal GDP was $101 billion in 1940, still below the $104 billion of 1929, and so each nominal billion of military spending translates into one percent of nominal GDP. Ramey (2009) documents from her *Business Week (BW)* reading the hasty upward revisions of defense appropriations for the fiscal year starting on July 1, 1940. Original Administration plans for that fiscal year started at $3.5 billion (*BW* May 25, 1940) but within three weeks were up to $5 billion (*BW* June 15, 1940). *Business Week* was not alone in reporting this upsurge in prospective government spending. On June 13, 1940, the *New York Times* reported that "22 new warships were signed for in an hour, topped by two new battleships." As early as June 22, 1940, *Business Week* could write:

> "National Defense has become the dominant economic and social force in the United States today. It has created a new industry – armament – the ramifications of which will reach into every phase of our business life, and bring increased employment, higher payrolls, widening demands for machinery, and the construction of new factories."

In the same issue Ramey quotes a guess that Federal government expenditures in 1941 would reach $10 billion. Her treatment makes clear that economic agents in the spring of 1940 were basing spending estimates on the explosion of military expenditures that occurred in 1917-18 during World War I. Would this happen again, and with what timing and magnitude? Nominal Federal government expenditures actually reached $15.3 billion in 1941, up from $2.5 billion in 1940 and $1.5 billion in 1939, much higher than the June,1940 forecast of $10 billion (NIPA Table 1.1.5). *Business Week* first mentions the possibility of a $15 billion defense bill for the calendar year 1941 in its issue of December 14, 1940.

Even in the previous quarter during the winter of 1939-40 the American economy was starting to revive in response to a greatly increased export demand for armaments from all the combatant countries on the Allied side. Monthly exports in January 1940 were up 70 percent over the previous January. British and French purchases of American exports were up year-over-year by more than 50 percent, Italy up 89 percent, and exports to the USSR tripled. In the article that includes these numbers, the author asks "Is the economy about to catch on fire?"[11] The same article cites a quadrupling of employment between mid-1939 and mid-1940 in

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10. A detailed chronology "Highlights of U. S. Government Economic Involvement Before Pearl Harbor" is presented in Vatter (1985, Chart 1.2, pp. 8-10).
11. "The Best Bargain We Can Jolly Well Make," *Fortune,* April 1940, p. 68 ff.

employment at United Aircraft's engine division and a tripling of output in early 1940 as compared with mid-1938.

On the surface the jump in appropriations in 1940:Q2 was a reaction to the stark reality of the Nazi blitzkrieg and the fall of France. But in addition the date of accelerated American involvement can be traced to a little-known decision by President Roosevelt in early June 1940 to strip the military arsenals of the United States in order to provide weapons that might allow the British to defend their island against the acute near-term threat of a German invasion, named by German planners as operation "Sea Lion." This is highly relevant to our account, as the stripping of the arsenals required immediate increases in production in order to replenish the arsenals' supplies. Orders went out immediately to increase production of every type of military weapon that had been removed from the arsenals, including 500,000 rifles and 76,000 machine guns (Goodwin, 1994, p. 66).

The Goodwin (1994, p. 66) narrative of the removal of virtually every military weapon from U. S. arsenals, and the method by which all these materials were transported to Britain in mid-June 1940, creates a little-known but dramatic tale worth retelling. As this remarkable exodus of weapons occurs, one can almost hear the underutilized American productive machine beginning to whirr to replace the exported weapons, and many more beyond:

> "Working night and day under strict secrecy, soldiers at each arsenal loaded huge crates of rifles and guns into more than six hundred freight cars headed for Raritan, New Jersey. All along the line, word was flashed to give these freight trains the right of way. In the meantime, a dozen empty British freighters were standing by at Raritan, waiting to take the precious cargo home. By June 11, everything was ready to be loaded, but the transfer could not take place until the contracts had been signed and Secretary Woodring refused to sign them. Only when the President directly ordered him to sign did Woodring finally execute the documents. Five minutes later, army headquarters called Raritan to say the transfer had been made. "Go ahead and load." .

These arms arrived in Britain in July 1940 and were distributed to the coastal defenses. There is no more dramatic account of their significance than that of Edward Stettinius who observed that [the guns] "strengthened the defenses of every threatened beachhead and every road leading in from the coast. . . They went to men who almost literally had no arms at all in the most critical hour of Britain's history since the Spanish armada sailed into the English Channel [in 1588]."

The next big event that increased aggregate demand was the passage in September 1940 of the Selective Service Act that instituted the military draft and authorized an army of 1.2 million men. Military personnel on active duty increased from 458,000 on June 30, 1940, to 1,801,000 on June, 30, 1941 (Vatter, 1985, p. 8). On August 19, 1940, Congress passed another supplemental appropriations bill, raising authorized spending for the 1940-41 fiscal year from the $5 billion of June to $10 billion, including $1 billion (or one percent of GDP) for new factories to produce war material (*New York Times*, August 20, 1940). The Navy planned for a two-ocean navy "ready by 1944." FDR made what many regarded as an implausible promise to build 50,000 planes by the end of June 1942. The acceleration of economic activity is evident in the report "since June, Ford, General Motors, Chrysler, General Electric, Westinghouse, and practically all of our great mass-producing corporations have begun work on war orders, from radio equipment to twenty-five-ton tanks. But to transform the assembly lines means a terrific retooling."[12]

The induction of a million draftees required the hasty construction of army training camps, and this in turn created 400,000 construction jobs, more than one percent of the total labor force of 1940.[13] The improvisation in the rapid building of these camps was noted in contemporary accounts, including a camp manager, whose camp already housed 28,000 men by February 5, 1941, who solved the problem of a shortage of heating boilers by renting four railroad locomotives which were hitched up to the existing heating pipes. Materials and equipment for the camps reflected widespread shortages: "all over the country, the army was crying for boilers, furnaces, heaters, and laundry machines."[14]

An advertisement for the Bell System in *Fortune* magazine (July 1941, p. 152) conveys the reality of demands for manufactured products created by the construction of all these Army training camps. "Every big military training camp is a city in itself. Like any city, it needs telephones. . . . It's a big job -- made more so by the fact that some six hundred other expanding army and navy establishments -- forts, flying fields, supply depots, arsenals, shipyards -- also need hurry-up telephone facilities. The Bell System is doing its best to meet these urgent defense needs -- and at the same time satisfy the great and growing civilian demand for day-to-day telephone service."

In addition to the 400,000 construction workers, by late September a Labor Department spokesman reported to Congress that spending just for naval vessels and aircraft would create 1.5 million man-years of work in the fiscal year beginning on July 1, 1940."[15]

The army training camps were built primarily in the warmer regions, benefiting the economically depressed southern states. The stimulus to aggregate demand from the successive appropriations bills spread across all regions of the country, from the machine tool industry then centered in the Connecticut Valley of New England, to 65,000 defense jobs created in upstate New York, to the aircraft factories which were concentrated on the west coast and

12. Quotes and facts in this paragraph are from "National Defense: The Sinews of War," *Fortune,* October 1940, p. 57ff.
13. Total employment in 1940, including the government sector, was 37.9 million (NIPA Table 6.5A).
14. "Camps for 1,418,000," *Fortune,* May 1941, p. 57ff.
15. "1,456,285 Man-Years Set in Ship and Plane Work," *New York Times*, September 24, 1940.

particularly in Los Angeles County.[16] In that county alone, aircraft employment rose from 12,000 in October, 1938 to 57,000 in early 1941 and to an anticipated 100,000 by the end of 1941. The Vultee aircraft company reported in May 1941 that in April it had a "1300% plant expansion, completed to increase production 10 times in 1941."[17]

> "This is a boom in which the lure is simply *lots of jobs*. . . .It is a boom confined to a few big plants . . . . This is different; it is based on the pay check. It is as big as it is broad, and even in the vastness of Los Angeles a thing this big cannot suddenly be absorbed."[18]

Starting with Ramey's (2009) quotes from *Business Week*, we traced above how defense appropriations for the fiscal year starting July, 1, 1940 increased from $3.5 billion in May to $10 billion in September, 1940. By May 31, 1941, *BW* expected Federal defense expenditures of $16 billion for calendar 1941 out of a total national income of $85 billion, and $24 billion in 1942 out of a total national income of $93 billion.[19] As an indication of how rapidly expenditures were being authorized, on June 26, 1941, the Senate spent only 80 minutes debating the largest single bill in the history of Congress to that date, a $10.4 billion appropriation bill for the army that included about 13,000 planes. That is, it took slightly more than an hour to pass by a voice vote the addition of expenditures amounting to almost 10 percent of 1941 GDP.

Simultaneous with the building of the army training camps was an explosion of demand for both naval vessels and merchant ships. ". . . between the fall of France and the fall of Greece, the U. S. maritime *paper* program had swelled suddenly, like a gargantuan blowfish. . . . First there was the matter of new naval construction . . . for 483 new ocean-going ships." The problem was "to increase our building capacity fourfold and train 450,000 shipyard workers."[20]

The tendency in the economic literature surveyed in Part 4 is to date the military-fueled economic expansion with the Pearl Harbor attack of December 7, 1941. Nothing could be further from the profound sense of national emergency evident in contemporary media. *Fortune* magazine, normally a beacon of capitalism and economic freedom, published a startling editorial in July 1941 ("Prelude to Total War", p. 35):

> "Our first act must be to give up the very basis of our civilization. Our prices must be controlled, our economic incentives must be taxed, our materials must be subjected to priorities, our property and our scientific inventions must be put at the disposal of the state. We surrender these liberties temporarily, but surrender them we must."

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16. Upstate New York jobs from *New York Times*, June 24, 1941.
17. Advertisement in *Fortune*, May 1941, p. 45.
18. Facts and quotes in this paragraph from "The City of Angels," *Fortune*, March 1941.
19. The actual figures in today's national accounts are $14.3 billion out of a nominal GDP of $126.7 billion for 1941 and $51.1 billion out of a nominal GDP of $161.9 billion for 1942.
20. "Ships for this War," *Fortune*, July 1941, pp. 40ff.

3.2 Was the American Economy Close to Operating at Full Capacity in 1941?

A critical aspect of twentieth century U. S. economic history depends on the rate of utilization of a particular single year, 1941. This matters not just for the topics of this paper, but also for any assessment of productivity growth and technical progress in the decade of the 1930s in constrast to the 1940s (Field, 2003). We have already displayed in Figure 3 above an exponential trend version of potential real GDP that extends a log-linear line between 1928 and 1950. This yields the implication that the percent log output gap was -2.8 percent in 1941:Q3 and +1.3 percent in 1941:Q4, meaning that the economy recovered its full potential level of output roughly on October 8, 1941, about two months before Pearl Harbor.[21]

But what if the exponential trend is wrong? It is quite plausible that potential GDP grew more slowly than the 1928-50 average during the 1930s, due to a very low level of investment (although the pace of innovation was exceedingly high, see Field (2003)). If the trend of potential GDP growth was slower in 1928-41 than in the 1928-50 average, while the trend was faster in 1941-50, then potential real GDP was lower than our estimate in 1941 and as a result the log percent output ratio was higher, i.e., closer to zero than our negative estimate for the full year 1941 of -4.1 percent.

Any such error in the exponential trend estimate of potential GDP would imply that the economy was suffering from greater capacity constraints in 1941 than is implied by our basic estimates. As a result, attempts to estimate fiscal multipliers for 1940-41 would be even more tainted by capacity constraints (see Part 7 below). What evidence is available about the utilization rate of the U. S. economy in 1941?

The first place we would normally look is the unemployment rate during 1941, which according to the official BLS data declined from 14.6 in 1940 to 9.9 percent in 1941. That point of departure makes 1941 look like a year of relatively low utilization. However, Darby (1976) has criticized the official estimate of 9.9 percent for 1941 because it omits those employed by government relief programs (who in the current era would be treated as employed, not unemployed). Darby's 1941 unemployment estimate, treating the government workers as employed, is 6.0 percent rather than 9.9 percent (Darby 1976, Table 3, p. 8). However, the government relief workers were not employed by the private sector and were being paid sub-average wages (Darby, 1976, Table 1, p. 5). Whether they are counted as unemployed or not, they were clearly available as part of the potential labor force and eagerly took higher-paying private-sector jobs as the expansion accelerated during 1940-41.

There is less uncertainty that much of the manufacturing sector was operating at or above capacity during 1941. While it is hard to match up estimates of production and capacity

21. The choice of an exact date is meant as a parody. But if we take the numbers literally and ignore standard errors and uncertainty, a log-linear transition between the output gaps of 1941:Q3 and 1941:Q4 would imply that the economy hit a zero output gap 59 percent of the distance between the midpoints of the two quarters, August 15 and November 15, and this translates to October 8, 1941.

for numerous industries, it is possible to do so for steel, clearly a critical material in the manufacture of armaments. The capacity utilization ratio of tons produced of steel and steel ingots reached as low as 20 percent in 1932, recovered to 72 percent in 1937, hit a new low of 39.6 percent in 1938, and then soared to 82.1 percent in 1940 and 97.3 percent in 1941. Steel supply was as tight in 1941 as in any subsequent year of World War II.[22] "By the second quarter of 1941, expansion of the defense program and of the level of civilian demand to new high levels brought ingot capacity utilization to overfull capacity rates" (Novick *et al.* 1949).

The soaring demand for aircraft led to supply constraints in the aluminum industry, and the inadequacy of supply to civilian industry was discussed with specifics:

> "Warplanes are almost entirely aluminum. So long as all these are being built, civilian fabricators must be content with the aluminum that is left. Trains, kettles, auto pistons, zippers, cables, dragline booms, and outboard motors stand on the aluminum bread line, grateful for favors received."[23]

This straining of production at the limits of steel and aluminum capacity is consistent with the possibility that our exponential trend correctly reflects productive capacity in 1941. Since we measure the percentage of recovery from the Great Depression by the shrinkage of the GDP gap during the 1939-41 period, it is quite possible that the full recovery was reached early in 1941:Q4, instead of in 1942 as is often suggested in the literature. Unfortunately it is not possible to match capacity with production estimates for any important industry besides steel in the 1940-41 period, so we turn now to anecdotal evidence.

It was already evident in May 1941 that automobile production would soon be subject to production limitations due to raw material constraints. "Don't be taken aback if production of 1942-model passenger cars is cut 50 percent, or even more, instead of the announced 20 percent . . . . new cars are selling faster than the auto companies can make them" (Ramey from *BW*, May 31, 1941, p. 13). Despite the high demand for automobiles, spending on consumer durables actually fell in the third and fourth quarters of 1941 due to capacity constraints (Vatter, 1985, p. 12; see also Ramey 2009, data supplement).

We have found evidence that as early as April 1940 a capacity ceiling had been reached in the machine tool industry:

> "Tearing along close to capacity, the toolmakers are said to be so wrought up under the strain of trying to fill foreign and domestic commitments that new

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22. *Historical Statistics of the United States Millennial Edition Online,* steel production series Dd399 divided by steel production capacity series Dd656. Utilization rates in the four years 1941-44 were respectively 97.3, 96.8, 98.1, and 95.5.

23. "Aluminum and the Emergency," *Fortune,* May 1941, pp. 66ff.

customers are almost afraid to appear with new orders, lest they be thrown out of the office."[24]

By May 1941 the machine tool shortage had become acute. A *Fortune* writer traveled to tiny Springfield, Vermont, population 5,000, where the Jones & Lanson company accounted for fully five percent of the total national machine tool output. The two hotels in town were "crammed" with "representatives of American and foreign firms nervous about their machine-tool priorities." Company representatives traced the boom in demand to a year earlier when "the collapse of France let loose a new batch of orders from the English and from U. S. firms, and . . . J&L found itself quoting lengthening delivery dates, from six months, to eight months, then a year in advance." By May 1941, the owner of the company was faced with an impossible task. "The fact is, he says, the demand is now infinite."[25]

Readers of *Fortune* magazine in 1940-41 could hardly turn a page without encountering indications of an ongoing boom of investment for plant construction. An ad for an architectural firm (*Fortune,* May 1941, p. 31) reflected the ongoing economic expansion created by defense spending: "To meet these needs . . . to make America "the great arsenal of Democracy" . . . industry finds itself calling for new factories, plant additions, improvements in plant layout to increase and speed production." Yet much of this new investment in plant and equipment was not counted as investment in the national accounts. An interesting aspect of the Jones & Lanson machine-tool article is the explicit comment that the ongoing attempt to double plant capacity was being financed by the government, not by the company's own funds. This is an early example of "government-owned privately-operated" (GOPO) investment that was discovered and analyzed by Gordon (1969) and further quantified by Wasson, Musgrave, and Harkins (1970). Since investment in war-related plant expansion was counted as government spending rather than private investment in the national accounts, the surge of war-related investment during 1941 occurred simultaneously with a decline in *measured* private investment in the last half of 1941 (see the bottom frame of Figure 7, cited above).

A notable feature of the 1930s and early 1940s was that the price *level* rose and fell with the level of output, contrasting with the Phillips curve mechanism in which the *rate of change* of prices rose and fell with the level of output (or unemployment). But whether embedded in a Phillips curve or aggregate-supply-curve framework, the increase of the aggregate price level in 1941 was evident and disturbing to the Roosevelt Administration. "Call it inflation or merely a big bulge in the cost of living, President Roosevelt is faced with the alternative of cracking down quickly or watching prices and wages go skyrocketing" (Ramey from *BW,* July 12, 1941). The annual rate of change of the GDP deflator between 1940:Q4 and 1941:Q4 was 9.3 percent. This supports the view that the U. S. economy was straining at the limit of capacity constraints, at least in some war-related industries, in 1941. Nevertheless there was still plenty of labor,

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24. "The Best Bargain We Can Jolly Well Make," *Fortune,* April 1940, p. 70.
25. Facts and quotes in this paragraph come from "Jones & Lanson," *Fortune,* May 1941, pp. 74ff.

with 3.9 percent of the labor force employed at low-paying government relief jobs and available for higher paying work in the private economy when such jobs were created. Also consistent with the view that product markets were tighter than labor markets was the decline in labor's share of net domestic factor income from 65.7 percent in 1939 to 62.0 percent in 1941.[26]

Thus we emerge with the verdict that the economy of 1941 was split between excess supply in the labor market and excess demand in a growing fraction of the manufacturing sector as the year progressed. This split personality is nicely summarized by this comment on the availability of labor and equipment in the construction of the training camps during the winter of 1940-41:

> "If the program hasn't unduly strained the overall economy of the U. S., that is because private construction has been in the doldrums for so long that both men and material were, with the exception of boilers, furnaces, heaters, and laundry machines, fairly plentiful . . . But in the immediate locations of the camps . . . it was practically impossible to hire a carpenter or a plumber for private construction during the building peak."[27]

Perhaps the most convincing contemporary account of capacity constraints in mid-1941 came from the Director of the Office of Price Administration. "Civilian supplies of all kinds are being requisitioned for military needs so as to force the cutting down of production for civilian use . . . When [aluminum supply] is cut off suddenly, as has happened recently, businessmen face bankruptcy and whole communities lose the payroll lifeblood of their existence . . . Auto production is being limited and faces almost complete extinction. Can anyone estimate, at this time, the far-reaching dislocations of stoppage?"[28]

4. The Literature on the End of the Great Depression

Economists differ across a spectrum regarding the factors that lifted the U. S. economy out of the Great Depression. Romer (1992) finds that fiscal policy had little to do with the recovery, and she suggests that expansionary monetary policy after 1934 was the true source. In contrast, Sims (1998, p. 20) concludes that "during the Great Depression, the role of interest rate policy in generating and propagating cycles was modest." Vernon (1994) also disagrees with Romer's monetary explanation, finding that the fiscal expansion related to WWII was the major factor in the recovery. Alternative ideas exist as well, including De Long and Summers (1988) and Bernanke and Parkinson (1989), who promote the idea that the recovery was largely due to the self-correcting or mean-reverting forces inherent in the structure of the economy.

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26. The source is NIPA Table 1.10. Labor's share is employee compensation divided by net domestic factor income, which in turn is gross domestic income minus production taxes less subsidies minus capital consumption allowances.
27. "Camps for 1,418,000," *Fortune,* May 1941, p. 57ff.
28. Leon Henderson, "We Only Have Months," *Fortune,* July 1941, p. 68.

Conversely, Gordon (1982) finds that classical self-correction in the form of a downward-shifting aggregate supply curve following a collapse of aggregate demand was missing in the 1930s. Of these competing theories, we will focus primarily on the debate between monetary and fiscal policy and their respective roles in ending the Great Depression.

Our new quarterly dataset shows that the ratio of real GDP to potential real GDP began a persistent rise starting in 1938:Q3. However, the increase in the latter half of 1938 can be viewed as a recovery from the recession of 1937:Q2-1938:Q2 instead of a recovery from the Great Depression itself. Real GDP did not return to its 1937:Q2 level until roughly 1939:Q1, the date that this paper uses as the start of the recovery from the Great Depression.[29]

How can U. S. economic conditions be characterized in early 1939? When Franklin Delano Roosevelt became President in 1933, he brought with him the "New Deal," which combined higher government spending on social programs with significant institutional and regulatory changes including the founding of the SEC, FDIC and many others. Unfortunately, the New Deal failed to bring about its promise of reigniting the economy.[30] Temin (1990), along with Cole and Ohanian (2004), describe how New Deal policies kept real wages artificially high and limited competition, preventing the labor market from returning to a full-employment equilibrium.

De Long and Summers (1988) investigate the natural rate hypothesis, which states that output and employment have self-correction mechanisms that cause the economy to revert back to its natural long run growth rates, and their paper uses the Great Depression as a case study. They conclude that the downturn and subsequent recovery of output in the Great Depression is incredibly unlikely if one believes that output follows a random walk, implying that some degree of mean reversion exists. Bernanke and Parkinson (1989, p. 211) agree, finding that "after a negative disturbance to the steady state, the economy is estimated to make up over half of the difference between actual and full employment in the first three quarters after the shock". This quotation is difficult to reconcile with Figures 3 and 5 above, which show that it took more than a decade for the economy fully to recover from the negative shocks of 1929-1933. In addition, Gordon (1982) argues that the standard Phillips Curve relationship between inflation and output was replaced during the 1930s by a relationship between the price level and the output level. Gordon's finding is significant because without a functioning Phillips Curve relationship, the natural rate hypothesis cannot be applied.

This paper will leave the natural rate hypothesis debate to further study, but one important statement made in De Long and Summers (1988) is that:

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29. Real GDP in $1937 was 92.9 billion in 1937:Q2, then fell to a low of 86.4 billion in 1938:Q2, followed by a recovery to 91.7 billion in 1939:Q1 and 94.5 billion in 1939:Q2. We take 1939:Q1 as the quarter that begins the end of the Great Depression, because it is closer in value to 1937:Q2 than is the value of 1939:Q2.

30. It must be noted that while they did not lead to a quick recovery, New Deal creations such as the SEC and FDIC likely had a positive long term impact on the U. S. economy

> By the time World War II began and the government began to exert command over the economy, more than five-sixths of the Depression's decline in output relative to trend had been made up. It is hard to attribute any of the pre-1942 catch-up of the economy to the war. Neither the federal government's fiscal deficit nor the surplus on trade account became an appreciable share of national product before Pearl Harbor. (p. 467)

This quotation from De Long and Summers is worth including for three reasons. First, it suffers from a logical flaw in citing the fiscal deficit and the trade deficit. Both tax revenues and imports are endogenous and thus deficits or surpluses cannot be used as measures of shocks to output. If tax revenues and imports rise rapidly enough, then an autonomous increase in government spending or exports can be masked by a non-increasing fiscal deficit or trade surplus. Second, their statement ignores the concept of the structural fiscal surplus or deficit, which was introduced by Brown (1956) to argue that the New Deal was unsuccessful because it failed to increase the structural deficit. Indeed we see in Figure 7 that the ratio of government spending (Federal, state, and local) hardly changed during the years 1933-39 and only began to take off in mid-1940. Third, and most importantly, the quotation treats U. S. expenditures on World War II as starting with Pearl Harbor, whereas both this paper's new dataset and contemporary accounts in Part 3 above show that World War II for the American economy began in mid-1940, not on December 7, 1941.

De Long and Summers' argument against fiscal policy is furthered by Romer (1992, p. 25), who states that "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". Romer finds that a large unsterilized influx of gold to the United States beginning in 1934 sharply increased the money supply and turned real interest rates negative over most of the period 1934-1941.[31] While postwar monetary policy has largely been conducted through open-market transactions in government bonds, the addition of a dollar of gold to the Federal Reserve's assets has exactly the same impact on the money supply as the addition of a dollar of Treasury bonds acquired through an open-market purchase. Given this increase in the monetary base, Romer conducts experiments which pit "normal monetary policy"[32] vs. actual monetary policy from 1933-1942. She concludes (1992, p. 12) that "real GNP in 1937 under normal monetary policy would have been nearly 25% lower than it actually was. By 1942 the difference between GNP under normal and actual monetary policy grows to nearly 50%. These calculations suggest that monetary developments were crucial to the recovery". In terms of the impact of WWII, Romer says the following:

31. Eggertsson (2008) also finds negative real interest rates over this time span, but he attributes them mainly to the change in expectations from deflationary to inflationary due to the fiscal expenditures related to the New Deal.
32. Romer's definition of normal monetary policy is based on a monetary policy multiplier estimated from the 1921 and 1938 recessions, which she believes were independent events.

> The U. S. money supply rose dramatically after war was declared in Europe because capital flight from countries involved in the conflict swelled the U. S. gold inflow. In this way, the war may have aided the recovery after 1938 by causing the U. S. money supply to grow rapidly. Thus, World War II may indeed have helped to end the Great Depression in the United States, but its expansionary benefits worked initially through monetary developments rather than through fiscal policy. (1992, p. 26)

Here again Romer cites monetary policy as the primary driver of the recovery, believing that fiscal spending increases related to WWII did not have an impact until 1942.

In addition to the refutation of her fiscal policy stance provided by this paper's new dataset and contemporary accounts from 1940-41, Romer's other results can be questioned. The money supply is equal to nominal GDP divided by velocity, and thus a rise in the money supply must either increase nominal GDP or reduce velocity. However, Romer seemingly ignores the issue of velocity and assumes that changes in the money supply directly influenced nominal GDP with an elasticity of 1.0. Romer provides no evidence that velocity was exogenous rather than negatively correlated with the increase in the money supply. In particular, velocity fell from 1937-1940 when the money supply was increasing without the support of expansionary fiscal policy, but then as shown in Figure 9 velocity rose in 1940-1941 when the stimulative effect of fiscal policy kicked in.

Furthermore, Romer's use of negative real interest rates as a cause of the recovery suffers from a logical flaw similar to the comments of De Long and Summers (1988) about fiscal deficits and the trade balance, as they all assume that these were exogenous rather than endogenous variables. Real interest rates are equal to nominal interest rates minus inflation. Nominal interest rates were low and quite stable throughout the Great Depression, but since the price level rose and inflation was positive for most of the period 1934:Q1-1941:Q4,[33] the real interest rate was negative. However, the price level is endogenous to the growth of nominal GDP, whatever its cause. Nominal GDP doubled over this time span, and this growth was split between an 83 percent rise in real GDP and a 17 percent increase in the price level. Therefore, as real interest rates are endogenous to the price level and thus output, they are a *result* of a demand stimulus rather than a cause. While the results of Romer (1992) may be called into question for all these reasons, they have remained widely cited and will be assessed below in our formal econometric analysis.

The arguments of De Long and Summers (1988) and Romer (1992) are countered by Vernon (1994), who argues that the expansionary fiscal policies related to WWII 'manufactured' the United States out of the Great Depression. Vernon (1994, p. 850) addresses the other authors directly, stating that "I take issue with De Long and Summers and Romer by arguing that

33. The GDP Deflator rose in nearly every quarter between 1934:Q1 and 1941:Q4, except during the 1937-38 recession. A graph of the newly interpolated quarterly GDP Deflator is not shown due to space constraints, but our data is available upon request.

World War II fiscal policies were in fact a major contributor to the recovery from the Depression, not merely a topping-off of the recovery after it had been substantially completed." By comparing real GNP to potential real GNP, Vernon finds that roughly 40% of the recovery took place in 1941 with another 15-20% in 1942. He then breaks down the increase between 1940 and 1941 real GNP to find that, even after netting out the opposing effects of personal, corporate, excise and social insurance taxes, "more than 80% of the 1941 increase in real GNP [is attributable] to World War II-associated federal fiscal policies" (1994, p. 866). He believes that the total contradiction between his results and those of Romer (1992) are primarily due to the different values placed on the fiscal multiplier, the amount by which a fiscal stimulus is amplified by the response of other types of spending. However, a criticism of Vernon (1994) is that his fiscal multiplier is derived from coefficients using a postwar macro MPS[34] model that he assumes without qualification can be applied to 1940-1941.

While Sims (1998) takes no stance on the role of fiscal policy, he does implicitly agree with Vernon that monetary policy was not the primary driver of the recovery from the Great Depression. Sims constructs interwar and postwar (VAR) models in an attempt to capture the behavior of monetary policy during these two periods.[35] His most important finding is that monetary policy, represented by the Federal Reserve Bank of New York discount rate, does not play a major role either in the initial downturn of the Great Depression, 1929-1932, nor in the recovery through December 1939. In addition, Sims shows that postwar monetary policy, if transplanted to the interwar period, would not have substantially altered these results. While he provides no insight on the factors that actually led to the recovery, Sims' results show that the discount rate could not have played a major role before 1940.

The purpose of this paper is to provide a fresh look into relative importance of fiscal and monetary policy in achieving the recovery from the Great Depression. This paper takes Vernon (1994) and his criticism of De Long and Summers (1988) and Romer (1992) as points of departure. However, in contrast to Vernon (1994), who tests fiscal and monetary policy one at a time in the context of the postwar MPS model, this paper will follow Sims (1998) by conducting tests within a VAR framework. Both monetary and fiscal policy are tested together as drivers of economic activity, acknowledging the correlation between the variables when determining which set of policies was the primary source of the recovery. The VAR framework also allows us to address the contemporary debate about the size of fiscal multipliers.

5. VAR Methodology

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34. The MPS model is an econometric macro model developed by the Federal Reserve and MIT in the 1960s. "MPS" stands for MIT-Penn-Social Science Research Council. The merger of MIT and Penn came about through the longstanding collaboration of Franco Modigliani at MIT and his frequent co-author Albert Ando at Penn.

35. Sims (1998) VARs serve as a guide for this paper's VAR methodology.

In order to determine whether fiscal or monetary policy had the greater impact on the recovery from the Great Depression, this paper develops a VAR model that captures co-movements among the variables. VARs treat all variables symmetrically by regressing each variable on a constant, a certain number of its own lags, and that same number of lags of the other variables in the model. The goal of this paper is to carry out VAR testing with minimal restrictions in order either to support or question the contradictory hypotheses advanced in the literature review of Part 4 above.

5.1 The Choice of Interwar VAR Time Period, 1920:Q2-1941:Q3

The benchmark interwar VAR described in this paper is estimated for the time span 1920:Q2-1941:Q3. This period is both long enough to obtain significant results and includes most of the 1939:Q1 to 1941:Q4 recovery from the Great Depression. The regression period stops in 1941:Q3 instead of 1941:Q4 for two main reasons. First, as discussed above in Part 3, our new dataset indicates that the date of full recovery from the Great Depression happened very early in 1941:Q4. Therefore, as we are trying to explain what ended the Great Depression without including the factors that subsequently pushed output above its potential level, we are better served by ending our regressions in 1941:Q3 (although we still conduct post-sample simulations through 1941:Q4). The second reason 1941:Q3 is chosen as the VAR end date is that the inclusion of the additional quarter 1941:Q4 leads to unusable regression results. Real Government Expenditures as a percentage of potential real GDP (G/YN) increased by a full 5.0 percentage points from 1941:Q3 to 1941:Q4, creating a strong bias towards a fiscal policy explanation of the recovery. Because in that quarter military expenditures were clearly crowding out private consumption and investment, fiscal multipliers are biased down as well. In contrast, by not including 1941:Q4 in our baseline VAR, we purposefully bias our results *against* fiscal policy as the main explanation of the end of the Great Depression.

5.2 VAR Methodology

The structuring of this paper's VAR models, statistical testing and overall methodology follow the examples set by Bernanke, *et al.* (1997), Gordon and Veitch (1986), Sims (1998) and Stock and Watson (2001). Our baseline VAR includes the variables real Government Spending on Goods and Services (G), real GDP minus G (N),[36] nominal M1 Money Supply (M1), M1 Money Multiplier (MM), and the Federal Reserve Bank of New York (nominal) Discount Rate (R).[37] M1, MM, and R are monetary variables that are used to determine the contribution of monetary policy, while G acts as the sole fiscal policy variable. In order to normalize these variables, they are divided by YN, except for MM and R, which enter in their natural form. In our set of robustness tests, we report results with the GDP deflator added as a sixth variable.

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36. N is equal to the sum of real Consumer Expenditures, real Private Investment and real Net Exports.
37. See the Data Appendix for the precise definition and calculation of these variables.

In contrast to Gordon and Veitch (1986), but in accordance with Bernanke *et al.* (1997), first differences are not taken because (1) the variables have already been normalized by expressing them as a ratio to potential real GDP and (2) first differencing throws information away while producing almost no gain in asymptotic efficiency in the context of a VAR.[38] In addition, our VAR uses 5 quarterly lags to correct any over-adjustment of seasonal effects present within the seasonally adjusted data.[39] By using these 5 variables and 5 lags, we assume there is no omitted variable bias and that the residuals are approximately white noise, thereby allowing unbiased and consistent estimation of the (5 x 5) matrix of coefficients by OLS regression. If the residuals are assumed to be normally distributed, then the estimation of the coefficients matrix is also asymptotically efficient.

The VAR historical decomposition presented in Section 6 requires assumptions to be made about the moving average representation of the vector time series:

$$y_t = X_t \beta + \sum_{s=0}^{\infty} \psi_s H H^{-1} u_{t-s} \qquad \textbf{(1)}$$ [40]

In this equation, y_t is an *M*-variate stochastic process, $X_t\beta$ is the deterministic part of y_t, $\{u_t\}$ is an *N*-variate white noise process where *u* is called an innovation process for *y*, and H is any non-singular matrix. Innovations[41] in the variables can be thought of as the changes in the variables' values not predicted by the VAR coefficients.

In equation (1), if H is chosen such that HH' equals the covariance matrix Σ, then the innovations are called orthogonalized and are uncorrelated across time and equations. For our purposes, this means that, by using orthogonalized innovations, innovations in each variable can be examined individually without worrying about their contemporaneous impact on the other variables, an important advantage of conducting our testing within the VAR framework.

One way of orthogonalizing the innovations is to use a structural VAR such as that described in Sims (1998), which creates identifying restrictions using assumptions based on prior knowledge. Stock and Watson (2001, p. 113) caution that for Sims' type of VAR, "their 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. This paper does not employ the structural VAR approach because it takes no stand based on prior knowledge of what the identifying restrictions should be. Its only assumptions are that, at least in principle, both fiscal and monetary policy influence output.

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38. This result is shown in Fuller (1976) Theorem 8.5.1.
39. The use of 5 quarterly lags is recommended in Chapter 10 of Estima (2007).
40. Equation (1) is a modified version of a formula from Chapter 10 of Estima (2007).
41. "Innovations" are also known as "shocks" in some other papers. The terms are interchangeable, but this paper uses "innovations" throughout for consistency.

Instead of imposing identifying assumptions, this paper uses the Cholesky factorization method, which forces H to be a lower triangular matrix with strictly positive diagonal entries. One problem with the Cholesky factorization is that, if the residuals are correlated, ordering the variables in different ways can produce results that in some models may differ substantially enough to alter the conclusions of the test. This problem is minimized by using a VAR model in which the ordering of the variables is based on their ex-ante exogeneity and predictive value for the other variables: exogenous variables with the most predictive value are placed first, while endogenous variables without predictive value are placed last. In addition, we perform several robustness tests using alternative VAR ordering schemes to ensure that changing the order of the variables in the VAR does not substantially change our conclusions.

5.3 VAR Variable Ordering

It has become standard practice in postwar empirical macroeconomics to treat government military spending as a truly exogenous variable, varying in response to political and military exigencies with no feedback from other economic variables. For a recent example see Barro and Redlick (2009). We accept this insight and take G to be an exogenous variable, ordered first in our baseline VAR model. Subsequently, we check this ordering by putting the monetary variables and N (non-government GDP) first to assess the robustness of the results to alternative orderings.

As for the other variables, we group the three monetary variables in the order M1, MM, and R, both for convenience to avoid displaying a plethora of results with alternative orderings and due to the fact that R is clearly endogenous. We place N (non-government GDP) alternatively before and after the monetary variables, presuming that N should be influenced by all the fiscal and monetary variables but also admitting evidence that N experiences substantial autonomous movements in 1939-41.

6. VAR Results

The VAR model described above yields three useful sets of estimated output: the VAR coefficients, the VAR residuals and a correlation matrix between the variables. The correlation matrix is altered using the Cholesky factorization detailed above and is then combined with the VAR residuals to produce orthogonalized innovations in the variables. This means that we can now study the effect that unexpected[42] movements in each of the five variables have on the output gap without worrying about the contemporaneous correlation between the variables.

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42. Unexpected in this case means not predicted by the VAR coefficients (the basic VAR dynamic forecast).

After presenting the results for our baseline VAR specification, we then perform a variety of robustness checks to make sure our conclusions do not change substantially when the setup of the VAR is altered in plausible ways.

6.1 VAR Historical Decompositions

The main tool we use to analyze the output of the VAR are historical decompositions. As graphed in Figures 10 and 11, these break down the contribution of innovations in each variable to the performance of G and N over the period 1939:Q1-1941:Q4. The results for G and N are then combined in Figure 12 to produce the historical decomposition of Y. Figure 13 summarizes the estimated contribution of monetary and fiscal policy at each point in the recovery from the Great Depression.

Figures 10, 11 and 12 each display three lines: the solid black lines of each figure show the actual path of the variable examined (either G, N or Y) as a percentage of YN, the dashed lines show the basic VAR dynamic forecast described below and the grey lines show how innovations in each of the five variables influence the variable examined over the 1939:Q1 to 1941:Q4 time period.

The basic VAR dynamic forecast projects each subsequent quarter's value using only the VAR estimated coefficients, which assumes that there are no innovations in any of the variables (i.e. the VAR residuals ε_t are set equal to zero). As an example for a particular quarter, the basic VAR dynamic forecast values in 1939:Q4 are presented below in equation (2):

$$\hat{y}_{1939:Q4} = c + \Phi_1 \hat{y}_{1939:Q3} + \Phi_2 \hat{y}_{1939:Q2} + \Phi_3 \hat{y}_{1939:Q1} + \Phi_4 y_{1938:Q4} + \Phi_5 y_{1938:Q3} \qquad \textbf{(2)}$$

The values y_t, the constant term c and the VAR coefficients Φ_i are all (5 x 1) vectors, corresponding to the five variables in the VAR. A "hat" over y_t means that the number is dynamically estimated by the VAR forecast.[43]

As expected, the innovation-free VAR predictions fail to capture the actual evolution of the variables, since innovations occurred in all of the variables over the 1939:Q1-1941:Q4 period. The combined effect of these innovations is equal to the difference between the actual level of each variable and the value given by the basic VAR dynamic forecast. The purpose of the historical decomposition is to quantify the relative contribution of innovations in each variable to explaining this gap. 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. For example, when looking at how much of the difference between the actual and basic

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43. Notice that $y_{1938:Q3}$ and $y_{1938:Q4}$ do not have 'hats' because the forecast starts in 1939:Q1, so for these quarters the actual values of the variables are used to forecast the $\hat{y}_{1939:Q4}$ (5 x 1) vector.

VAR dynamic forecast value of the variable examined can be attributed to innovations in G, equation (2) is altered as shown below.

$$\hat{y}_{1939:Q4} = c + \Phi_1 \hat{y}_{1939:Q3} + \Phi_2 \hat{y}_{1939:Q2} + \Phi_3 \hat{y}_{1939:Q1} + \Phi_4 y_{1938:Q4} + \Phi_5 y_{1938:Q3} + \varepsilon_{1939:Q4} \quad \textbf{(3)}$$

Here $\varepsilon_{1939:Q4}$ is a (5 x 1) vector that equals 0 except in the first row, where the innovation in G is allowed to enter into the equation.[44] Innovations in fiscal policy influence the variable examined for every time period in the dynamic forecast, and once again the previously forecasted values are used to forecast each subsequent value. When the dynamic forecast ends in 1941:Q4, the cumulative effect of the innovations in G on the movements of the variable examined can be calculated. This process is then repeated for the other four variables to judge which variables' innovations had the greatest effect. The results can be seen for all three variables examined (G, N and Y) in the grey lines in Figures 10, 11 and 12, respectively.

The historical decomposition of G shown in Figure 10 supports our view that the sharp rise in G during 1940-41 was exogenous. The basic VAR dynamic forecast does a poor job predicting what actually happened in G/YN between 1939:Q1 and 1941:Q4 period, illustrating that if all innovations had been suppressed, G/YN would have risen by much less than it did in reality. By following the basic VAR dynamic forecast, G would have increased by only 3.4 percent of YN from 1939:Q1 to 1941:Q4 instead of the 12.9 percent of YN that actually occurred. As displayed in Figure 10, 69.1 percent of the difference between actual and forecasted G as a percentage of YN is explained by innovations in G, 27.0 percent is explained by innovations in MM, and all other variables' innovations have little or no impact.

Figure 11 displays the historical decomposition of N, which allows us to assess the impact of fiscal and monetary policy on the non-government components of GDP during the recovery period. The basic VAR dynamic forecast predicts a 6.4 percentage point *fall* in N/YN over the period when it actually *rose* by 10.4 percent. This substantial rise in *N* appears in the top left frame of Figure 11 to be caused entirely by government spending. A glance at the other frames reveals that the other variables in the VAR model all predict that *N* should have declined in the 1939-41 period.

A striking conclusion is that innovations in N itself had a negative impact on the value of N. If all other variables had followed the paths predicted by the VAR coefficients and only N had been allowed to deviate as it did in reality, N would have ended up a full 19.1 percent of YN lower in 1941:Q4 than the actual outcome.

As the threat of war grew in the United States during 1940-1941, real consumer expenditures and private investment fell as American resources were being diverted toward the

44. The first row of the (5 x1) vector is now the 1939:Q4 innovation in G, as G is placed first in the ordering of the VAR that yields the baseline results of this paper.

war effort.[45] This shift shows up as negative innovations in N, but it also shows up as positive innovations in G as the resources were now being used for government-financed war production. Government spending "crowded out" private investment through supply restrictions[46] rather than the traditional channel of higher interest rates. Therefore, if the negative innovations in N are factored into the forecast, but the positive innovations in G are suppressed, the net effect is the much lower forecast of N seen in the grey line in the lower right frame of Figure 11. The upper left frame displays the opposite effect where the positive innovations in G are included and the negative innovations of N are suppressed. As expected, the outcome is flipped, with the innovations in fiscal policy nearly singlehandedly making up the gap between the actual values of N and basic VAR dynamic forecast.

If innovations in G only are allowed to enter into the 1939:Q1-1941:Q4 VAR dynamic forecast of N, the result is 14.2 percent higher in 1941:Q4 than that of the basic VAR dynamic forecast. Innovations in the monetary policy variables M1, MM and R play a role in the increase in N/YN over this period, particularly in 1939-1940, though are not nearly as influential. The combined effect of innovations in all three monetary policy variables raise N/YN by 4.3 percent, less than one-third the impact of innovations in fiscal policy.

Figure 12 is a combined version of Figures 10 and 11. Since the sum of G and N is real GDP (Y), then the sum of each of the lines in Figures 10 and 11 is equal to its corresponding line in Figure 12. which thus displays the contribution of each variable to the recovery in Y, the economy as a whole, over the 1939:Q1-1941:Q4 period. Table 1 summarizes the graphical results in tabular form. As before, in each case the contribution of a variable like government spending (G) must be compared not to a baseline of zero change, but rather to the no-innovation basic VAR dynamic forecast.

There was a 23.2 percent change between the actual recovery of Y from 78.1 percent in 1939:Q1 to 101.3 percent in 1941:Q4, but the basic VAR dynamic forecast of Y, again represented by the dashed line in Figure 12, does not predict any recovery from the Great Depression at all. In fact, it predicts a decline in the Y/YN ratio by 3.7 percentage points between 1939:Q1 and 1941:Q4, as shown in the second row and third column of Table 1. Thus the total gap between the actual 23.2 percent increase and the 3.6 percent VAR forecast decline comes out at a 26.8 percent failure of the VAR forecast to explain the 1939:Q1-1941:Q4 economic recovery. By definition, innovations in the variables that are excluded from the basic VAR dynamic forecast must have contributed that 26.8 point difference.

The dominant explanatory variable is government spending (G), for which the predicted Y/YN ratio of 78.5 percent in 1939:Q1 rises to 95.8 percent in 1941:Q4, for a fiscal explanation of

45. In addition, the third component of N, NX, fell sharply starting in 1940:Q4, reflecting the closures of foreign markets that were previously customers of U. S. exports (Germany, France, all of Western Europe, Japan after the oil embargo of mid-1941, and also a reduction in the ability of the UK to finance civilian imports). This drop would enter as negative innovations in N, as well.

46. These included both current and anticipated supply restrictions, see Section 3.

17.3 percent, or a 20.9 percent (17.3+3.7) rise relative to the VAR baseline. Comparing this value to the actual 23.2 percent rise in the Y/YN ratio indicates that innovations in fiscal policy are responsible for 89.1 percent of the recovery, as shown in the right-hand column of Table 1.

Calculated in the same way, the contribution of innovations in the money supply (M1) is 8.8 percent, money multiplier (MM) 20.5 percent, nominal interest rate (R) 4.9 percent, and non-government GDP (N) -10.5 percent. Summing together the percent of the recovery explained by the five explanatory variables, combined with the -12.7 percent attributable to the basic VAR dynamic forecast, accounts for the entire 23.2 percent rise in the Y/YN ratio from 1939:Q1-1941:Q4.

6.2 Summary of the Main Results

From the results presented in Figure 12 and Table 1 we obtain our baseline result: between 1939:Q1 and 1941:Q4, 89.1 percent of the recovery can be attributed to fiscal policy innovations, 34.1 percent to monetary policy innovations and the remaining -23.2 percent to the combined effect of the basic VAR dynamic forecast and innovations in N. Fiscal policy innovations related to World War II were the key to the recovery from the Great Depression, with monetary policy innovations playing a supporting role.

Figure 13 displays how this baseline result changed over the course of the recovery. During the first quarter of the recovery, from 1939:Q1 to 1939:Q2, both fiscal and monetary policy innovations had negative effects on Y/YN. At this point, the basic VAR dynamic forecast and innovations in N explained the entire 1.9 percent of YN increase in real GDP, though this "other" category's contribution decreases substantially in subsequent quarters before settling around -20 percent due to the "crowding out" effect described above.

Moving rightward, Figure 13 shows that monetary policy innovations accounted for the entire 1939:Q1-1940:Q2 increase in Y/YN, with neither fiscal policy innovations nor the "other" factors having any effect. This result is consistent with both Romer (1992) and Vernon (1994), both of whom attribute this early portion of the recovery to monetary factors.

However, the recovery was only 20.9 percent[47] complete in 1940:Q2, and after this point our results become increasingly contradictory to Romer (1992)[48] as the percentage of the recovery attributable to fiscal policy innovations rises dramatically. Already by 1941:Q1 fiscal policy innovations explained 69.4 percent of the recovery to monetary policy innovations' 56.0 percent. Taking the contributions all the way out to the full recovery date of 1941:Q4 leads to our baseline result, with 89.1 percent of the recovery from the Great Depression attributable to

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47. 20.9 percent = (1940:Q2 value of Y/YN minus 1939:Q1 value of Y/YN) / (100 minus 1939:Q1 value of Y/YN) = (82.66 – 78.08) / (100 – 78.08).

48. Our results remain fairly consistent with those of Vernon (1994) throughout, even though we use a completely different dataset and methodology.

innovations in fiscal policy, 34.1 percent to monetary policy innovations, and -23.2 percent to other factors.

6.3 Robustness Checks

In order to determine whether this paper's results are robust, several variations need to be assessed, including changing the VAR time period, using alternative or additional variables, redefining the variables as natural logs instead of percentages of YN, and, perhaps most importantly, altering the order of the VAR variables. This section will determine the effect of these alternative VAR specifications on the baseline result derived above, with the results summarized in Table 1.

The VAR start date of 1920:Q2 was selected based on data availability, as the new dataset starts in 1919:Q1 and thus 1920:Q2 is the earliest possible regression start date when using 5 lags. In contrast, the VAR end date of 1941:Q3 was chosen for the more substantive reasons described above. What happens to the baseline result if these VAR start and end dates are tweaked?

It is possible the starting the regression in 1923:Q4 would make more sense that 1920:Q2, as this new date omits the 1920-21 recession and the possible role of declining government spending in 1919-20 as its main cause. With the alternative starting date, the baseline result shifts though the end conclusions remain similar: 64.9 percent of the 1939:Q1-1941:Q4 recovery can now be attributed to fiscal policy innovations, 40.8 percent to monetary policy innovations and the remaining -5.6 percent to the combined effect of the basic VAR dynamic forecast and innovations in N.

Section 5 argues that moving the regression end date past 1941:Q3 would make G completely dominate the results, and a robustness check confirms this. If the end date is moved just one quarter forward to 1941:Q4, the portion of the 1939:Q1-1941:Q4 recovery explained by innovations to fiscal policy more than doubles to 186.2 percent, leaving a nonsensical -86.2 percent attributable to the combined effect of the basic VAR dynamic forecast and innovations in the monetary policy variables and N.

What if the VAR end date is moved one quarter back to 1941:Q2? There is no reason to do this, but it does allow us to see if fiscal policy loses its importance if 1941:Q3 is taken out of the regression. The portion of the 1939:Q1-1941:Q4 recovery explained by innovations to fiscal policy drops dramatically, falling to 27.7 percent, while the percentage attributable to innovations to momentary policy rises to 41.5 percent, and 30.8 percent of recovery is now explained by the combined effect of the basic VAR dynamic forecast and innovations in N. This result is consistent with the contemporary evidence presented in Section 3, which shows government expenditures "crowding out" of N was in full force in 1941:Q3. Excluding the 1941:Q3 data from the regression removes large negative innovations from N and a large positive innovation from G, resulting in a large swing in the percentage contributions.

As mentioned previously, the M1 Money Multiplier (MM) is equal to the M1 Money Supply (M1) divided by the Monetary Base (MB). What happens if the variable used in the VAR along with MM is its denominator MB instead of its numerator M1? The result, as presented in Table 2, shows that replacing M1 with MB does not change the contribution of any grouping (fiscal policy, monetary policy or "other") by more than 7.6 percent from the baseline result. Therefore, our conclusions are robust to the use of MB in place of M1 in the VAR.

Other papers on similar subjects such as Sims (1998) have included a variable in the VAR to isolate the effects of inflation. This paper measures inflation using the newly interpolated quarterly GDP deflator, and it is possible that leaving this variable out of the VAR might have introduced omitted variable bias. Table 2 presents a version of the VAR model that includes the GDP deflator as a sixth variable. As expected, this addition has little effect other than shifting some of the explanatory power from fiscal and monetary policy innovations to the "other" category, which now includes the cumulative contribution of the basic VAR dynamic forecast and innovations in both N and the GDP deflator.

Another robustness check is to see whether the same results are obtained when defining the variables as natural logs of their $1937 levels instead of as percentages of YN. The rationale for this test is simply that natural logs have been used in similar papers and provide another way of normalizing the data over time. One problem with this approach and the reason that it was not used to produce the baseline result of this paper is that the calculations become distorted when changing the results from natural logs back to percentages of YN. This problem occurs because the innovations are no longer additive, as exp(X+Y) does not equal exp(X) + exp(Y). Thus, once the results have been translated back to percentages of YN, they do not explain exactly 100% of the 1939:Q1-1941:Q4 recovery.[49]

In Table 1, the first row under the natural logs header shows that running the natural log regression over the same time period does have a material impact on the results, though not enough to change the conclusion that fiscal policy innovations were the key to the recovery. The results are actually surprisingly similar to the baseline result using the 1923:Q4 start date, though this is likely just a coincidence. The new specification shows that 64.5 percent of the 1939:Q1-1941:Q4 recovery can be attributed to fiscal policy innovations, 41.0 percent to monetary policy innovations and the remaining -5.5 percent to the combined effect of the basic VAR dynamic forecast and innovations in N or left unexplained.

The second row under the natural logs header shows that defining the variables as natural logs allows the regression time period to extend to 1941:Q4 without the results becoming nonsensical. In fact, these results are actually quite comparable to our baseline result, finding that 91.5 percent of the 1939:Q1-1941:Q4 recovery can be attributed to fiscal policy

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49. The percentage that these VARs leave unexplained can be seen in the far-right column of Table 2.

innovations, 38.3 percent to monetary policy innovations and the remaining -29.8 percent to the combined effect of the basic VAR dynamic forecast and innovations in N or left unexplained.

Taking these two results together implies that defining the variables as natural logs instead of as percentages of YN somewhat mutes the large baseline contribution of fiscal policy. Even so, our main conclusion that fiscal policy innovations dominated the recovery, with monetary policy innovations playing a supporting role, remains robust to this specification.

An additional way to test the robustness of our results is use an alternative dataset in the VAR. It is possible that our newly interpolated data series for G and N contain some errors, and thus for this test we substitute in the data from Ramey (2009) for the crucial time period of 1939:Q1-1941:Q4.[50] As mentioned previously in section 2.2, Ramey uses a completely different method to arrive at her quarterly data for GDP and GDP components. Her quarterly data were compared to ours in Figure 2. As displayed in Table 2, using the Ramey data in place of our interpolated data actually increases the percentage explained by fiscal policy innovations to 135.1 percent at the expense of the “other” category. Therefore, our conclusion of fiscal policy dominance becomes more robust when using Ramey’s alternative dataset.

As explained in Section 5, VAR results using orthogonalized innovations are subject to change when the VAR ordering is modified, and thus alternatives to our baseline VAR ordering of (G, M1, MM, N, R) must be tested. The final four rows of Table 2 display the results of four other plausible VAR orderings: (G, N, M1, MM, R), (N, G, M1, MM, R), (M1, MM, G, N, R) and (M1, MM, N, G, R). One interesting result that emerges is that advancing a variable in the VAR ordering does not necessarily increase the percentage of the recovery it explains, implying that the added influence of moving a variable up in the ordering can work both ways.

For example, monetary policy innovations explain 13.9 more more of the recovery in the baseline ordering where M1 and MM are placed after G than when they are moved ahead of G. On the other hand, when N is placed in front of M1 and MM, the percentage of the recovery explained by the “other” category which includes the basic VAR dynamic forecast and innovations in N increases by 2.5 percent. While the outcomes of the different orderings are interesting to examine individually, the most important conclusion is that these alternative results have virtually no impact on our central result that innovations in G were the major factor in the recovery from the Great Depression. All four theoretically conceivable variations indicate that fiscal policy innovations account for the vast majority of the recovery, and while all show a decrease in the amount explained by monetary policy innovations, they remain an important secondary factor in the recovery.

The results of robustness checks of altering the VAR time period, replacing M1 with MB, including the GDP Deflator, defining the variables as natural logs, substituting Ramey (2009) 1939:Q1-1941:Q4 data for G and N, and altering the VAR ordering indicate that the baseline

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50 Ramey’s 1939:Q1-1941:Q4 data is ratio-linked to our newly interpolated quarterly data in 1939:Q1.

result of this paper is not specific to just one VAR specification. Instead, the conclusion that innovations in G played the major role the recovery is robust to a variety of different conditions and thus much more confidence can be placed in this result.

7. Fiscal Multipliers

The Obama stimulus program enacted in March 2009 created an explosion of papers revisiting the validity of one of the central implications of Keynesian economics, that when private aggregate demand is low, an increase in government spending can bridge the gap with a multiplier effect well above unity (defined as the total change in real GDP divided by the change in government spending that caused it). Among the recent papers on this topic are Hall (2009), Christiano-Eichenbaum-Rebelo (2009), Ramey (2009), and Barro-Redlick (2009).

Barro-Redlick has focused attention on a central dilemma in this literature. Except for World War II and the Korean War, the magnitude of the fiscal stimulus was not sufficiently large to produce statistically significant results, while those two wartime episodes both involved capacity constraints in non-military GDP which created a crowding out effect from the supply side even if interest rates were fixed or relatively stable. An equally significant shortcoming of the recent literature is that government spending multipliers are derived by comparing actual changes in GDP relative to actual changes in government spending, which ignores the VAR approach which would estimate government multipliers as the marginal effect of orthogonalized innovations in G relative to a forecast of the economy's behavior in the absence of such innovations.

In short, our VAR model is precisely the framework needed to discuss fiscal multipliers, and our previous results can, without any changes at all, be interpreted to provide new evidence on fiscal multipliers in a period of truly exogenous changes in the G/YN ratio in 1940-41. We do not measure the actual change in GDP divided by the actual change in government spending, as do some recent papers, but rather our multiplier is the marginal effect of G innovations on GDP relative to the marginal effect of G innovations on G itself. Further, the evidence provided above in Part 3 about capacity constraints in the last half of 1941, together with our new quarterly data set, allows us to contrast the estimated fiscal multipliers for two alternative periods that stop in 1941:Q2, before the capacity constraints became effective, and stop in 1941:Q4 when the capacity constraints distort the estimates.

Table 2 provides a summary of the implications of this paper for fiscal multipliers. The left column is the most important, because it makes its calculation stopping in 1941:Q2, before most of the capacity constraints took effect The right column going through 1941:Q4 yields uniformly lower multiplier estimates, reflecting the impact of the capacity constraints of the last half of 1941.

Two flavors of fiscal multipliers are provided in the more relevant left column of Table 2. The top section is based on the same basic VAR dynamic forecast used in Section 6 that starts in 1939:Q1. The right way to calculate the multiplier is to subtract out the baseline VAR forecast that suppresses all innovations in any variable. This multiplier is a very high 4.24, in contrast to a less justifiable multiplier of 1.98 that does not subtract out the (declining) basic VAR forecast. The same exercise is repeated in the bottom part of Table 3 for an alternative dynamic forecast that starts in 1940:Q2, the quarter when the fiscal expansion started. Given that we are estimating the 1940:Q2-1941:Q2 multiplier, it makes sense to begin the forecast at this later date. These results are reassuring, in that the fiscal multipliers of 1.80 and 2.19 are relatively similar, whether or not the baseline VAR forecast is subtracted. These are the basic multiplier results of this paper that we believe are most relevant to discussions of the current 2009-10 economy.

While the equivalent multipliers on the right side of Table 2 are uniformly lower, we consider them irrelevant to the key question of the recent literature – what is the government spending multiplier in a situation of high unemployment and unutilized manufacturing capacity like 2009-10? Our estimates in the left column of Table 3 center around 2.0, not too far from a textbook IS-LM multiplier with constant interest rates, income-dependent taxes and income-dependent net exports.

8. Conclusion

This paper is about two perennial topics in macroeconomics, about which interest has been revived by the worldwide economic crisis of 2008-10. These are the size of fiscal multipliers and the sources of recovery from the Great Depression. This paper has provided a set of new results that shed light on both topics. First, we cannot estimate fiscal multipliers relevant for an economy like 1933 or 2010, in which there is low utilization of capital and labor, from a period like 1941 where significant capacity constraints were widespread in the U. S. economy. Second, we cannot talk about capacity constraints in 1941 without revisiting the statistical estimation of potential real GDP in the interwar period. Third, we must weigh evidence on capacity constraints by reading the contemporary descriptions of economic conditions in the business press published in 1940 and 1941. Fourth, fiscal multipliers should be measured not as raw GDP changes divided by raw changes in government spending, but both numerator and denominator must be stated *relative* to the forecast of some model of an alternative scenario in which the fiscal shock is absent. Fifth, the relative role of monetary and fiscal policy in ending the Great Depression during 1939-41 must be guided by an explicit econometric model.

This paper advances the understanding of fiscal multipliers and of the role of policy in ending the Great Depression in several steps. We have developed a new quarterly data set back to 1919, estimated a new VAR model for 1920-41 using those data, decomposed the absolute and relative contributions of monetary and fiscal policy as explanations of the end of the Great Depression, and suggested a new framework for estimating fiscal multipliers for 1940-41. In addition, we provide new quarterly estimates of potential real GDP and of the output gap for the interwar period.

A new series for potential or natural real GDP (YN) is created using selected "benchmark" years during which Y is assumed to be equal to YN. The level of YN is then assumed to change between these benchmark years along a loglinear trend. The resulting trend run between benchmark years 1928 and 1950 implies that full recovery from the Great Depression occurred in the early part of the fourth quarter of 1941, roughly two months before Pearl Harbor. This date is somewhat earlier than full recovery dates used by other papers on this subject, which if anything should make this paper's results more biased against fiscal policy than the other papers, as military expenditures dramatically increased following the attack on Pearl Harbor. The relatively early date of full recovery is also consistent with evidence from contemporary media presented above in Part 3 implying that parts of the economy, particularly durable goods manufacturing, were straining at available capacity by mid-1941.

All testing in this 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. Our VAR model is run from 1920:Q2 to 1941:Q3, and post-sample simulations are conducted through 1941:Q4 by using the model to extend the series of innovations in the variables. In 1941:Q4, real GDP stood at 101.3 percent of potential real GDP compared with 78.1 percent in 1939:Q1, the date that this paper uses as the start of the recovery from the Great Depression. Therefore, this paper attempts to explain the 23.2 percent of YN increase in real GDP that occurred over this time period.

The results of this paper contradict the views of Romer (1992) and De Long and Summers (1988), who believe that fiscal policy did not meaningfully contribute to the recovery effort until 1942. This paper's new dataset, as well as contemporary evidence from 1940-41 editions of *Business Week*, *Fortune* and the *New York Times,* show that government spending as a percentage of potential output started to rise dramatically in 1940:Q3, five quarters before the recovery was complete and fully 18 months *before* Pearl Harbor. Romer recently defended her 1992 paper, stating that "My argument paralleled E. Cary Brown's famous conclusion that in the Great Depression fiscal policy failed to generate recovery, not because it does not work but because it was not tried" (Romer 2009, p.7).

While the new data agree with Romer that fiscal spending remained relatively flat throughout the 1930s, the Great Depression did not end until 1941:Q4.[51] The new dataset shows that during the prime recovery period between 1939:Q1 and 1941:Q4, the government spending percentage of potential output doubled, rising by 12.8 percent to 25.6 percent of YN. Therefore, it is unclear how Romer can claim that fiscal policy "was not tried." Also contradicted by this paper's findings is the implicit conclusion in Sims (1998) that monetary policy was impotent during the interwar period.

51. Romer (1992) actually had an even later date of full recovery that occurred sometime in 1942.

Instead, this paper's results are complementary to those of Vernon (1994) in finding that while both fiscal and monetary policy played a role in the recovery, fiscal policy was the dominant factor. By using VAR dynamic forecasting and allowing examining the effect of innovations to each variable individually, this paper's baseline result can be calculated: 89.1 percent of the 1939:Q1-1941:Q4 recovery can be attributed to fiscal policy innovations, 34.1 percent to monetary policy innovations and the remaining -23.2 percent to the combined effect of the basic VAR dynamic forecast and innovations in the non-government components of GDP (N), namely consumption, investment, and net exports. The paper attributes the negative innovations of N in the second half of 1941 to the capacity constraints described in Part 3.

The conclusion that fiscal policy dominated the recovery from the Great Depression is robust to alterations to the VAR specifications. In particular, the result remains intact in response to changes in the VAR time period, using the Monetary Base in place of the M1 Money Supply, adding the GDP deflator to the VAR model, redefining the variables as natural logs instead of percentages of YN, substituting in Ramey (2009) 1939:Q1-1941:Q4 data for G and N, and altering the ordering of the VAR variables in numerous ways.

Also consistent with Vernon (1994), this paper finds that the majority of the recovery up through 1940 can be explained by monetary policy innovations. In fact, monetary policy innovations had a greater impact on the recovery than fiscal policy innovations as late as 1940:Q4. However, when looking at the whole of the recovery from the Great Depression, 1939:Q1-1941:Q4, positive fiscal policy innovations related to WWII were the dominant factor despite their late appearance, with monetary policy innovations playing a supporting role.

This paper addresses the recent literature by using its VAR model to calculate fiscal multipliers. Instead of calculating multipliers simply as the change in GDP divided by the change in government spending over a particular interval, it subtracts from both numerator and denominator the prediction of the VAR model when all innovations are suppressed. Reflecting the evidence gathered here that the economy was operating under severe capacity constraints in the last half of 1941, the paper calculates two multipliers. The first, relevant for contemporary discussions of 2009-10, is based on changes in GDP and in government spending relative to the no-innovation VAR forecast of both variables over the period 1940:Q2 to 1941:Q2. This multiplier is 1.80, not far from the standard textbook result.

Beyond its statistical estimates of policy contributions and fiscal multipliers, this paper makes a unique contribution by reviewing the contemporary media for 1940-41. We document that the American economy went to war starting in June 1940, and we demonstrate that estimates of fiscal multipliers for 1940-41 are not relevant to situations like 2008-10 when there is ample excess capacity. The fiscal stimulus in 1940-41 was partly crowded-out not by any increase of interest rates, but rather by capacity constraints in critical areas of manufacturing that became increasingly acute in the second half of 1941. Previous studies of 1940-41 have been misled by the high 1941 unemployment rate into thinking that multipliers calculated from 1940-

41 can be applied to 2008-10. We show to the contrary that the 1941 economy was bifurcated, with excess capacity in its labor market but capacity constraints in many of the key manufacturing industries. Because of these capacity constraints, our fiscal multipliers are radically different, 0.88 compared with the aforementioned 1.80, when we extend our calculations to 1941:Q4 instead of stopping them in 1941:Q2.

The media citations presented here by themselves constitute a fascinating rebuttal to anyone who believes that World War II for the American economy began on December 7, 1941. Fully one percent of the American labor force was at work in February 1941 building army training camps for 1.4 million new draftees. During the year 1941 employment in ship-building, both to expand the U. S. Navy and to supply Lend-Lease aid to Britain, accounted for another one percent of the labor force. We find evidence that supply constraints were predicted as early as June 1941 to cause a radical near-term cutback in automobile production.

By July 1941, the American economy was in a state of perceived national emergency. We document a plea from the business-oriented *Fortune* magazine that the free enterprise system must now succumb to pervasive government controls, including price controls. We show in quarterly data not just that private consumption and investment actually declined in late 1941, but also we explain why. Shortages of steel prevented auto companies from satisfying demand, and shortages of aluminum needed for aircraft production suppressed civilian production. Macroeconomists have a lot to learn from the unprecedented events of 1940 and 1941, and this paper makes a substantial start toward a new level of understanding.

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Data Appendix by Source

Section 1: Monetary Policy Variables

- ***Source:*** NBER Macrohistory Database, Last modified April 10, 2008
  http://www.nber.org/databases/macrohistory/contents/

Interest Rate (Jan. 1919-Dec. 1951): Discount Rates, Federal Reserve Bank of New York, NBER Series 13009, X11 s.a.
Data Adjustments: Data are in monthly format. Quarterly data = average of monthly data by quarter.
Variable: R

M1 Money Supply (Jan. 1919-Jan. 1959):
Data for Jan. 1919-Dec. 1946. Ratio-linked to FRED data in Jan. 1959, see below:
U.S. Money Stock, Commerical Banks Plus Currency Held By Public, NBER Series 14144a, Seasonally adjusted (s.a.)
Data for Jan. 1947 to Jan. 1959. Ratio-linked to FRED data in Jan. 1959, see below:
U.S. Demand Deposits, Adjusted Time Deposits, All Commercial Banks, Plus Currency Held By the Public, NBER Series 14144c, s.a.
Variable: M1

- ***Source:*** Federal Reserve Bank of St. Louis – FRED. http://research.stlouisfed.org/fred2/

M1 Money Supply (Jan. 1959-Dec. 2008): M1 Money Stock, FRED Series M1SL. Last updated: 2/13/2009, s.a.
Data Adjustments: Series ratio-linked in January 1959 to M1 series from NBER Macrohistory Database cited above. The 1919-1959 series is ratio linked to the FRED data because we originally wanted a continuous series for M1 from 1919-2009, and multiplying the original data by a fixed ratio should not affect the results. Data are in monthly format. Quarterly data = average of monthly data by quarter.
Variable: M1

Monetary Base (Jan. 1918-Jan. 2009): St. Louis Adjusted Monetary Base, FRED Series AMBSL. Last updated: 2/20/2009, s.a.
Data Adjustments: Data are in monthly format. Quarterly data = average of monthly data by quarter.
Variable: MB

M1 Money Multiplier: Equals M1 Money Supply divided by the Monetary Base.
Variable: MM

Section 2: Real GDP, GDP Deflator and Real GDP Components

2a. Chow-Lin Interpolation of GDP Components Using Interpolators from the NBER Database

In order to increase the frequency of our database and thus the degrees of freedom in our regressions, this paper converts annual GDP component data into quarterly data using an interpolation procedure described in Chow and Lin (1971). Annual GDP component data are taken from the NIPA,[52] but as the NIPA dataset only begins in 1929, annual data for 1919-1928 are obtained by ratio-linking the 1929 NIPA data[53] to annual data[54] from Gordon and Veitch (1986).[55] The continuous annual time series from 1919-1941 are then transformed into monthly data from 1919:1-1941:12 using the Chow-Lin interpolation procedure.[56] The Chow-Lin process converts each annual series into a monthly series while maintaining the annual sum by regressing on related monthly series. The related monthly series are obtained from the NBER's Historical Statistics Database and are chosen based on their perceived relevance to the variable in question.[57] The goal is to select monthly series that have annual values highly correlated with the movements of the annual series over the 1919-1941 time period. For example, the related monthly series for the GDP Deflator are the monthly Consumer Price Index and the monthly Index of Wholesale Prices. The Chow-Lin interpolation process regresses the annual dependent variable (Y_{it}) on annualized forms of the monthly independent variables (the matrix X_{it}) and an *annual* error term (U_t):

$$Y_{it} = X_{it}\beta + U_t \quad (1)$$[58]

The *monthly* errors (u_t) in each interpolation are assumed to follow an AR(1) process, which makes the first autocorrelation (ρ_A) of U_t related to the monthly autocorrelation coefficient (ρ_M). By solving the system of equations and performing an iterative GLS procedure to obtain estimates of β and ρ_M, monthly estimates for the dependent variable can be calculated using the formula:

$$\hat{y}_{it} = x_{it}\hat{\beta} + \hat{\rho}_M \hat{u}_{t-1} \quad (2)$$

This interpolation process is repeated for each of the nine real GDP components, and the related monthly series used to interpolate each annual series are identified in the table on the next page. Following the advice of Gordon and Veitch (1986), different sets of monthly interpolators are used for each component of GDP, "in order to avoid a spurious correlation between the dependent and explanatory variables" when performing the statistical tests (287).

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[52] Individual annual GDP component sources are described in Section 2b below.

[53] The value for 19xx = G-V's 19xx value multiplied by (NIPA 1929 value / G-V 1929 value).

[54] G-V's dataset consists of annualized quarterly data. Annual data equals the sum of the quarterly data divided by 4.

[55] G-V's data for 1919-1928 is sourced primarily from Swanson and Williamson (1971) along with other sources described in the G-V Data Appendix.

[56] This process was done in the statistical software program RATS using the procedure Chowlin; specific code is available upon request.

[57] Related monthly series were also chosen so that they could be made into a continuous strand from 1919:1-1951:12.

[58] For a more complete and technical description of the complex formulas and statistics that go into the Chow-Lin process, see Chow and Lin (1971).

For testing purposes, the monthly data are aggregated into quarterly data to smooth out any monthly anomalies and thus create a more reliable dataset.

GDP components for 1942:1-1951:12 (not directly used in the paper) are obtained by repeating the above procedure over the entire 1919-1951 span. The 1919:1-1941:12 data are run separately in order to avoid having the Chow-Lin procedure's smoothing parameter affect the data for the second half of 1941, a crucial period for our study.[59] For example, as real investment is severely depressed in early-1942, when the Chow-Lin procedure is run over the entire 1919-1951 period the data for late-1941 is also depressed because of the smoothing mechanism. This is not what the monthly interpolators indicate actually happened to real investment in late-1941 and thus we cut off the Chow-Lin procedure in 1941:12 to avoid this issue.

Gordon and Veitch (1986) also use the Chow-Lin procedure to interpolate quarterly GDP components for the interwar period. However, our new dataset goes beyond theirs in several ways. Two of the new dataset's major improvements are extending the time series out to 1951 for comparison purposes[60] and utilizing more monthly interpolating variables. Our 1951:Q4 end-date, as opposed to 1941:Q4 in Gordon-Veitch, allows for a comparison with the official BEA quarterly data during the five-year overlap period that starts in 1947:Q1. The new quarterly estimates can be 'tested' against those of the BEA for the period 1947:Q1-1951:Q4 and indeed the interpolated variables match up very well, with an average correlation coefficient for the 12 comparable series equal to 93.1%.[61] The new data also compare favorably over the crucial period 1939:Q1-1941:Q4 to an independently developed quarterly dataset for GDP components created by Ramey (2009) (see Figure 2). The main differences between the new dataset and that of Gordon and Veitch are described below and on the following page.

Gordon and Krenn (2009) vs. Gordon and Veitch (1986)

	G&K (2009)	G&V (1986)
Interpolation End-Date	1951:Q4	1941:Q4
Number of Interpolators Used	29	14
Separation of Cons. Nondurables and Services?	Yes	No
Comparison to BEA Quarterly Data?	Yes	No

[59] The only series where 1919:1-1941:12 data comes from the Chow-Lin process run over the entire 1919-1951 period is the GDP Deflator.

[60] Note the data used in the paper comes from the 1919:1-1941:12 interpolation, not the 1919:1- 1951:12 interpolation described here.

[61] Comparisons to BEA quarterly data 1947:Q1-1951:Q4 are done with interpolations based on $2000 annual variables to be more similar to the $2000 BEA quarterly data. Comparison testing was not done for $1937 because no official $1937 quarterly data exist, but interpolations based on $1937 annual variables follow the same interpolated trends as the $2000 annual variables.

Variables Used in Chow-Lin Interpolation

Variable Interpolated	Time Period Interpolated	Independent Series in Interpolation
1. Real GDP		Sum of Components
1A. GDP Deflator	1/17-12/41	*C T CPI WPI*
2. Real Consumer Durables	1/19-12/41	*C T IPDM ORDDUR*
3. Real Consumer Nondurables	1/19-12/41	*C T COAL DPTSLS FOOD GROC PAP POW*
4. Real Consumer Services	1/19-12/41	*C T BUS DPTSLS GROC IIPT*
5. Investment, Real Producers' Durable Equipment	1/19-12/41	*C T EMPD IIPT IPDM*
6. Investment, Real Residential	1/19-12/41	*C T RCONSTR RCONT RFLOOR RNUM RVAL*
7. Investment, Real Nonresidential Structures	1/19-12/41	*C T NRCONSTR NRCON NRFLOOR NRVAL*
8. Real Change in Business Inventories	Smoothed into monthly data using sliding weights	
9. Real Government Expenditures	1/19-12/41	*C T GOV*
10. Real Exports	1/19-12/41	*C T EXP*
11. Real Imports	1/19-12/41	*C T IMP*

** See Below for description of abbreviations.

- ***Source:*** NBER Macrohistory Database, Last modified May 17, 2001
  http://www.nber.org/databases/macrohistory/contents/

Monthly Interpolators:

BUS = Index of the Physical Volume of Business Activity, Babson, NBER Series 01001, X11 seasonally adjusted (s.a.)

C = Constant term used the regression

COAL = Bituminous Coal Production, NBER Series 01118, X11 s.a.
Data Adjustment: In original series, April 1946 is set to 46.1 from 6.1 to correct for a probable typo.

CPI = Consumer Price Index, All Items Less Food, NBER Series 04052, X11 s.a.

DPTSLS = Index of Department Store Sales, NBER Series 06002b, X11 s.a.

EMPD = Index of Factory Employment, Total Durable Goods, NBER Series 08146a and 08146c, X11 s.a.
Data Adjustment: Series ratio linked in Jan. 1939

EXP = Total Exports, NBER Series 07023, X11 s.a.
Data Adjustment: Changed to real terms by dividing by X-Deflator/100

FOOD = Index of Production of Manufactured Food Products, NBER Series 01260b, s.a.

FREIGHT = Freight Car Shipments, Domestic, NBER Series 01149, X11 s.a.

GOV = Federal Budget Expenditures, Total, NBER Series 15005b through 15005f, X11 s.a.
Data Adjustment: Changed to real terms by dividing by G-Deflator/100. Series ratio linked in Jan. 1932, July 1937, July 1939, and July 1945.

A problem arises in this series because it includes not just G but also transfer payments, which are excluded when calculating GDP. The monthly interpolator series is distorted by particularly large transfer payments in scattered quarters. To find these quarters, we calculated the monthly log change in the interpolator, after changing the data to real terms and X11 s.a. Whenever a monthly change of +40 percent or more was followed by a monthly change of approximately the same amount with a negative sign, we replaced that "bulge" observation by the average of the preceding and succeeding months. These bulges occurred and were corrected for in 4 months: 1931:12, 1934:01, 1936:06, and 1937:06. Because the interpolation procedure forces the sum of the monthly values to equal the annual value, this approximation has no effect on the annual values of the monthly or quarterly series of G.

GROC = Sales by Grocery Chain Stores, NBER Series 06008a and 06008b, X11 s.a.
Data Adjustment: Series ratio linked in Jan. 1935

IIPT = Index of Industrial Production and Trade, NBER Series 12004c, s.a.

IMP = Total Imports, NBER Series 07028, X11 s.a.
Data Adjustment: Changed to real terms by dividing by IM-Deflator/100

IPDM = Index of Production of Durable Manufactures, NBER Series 01234b, s.a.

IPM = Index of Production of Manufacturers, Total, NBER Series 01175, X11 s.a.

NRCONT = Total Building Contracts, Engineering News-Record, Original Data, NBER Series 02003, X11 s.a.
Data Adjustments: Changed to real terms by dividing by I-Nonresidential Structures Deflator/100.

NRCONSTR = Total Construction, Value, Engineering News-Record, Original Data, NBER Series 02003, X11 s.a.
Data Adjustments: Changed to real terms by dividing by I-Nonresidential Structures Deflator/100.

NRFLOOR = Total Nonresidential Building Contracts, Floor Space, F.W. Dodge Corp., NBER Series 02178a and 02178c, X11 s.a.
Data Adjustment: Series ratio linked in Jan. 1925

NRVAL = Total Nonresidential Building Contracts, Value, F.W. Dodge Corp., NBER Series 02177a and 02177c, X11 s.a.
Data Adjustments: In original series, May 1951 is set to 631 from 1631 to correct for a probable typo. Changed to real terms by dividing by I-Nonresidential Structures Deflator/100. Series ratio linked in Jan. 1925.

ORDDUR = U.S. Manufacturers' New Orders of Durable Goods, NBER Series 06084a, 06084b, 06084c, and 06091, X11 s.a.
Data Adjustments: In original series 06084b, Aug. 1945 set equal to average of July and Sept. 1945 to correct for a probable typo. In original series 06091, values for 1919 (all months) set equal to value of Jan. 1920 to complete series. Series 06084b and 06084c changed to real terms by dividing by C-Durable Goods Deflator/100. Series ratio linked in Jan. 1929, Jan. 1939, and Jan. 1947.

PAP = Index of Paper and Pulp Production, NBER Series 01259, X11 s.a.

POW = Electric Power Production, NBER Series 01128 and 01128a, X11 s.a.
Data Adjustment: Series ratio linked in Jan. 1936

PWEM = Production Worker Employment, Manufacturing, Total, NBER Series 08010, X11 s.a.

RCONT = Total Building Contracts, Engineering News-Record, Original Data, NBER Series 02003, X11 s.a.
Data Adjustments: Changed to real terms by dividing by I-Residential Deflator /100.

RCONSTR = Total Construction, Value, Engineering News-Record, Original Data, NBER Series 02003, X11 s.a.
Data Adjustments: Changed to real terms by dividing by I-Residential Deflator/100.

RFLOOR = Total Residential Building Contracts, Floor Space, F.W. Dodge Corp., NBER Series 02012a and 02012c, X11 s.a.
Data Adjustment: Series ratio linked in Jan. 1925

RNUM = Total Residential Building Contracts, Number of Buildings, F.W. Dodge Corp., NBER Series 02013a and 02013c, X11 s.a.
Data Adjustment: Series ratio linked in Jan. 1925

RVAL = Total Residential Building Contracts, Value, F.W. Dodge Corp., NBER Series 02011a and 02011c, X11 s.a.
Data Adjustments: Changed to real terms by dividing by I-Residential Deflator/100.
Series ratio linked in Jan. 1925

T = Trend term appearing in the regression

WPI = Index of Wholesale Prices, NBER Series 04048c, X11 s.a.

NBER Macrohistory Database Notes:
- All monthly interpolator series are set to 1/1919 = 100 except CPI and WPI, which were set to 1/1917 = 100 (these two extra years for YDEF allow for inflation calculations if need be).
- All monthly interpolator series cover the timespan 1919:01-1951:12 except CPI and WPI, which cover 1917:01-1951:12.
- s.a. = already seasonally adjusted in NBER Macrohistory Database.
- X11 s.a. = seasonally adjusted via the X11 seasonal adjustment program in RATS.

2b. Annual Variables from BEA and Earlier Data Sources: 1919-1951

Note: We debated between using $1937, $1952, and $2005 for the annual 1919-1951 data. We settled on $1937 (except Figure 1 which uses $2005 for comparison's sake) because we wanted to be able to set 'GDP = sum of components' with the smallest residual possible. See table below:

Average Abs. Value of Residual / GDP

Time Period	$1937	$1952	$2005
1919-1929	1.5%	7.5%	3.4%
1929-1939	1.3%	4.2%	4.9%
1939-1945	1.0%	2.4%	15.3%
1945-1951	4.6%	0.1%	4.2%
1919-1941	1.3%	5.7%	4.4%
1919-1951	2.0%	4.1%	6.1%

$1937 has the lowest absolute value of the residual as a percentage of GDP for 3 of the 4 time periods. Most importantly, it has the smallest residual for the time periods this paper is concentrated on: 1939-1945 and 1919-1941. Thus all values in this paper are expressed in billions of $1937.

- ***Source:*** Bureau of Economic Analysis (BEA): http://bea.gov/index.htm

Real GDP: Billions of chained $1937. Sum of interpolated GDP components: CD + CND + CS + IPDE + IRES + INRES + BUSINV + G + X – IM.
Data Adjustments: Data from 1913:Q1-1918:Q4 is from Gordon-Veitch variable RGNP72, ratio linked in 1919:Q1 to sum of interpolated GDP components as described above. Data from 1952:Q1 to 1954:Q4 is from the NIPA Table 1.1.6B, Line 1: GDP minus Line 25: Residual, last revised 3/19/04. This series has been reverse ratio linked in 1951:Q4 to sum of interpolated GDP components as described above.
Variable: Y

GDP Deflator: NIPA Table 1.1.9, last revised 12/23/08. Index numbers, 1937=100.
Data Adjustments: Ratio linked to Gordon-Veitch (1986) variable GNPDEF in 1929. Changed from 2000=100 to 1937=100 by multiplying by 100 divided by the 2000=100 1937 value. Annual data multiplied by 12 to keep Chow-Lin interpolated monthly data as 1937=100.
Chow-Lin Interpolated Variable: YDEF

Personal Consumption Expenditures (C)-Durable Goods: NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustments: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable CDUR72 in 1929.
Chow-Lin Interpolated Variable: CD

C-Nondurable Goods: NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustments: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable CNDUR72 in 1929 multiplied by the 1929 ratio of C-Nondurable Goods to C-Nondurable Goods and Services.
Chow-Lin Interpolated Variable: CND

C-Services: NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustments: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable CNDUR72 in 1929 multiplied by the 1929 ratio of C-Services to C-Nondurable Goods and Services.
Chow-Lin Interpolated Variable: CS

C-Durable Goods Deflator: NIPA Table 1.1.9, last revised 12/23/08. Index numbers, 2000=100.
Data Adjustments: Ratio linked to Gordon-Veitch (1986) variable CDURDEF in 1929. Monthly deflator obtained by setting annual values = July values. Other months obtained by yearly log-linear interpolation.

Gross Private Domestic Investment (I)-Nonresidential Equipment and Software: NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustments: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable PRODUR72 in 1929.
Chow-Lin Interpolated Variable: IPDE

I-Residential: NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustments: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable IRES72 in 1929.
Chow-Lin Interpolated Variable: IRES

I-Nonresidential Structures: NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustments: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable NONRES72 in 1929.
Chow-Lin Interpolated Variable: INRES

I-Residential Deflator: NIPA Table 1.1.9, last revised 12/23/08. Index numbers, 2000=100.
Data Adjustments: Ratio linked to Gordon-Veitch (1986) variable IRESDEF in 1929. Monthly deflator obtained by setting annual values = July values. Other months obtained by yearly log-linear interpolation.

I-Nonresidential Structures Deflator: NIPA Table 1.1.9, last revised 12/23/08. Index numbers, 2000=100.
Data Adjustments: Ratio linked to Gordon-Veitch (1986) variable NONRESDF in 1929. Monthly deflator obtained by setting annual values = July values. Other months obtained by yearly log-linear interpolation.

I-Change in Private Inventories: NIPA Tables 1.1.6A and 1.1.6B, last revised 3/19/04. Billions of chained $1937.
Data Adjustments: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Data for 1919-1928 is from Gordon-Veitch (1986) variable DBUSI72. This was changed to real $1937 terms by multiplying the value by the average 1929 value of Gordon-Veitch variable GNPDEF

divided by the 1929 value of YDEF. Annual data smoothed to monthly data using sliding weights and dividing by 12 (note: 1918 value assumed to be 0):

Weights on Annual Data by Month

	t-1	t	t+1
Jan	11/24	13/24	0
Feb	3/8	5/8	0
Mar	7/24	17/24	0
Apr	5/24	19/24	0
May	1/8	7/8	0
June	1/24	23/24	0
July	0	23/24	1/24
Aug	0	7/8	1/8
Sept	0	19/24	5/24
Oct	0	17/24	7/24
Nov	0	5/8	3/8
Dec	0	13/24	11/24

Variable: BUSINV

Government Consumption Expenditures and Gross Investment (G): NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustment: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable GOVPUR72 in 1929.
Chow-Lin Interpolated Variable: G

G-Deflator: NIPA Table 1.1.9, last revised 12/23/08. Index numbers, 2000=100.
Data Adjustments: Ratio linked to Gordon-Veitch (1986) variable GOVPURDF in 1929. Monthly deflator obtained by setting annual values = July values. Other months obtained by yearly log-linear interpolation.

Imports (IM): NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustment: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable MPT72 in 1929.
Chow-Lin Interpolated Variable: IM

Exports (X): NIPA Table 1.1.6A, last revised 3/19/04. Billions of chained $1937.
Data Adjustment: Reverse ratio linked to NIPA Table 1.1.6B (last updated 3/19/04) in 1947 to extend the series (in chained $1937) out to 1951. Ratio linked to Gordon-Veitch (1986) variable XPT72 in 1929.
Chow-Lin Interpolated Variable: X

IM-Deflator: NIPA Table 1.1.9, last revised 12/23/08. Index numbers, 2000=100.
Data Adjustments: Ratio linked to Gordon-Veitch (1986) variable MPTDEF in

1929. Monthly deflator obtained by setting annual values = July values. Other months obtained by yearly log-linear interpolation.

X-Deflator: NIPA Table 1.1.9, last revised 12/23/08. Index numbers, 2000=100.
Data Adjustments: Ratio linked to Gordon-Veitch (1986) variable XPTDEF in 1929. Monthly deflator obtained by setting annual values = July values. Other months obtained by yearly log-linear interpolation.

BEA Notes:

- See Table 1 for specific Chow-Lin interpolators used for each variable.
- All annual series are 1919-1951 except YDEF, which is 1917-1951 to allow for the possible inflation calculations.
- It doesn't matter that all deflators (except the GDP Deflator) are 2000=100 because they are only used to change some of the interpolators into real terms, and the interpolators are all set to 1919=100.

- ***Source:*** Gordon, Robert J. and John M. Veitch (1986). "Fixed Investment in the American Business Cycle, 1919-83," in Robert J. Gordon, ed., The American Business Cycle: Continuity and Change (University of Chicago Press for NBER, 1986), pp. 267-335. Data below from the quarterly data. http://www.nber.org/data/abc/.

Note: This data is used to extend our annual series back to 1919 (1917 for YDEF), see above for specific series details.

CDUR72 = Consumption Durable Goods, $1972
CDURDEF = Consumption Durable Goods, Deflator
CNDUR72 = Nondurable Goods and Services, $1972
DBUSI72 = Change in Business Inventories, $1972
GNP = Nominal GNP
GNPDEF = GNP Deflator ($1972=100)
GOVPUR72 = Government Purchases, $1972
GOVPURDF = Government Purchases, Deflator
IRES72 = Investment Residential Structures, $1972
IRESDEF = Investment Residential Structures, Deflator
MPT72 = Imports, $1972
MPTDEF = Imports, Deflator
NONRES72 = Non-Residential Structures, $1972
NONRESDF = Non-Residential Structures, Deflator
PRODUR72 = Producers Durable Equipment, $1972
RGNP72 = Real GNP, $1972
XPT72 = Exports, $1972
XPTDEF = Exports, Deflator

Gordon-Veitch Note: Data changed to annual terms needed for interpolation by summing quarterly data and dividing by four.

Section 3. Calculation of Sum of Components Potential Real GDP (YN): 1913:Q3-1954:Q4

Following the rational of Gordon (2008) pp. 7-8, the years 1913, 1928, 1950 and 1954 were chosen as "benchmark" years, as in these years it is assumed that sum of components real GDP is roughly equal to sum of components potential real GDP. These years were chosen such that the economy was "neither in a recession nor in an unsustainable peacetime or wartime boom" (8). This paper adds 1924 as an additional benchmark year after examining a study of capacity utilization found in Lazonick (2002). Between these years, it is assumed that sum of components potential real GDP grows at a constant exponential rate, in order to avoid the distortion caused by the two world wars and the Great Depression. The exponential quarterly growth rates g_i are calculated with the formula:

$$g_i = \ln(x_t / x_{t-n}) / n$$

where i = (1 for 1913-24, 2 for 1924-28, 3 for 1928-50, and 4 for 1950-54), x_t = the annual sum of components real GDP for the benchmark year, and n = the number of quarters between the benchmark years. For example, n = 44 for 1913-1924.

The sum of components potential real GDP series starts in 1913:Q3. 1913:Q3 = $(x_{1913} / 4)* \exp(g_1 / 2)$. Subsequent quarters' values until 1924:Q3 are equal to the previous quarters' values multiplied by $\exp(g_1)$.

1924:Q3's value = (1924:Q2's value)*$\exp((g_1 + g_2) / 2)$. Subsequent quarters' values until 1928:Q3 are equal to the previous quarters' values multiplied by $\exp(g_2)$.

1928:Q3's value = (1928:Q2's value)*$\exp((g_2 + g_3) / 2)$. Subsequent quarters' values until 1950:Q3 are equal to the previous quarters' values multiplied by $\exp(g_3)$.

1950:Q3's value = (1950:Q2's value)*$\exp((g_3 + g_4) / 2)$. All subsequent quarters' values are equal to the previous quarters' values multiplied by $\exp(g_4)$.

Section 4. Real Compensation per Hour and Total Economy Productivity: 1933-1941

- ***Source:*** Bureau of Economic Analysis (BEA): http://bea.gov/index.htm

Nominal Compensation of Employees, Paid (NCOMP): NIPA Table 1.10, last revised 4/29/09.

GDP Deflator (YDEF): NIPA Table 1.1.9, last revised 4/29/09.

Real GDP (RY): Billions of $1937. NIPA Table 1.1.6A, last revised 3/19/04.

- ***Source:*** Kendrick, John W. (1961). *Productivity trends in the United States.* General Series 71, National Bureau of Economic Research. Princeton, N.J.: Princeton University Press.

Total Man-hours Including Government (H): Table A-X p. 313

- ***Calculations:***

Real Compensation of Employees, Paid (RCOMP): Equals 100*(NCOMP / YDEF)

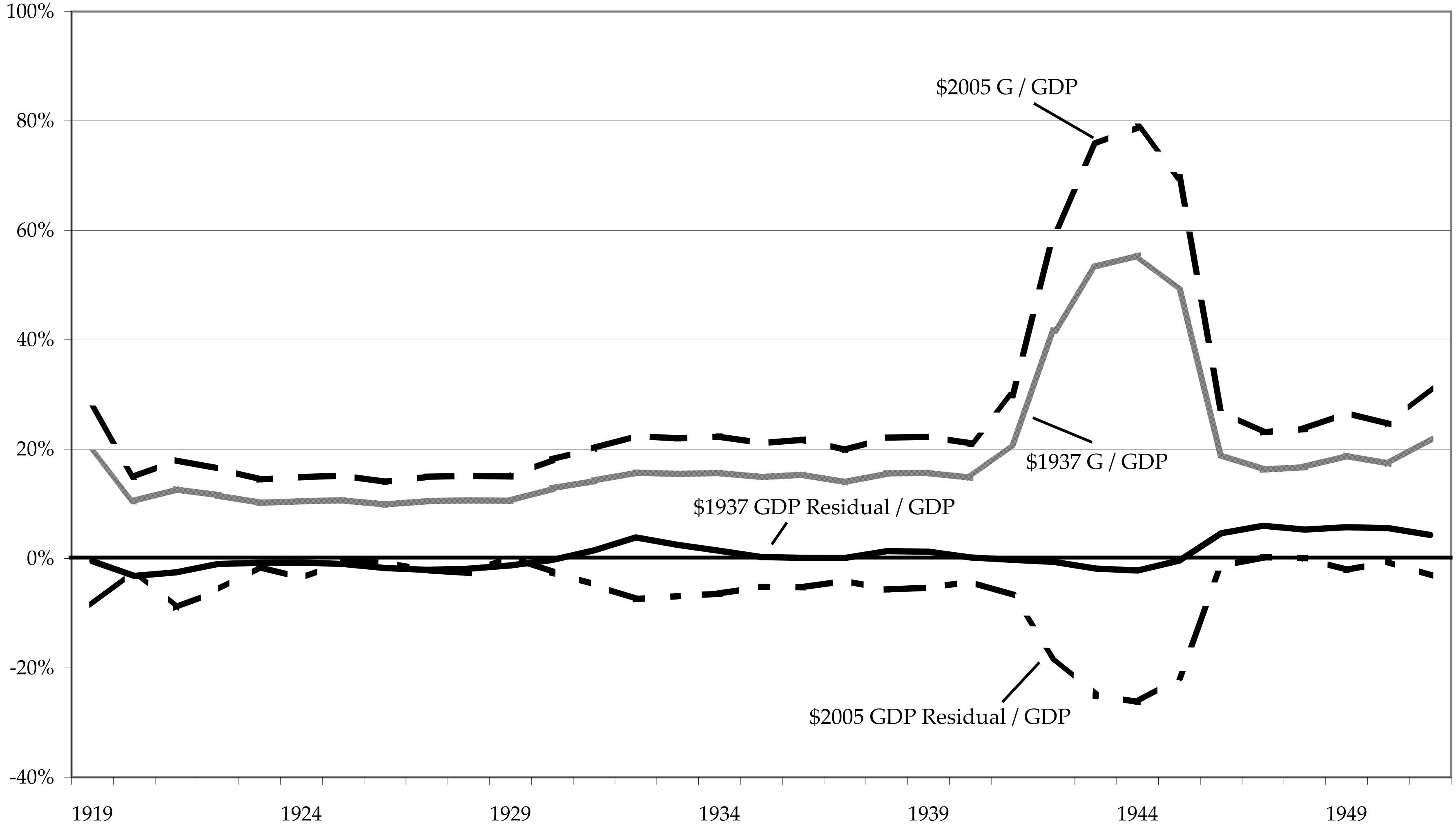
Real Compensation per Hour: Equals RCOMP / H.

Total Economy Productivity: Equals RY / H.

Section 5. Figure 1 Source ($2005 data)

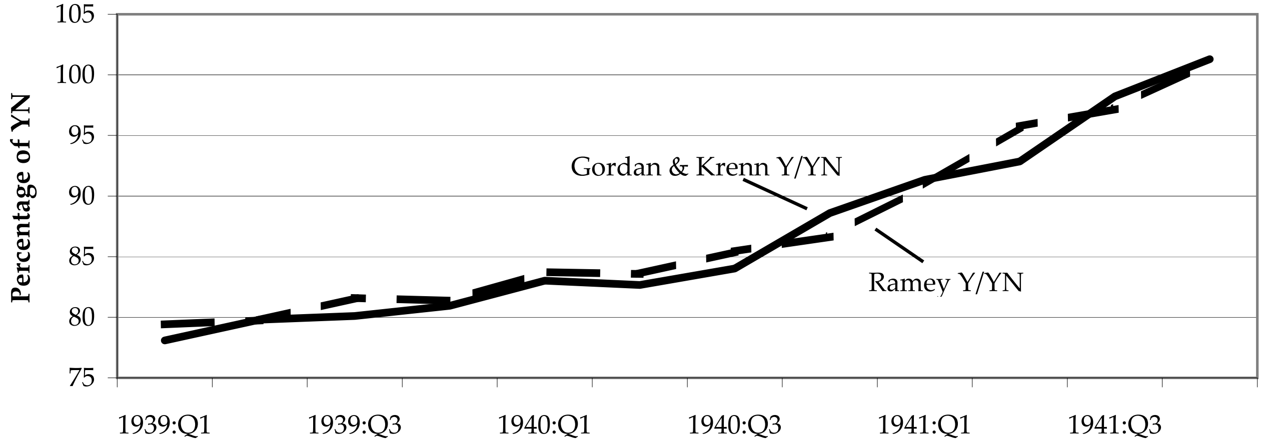
1919-1929 annual data from Balke and Gordon (1989), ratio-linked in 1929 to annual data from BEA NIPA Table 1.1.6 (last revised 8/27/10)

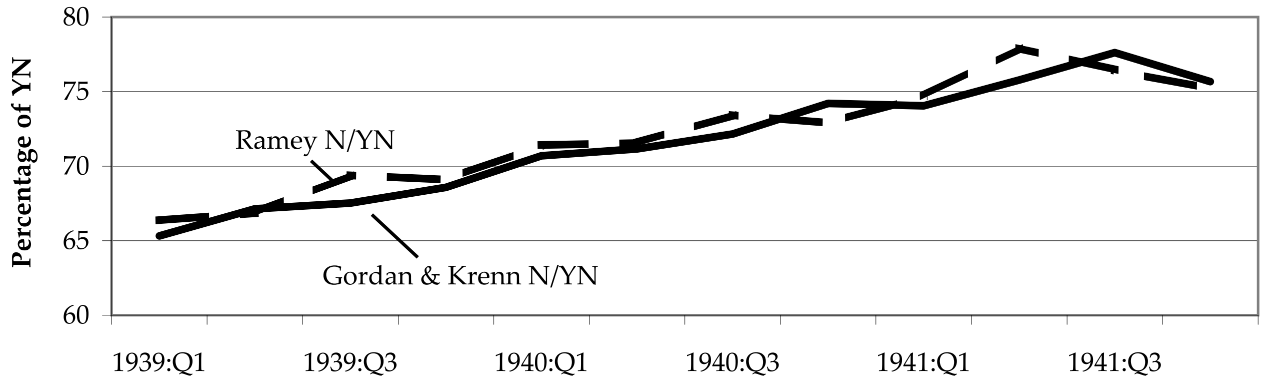
Figure 1: $1937 vs. $2005 Comparison for GDP Residual / GDP and G / GDP: 1919-1951



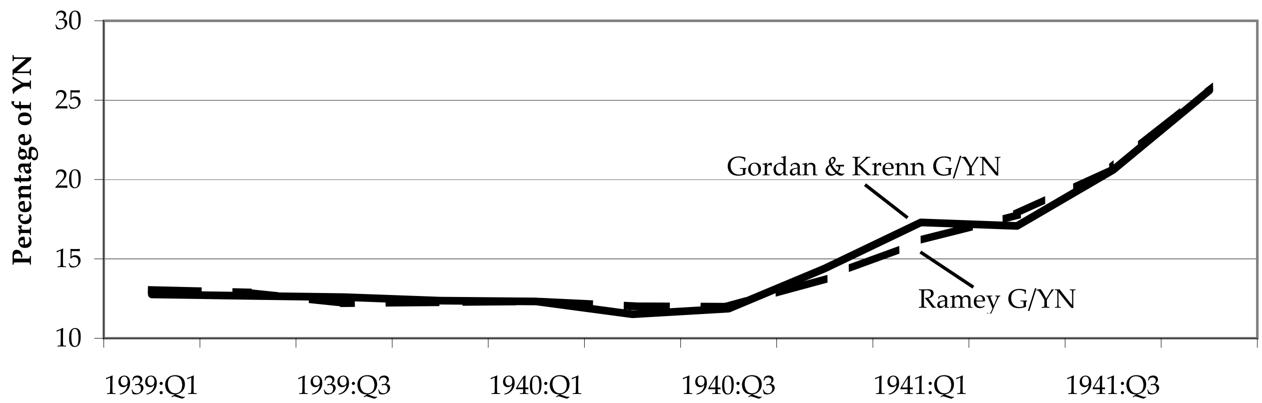
Source: See Data Appendix

Figure 2: Comparison of Newly Interpolated Dataset to Data from Ramey (2009), 1939:Q1-1941:Q4*



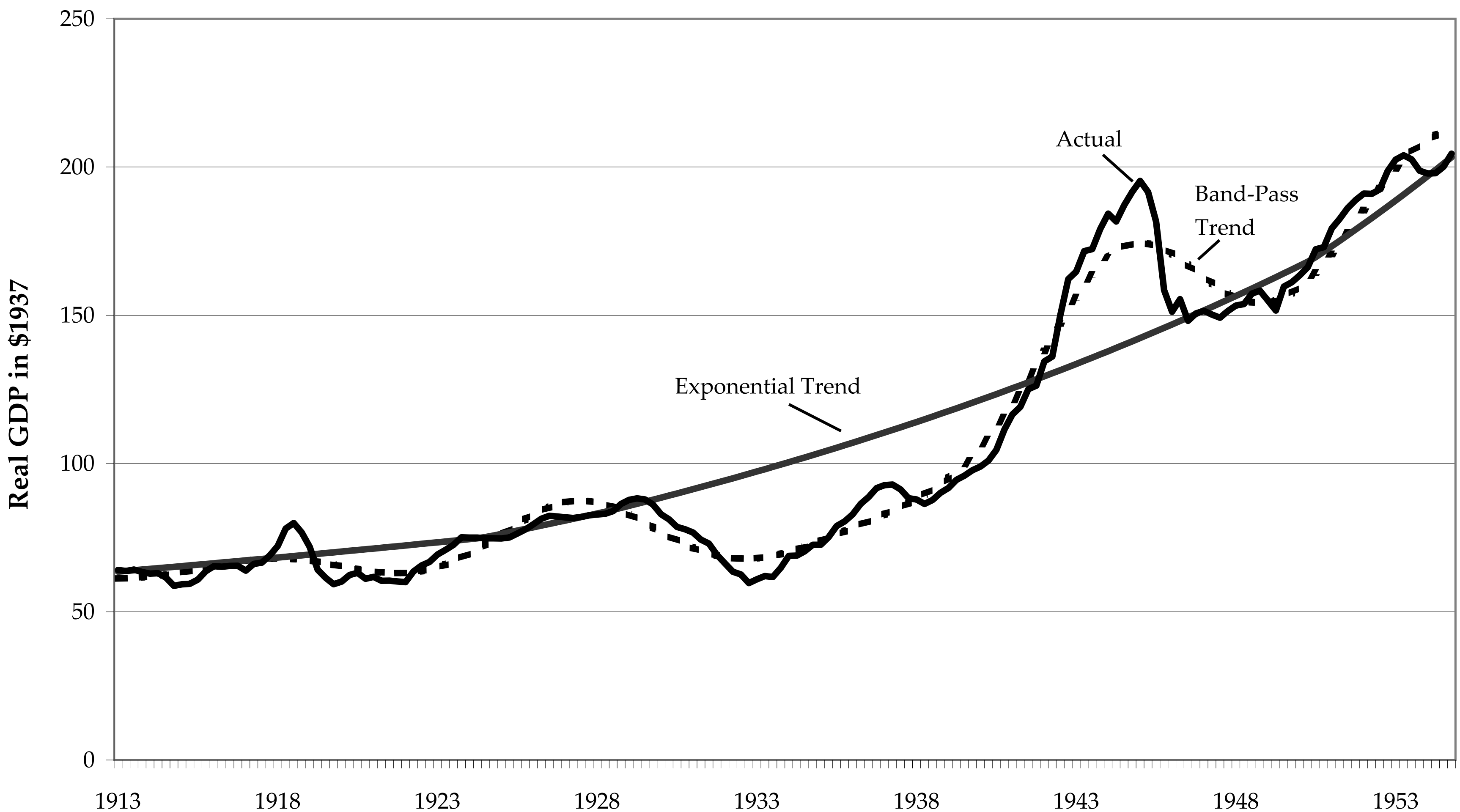


* N = Real GDP (Y) minus Real Government Spending (G)



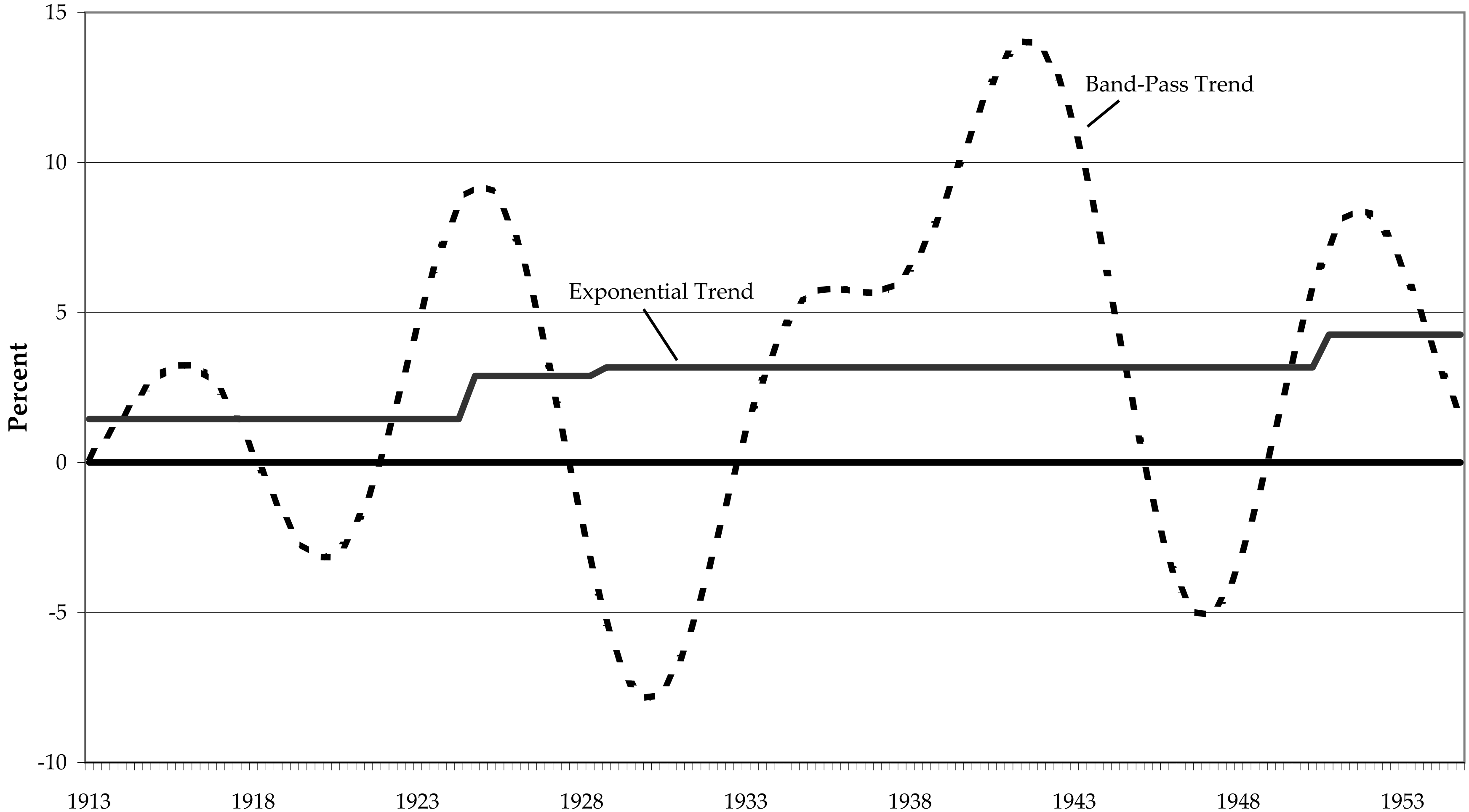
Source: See Data Appendix

Figure 3: Real GDP in $1937, Actual and Two Trends, Band-Pass Filtered and Exponential-through-Benchmarks, 1913-54



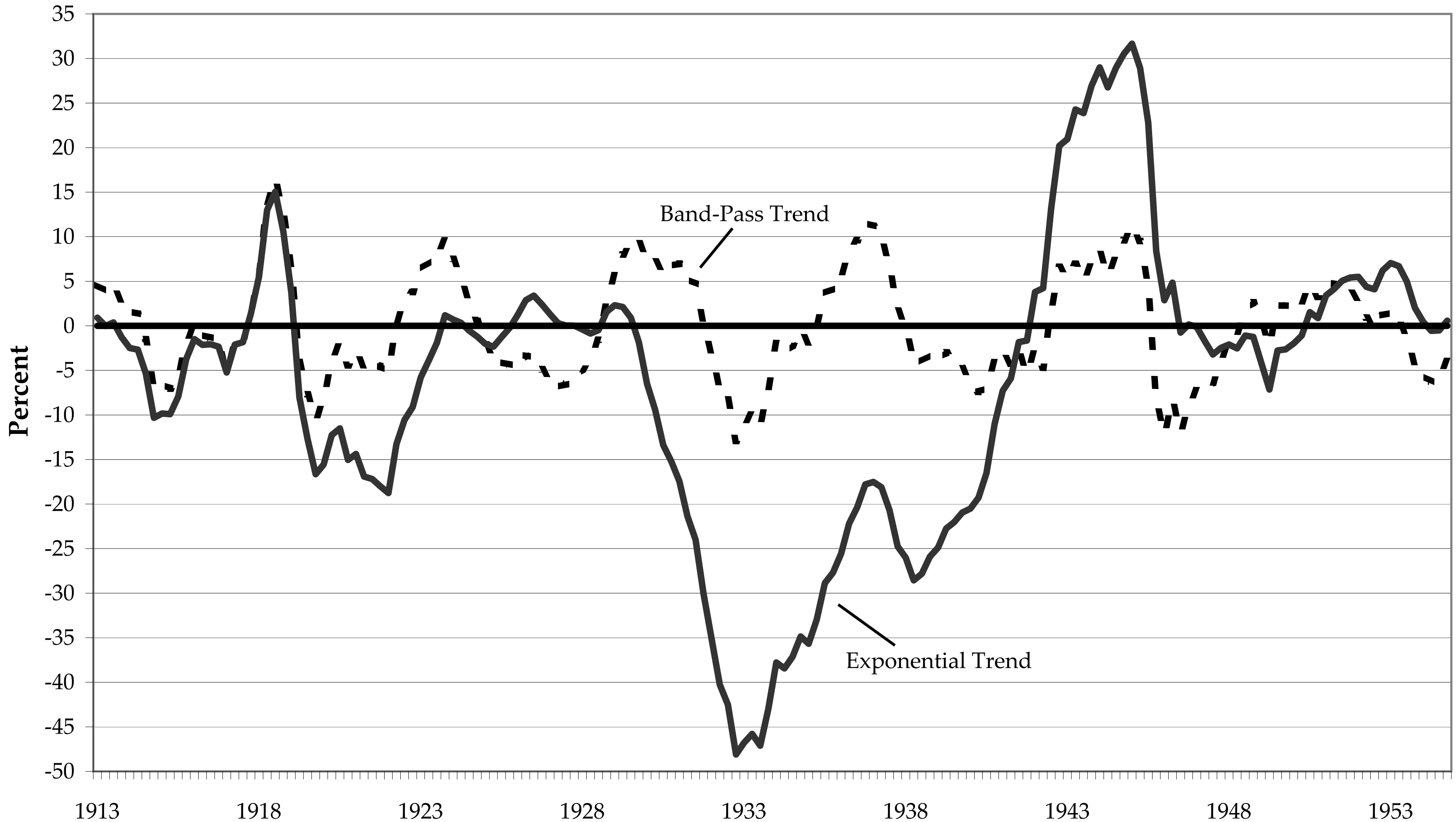
Source: See Data Appendix

Figure 4: Annual Rates of Change of Band-Pass Filtered and Exponential-through-Benchmarks Estimates of Real GDP, 1913-54



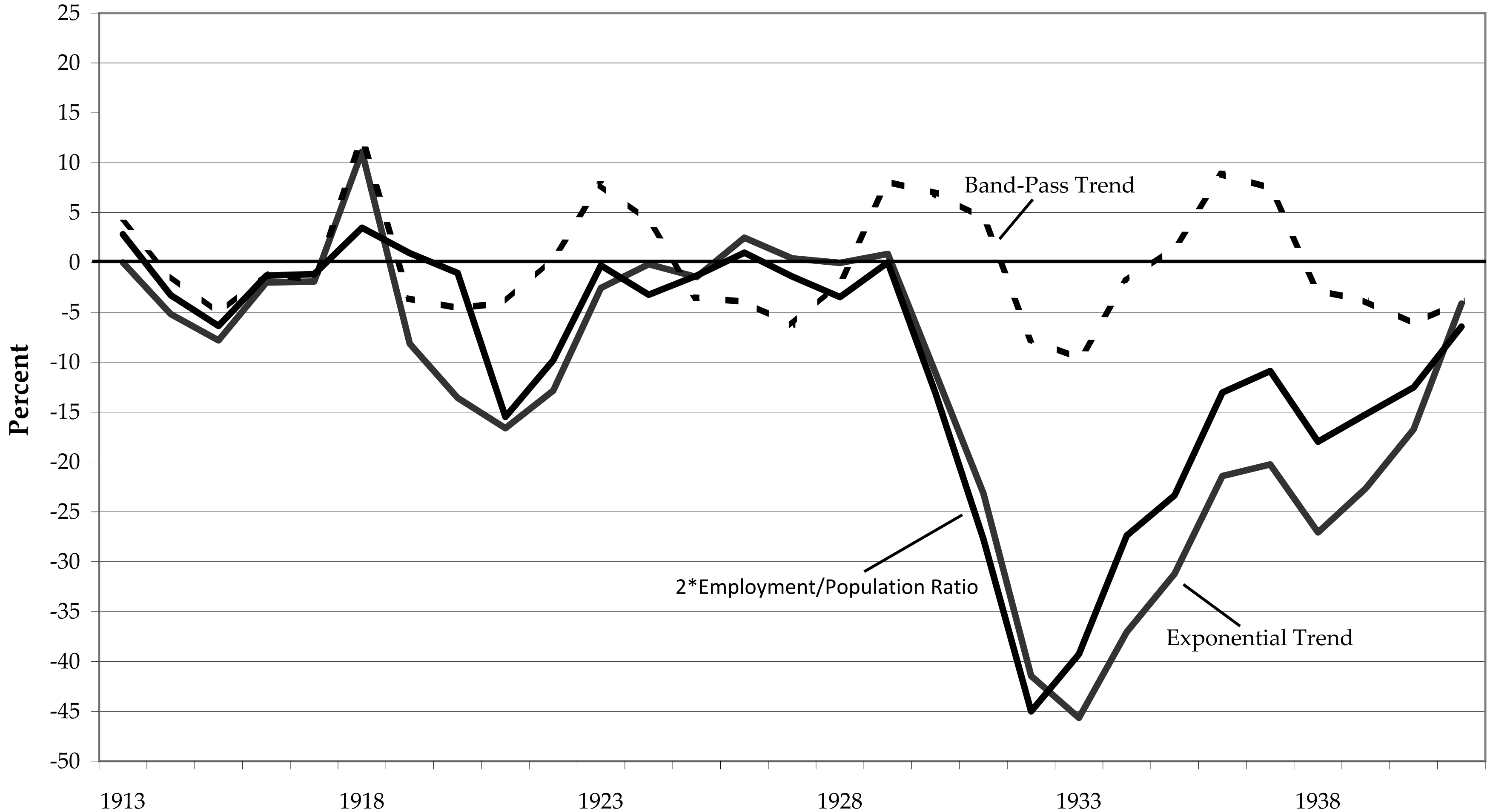
Source: See Data Appendix

Figure 5: Percent Log Ratio of Actual to Trend Real GDP, Band-Pass Filtered and Exponential-through-Benchmarks, 1913-54



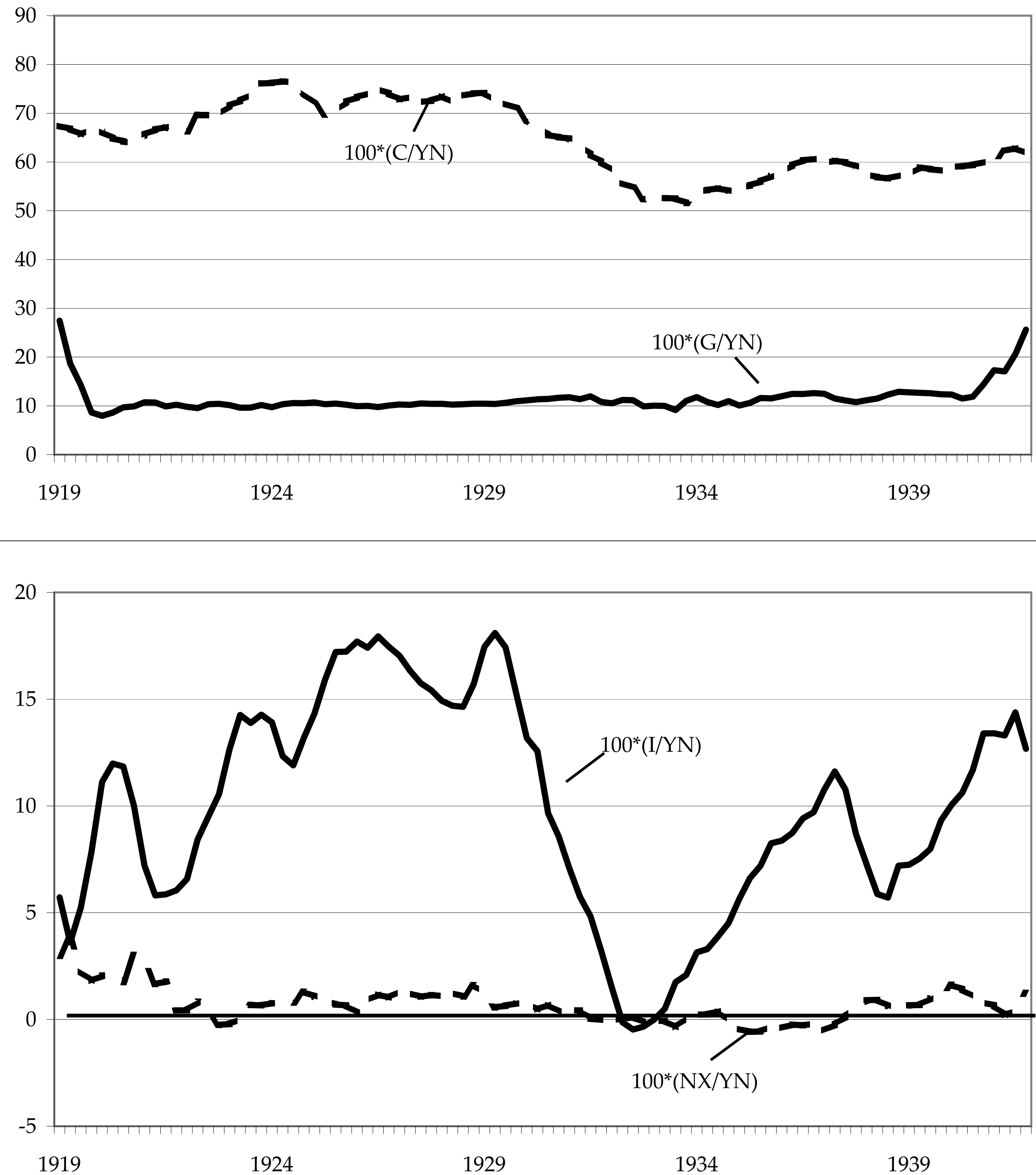
Source: See Data Appendix

Figure 6: Percent Log Ratio of Actual to Trend Real GDP, Band-Pass Filtered and Exponential-through-Benchmarks and Twice the Percent Log of the Employment/Population Ratio (1929=1), Annual, 1913-41



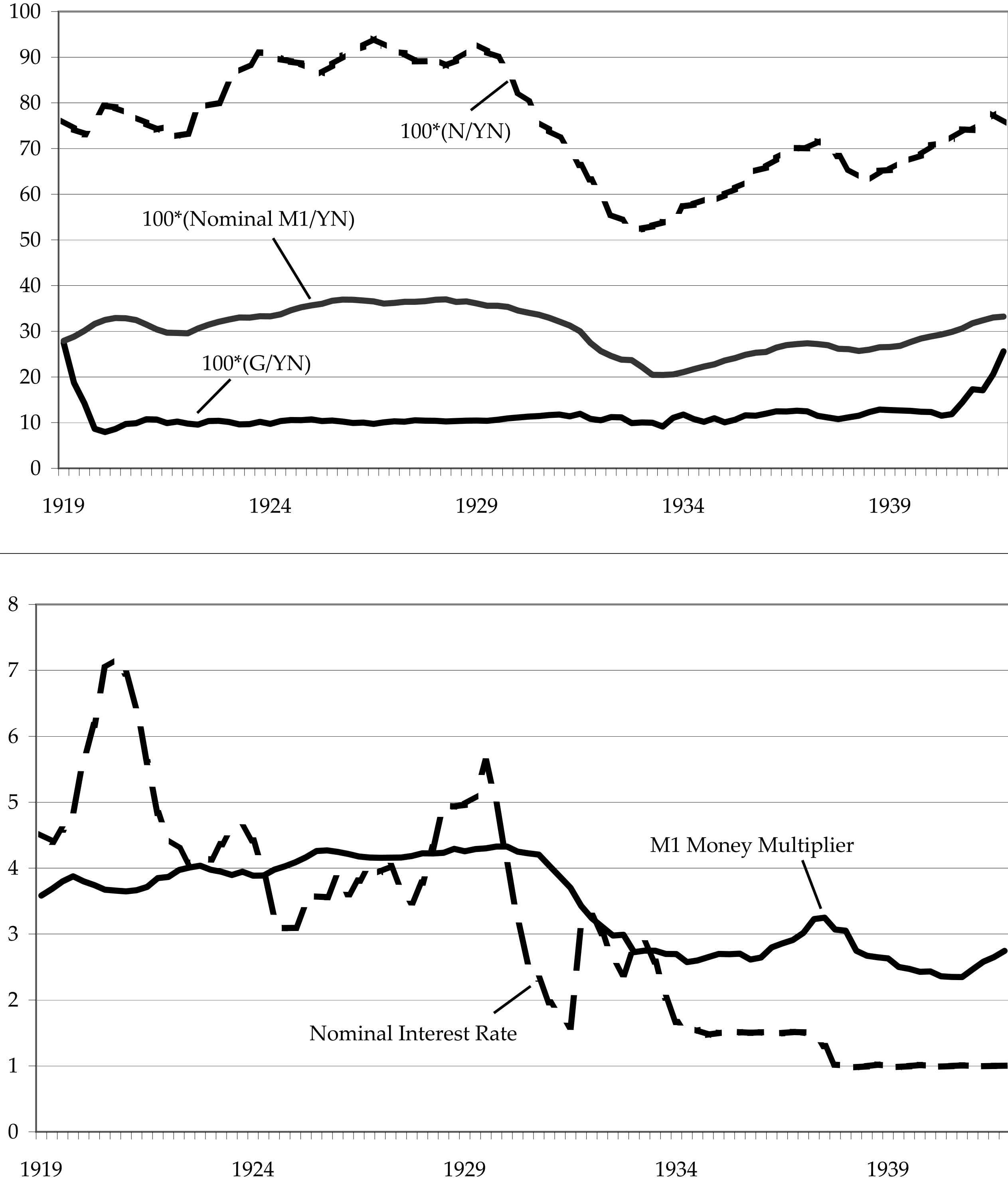
Source: See Data Appendix

Figure 7: Real GDP Components as Percentages of Sum of Components Potential Real GDP, 1919:Q1-1941:Q4



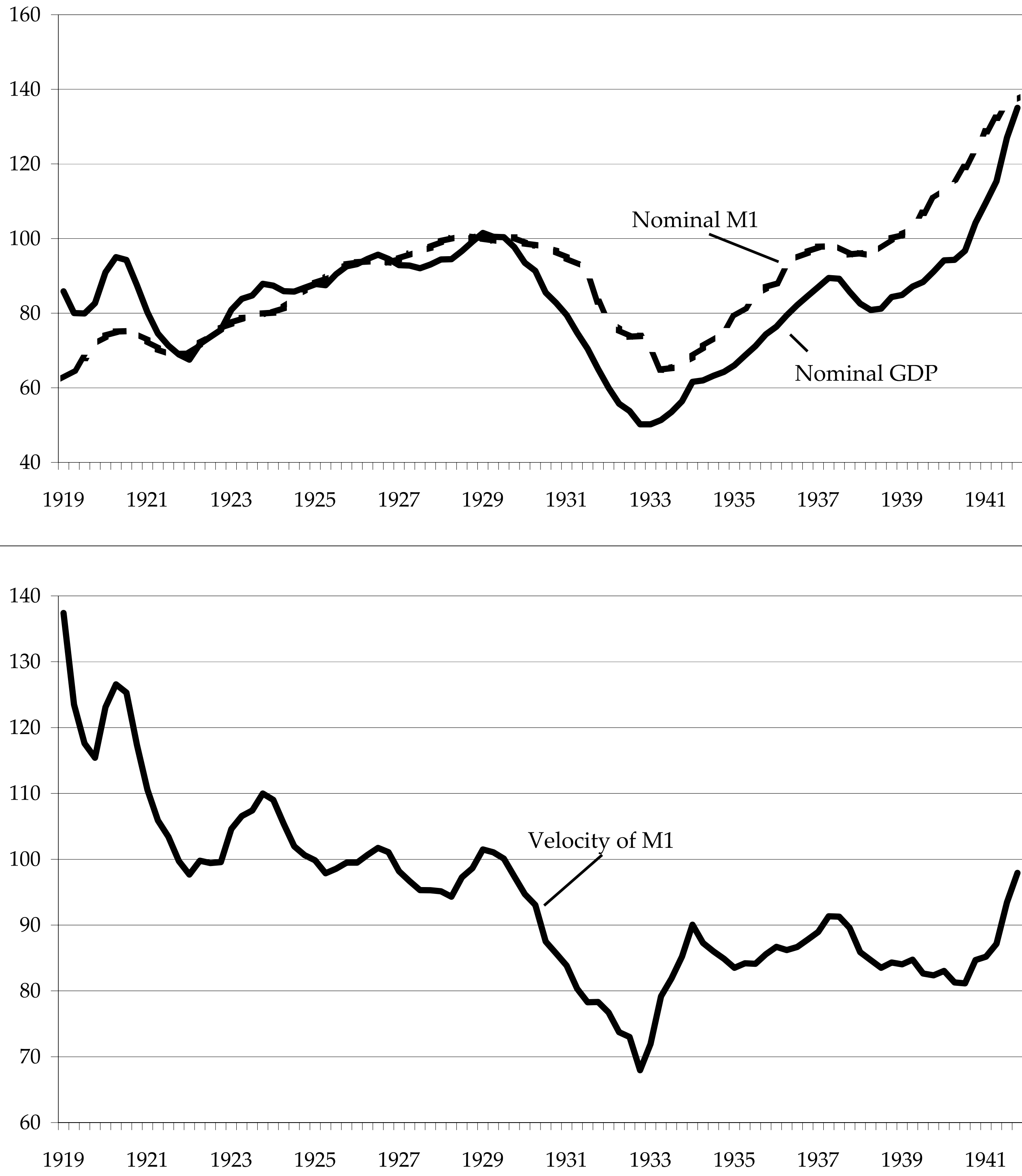
Source: See Data Appendix

Figure 8: Variables Used in the VAR, 1919:Q1-1941:Q4, Percentages of YN (Upper Frame) and Percentage Values (Lower Frame)



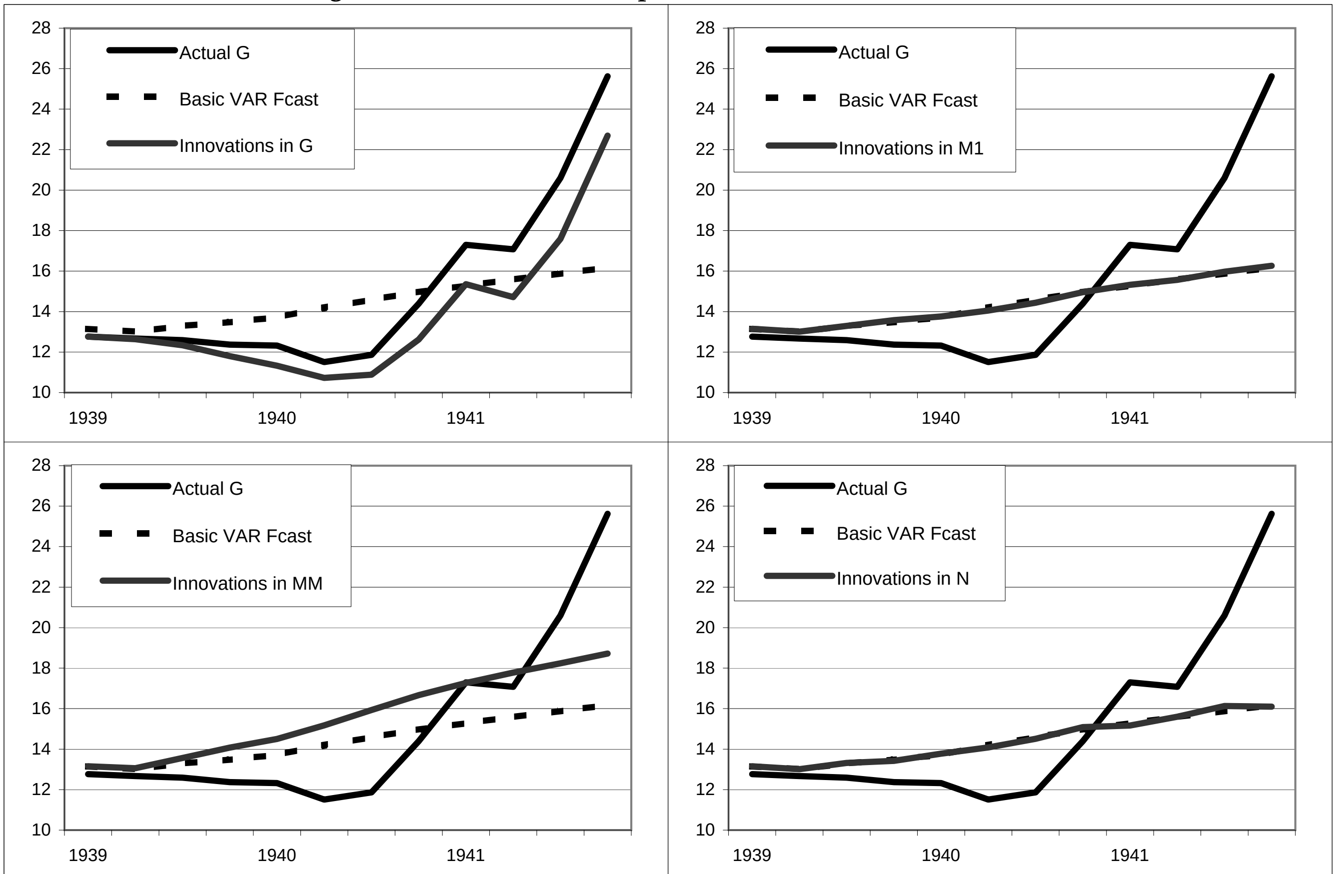
Source: See Data Appendix

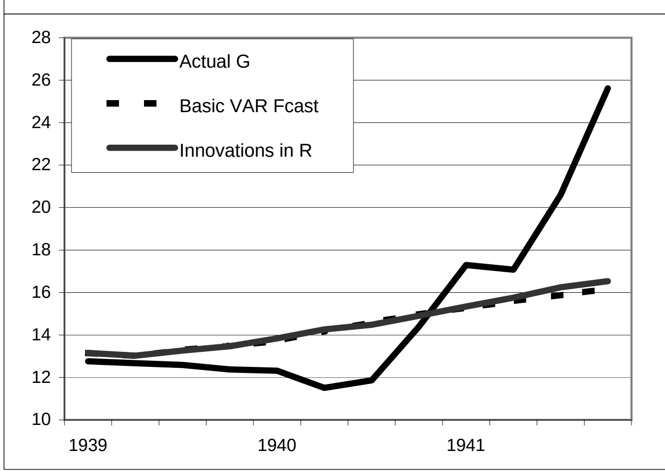
Figure 9: Nominal GDP versus Nominal M1 Money Supply and Velocity of M1, 1919:Q1-1941:Q4, 1929 Avg. = 100



Source: See Data Appendix

Figure 10: Historical Decomposition of G: 1939:Q1 to 1941:Q4





Source : See Data Appendix

Variable Definitions:

G: Ratio of Government purchases to Potential GDP, $1937

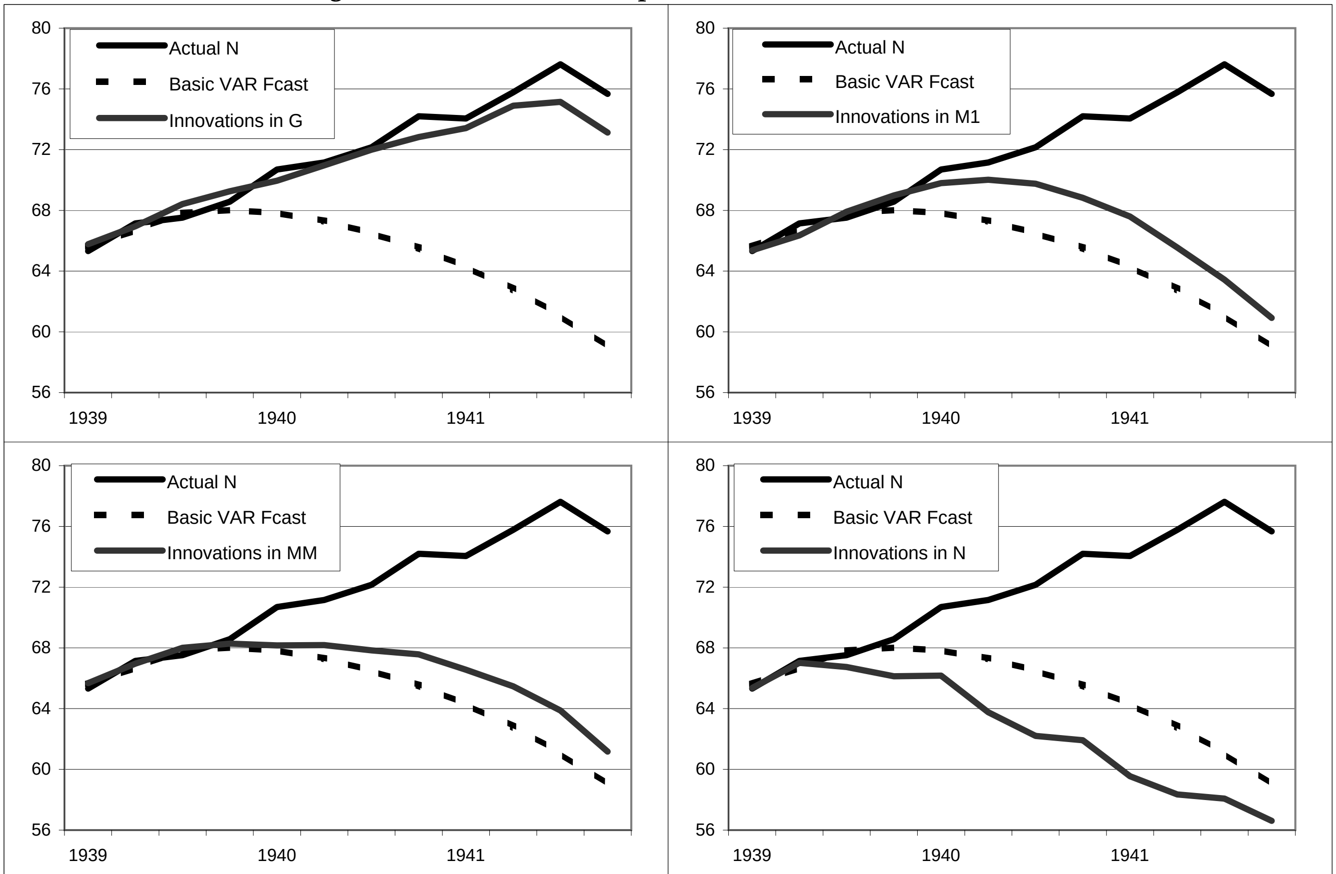
M1: Ratio of Nominal M1 Definition of the Money Supply to Potential GDP, $1937

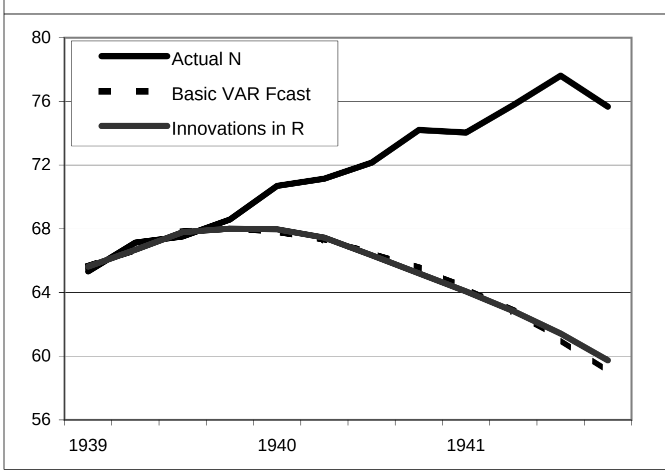
MM: Money Multiplier (M1/Monetary Base)

N: Ratio of Consumption, Investment, and Net Exports to Potential GDP, $1937

R: Federal Reserve Discount Rate

Figure 11: Historical Decomposition of N: 1939:Q1 to 1941:Q4





Source : See Data Appendix

Variable Definitions:

G: Ratio of Government purchases to Potential GDP, $1937

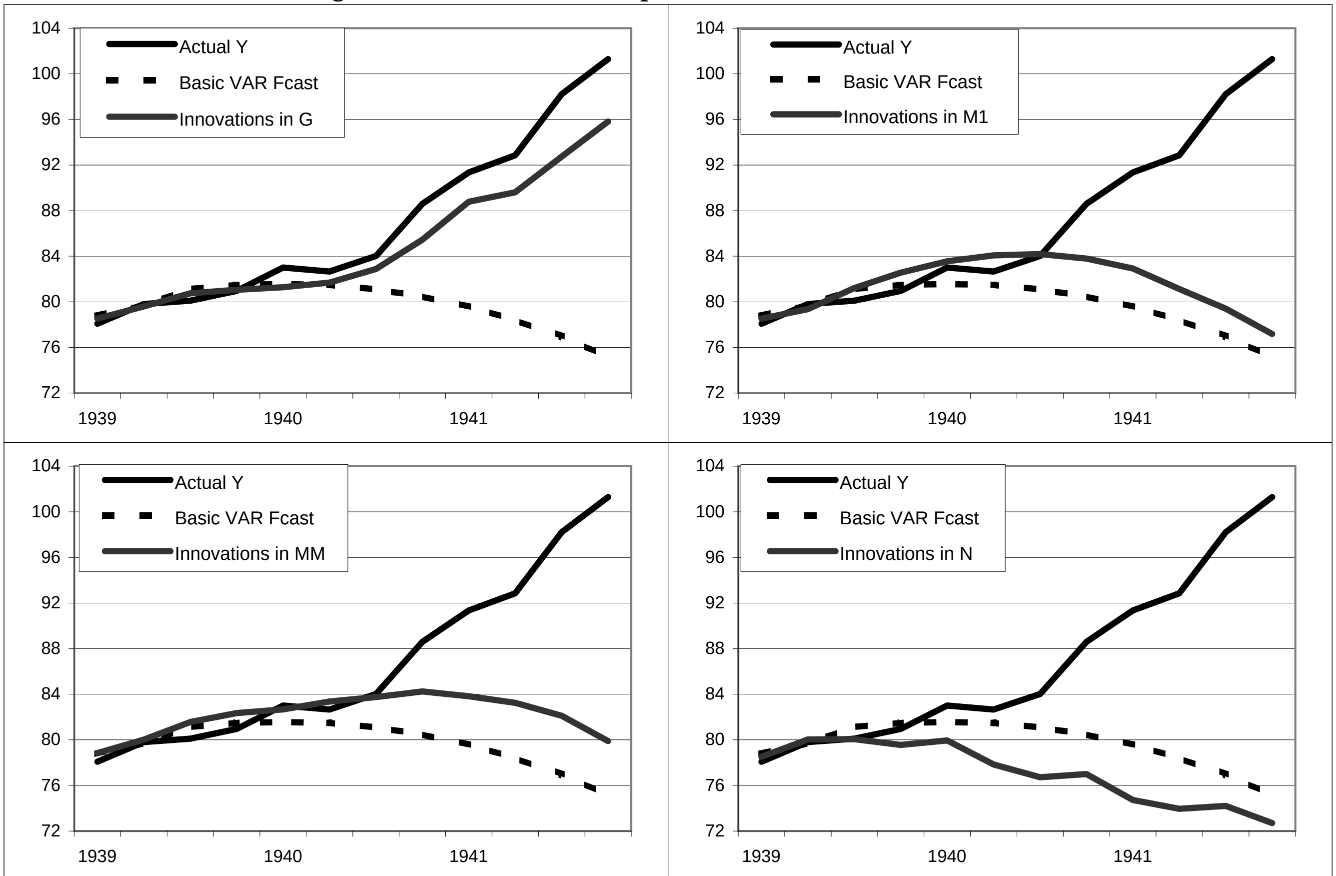
M1: Ratio of Nominal M1 Definition of the Money Supply to Potential GDP, $1937

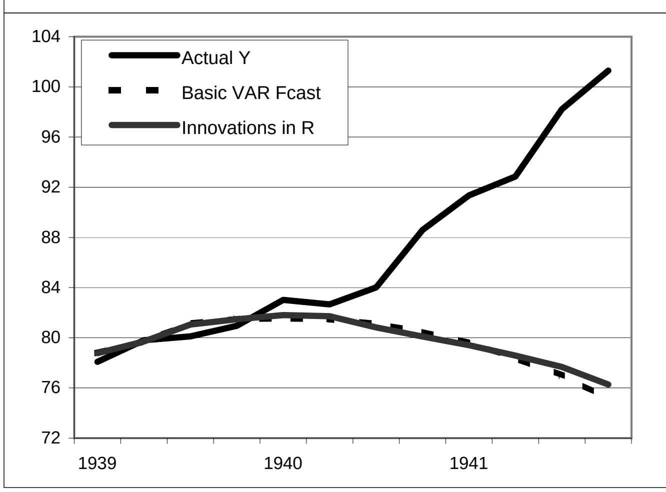
MM: Money Multiplier (M1/Monetary Base)

N: Ratio of Consumption, Investment, and Net Exports to Potential GDP, $1937

R: Federal Reserve Discount Rate

Figure 12: Historical Decomposition of Y: 1939:Q1 to 1941:Q4





Source : See Data Appendix

Variable Definitions:

G: Ratio of Government purchases to Potential GDP, $1937

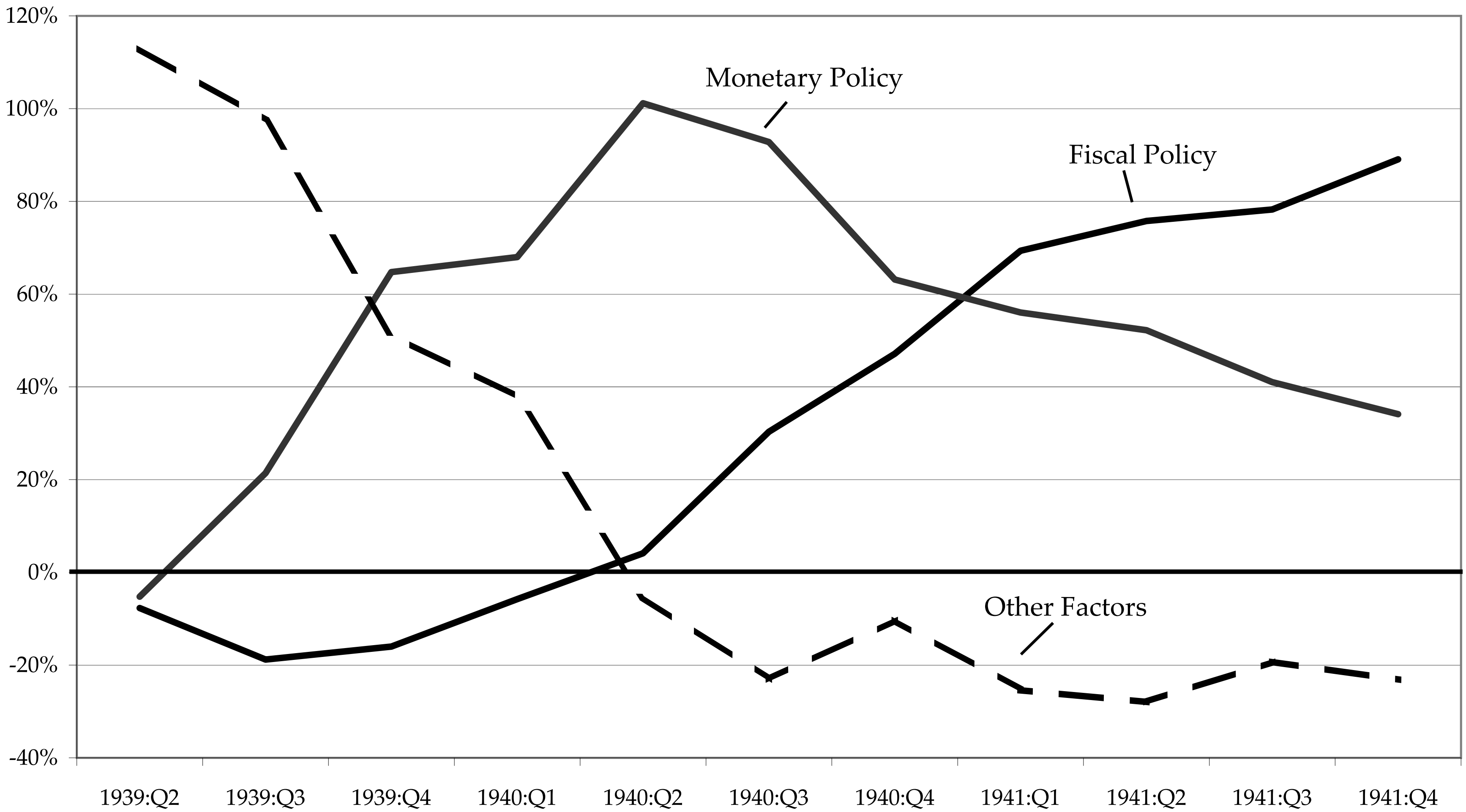
M1: Ratio of Nominal M1 Definition of the Money Supply to Potential GDP, $1937

MM: Money Multiplier (M1/Monetary Base)

N: Ratio of Consumption, Investment, and Net Exports to Potential GDP, $1937

R: Federal Reserve Discount Rate

Figure 13: Percentage of the Recovery Explained by Fiscal Policy Innovations, Monetary Policy Innovations and Other Factors: 1939:Q2 to 1941:Q4



Source: See Data Appendix

Table 1

Summary of VAR Robustness Checks

VAR Time Period	VAR Ordering	Percentage of Recovery Explained [1] Innovations in G	Innovations in MP [2]	Other[3]	Unexplained[4]
Baseline Result					
1920:Q2-1941:Q3	G, M1, MM, N, R	89.1	34.1	-23.2	0.0
Change in VAR Period Start Date					
1923:Q4-1941:Q3	G, M1, MM, N, R	64.9	40.8	-5.6	0.0
Change in VAR Period End Date					
1920:Q2-1941:Q4	G, M1, MM, N, R	186.2	28.2	-114.4	0.0
1920:Q2-1941:Q2	G, M1, MM, N, R	27.7	41.5	30.8	0.0
Using Monetary Base in Place of M1					
1920:Q2-1941:Q3	G, MB, MM, N, R	83.9	31.6	-15.6	0.0
Adding GDP Deflator to the VAR Model					
1920:Q2-1941:Q3	G, M1, MM, N, R, YDEF	81.8	28.2	-10.0	0.0
Using Natural Logs Instead of Ratios to YN for G, M1 and N [5]					
1920:Q2-1941:Q3	G, M1, MM, N, R	64.5	41.0	-11.3	5.8
1920:Q2-1941:Q4	G, M1, MM, N, R	91.5	38.3	-37.7	7.9
Using Ramey (2009) Data for G and N from 1939:Q1 Onwards [6]					
1920:Q2-1941:Q3	G, M1, MM, N, R	135.1	32.3	-67.4	0.0
Alternative VAR Orderings					
1920:Q2-1941:Q3	G, N, M1, MM, R	89.1	31.7	-20.7	0.0
1920:Q2-1941:Q3	N, G, M1, MM, R	93.7	31.7	-25.4	0.0
1920:Q2-1941:Q3	M1, MM, G, N, R	109.4	13.8	-23.2	0.0
1920:Q2-1941:Q3	M1, MM, N, G, R	117.6	13.8	-31.4	0.0

[1] Totals may not add up to 100.0% due to rounding
[2] MP = Monetary Policy (Combined Effect of Innovations in M1, MM and R)
[3] Other = Combined Effect of Basic VAR Dynamic Forecast and Innovations in N
[4] Totals do not add up to 100.0% because converting from logs to percentages of YN leaves a certain percentage unexplained
[5] G, M1 and R are entered as natural logs instead of as a % of YN. MM and R are still entered as their original percentages
[6] Ramey (2009) data is reverse ratio linked to Gordon and Krenn (2009) data in 1939:Q1 for G and N

Source : See Data Appendix

Table 2

Fiscal Multiplier Estimates

Specifications	**Multiplier Time Period** 1940:Q2-1941:Q2	1940:Q2-1941:Q4
Basic VAR Dynamic Forecast Starts in 1939:Q1		
Subtracting out the Basic VAR Dynamic Forecast	4.24	2.05
Not Subtracting out the Basic VAR Dynamic Forecast	1.99	1.18
Basic VAR Dynamic Forecast Starts in 1940:Q2		
Subtracting out the Basic VAR Dynamic Forecast	1.80	0.88
Not Subtracting out the Basic VAR Dynamic Forecast	2.19	1.28

* For information on the precise calculation of these fiscal multiplier estimates, see Part 7.

Source : See Data Appendix