

Monetary Policy in the Midst of Big Shocks

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May 26, 2014

Abstract

This paper studies the impact of the largest deviations from price stability during the Fed's first 100 years, with a focus on understanding the Fed's role in impacting the economy during the post-World War I period, the Great Depression, World War II, and the Stagflation of the 1970s. I find that deflation was very depressing in the 1930s, but because of cartel and wage setting policies, and that there is no presumption that deflation is as destructive as commonly believed. In particular, the similar deflation in the early 1920s did not depress the economy nearly as much as in the 1930s. I find that the biggest impact of monetary policy during World War II was in debasing debt through inflation, which was achieved without much impact to Fed credibility. I find that the main drivers of the 1970s economy were long-run changes in productivity and the labor market, and that there may have been little that the Fed could have done at this time.

1 Introduction

A central goal of the Federal Reserve is to conduct monetary policy that is consistent with price stability. But in its first 100 years, the Fed has presided over several historical episodes of very large deviations from price stability. These episodes include the two most severe deflations in the history of the U.S., which are the post-World War I deflation of the early 1920s and the deflation of the 1930s, and three large inflations: the World War I inflation, the inflation of the mid-late 1940s, and the chronic Great Inflation of the 1970s and early 1980s.

These deviations from price stability all occur during major economic events: World War I, the 1921-22 economic downturn, the Great Depression, World War II and its aftermath, and the oil shocks and "stagflation" of the 1970s. The coincidence of these deviations from price stability with these economic events raises two questions. What is the impact of Fed policy during these periods, and how did these events shape Fed policy? This paper focuses on the first question, with a goal of understanding how these deviations impacted employment and output during these episodes. I use general equilibrium business cycle models to study each episode. There are two main findings. One is that deflations per

se are not as depressing as is commonly believed, and that the deflation of the 1930s was uniquely depressing because of government wage setting and cartel policies. An implication is that price stability during the 1930s would likely have resulted in a much milder economic downturn than the Great Depression and that the absence of cartel policies, which were developed by Presidents Hoover and Roosevelt, would have promoted a much faster recovery. Moreover, the findings have implications for current monetary policy, as they suggest that focusing on "deflation avoidance", which is a key feature of recent policies, may be misplaced.

A second finding is that the inflation of World War II may have had little impact on the real economy during the war, but that the large postwar inflation of the late 1940s reduced the postwar tax burden, reflecting a substantial unanticipated inflation after the war. This debt debasement did not occur during the inflationary 1970s, however, when interest rates rose roughly one-for-one with inflation, and it is unlikely that inflation could achieve such a debasement again without incurring substantial costs. More broadly, it is challenging to find evidence of significant expansionary effects from the Fed's inflationary deviation during the 1970s. The primary determinants for economic activity during the 1970s are long-run movements in productivity, which reflects the productivity slowdown, and the labor wedge. And the inflation of the 1970s may have had a substantial cost as the disinflation of the early 1980s is associated with lower output and employment. I conclude from these analyses that deviations from price stability during the Fed's first 100 years have probably on net hurt the economy.

The paper is organized as follows. Section two presents some background statistics on inflation. Section three discusses the impact of the two major deflations during the early 1920s and the early 1930s, and the impact of those deviations from price stability on real economic activity. Section four discusses the inflation of the 1940s, and its impact on real economic activity. Section five discusses the Great Inflation and economic activity during the 1970s. Section six concludes.

2 Background

The mean inflation rate as measured by log changes in the CPI since 1913 has been about 3.2 percent per year, with a standard deviation of 4.8 percent. The skewness is about .3224, which is not statistically significant at the 5 percent level. There is significant excess positive kurtosis (5.70). Inflation is positive serially correlated, with a first order autocorrelation coefficient of about 0.64. There have been 11 years in which the CPI fell (measured year-over-year changes in December), and 89 years of increases. The CPI changed between -3 percent to and increase of 6 percent in 79 of the Fed's first 100 years. The four episodes I consider have percent changes that are outside of this band.

I will assess these episodes from the widely-held perspectives that (i) significant changes in inflation or deflation significantly impact economic activity,

with deflation depressing economic activity, and (at least modest to moderate) inflation increasing economic activity, and (2) that the Fed can use monetary policy to expand economic activity in response to temporary negative shocks.

3 The Federal Reserve and the Great Deflations of 1920-22 and 1929-33

The two most severe deflations in U.S. history occurred less than a decade apart. The first occurred between 1920-22, when the CPI fell nearly 18 percent, reflecting annual inflation rates of about 11 percent between 1920 and 1921 and about 7 percent between 1921 and 1922. The deflation during these years was even more severe measured using the GNP deflator with a cumulative price decline of 19.4. The second deflation occurred between 1929-33, with an average rate of deflation of about 7 percent per year, and a cumulative deflation of about 28 percent over this four year period. This section analyzes the impact of these two deflations on the economy with a focus on understanding why the downturns that occurred in the early 1920s and 1930s were so remarkably different, how price stability would have made a difference during the 1930s, and what the implications of these episodes are for rules-based policy going forward.

The 1929-33 deflation has received enormous attention in the literature. A widely held view is that the deflation of the early 1930s was a major factor in turning what otherwise would have been a "garden variety" recession into the Great Depression (see Friedman and Schwartz (1963), and Bernanke (1995)). The deflation of 1920-22, however, has received comparatively little attention in the literature. This section first compares economic performance during these two severe deflations. This comparison suggests that severe deflation per se does not always have large and persistent effects on real economic activity, as is often assumed. The analysis then draws on Ohanian (2009) and Cole and Ohanian (2004) for an explanation of why the Great Depression was so severe and lasted so long, and for understand the role of deflation during the 1930s. The evidence will suggest that the Great Depression was a "one off" event, in which government cartel and wage setting policies, and their interaction with deflation, played a key role in the Depression, and provide an explanation for why similar deflations are associated with such different patterns of real economic activity between the early 1920s and early 1930s.

I begin by showing the pattern and timing of deflation in the two episodes. Since the deflation of the early 1920s lasted two years, I focus on comparing the 1920-22 episode with 1929-31. Table 1 shows that deflation was even more severe during the 1920-22 episode than that in the first two years of the 1929-33 episode. As noted above, deflation is 18 percent (CPI) and 19 percent (GNP deflator) between 1920-22. This compares to a cumulative deflation of about 12 percent between 1929-31 using either the CPI or the GNP deflator, and just a 2-3 percent deflation in the first year, between 1929 and 1930.

The sources of these two deflations were different. It is not surprising that

the 1920-22 deflation was more immediately severe, as the money supply (M1) declined by more than nine percent between 1920 and 1921. This money supply contraction followed an 80 percent increase in the CPI, and a 60 percent increase in M1 between 1916 to 1920.(see Friedman and Schwartz (1963), Meltzer (2004), and Anderson (2003)). The large expansion of the money supply and the associated inflation, occurred during World War I, reflecting gold inflows from other countries and Fed credit expansion (see Friedman and Schwartz (1963), Meltzer (2004), Hetzel (1985) and Wheelock (1992)). The monetary contraction reflected much lower bank reserves (see Friedman and Schwartz (1963) and Hetzel (1985)).

Studies about this episode suggest debate among Fed policymakers both in terms of how to control the money supply, and about the primary economic forces that cause inflation. Some scholars suggest that the Fed was uncertain as to how to stabilize money and credit, and how to control inflation during World War I. In the early 1920s. New York Fed President Benjamin Strong cited open market operations guided by a rule that policy should provide adequate credit for business purposes and that policy should promote large price stability, as the main principles that should govern monetary policy (see Hetzel (1985)) Such a policy rule is similar in spirit to recent rules (see Taylor (1993)). In fact, Strong seems to note that the episode of high wartime inflation and the postwar deflation provide strong evidence of how open market operations impacted the money supply and inflation, and how the Fed could use open market operations to stabilize the price level and credit. The literature also describes growing support in Congress for policy rules, as opposed to policymaker discretion, reflecting the rollercoaster of the very high inflation of World War I and the sharp postwar deflation. I thus assume that a well-defined policy rule aimed at stabilizing prices emerged after World War I, and could have been followed going forward from that time.

In terms of comparing money growth, the money supply did not fall as quickly in the early 1930s as it did in the early 1920s. There was only a 3 percent drop in M1 between 1929 and 1930, and a cumulative decline in M1 of about 9 percent over the two years between 1929-31. Both deflation and the decline in M1 accelerated after this. Friedman and Schwartz (1963) argue that the deflation of the early 1930s was due to an unprecedented change in the currency/deposit ratio that sharply contracted M1, as opposed to Fed policy that contracted the monetary base, which declined very little during the early 1930s. Friedman and Schwartz argue that the Fed could have prevented this money supply collapse with aggressive open market purchases that in turn would have prevented the large deflation of the 1930s. They suggest that Strong's rules-based policy for price stability and maintaining adequate credit could have prevented the deflation and banking crises of the Depression had he not passed away in 1928.

I now turn to comparing real output and its components during these two deflations, one of which was the result of a large contraction in bank reserves following the war, and the other which was the result of the Fed not expanding open market operations to offset a sharp decline in the deposit/currency

ratio. Table 1 shows these real variables, which are measured in per capita terms and are relative to a two percent annual trend. There are two key differences between real economic performance in these two deflations. One is that the real economic activity declined much less in 1921-22 compared to 1929-31, and the other is that most of the 1921-22 downturn was not so much a decline in domestic, private sector spending. In contrast, the very large 1929-31 economic decline was entirely due to lower private spending.

Specifically, real per capita GNP declines about 3.8 percent relative to trend between 1920-22, but declines by nearly 24 percent relative to trend between 1929-31. Note that by 1922, private consumption and business investment are both above trend. In contrast, private consumption falls by 16 percent between 1929-31, and business investment falls by more than 50 percent between 1929-31. The main feature of these data is that despite the more severe deflation of 1920-22, there was no major depression at that time. The 1920-22 experience is closer to the average relationship between deflation and depression. Specifically, Atkeson and Kehoe (2004) examine cross-country data and find little evidence for the impact of deflation on depression outside of the 1930s.

Another difference between the two periods is in terms of the recovery. The recovery from the 1921 downturn was very rapid, while the recovery from the Great Depression was very slow, despite the fact that deflation stopped in 1933. Cole and Ohanian (2004) document that both real output per person and hours worked per person remained more than 20 percent below trend in 1939. This suggests.

The timing of deflation and depression also suggests important differences between the 1930s and the 1920s. Figure 1 shows monthly industrial production, along with the CPI, and two measures of the money supply, and M1 January, 1929 and October, 1930. The most striking feature of this graph is that the Depression did not start as a "garden variety" recession, as is widely believed (see Bernanke (1995)). In contrast, the Depression was immediately severe, as industrial production declines by about 35 percent over this period. This immediately severe depression does not coincide with either significant monetary contraction or deflation. M1 and the CPI change very little through mid-1930. It is not until industrial production has declined by about 30 percent that these series decline, and even then they decline only modestly. Moreover, this decline in industrial production occurs before any banking crises, which are cited by Friedman and Schwartz (1963) as being central for understanding the fall in money, and cited by Bernanke (1983) as depressing the economy through channels other than reducing the money supply. Thus, the U.S. experienced a severe industrial depression before deflation, monetary contraction, and banking crises.

These data comparing the 1920s and 1930s, and data on the timing of depression and deflation, suggest that deflation per se may not be nearly as depressing as is commonly assumed. The common perception about the impact of deflation largely comes from the 1930s. This guides much of the profession's views about the general impact of deflation, and was a central feature in designing recent monetary policy which has had a goal of preventing deflation. In terms of policymakers' views about deflation, Bernanke (2002) summarizes his

assessment about deflation and depression in a speech presented at Friedman's 90th Birthday conference, and Katz (2014) describe's Christine Lagarde's views about deflation. These comparisons indicate that the Depression is not simply the consequence of deflation. If it was, then we would likely have seen a much larger economic decline in the early 1920s, and a milder start to the Great Depression in the early 1930s.

My research identifies two factors that can account for why the Depression was immediately so severe, why deflation had a much larger effect in the 1930s than the 1920s, and why the Depression continued after deflation and banking panics had ended. I summarize that research here.

Ohanian (2009) develops a theory to account for the facts that the Depression was well under way before significant deflation, monetary contraction, or banking crises, and for why the agricultural sector of the economy, which had about a 25 percent employment share in 1929, which is roughly the same as the size of manufacturing employment, remained roughly on trend.

The theory is based on policies that depressed competition in product and labor markets, which I will hereafter refer to as *cartel policies*. The genesis of these policies reflect a much different view about competition than we have today. Specifically, many policymakers at that time, including Presidents Hoover and Roosevelt, and many of their economic advisors, believe that competition could be harmful to the economy. Hoover believed that many resources were wasted when firms compete against each other. Hoover championed the development of trade associations which allowed industry to cooperate and coordinate on a number of decisions that subsequent research would find as highly collusive (see Kovacs and Shapiro (2000)). Hoover (1952) stated

...the great area of indirect economic wrong and unethical practices that spring up under the pressures of competition...the great waste through competition, through failures of industries to synchronize...we enlisted the trade associations in creation of codes of business practice that eliminate waste and abuses .

Hoover (1952) also had a very different vision of the process that connects economic growth to wage growth. Specifically, modern economics ties productivity growth as they key driver of growth in output, income, and compensation. Hoover, however, believed that raising wages in and of itself would increase economic activity by giving workers greater purchasing power:

The very essence of great production is high wages...because it depends upon a widening range of consumption only to be obtained from the purchasing power of high real wages"

Hoover also was a strong supporter of unionization. He promoted and signed the Davis-Bacon Act of 1931 and the Norris-Laguarding Act of 1932 which raised wages and facilitated unionization. Hoover expanded cartel policies in

November, 1929, when he called together the heads of many of the country's leading businesses, including Alfred Sloan of GM, Henry Ford of Ford Motor, and Charles Schwab of Bethlehem Steel (Rose (2010) provides a full accounting of those at Hoover's meeting). At these conferences, Hoover implored business leaders to either maintain or raise nominal wages. Hoover believed that this would limit the depth and duration of any recession that might have been developing after the stock market decline in October of that year. Hoover stated that the recession was not to be born "on the backs of our workers" and reminded industry leaders that their profits and dividend payments were at record highs. Hoover stated that in return for maintaining or raising wages, that he would insure that there would be no disruptive union activity. This statement was important, because rules towards unions had changed markedly in the late 1920s. In addition, Hoover asked that industry not lay off workers, but rather share jobs in order to spread work evenly across their workers.

Throughout the early and mid-1920s, there was very little new union organization because the Clayton Act was interpreted as indicating that union formation was restraint of trade, and that firms were allowed to vigorously defend against any union organization or picketing. Bernstein (1960) presents evidence that firms were able to limit wage growth because of the anti-union interpretation of the Clayton Act. He cites archival data that indicates that some major firms colluded in setting compensation policy and personnel policy, and that business only gave raises in the 1920s if there were attempts to try to organize workers. Note that real wages for non-union workers during the decade of the 1920s grew only around 6 percent, despite the fact that labor productivity grew by about 20 percent over this period (see Ohanian (2009)).

However, there was a major change in 1929, when the Supreme Court upheld the Texas Railway Labor Act (TRLA). The TRLA had provided for the legal formation of railroad unions, but railroad firms had challenged the constitutionality of the law. In upholding the law, the Supreme Court not only paved the way for the legal right for workers to form independent, collective bargaining organizations, but also struck down several lower court rulings on the interpretation of the Clayton Act. The result of these Court decisions was called "Labor's New Magna Carta" in the New York Times on October, 27 1929 (see Ebel and Ritschl (2010)). Rules towards union organization had changed substantially and permanently, and major industry unanimously agreed to Hoover's demands for wage maintenance and work sharing.. Ohanian (2009) describes how industry kept wages fixed in nominal terms, or in a few cases, including Ford Motor, raised nominal wages at this time, and also shared jobs, even though it may have negatively impacted productivity.

As deflation accelerated, and as productivity fell, real labor costs rose, and industry requested from Hoover the right to cut wages in order to shore up business. Each time this request was made, however, Hoover refused, and the Commerce Department responded by stating that wage cuts would lead to "hell to pay with unions.". By late 1931, industry told Hoover that they needed some type of relief from his policies and asked him if he would support the "Swope Plan", named after Gerard Swope, who was the head of General Electric

and who had formulated a plan that would provide guaranteed profit levels for industry. Hoover replied that he could not support it, as the Attorney General viewed the plan as unconstitutional. Industry then broke ranks from Hoover at that time and advised him that they would not be supporting his candidacy in 1932. Only by late 1931 do the biggest corporations cut wages, including GM, Ford, U.S. Steel and Bethlehem Steel. These cuts reduced real wages,, but the very rapid deflation that began in 1932 continued to put upward pressure on real wages.

Ohanian (2009) reports that real wages relative to a two percent long-run trend rose about 10 percent between 1929 and mid-1931. This reflected the fact that nominal wages were almost unchanged, falling just 2 percent, while the price level declined by about 8 percent.

The Hoover policy provides a theory for potentially understanding why the Depression was so immediately severe, and why the Depression was so asymmetric, with industry employment and output declining enormously, and agricultural output staying on trend. Regarding the sharp asymmetry between agriculture and industry, the agricultural sector was not impacted by Hoover's cartel policies. In fact, agricultural activity would remain near trend until the mid-1930s, when FDR's agricultural adjustment Act helped cartelize the farm sector by restricting output in order to raise prices.

Ohanian (2009) develops a two sector model, with an industrial sector and an agricultural sector. There are many industries in each sector. There is a representative household that values consumption and leisure, and there is disutility from entering the workforce. In this model, workers and hours per worker are not perfect substitutes, as there is a cost of entering the work force that varies across household members. Thus, there will be a choice for both employment and hours per worker. This specification which features the length of the workweek is used because Hoover's program impacted not only wages, but also impacted the workweek through job sharing.

The model is given by:

$$\max \Sigma \beta^t \{ \ln(c_t) + e_{at} \mu \ln(1 - h_{at}) + e_{mt} \mu \ln(1 - h_{mt}) - v(e_{at} + e_{mt}) \} (1 + n)^t$$

subject to the budget constraint:

$$\Sigma Q_t [w_{mt} e_{mt} + w_{at} e_{at}] - c_t + \Pi_0 = 0$$

in which Q_t is the date-t price of goods, h_{jt} is the length of the workweek in sector j, e_{jt} is the number of workers in sector j, and Π_0 are date zero profits.

The technologies are given by:

$$Y_s = \left(\int y_s(i)^\theta di \right)^{1/\theta}$$

$$y_s(i) = h_s(i) k_s^\gamma(i) e(i)^{1-\gamma}$$

$$Y = [\alpha_m Y_a^\phi + \alpha_s Y_m^\phi]^{1/\phi} = C + X$$

The cost of entering the workforce is increasing in household members. Increasing the labor force means adding additional workers who have an increasing utility cost of entering. This is given by:

$$v(e_{at} + e_{mt}) = \int_{i=0}^{e_t} (\xi_0 + 2\xi_1 x) dx$$

Ohanian (2009) analyzes the U.S. economy between 1929 through the end of 1931, which is roughly when the Hoover wage maintenance program broke down. The sequence of the real industrial wage is fed into this model between 1929:4 and 1931:4. In addition, the sharp reduction in the average length of the workweek that occurred during this period is also exogenously fixed. In the production technology for the manufacturing sector. This works like a reduction in productivity. Thus, labor costs rise because of the fixed high real wage and because of the workweek reduction. The agricultural sector is not subject to the Hoover policy. I assume perfect foresight, and calculate the transition path of the economy from 1929 to the steady state of the model in which wages are . In addition, the length of the workweek is reduced by . Ohanian (2009) reports that the model generates an immediate and substantial decline in economic activity. Real output in the model declines about 18 percent by the end of 1931, compared to about a 26 percent decline in the data. Investment declines by nearly 40 percent in the model, which is almost the same as in the data. The model captures the asymmetry between the farm sector and manufacturing, as model manufacturing labor declines by about 29 percent, compared to a 45 percent drop in the data, whereas, agricultural labor drops by about 12 percent in the model, and by about 5 percent in the data. The economy begins to decline immediately, before real wages rise, because the economy is transiting to a new steady state with lower capital, output, labor, and consumption. Thus, the transition process begins immediately in the model. This analysis suggests that Hoover's cartel/wage-fixing policies were central for understanding why the Depression was so deep. In the absence of these policies, the Depression may have been much milder.

My research with Harold Cole (and Ohanian (2004)) indicates that cartel policies also were a factor in the post-1933 economy. This paper presents data that shows the economy did not return to trend, and argue that this is puzzling, given that many factors assumed to be important for the depression - declining productivity, deflation, banking crises and high real interest rates - ended in 1933. They develop a theory of the failure to recover based on the continuation of cartel policies. After Hoover left office, Roosevelt expanded these cartel policies. Specifically, the centerpiece of FDR's recovery program was the National Industrial Recovery Act (NIRA), which explicitly cartelized industry. This law de facto suspended the Sherman and Clayton antitrust acts. FDR and his

advisors wanted to industry to cooperate and raise prices, with the view that rising prices and wages would return the economy to trend.

Explicit cartelization was accomplished by industries writing "codes of fair competition" which were the rules governing competition in an industry. These included minimum prices for output, restrictions on new investment, and production quotas, and these collusions were approved by the government only if industry agreed to raise wages immediately and substantially, and also agree to collectively bargain with workers in the future.

By December, 1933, over 500 industrial codes of fair competition had been approved. Cole and Ohanian (2004) report that industrial wages and relative prices rose substantially immediately afterwards. It is common to disregard the impact of the NIRA because real GNP did grow after 1936. However, about 75 percent of the increase in real GNP that occurred was due to higher productivity growth, as productivity returned to trend and then rose above trend, and not because of an increase in labor, which remained far below trend after 1933. The fact that labor input and investment remained so depressed is the source for why the economy remained so far below trend in the 1930s.

Some, including Friedman and Schwartz (1963), point to the Fed raising bank reserve requirements in 1936 and 1937 as contributing to the 1937-38 downturn, as real GNP fell in 1938. A challenge to this monetary explanation, however, is that the largest increases in reserve requirements began about a year before industrial production turned down, and that there were further large increases in wages at that time. Specifically, Cole and Ohanian (2004) discuss that the Supreme Court upheld the Wagner Act around this time, and that as a consequence, unionization rose substantially, and real wage rates in industry rose from about 7 percent above trend in 1936 to 17 percent above trend in 1938. By the late 1930s, industry prices and wages were close to 20 percent above trend levels. Cole and Ohanian found that a multisector growth model with cartelization policies could account for about 60 percent of the gap between observed output and labor, and their trend values. It is possible that monetary policy could have played a role in facilitating recovery had inflation been very high in order to reduce the real values of industrial wages and prices. But this would have required substantial inflation to offset the large nominal increases that occurred in wages and prices, and would also have required no further increases in those prices and wages in response to a hypothetical, higher inflation.

My research suggests that deflation was depressing in the 1930s, but only because of one-off cartelization and wage-setting policies. It is unlikely that monetary policy would have similar, depressing effects again because it is unlikely that economic policy would advance such extreme price and wage setting policies. This research also suggests that creating inflation didn't do much to increase employment after 1933, because of an expansion of cartel policies and setting wages far above trend. This analysis puts policies that impede competition and that foster above-market prices and wages front and center, rather than monetary policy per se.

4 World War II and the Inflation of the 1940s

The second major inflation under the Fed occurred during the 1940s. M1 grew more than four-fold between 1940 and 1947, and the CPI grew about 70 percent over this period, with about 60 percent of this increase occurring between 1945 and 1947. Friedman and Schwartz (1963) and Meltzer (2004) discuss how the expansion of the money supply at this time reflected the Fed's commitment to purchase Treasury securities to try to maintain nominal yields at low levels. It appears that the Fed succeeded, as nominal yields on Treasury securities ranged between 3/8% on short term debt, up to 2.5 percent for long-term Treasuries. Wartime monetary policy is complex, however, as it reflects not only this significant expansion of the money supply, but it also reflects price and wage controls, rationing of goods for private use (as opposed to government use), and restrictions and regulations on the types of assets that banks, insurance companies, and pension funds could hold at that time. This makes directly assessing the impact of World War II monetary policy challenging.

I therefore pursue an alternative strategy to assessing the impact of monetary policy during the war, based on McGrattan and Ohanian (2010), who study the impact of various non-monetary shocks on the World War II economy, including changes in government purchases, government investment, salaries to military personnel, changes in capital and labor income taxes, productivity, and conscription, as military personnel rose from about 330,000 in 1939 to more than 12 million in 1945. In addition to not considering monetary shocks, their analysis also abstracts from price controls, rationing and the Fed's purchase of Treasuries. The McGrattan-Ohanian paper provides an indirect way of analyzing the impact of Fed policy on the economy at this time as follows. Specifically, if a standard model, with the shocks considered above cannot account for a sizeable fraction of economic activity in the 1940s, then this may suggest that monetary policy had important effects on allocations and/or relative prices. Alternatively, if a standard model can account for the bulk of the very large World War II changes in the economy, then this may suggest that monetary policy did not have major effects.

McGrattan and Ohanian (2010) utilize a large family construct with some members drafted and some members are civilians:

$$\max \sum \beta^t \{a_t \{[\ln(c_{dt}) + \phi \ln(1 - \bar{l}_{dt})] + (1 - a_t)[\ln(c_{ct}) + \phi \ln(1 - l_{ct})]\} N_t$$

subject to:

$$a_t c_{dt} + (1 - a_t) c_{ct} + i_{pt} + b_{t+1} \leq R_t b_t + (1 - \tau_{lt}) w_t (1 - a_t) l_{ct} + (1 - \tau_{kt}) r_{pt} k_{pt} + \delta \tau_{kt} k_{pt} + (1 - \tau_{lt}) w_t a_t \bar{l}_{dt} + T$$

Note that preferences for a large family-household include utility for those drafted, with subscript d and those who are not in the military, with subscript c. The variable a refers to the fraction of the household serving in the military, \bar{l}_d is the exogenously specified time that draftees work, b_t is one-period government

debt that is repaid with return R_t , τ_k and τ_l are capital and labor income taxes, T is government lump sum taxes/transfers. The population, N , grows at a constant rate. The variable i_p is private investment, as opposed to investment in plant and equipment that is made by the government.

The government's spending is divided between government consumption, investment, and payments to the military:

$$G_t = C_{gt} + I_{gt} + N_t w_t a_t \bar{l}_{dt}$$

The capital stock that enters production includes government-owned capital and private capital. They are perfect substitutes:

$$Y_t = A_t (K_{gt} + K_{pt})^\theta L_{pt}^{1-\theta}$$

The government's budget constraint is:

$$B_{t+1} = G_t + R_t B_t - N_t \tau_l w_t (a_t \bar{l}_{dt} - (1 - a_t) L_{ct}) + (\tau_{kt} - \delta) K_{pt} - r_{gt} K_{gt} + T_t$$

The stochastic process for the shocks to productivity (A), tax rates, government consumption, investment, the draft, and transfers is governed by a Markov chain. They find that government spending shocks, tax shocks, productivity shocks, and the draft accounts for much of the World War II economy. Moreover, the impact of these shocks is not through the "Keynesian" channel of raising aggregate demand, as is commonly thought. Rather, the combination of shocks to productivity, taxes, government investment, government spending on goods, government spending on military personnel, and the draft interacted in such a way in the model to significantly expand output, moderately expand labor, leave private consumption relatively unaffected, and depress private investment. This operates through channels that most importantly impact household wealth, as the war is sufficiently expensive and long-lived as to depress wealth. This factor, along with higher productivity, leads to an expansion of labor, despite the fact that labor tax rates increase significantly and the labor endowment decreases substantially through the draft. The large fall in investment reflects both consumption smoothing, as well as the fact that the government was investing in plant and equipment at this time, thus substituting for private investment.

Figures 2 - 5 show the model's predictions for output and its components, labor, and the returns to capital and labor. These figures show that the model accounts for much of the changes in economic activity that occurred during the war. Since a non-monetary model can match the data quite well, this suggests the possibility that monetary policy did not have major effects on allocations at this time. However, Fed policy did impact the economy after the war, when the price level rose about 1/3 between 1945 and 1947. My research (Ohanian, 1993) suggests that this inflation was unexpected. Specifically, capital markets did not

seem to expect inflation, as nominal interest rates remained roughly unchanged between 1945 and 1947 (Banking and Monetary Statistics (1943)). Consistent with this view that the inflation was unexpected is that some economists and policymakers worried that the Depression would return. Paul Samuelson (1943) advised Congress that the Depression and deflation would return once the war ended.

This post-World War II inflation reduced the debt to GDP ratio by about 1/3. In a standard one-sector optimal growth model with log utility over consumption and log utility over leisure, and Cobb-Douglas production with standard income shares and depreciation rate, Ohanian (1993) finds that the welfare benefit of this debasement is equal to about 1 percent of consumption per year in perpetuity as a result of lower future taxes on capital income and labor income. This is a sizeable impact of monetary policy on the real economy, though the channel differs considerably from standard channels through which monetary policy is assumed to operate, such as incomplete nominal adjustment of prices and/or wages.

In terms of this debt debasement, the U.S. is typically considered to be a country which honors its sovereign debt, yet the U.S. has not fully honored any of its obligations after major wars. Hall and Sargent (2014) discuss the nearly complete repudiation of some classes of Colonial war debt, and they also discuss how the country worked hard to establish a reputation of honoring its debt following the Civil War, though as Ohanian (2014) points out, the Civil War debt was not fully repaid due to the fact that the post-Civil War return on the debt was not sufficiently high to make bondholders whole. In terms of World War I, the 20 percent deflation after the war was not nearly sufficient to offset the 70 percent inflation that occurred. Ironically, perhaps the most important channel through which monetary policy impacted the real economy around this time - inflating away public debt - is generally considered as not being used by the U.S.

Following this inflation, as was the case following World War I, there was much concern Fed policy and how to establish monetary policy rules. Specifically, there was considerable worry about the lack of Fed independence following World War II. This led to the Federal Reserve-Treasury Accord of 1951, which severed the connection between the Fed trying to fix nominal returns on Treasury debt. This was viewed as returning independence to the Fed, and there appeared to be no significant costs to the Fed from this large inflation.

5 The Great Inflation and Stagflation of the 1970s

The last significant inflation occurred in the 1970s. Between 1973 and 1981, the CPI rose at an average rate of about 9 percent per year, resulting in a doubling of the price level over this period. This period is often characterized as one of "stagflation", reflecting both slow economic growth as well as a record high peacetime inflation. This period coincided with a long-term decline in productivity growth, as well as an increase in oil prices. There is consider-

able research about the relationship between macroeconomic performance and Fed policy during this period, with a focus on the impact of oil prices on the economy. Several economists note that the Fed tended to vacillate between reducing inflation and attempting to increase employment and output. Kilian (2014) summarizes recent research in this area. Kilian argues that the Fed was attempting to reduce inflation in the early 1970s, but then began to pursue expansionary monetary policy to try to raise employment and output as economic activity weakened. Romer and Romer (1989) argue that the Fed tried to reduce inflation beginning around April 1974, then again in late 1978 and late 1979. Goodfriend and King (2000) also discuss "start-stop" monetary policies. An older literature, including

I briefly touch on three issues in this section: the growth rate of money during the period, which was substantial, and which suggests that the Fed on balance was pursuing inflationary policies through the 1970s, how the Great Inflation was different from the perspective of capital markets compared to the wartime inflations, and presenting evidence that the main drivers of business cycle deviations during this period were largely long-run changes in productivity and factors impacting the labor market, suggesting that the Fed inflation may not have done much to expand the economy.

Money growth was high during this period. The monetary base, which is impacted significantly by Fed policy, also doubled between 1973-81, and M1 grew by 70 percent. Given this increase in the money supply, it is perhaps not surprising that inflation and the price level rose so much. While the other major inflations under the Fed also featured high money growth, the 1970s inflation differs considerably from the World War I and World War II inflations. One difference is in terms of how capital markets responded to the inflation. During the 1970s, nominal interest rates rose substantially throughout the period, suggesting that capital markets were anticipating high and rising inflation. The 10 year constant maturity Treasury was around 7.5 percent at the beginning of this period, and rose over time to 15.5 percent, before beginning to fall modestly in 1981. Similarly, 1 year constant maturity Treasuries were around 7.5 percent at the beginning of the period and rose to about 17.5 percent over time. Thus, real interest rates were not low during this period, as they were during the wartime inflations.

A second and related difference between the Great Inflation and the wartime inflations is in terms of how much inflation reduced public debt. Recall that the nominal debt to GDP ratio declined by about 1/3 after World War II as a consequence of inflation. But because debt was fairly low at this time, and because of the large interest rate increases of the 1970s, there was very little debt that was inflated away during the 1970s. Aizenman and Marion (2011) estimate that debt to GDP changed very little during this period as a consequence of inflation. Moreover, the aftermath of the Great Inflation was different in terms of the perception of Fed credibility. As noted above, The Fed-Treasury Accord of 1951 seemed to solve credibility problems that the Fed may have had after World War II, as the Accord re-established Fed independence. However, chronically rising inflation and interest rates ultimately led to a large change in

Fed policy including the Volcker deflation. Moreover, this disinflation coincided with significant recessions in 1980 and 1981-82, and very high real interest rates. This suggests the possibility that some of the 1980 and 1981-82 recessions were related to the Fed's goal of establishing credibility following the Great Inflation.

To assess fluctuations during this period, I use a business cycle model taken from Cole and Ohanian (2013), which includes monetary shocks, productivity shocks, and shocks to the first order condition that otherwise would equate the marginal rate of substitution to the marginal product of labor. The model is given by:

$$\max E \sum \beta^t \{ (\ln(\alpha c_{1t}^\sigma + (1-\alpha)c_{2t}^\sigma))^{1/\sigma} + \phi \ln(1-l_t) \},$$

where c_1 and c_2 are cash and credit goods consumption.

Utility is maximized subject to a budget constraint:

$$m_t + (T_t - 1)M_t + (1 - X_t)w_t l_t + r_t k_t \geq m_{t+1} + p_t [c_{1t} + c_{2t} + i_t] + \bar{X}_t w_t l_t$$

and the CIA constraint:

$$m_t + (T_t - 1)M \geq p_t c_{1t}$$

The term X_t is the labor wedge, and is specified as a first order autoregressive process in logs. Log of productivity and money growth are also first order autoregressive processes. Cole and Ohanian discuss the calibration of the model, which includes a standard process for productivity with an annual serial correlation parameter of about 0.8, a serial correlation coefficient for the labor wedge process of 0.8, and a white noise process with drift for money growth.

As in Chari, Kehoe, and McGrattan (2006), the labor wedge works like a tax on labor income with only substitution effects, as the proceeds of this tax are rebated back, lump sum, to the household ($\bar{X}_t w_t l_t$). This formulation captures not only changes in labor income taxes, but also is observationally equivalent to cartel policies and as in Ohanian (2009) and Cole and Ohanian (2004).

Production is given by:

$$Y_t = z_t (U_t K_t)^\theta L_t^{1-\theta} = C_{1t} + C_{2t} + I_t$$

Capital accumulation is given by:

$$K_{t+1} = I_t + (1 - \delta(U_t))K_t, \delta' > 0, \delta'' > 0$$

The function governing depreciation is a power function in utilization, with an exponent that is 1.1 (see King and Rebelo(2000)).

A representative firm operates this technology and has a standard profit maximization problem in choosing labor and capital, but also chooses capital utilization, U_t . This specification is often used in the literature (see Greenwood, Hercowitz, and Huffman (1988)), in which the trade-off is that increasing capital

services by raising the utilization rate means that the capital depreciates at a higher rate.

Money is non-neutral in this model through an information imperfection. Households choose their labor supply before observing the innovations to productivity and money. The household observes a nominal wage, and uses the value of the nominal wage, lagged values of the money supply and productivity, and the labor wedge to make an inference about the real wage. With log-normal shocks, this is a standard signal extraction problem (see Cole and Ohanian (2013)), and the size of the nonneutrality of money depends on the innovation variances to the productivity and money shocks, and other model parameters.

I simulated the model in response to unanticipated money shocks, but found that very little of the change in employment, and output and its components are accounted for by money shocks during this period. Instead, the model suggests output deviations from trend over this period are primarily the combined result of large, negative productivity shocks, which drive output and employment much lower *ceteris paribus*, and large, positive changes in the labor wedge, which drive employment and output higher. TFP, measured using factor shares of 1/3 for capital and 2/3 for employment, declines beginning in 1973 and is about 11 percent below trend by 1981. In contrast, the labor wedge narrows by about 13 percent between 1973 and 1981, which is observationally equivalent to a decline in the labor income tax rate. The labor wedge is measured as the log deviation in consumption, labor productivity, and hours worked which comes from the atemporal first order condition that otherwise would equate the marginal rate of substitution in leisure and consumption to the marginal product of labor.

Both of these shocks appear to be very persistent, which raises questions about the application of stimulative monetary policy, which is typically considered to be useful in the presence of temporary shocks. In terms of the persistence of these shocks, there is a large literature that discusses the trend change in productivity at this time (see Cullison (1989) and its references). The labor wedge also is very persistent at this time. The labor wedge narrows not only during the 1970s, but continues to narrow through the 1980s and 1990s, as the employment to population ratio rises from around 57 percent in the early 1970s to more than 64 percent by the mid-1990s. This increase in labor input, conditional on changes in consumption and productivity, manifests itself as a continuing narrowing of the labor wedge (see Shimer (2009)). This increase in labor input likely reflect the large increase in women entering the labor force, as women's participation rate rose from about 40 percent in the early 1970s to about 60 percent by the mid-1990s (see McGrattan and Rogerson (2004)), and may also reflect tax changes (see Ohanian, Raffo, and Rogerson (2008)).

Figures 6 - 8 show predicted output with both the productivity shock and the labor wedge shock, just the productivity shock, and just the labor wedge shock. Figure 6 shows model output with both shocks over this period. There are some deviations between model and data, though the model qualitatively tracks actual output and both model and data are quite similar at the end of the period. Figure 7 shows model output with just the productivity shock.

Note that the persistent, negative productivity shocks generate a depression, with output falling by 15 percent. Figure 8 shows model output with just the trend reduction in the labor wedge, which by itself increases output by 11 percent. Thus, this analysis suggests that the 1970s economy was largely driven by long-run changes in productivity growth and factors impacting work incentives/opportunities, and not short-run demand or supply shocks.

This aggregate analysis has abstracted from distributional considerations, which Doepke and Schneider (2006) show as being quantitatively significant. In particular, they show that the inflation of this period redistributed wealth from creditors to borrowers, and across generations. Future research should focus on this impact of inflation on the aggregate economy.

6 Summary and Conclusions

I assume that the Fed could have used a price stability rule to guide monetary policy after World War I. The Fed deviated significantly from price stability four times World War I, including the large deflations of the 1920s and 1930s, and the large inflations of the 1940s and the 1970s. These large deviations from price stability suggest that the Fed follows discretionary policies, rather than rules-based policies, when confronted with unusual economic situations. This paper analyzed the impact of these deviations on real economic activity and found that deflations per se may not be nearly as depressing as is commonly believed, and that the deflation of the 1930s was uniquely depressing because of government wage setting and cartel policies. An implication is that price stability during the 1930s would likely have resulted in a much milder economic downturn than the Great Depression and that in the absence of the Hoover and Roosevelt cartel policies that the 1930s downturn may have been much milder and recovery would have been much faster.

I find that the inflation of World War II may have had little impact on the real economy during the war, but that the large postwar inflation of the late 1940s substantially reduced the postwar tax burden. This debt debasement did not occur during the inflationary 1970s, however, when interest rates rose roughly one-for-one with inflation. It is hard to see any positive effects from the Fed's inflationary deviation from the 1970s, but this inflation may have had a significant cost in setting the stage for a disinflation that may have been costly in terms of lost output and employment.

These findings have implications for policy today. One is that since the financial crisis, monetary policy has been aimed at trying to prevent deflation at virtually all costs, and this policy has been motivated by the presumption that even a small deflation would be very depressing. This presumption is largely drawn from the 1930s experience with deflation. My findings suggest that this concern may be overstated, and that advancing inflationary monetary policies in order to avoid deflation may not be worth the cost of inducing an inflationary bias into monetary policy. Another implication is that historical deviations from price stability rules don't have obvious, quantitatively important benefits that

would extend to today's economy, but may have significant costs.

As in the past, very unusual economic conditions have led to Fed to deviate at least somewhat from rules-based policies since 2008. Thus far, this deviation to discretionary policy has not produced deviation from price stability. However, it is a challenge to see that these policies have significantly increased economic activity. In particular, the employment/population ratio is about 7 percent below its level from 2006, and has recovered very little from its 2009 trough. In terms of productivity, output per worker in the business sector is growing at about half of its historical rate (1.1 percent growth vs. 2.5 percent average growth) since the second half of 2009. This suggests that a return to normal monetary policy rules may be useful, given that unconventional monetary policy appears to be having fairly limited positive impact on economic performance.

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TABLE 1: DEFLATION AND OUTPUT

Depression of 1921-1922 (1920=100)					Great Depression (1929=100)				
Year	P	Y	C	I	Year	P	Y	C	I
1921	85.2	93.9	102.4	86.1	1930	97.5	86.9	90.0	73.2
1922	80.6	96.2	102.7	114.4	1931	88.5	77.6	84.3	48.5
					1932	79.5	64.0	74.3	26.7
					1932	77.5	60.9	70.8	23.0

Figure 1 - M1, CPI, and Industrial Production at Start of Depression

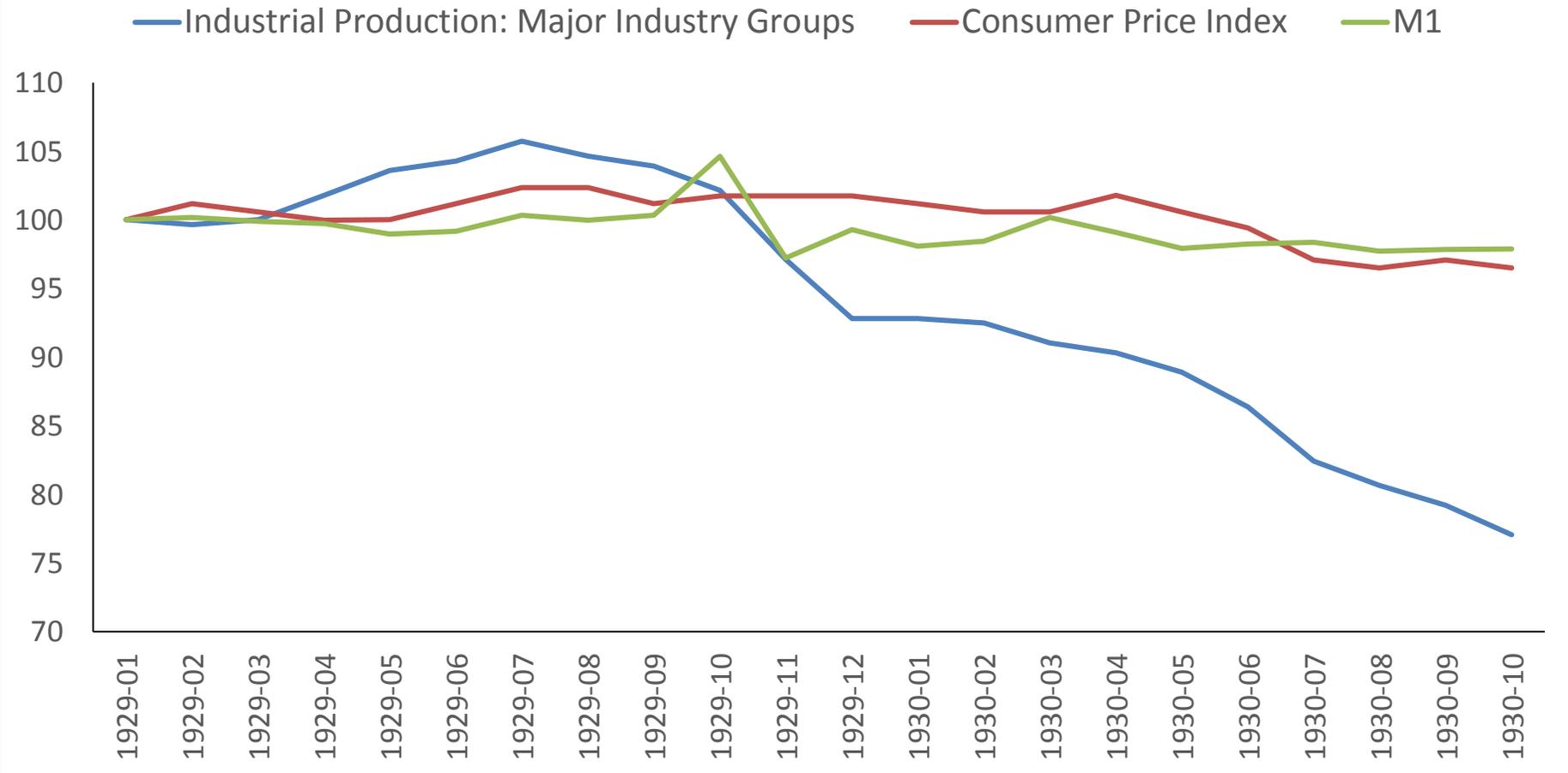
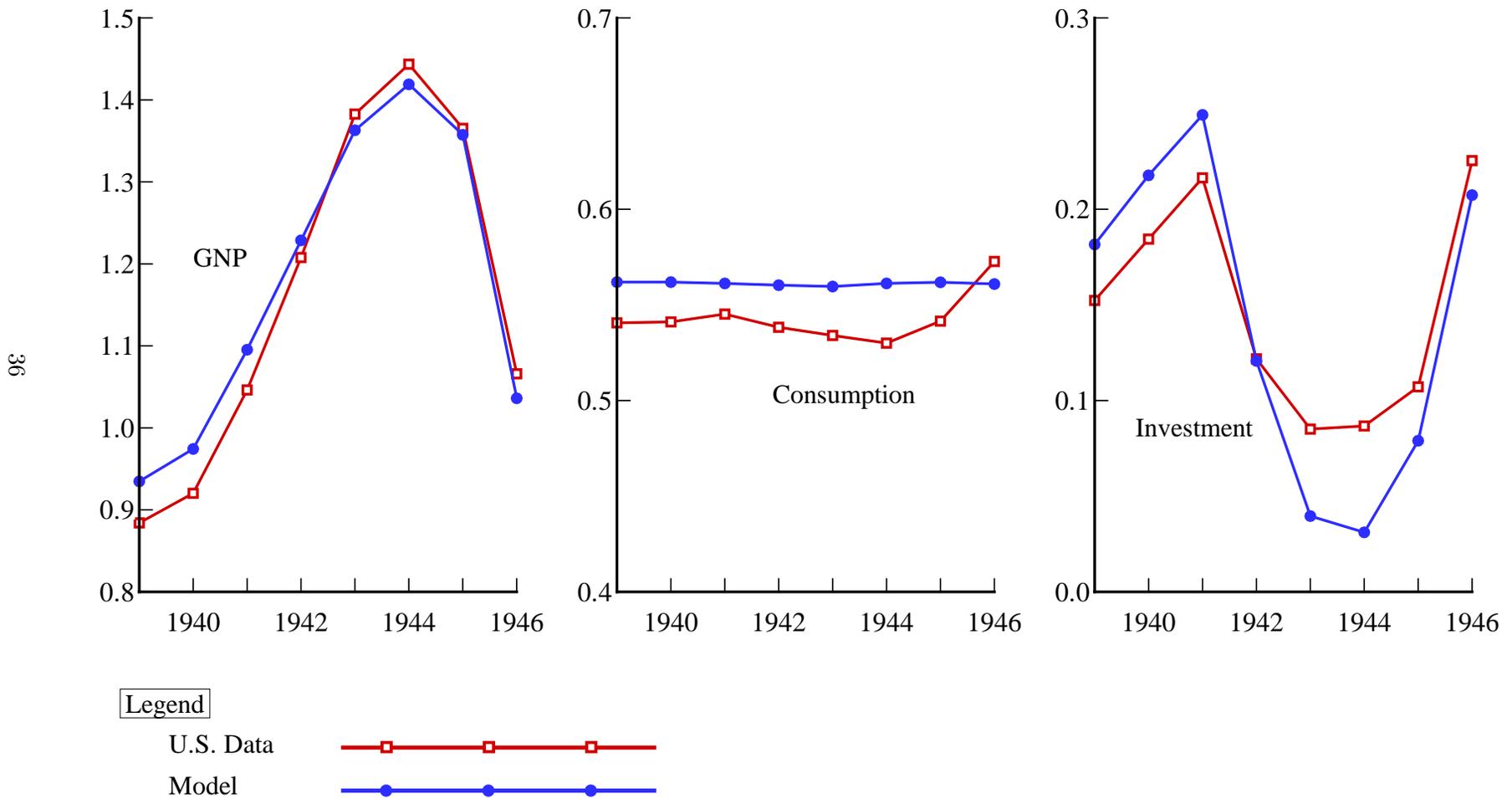


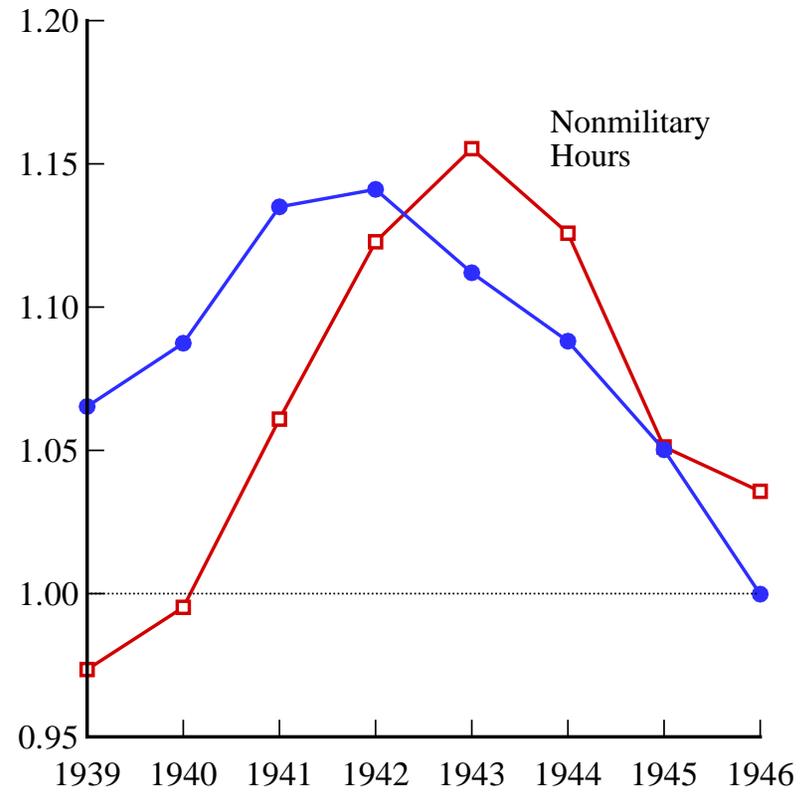
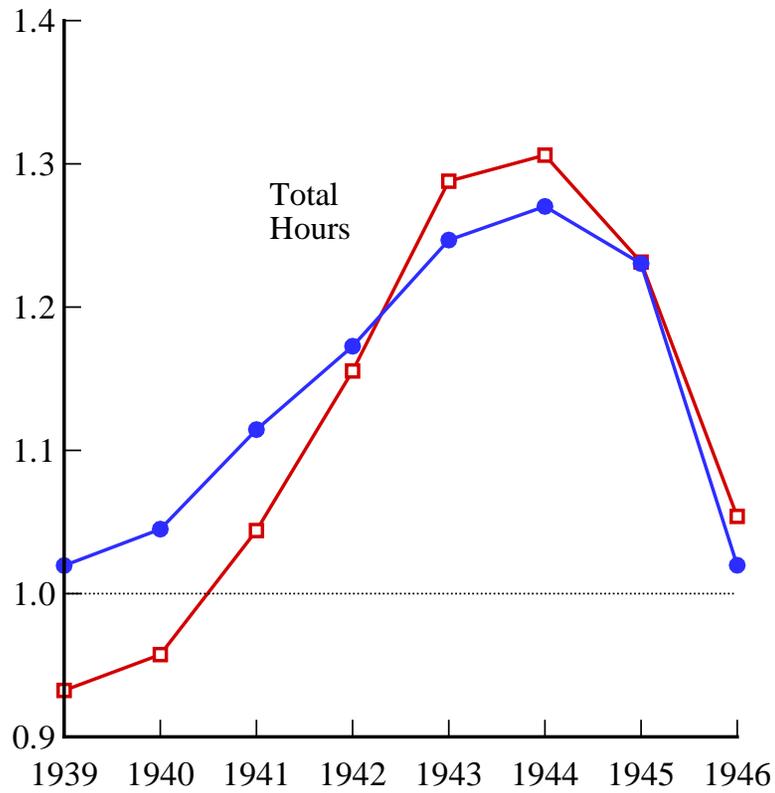
Figure 2. Real Detrended GNP, Private Consumption, and Private Investment, 1939–1946
(Benchmark Deterministic Model)



Note: Data series are divided by the 1946 real detrended level of GNP less military compensation.

Figure 3. Per Capita Total and Nonmilitary Hours of Work, 1939–1946
(Benchmark Deterministic Model)

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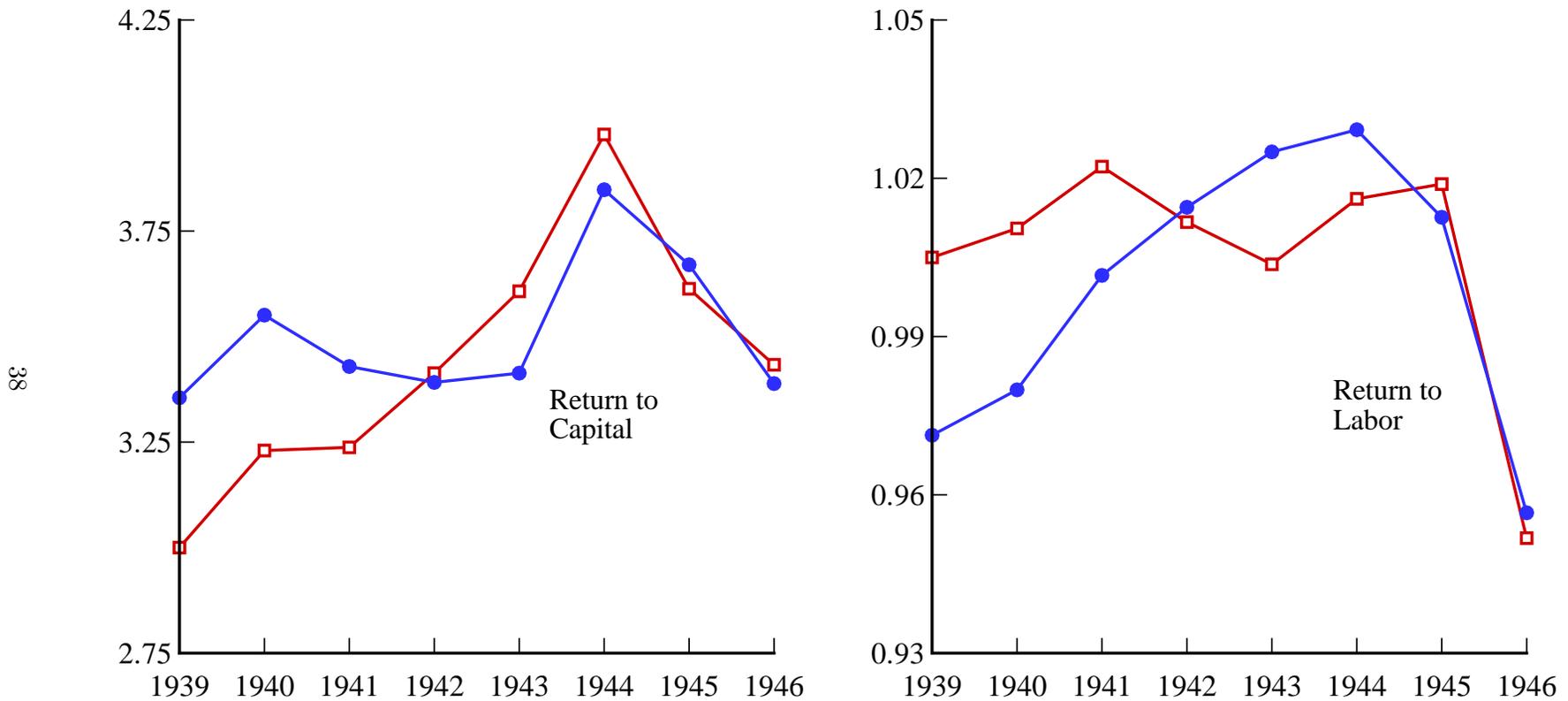


Legend

- U.S. Data —□—
- Model —●—

Note: Hours series are divided by the 1946–1960 U.S. averages.

Figure 4. After-tax Returns to Capital and Nonmilitary Labor, 1939–1946
 (Benchmark Deterministic Model, All Series Constructed Using Marginal Productivities)



Legend

- U.S. Data —□—□—□—
- Model —●—●—●—

Note: Return to capital is equal to $100(1-\tau_k)(\theta Y/K-\delta)$.

Return to labor is after-tax nonmilitary labor productivity, with hours normalized by the 1946–1960 U.S. average.

Figure 5. U.S. Pre-tax Wage Rates and Prediction of Model with Labor Tax Rate Series Implying Nonmilitary Hours Are Equal in Model and Data, 1939–1946

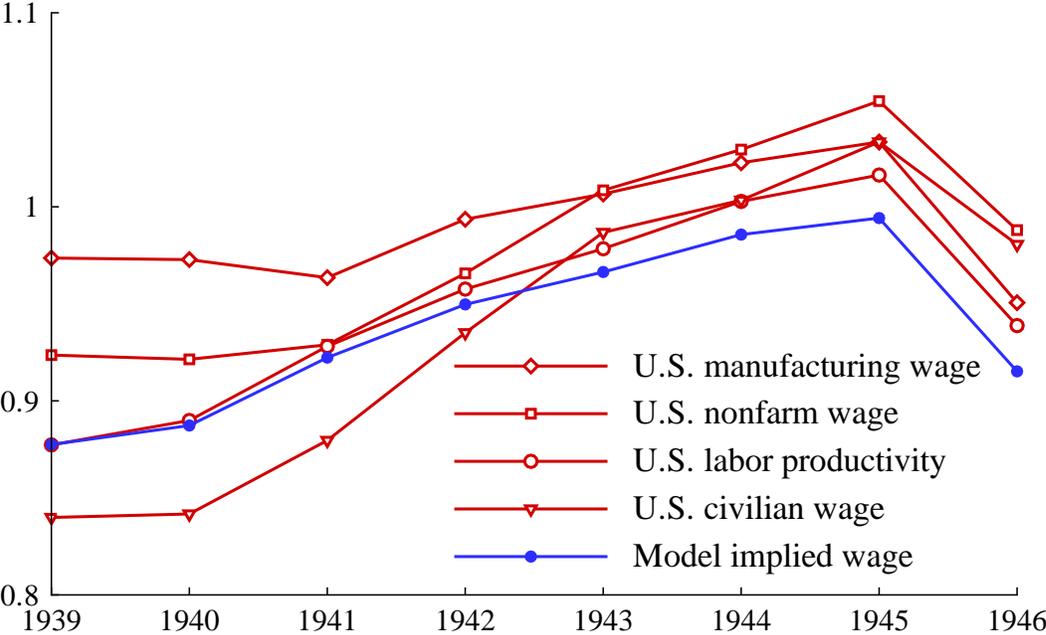


Figure 6 – Model Output with Productivity Shock and Labor Wedge

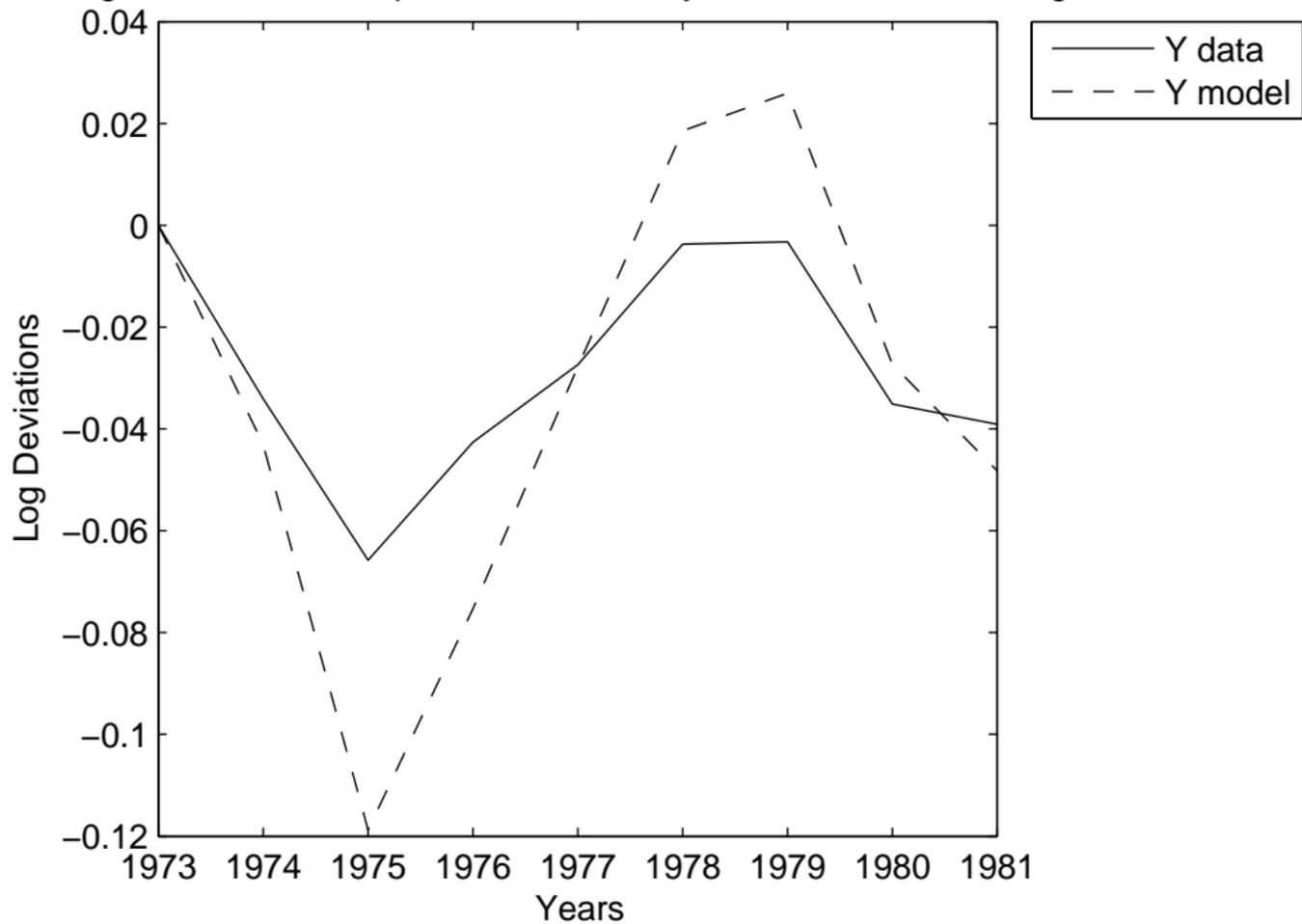


Figure 7 – Model Output with Productivity Shock

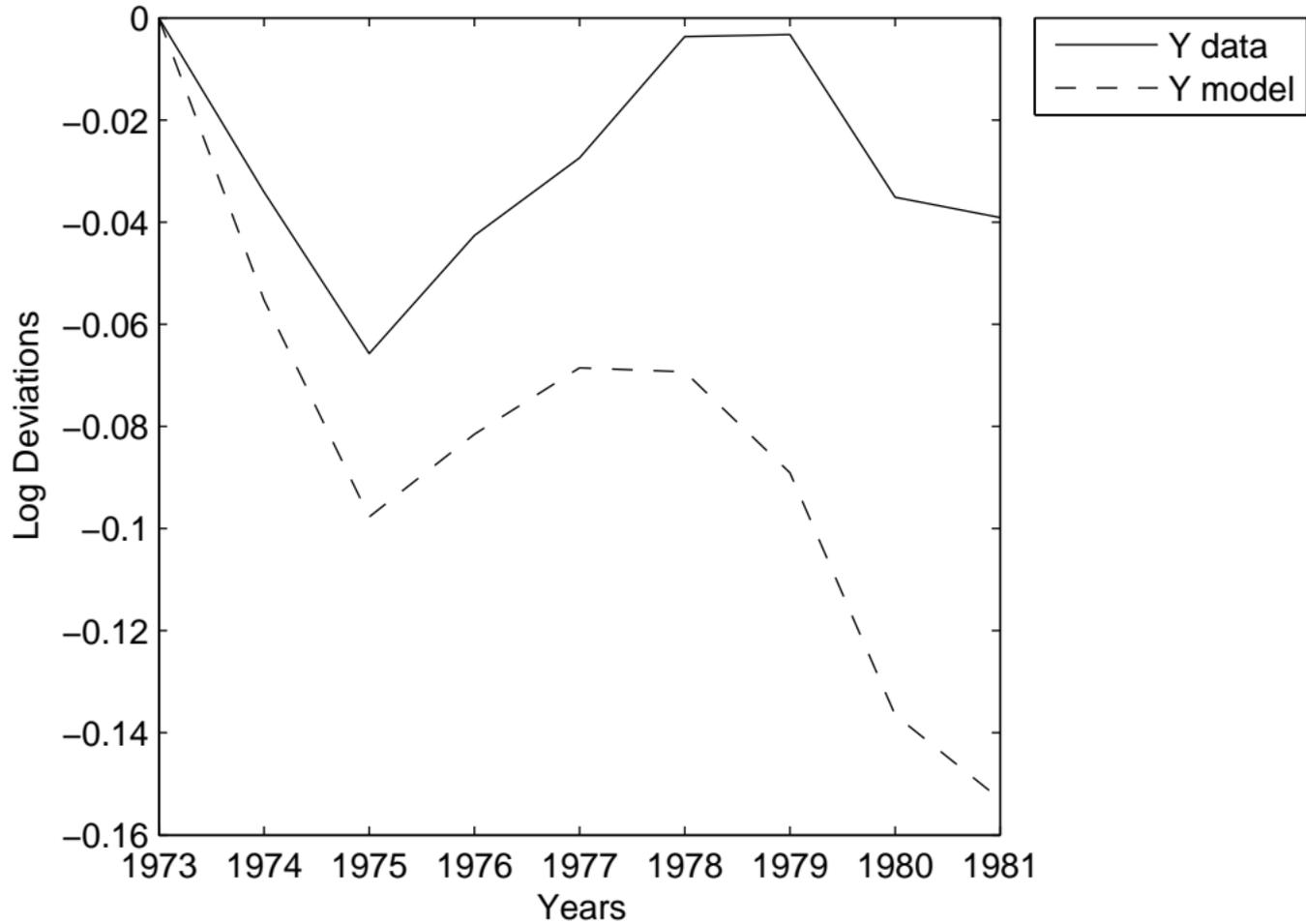


Figure 8 – Model Output with Labor Wedge

