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## WORKING PAPER

### **HAS THE FED BEEN A FAILURE?**

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Revised, December 2010.

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1000 Massachusetts Avenue, N.W.  
Washington, D.C. 20001

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## **Has the Fed Been a Failure?**

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November 9, 2010  
Revised: December 1, 2010

JEL Classifications: E30, E42, E52, E58

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## **ABSTRACT**

As the one-hundredth anniversary of the 1913 Federal Reserve Act approaches, we assess whether the nation's experiment with the Federal Reserve has been a success or a failure. Drawing on a wide range of recent empirical research, we find the following: (1) The Fed's full history (1914 to present) has been characterized by more rather than fewer symptoms of monetary and macroeconomic instability than the decades leading to the Fed's establishment. (2) While the Fed's performance has undoubtedly improved since World War II, even its postwar performance has not clearly surpassed that of its undoubtedly flawed predecessor, the National Banking system, before World War I. (3) Some proposed alternative arrangements might plausibly do better than the Fed as presently constituted. We conclude that the need for a systematic exploration of alternatives to the established monetary system is as pressing today as it was a century ago.

*“No major institution in the U.S. has so poor a record of performance over so long a period, yet so high a public reputation.” Milton Friedman (1988).*

## *I. Introduction*

In the aftermath of the Panic of 1907 the U.S. Congress appointed a National Monetary Commission. In 1910 the Commission published a shelf-full of studies evaluating the problems of the post-bellum National Banking system and exploring alternative regimes. A few years later Congress passed the Federal Reserve Act.

Today, in the aftermath of the Panic of 2007, and as the one-hundredth birthday of the Federal Reserve System approaches, it seems appropriate to once again take stock of our monetary system. Has our experiment with the Federal Reserve been a success or a failure? Does the Fed’s track record during its history merit celebration, or should Congress consider replacing it with something else? Is it time for a new National Monetary Commission?

The Federal Reserve has, by all accounts, been one of the world’s more responsible and successful central banks. But this tells us nothing about its absolute performance. To what extent has the Fed succeeded or failed in accomplishing its official mission? Has it ameliorated to a substantial degree those symptoms of monetary and financial instability that caused it to be established in the first place? Has it at least outperformed the system that it replaced? Has it learned to do better over time?

We address these questions by surveying available research bearing upon them. The broad conclusions we reach based upon that research are that (1) the full Fed period has been characterized by more rather than fewer symptoms of monetary and macroeconomic instability than the decades leading to the Fed’s establishment; (2) while the Fed’s performance has undoubtedly improved since World War II, even its postwar performance has not clearly surpassed that of its (undoubtedly flawed) predecessor; and (3) alternative arrangements exist that might do better than the presently constituted Fed has done. These findings do not prove that any particular alternative to the Fed would in fact have delivered

superior outcomes: to reach such a conclusion would require a counterfactual exercise too ambitious to fall within the scope of what is intended as a preliminary survey. The findings do, however, suggest that the need for a systematic exploration of alternatives to the established monetary system, involving the necessary counterfactual exercises, is no less pressing today than it was a century ago.

As far as we know the present study is the first attempt at an overall assessment of the Fed's record informed by academic research.<sup>1</sup> Our conclusions draw importantly on recent research findings, which have dramatically revised economists' indicators of macroeconomic performance, especially for the pre-Federal Reserve period. We do not, of course, expect the conclusions we draw from this research to be uncontroversial, much less definitive. On the contrary: we merely hope to supply *prima facie* grounds for a more systematic stock-taking.

In evaluating the Federal Reserve System's record in monetary policy, we leave aside its role as a regulator of commercial banks. Adding an evaluation of the latter would double an already large task. It would confront us with the problem of distinguishing areas where the Fed has been responsible for rule-making from those in which it has simply been the rule-enforcing agent of Congress. It would also raise the thorny problem of disentangling the Fed's influence from that of other regulators, because every bank the Fed regulates also answers to the FDIC and a chartering agency. Monetary policy, by contrast, is the Fed's responsibility alone.<sup>2</sup>

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<sup>1</sup> Although Martin Feldstein (2010, p. 134) recognizes that “[t]he recent financial crises, the widespread losses of personal wealth, and the severe economic downturn have raised questions about the appropriate powers of the Federal Reserve and its ability to exercise those powers effectively,” and goes on to ask whether and in what ways the Fed's powers ought to be altered, his conclusion that the Fed “should remain the primary public institution in the financial sector” (*ibid.*, p. 135) rests, not on an actual review of the Fed's overall record, but on his unsubstantiated belief that, although the Fed “has made many mistakes in the near century since its creation in 1913...it has learned from its past mistakes and contributed to the ongoing strength of the American economy.”

<sup>2</sup> Blinder (2010) argues that, *given* the premise that the Fed as presently constituted will continue to be responsible for conducting U.S. monetary policy, it ought also to have its role as a supervisor of “systematically important” financial institutions preserved and even strengthened. Goodhart and Schoenmaker (1995) review various arguments for and against divorcing bank regulation from monetary control.

## *II. The Fed's Mission*

According to the preamble to the original Federal Reserve Act of 1913, the Federal Reserve System was created “to furnish an elastic currency, to afford means of rediscounting commercial paper, to establish a more effective supervision of banking in the United States, and for other purposes.” In 1977 the original Act was amended to reflect the abandonment of the gold standard some years before, and the corresponding increase in the Fed’s responsibility for achieving macroeconomic stability. The amended Act makes it the Fed’s duty to “maintain long-run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates.” On its website the Board of Governors adds that the Fed also contributes to “better economic performance by acting to contain financial disruptions and preventing their spread outside the financial sector.”

These stated objectives suggest criteria by which to assess the Fed’s performance, namely, the relative extent of pre- and post-Federal Reserve Act price level changes, pre- and post-Federal Reserve Act output fluctuations and business recessions, and pre-and post-Federal Reserve Act financial crises. For reasons already given, we don’t attempt to address the Fed’s success at bank supervision.

## *III. Inflation*

The Fed has failed conspicuously in one respect: far from achieving long-run price stability, it has allowed the purchasing power of the U.S. dollar, which was hardly different on the eve of the Fed’s creation from what it had been at the time of the dollar’s establishment as the official U.S. monetary unit, to fall dramatically. A consumer basket selling for \$100 in 1790 cost only slightly more, at \$108, than its (admittedly very rough) equivalent in 1913. But thereafter the price soared, reaching \$2422 in 2008 (Officer and Williamson 2009). As the first panel of Figure 1 shows, most of the decline in the dollar’s purchasing power has taken place since

1970, when the gold standard no longer placed any limits on the Fed's powers of monetary control.

The highest annual rates of inflation since the Civil War also occurred under the Fed's watch. The high rates of 1973-5 and 1978-80 are the most notorious, though authorities disagree concerning the extent to which Fed policy was to blame for them.<sup>3</sup> Yet those inflation rates, in the low 'teens, were modest compared to annual rates recorded between 1917 and 1920, which varied from just below 15% to 18%, with annualized rates for some quarters occasionally approaching 40% (see Figure 1, third panel). Significantly, both of the major post-Federal Reserve Act episodes of inflation coincided with relaxations of gold-standard based constraints on the Fed's money creating abilities, consisting of a temporary gold export embargo from September 1917 through June 1919 and the permanent closing of the Fed's gold window in 1971.<sup>4</sup>

Although the costs of price level instability are hard to assess, the reduced stability of prices under the Fed's tenure has certainly not been costless. As the Board of Governors itself has observed (Board of Governors, 2009),

[s]table prices in the long run are a precondition for maximum sustainable output growth and employment as well as moderate long-term interest rates. When prices are stable and believed to remain so, the prices of goods, services, materials, and labor are undistorted by inflation and serve as clearer signals and guides to the efficient allocation of resources ... .

Moreover, stable prices foster saving and capital formation, because when the

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<sup>3</sup> Because these were episodes not merely of inflation but of stagflation, they are frequently said to have depended crucially on adverse aggregate supply shocks triggered by OPEC oil price increases. This "traditional" explanation has, however, been cogently challenged by Robert Barsky and Lutz Kilian (2001) (see also Ireland 1999 and Chappell and McGregor 2004), who concludes "that in substantial part the Great Stagflation of the 1970s could have been avoided, had the Fed not permitted major monetary expansions in the early 1970." Blinder and Rudd (2008) have in turn written in defense of the "traditional" perspective.

<sup>4</sup> World War II was also a period of substantial inflation, though this fact is somewhat obscured by standard (BLS) statistics, which do not fully correct for the presence of price controls. Friedman and Schwartz (1982, p. 106) place the cumulative distortion in the wartime Net National Product deflator at 9.4%, while Rockoff and Mills (1987, pp. 201-3) place it between that value and 4.8%.

risk of erosion of asset values resulting from inflation—and the need to guard against such losses—are minimized, households are encouraged to save more and businesses are encouraged to invest more.

More specifically, as Ben Bernanke (2006, p. 2) observed in a lecture several years ago, besides reducing the costs of holding money, stable prices

allow people to rely on the dollar as a measure of value when making long-term contracts, engaging in long-term planning, or borrowing or lending for long period. As economist Martin Feldstein has frequently pointed out, price stability also permits tax laws, accounting rules, and the like to be expressed in dollar terms without being subject to distortions arising from fluctuations in the value of money.

Feldstein (1997) had in fact reckoned the recurring welfare cost of a *steady* inflation rate of just 2%—costs stemming solely from the adverse effect of inflation on the real net return to saving—at about 1% of GNP.<sup>5</sup>

As Bernanke's remarks suggest, *unpredictable* changes in the price level have greater costs than predictable changes. Benjamin Klein (1975) observed that, although the standard deviation of the rate of inflation was only a third as large between 1956 and 1972 as it had been from 1880 to 1915, inflation had also become much more persistent. The price *level* had consequently become less rather than more predictable since the Fed's establishment. Robert Barsky (1987) reported in the same vein that, while quarterly U.S. inflation could be described as a white-noise process from 1870-1913, it was positively serially correlated from 1919 to 1938 and from 1947 to 1959 (when the Fed was constrained by some form of gold

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<sup>5</sup> Lucas (2000), in contrast, put the annual real income gain from reducing inflation from 10% to zero at slightly *below* 1 percent of GNP. The difference stems from Lucas's having considered inflation's effect on money demand only, while overlooking its influence on effective tax rates, which play an important part in Feldstein's analysis. Leijonhufvud (1981) and Horwitz (2003) discuss costs of inflation, including those of "coping" with high inflation environments and those connected to inflation's tendency to distort relative prices, that elude measurement and are for that reason overlooked by both Feldstein and Lucas.



standard), and has since become a random walk. These findings suggest that, as the Fed gained greater control over long-run price level movements, those movements became increasingly difficult to forecast.

Our own estimates from an ARMA (1,1) model yield conclusions similar to Klein's. Although the standard deviation of inflation was greater before the Fed's establishment than it has been since World War II, the postwar inflation process includes a large (that is, above 0.9) autoregressive component, whereas that component was small and negative before 1915 (see Table 1).<sup>6</sup> Relatively small postwar inflation-rate innovations have consequently been associated with relatively large steady-state changes in the price level (see Figure 2). A GARCH (1,1) model of the errors from the ARMA model accordingly reveals a stark difference between the conditional variance of the inflation process before and since the Fed's establishment, with almost no persistence in the variance of inflation prior the Fed's establishment, and a very high degree of persistence afterwards, and especially since the closing of the Fed's gold window (Table 1, second panel).<sup>7</sup> Lastly, by treating six-year rolling standard deviations for quarterly inflation and price-level series as proxies for the uncertainty associated with each, we confirm Klein's finding that, while the rate of inflation has tended to become more predictable as inflation has become more persistent, forecasting future price levels has generally become more difficult, with the degree of difficulty increasing with the

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<sup>6</sup> These findings are based on Balke and Gordon's (1986) quarterly GNP deflator estimates spliced to the Department of Commerce deflator series in the fourth quarter of 1946. Hanes (1999) argues that pre-Fed deflator estimates understate somewhat the serial correlation of pre-Fed inflation, while overstating the volatility of pre-Fed inflation, owing to their disproportionate reliance upon (relatively pro-cyclical) prices of "less-processed" goods.

<sup>7</sup> The coefficient on the ARCH(1) term for the pre-Fed period is not significantly different from zero. In the event that it is indeed zero, the GARCH(1) coefficient is not identified.

Although Cogley and Sargent (2002) and several other researchers reported a decline in the persistence of inflation coinciding with the beginning of the Great Moderation, Pivetta and Reis (2007, p. 1354), using a more flexible, non-linear Bayesian model of inflation dynamics and several different measures of persistence, find "no evidence of a change in [inflation] persistence in the United States" since 1965, save for "a possible short-lived change during the 1982-1983 period."

forecast horizon (Figure 3). The conditional variances implied by the GARCH model are shown in Figure 4.<sup>8</sup>

The last panel of Figure 4 makes it especially easy to appreciate why corporate securities of very long (e.g. 100-year) maturities, which were common in decades just prior to the passage of the Federal Reserve Act, have become much less common since. To the extent that its policies discouraged the issuance of longer-term corporate debt, the Fed can hardly be credited with achieving “moderate long-term interest rates.”<sup>9</sup>

#### *IV. Deflation*

While it has failed to prevent inflation, the Fed has also largely succeeded, since the Great Depression, in eliminating deflation, which was a common occurrence under the pre-Fed, post Civil War U.S. monetary system. Between 1870 and 1896, for example, U.S. prices fell 37%, or at an average annual rate of 1.2% (Bordo *et al.* 2004, and Figure 1, panel 2).

The postwar eradication of deflation would count among the Fed’s achievements were deflation always a bad thing. But is it? Many economists appear to assume so. But a contrasting view, supported by a number of recent studies, holds that deflation may be either harmful or benign depending on its underlying cause. Harmful deflation—the sort that goes hand-in-hand with depression—results from a contraction in overall spending or aggregate demand for goods in a world of sticky prices. As people try to rebuild their money balances they

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<sup>8</sup> Concerning the difficulty of forecasting inflation in recent years especially see Stock and Watson (2007).

<sup>9</sup> For more recent and international evidence of the negative effect of inflation on firm debt maturity see Demirgüç-Kunt and Maksimovic (1999). As one might expect, the post-1983 “Great Moderation” (discussed further below) revitalized some previously moribund markets for very long term corporate debt. Thus Disney’s 1993 “Sleeping Beauty Bonds” became the first 100-year bonds to be issued since 1954. The more recent decline in U.S. Treasury bond yields has also added to the attractiveness of very long-term corporate debt. Indeed, on August 24, 2010, Norfolk Southern managed to sell \$250 million worth of century bonds bearing a record low yield of just 5.95 percent, despite the risks involved. Still many investors remained skeptical. As one portfolio manager opined (*Financial Times* August 24, 2010), “You are giving a company money for a long period of time with no ability to foresee the conditions in that period of time and for a very low interest rate.”

spend less of their income on goods. Slack demand gives rise to unsold inventories, discouraging production as it depresses equilibrium prices. Benign deflation, by contrast, is driven by improvements in aggregate supply—that is, by general reductions in unit production costs—which allow more goods to be produced from any given quantity of factors and which are therefore much more likely to be quickly and fully reflected in corresponding adjustments to actual (and not just equilibrium) prices.<sup>10</sup>

Historically, benign deflation has been the far more common type. Surveying the 20<sup>th</sup>-century experience of 17 countries, including the United States, Atkeson and Kehoe (2004, p. 99) find “many more periods of deflation with reasonable growth than with depression, and many more periods of depression with inflation than with deflation.” Indeed, they conclude “that the *only* episode in which there is evidence of a link between deflation and depression is the Great Depression (1929-1934).” This finding stands in stark contrast with the more common view exemplified by Ben Bernanke’s (2002a) assertion, in a speech aimed at justifying the Fed’s low post-2001 funds target, that “Deflation is in almost all cases a side effect of a collapse in aggregate demand—a drop in spending so severe that producers must cut prices on an ongoing basis in order to find buyers.”

Atkeson and Kehoe’s arresting conclusion depends on their having looked at inflation and output growth statistics averaged across five-year time intervals and over a sample of 17 countries. There have in fact been other 20<sup>th</sup>-century instances in which deflation coincided with recession or depression in individual countries over shorter time intervals. In the U.S. this was certainly the case, for example, during the intervals 1919-1921, 1937-1938, 1948-1949 (Bordo and Filardo 2005, pp. 814-19), and, most recently, 2008-2009. It remains true, nonetheless, that taking both 19<sup>th</sup> and 20<sup>th</sup>-century experience into account, it is, as Bordo and Filardo (*ibid.*,

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<sup>10</sup> Selgin (1997) presents informal arguments for permitting benign (productivity-driven) deflation, while Edge, Laubach, and Williams (2007), Schmidt-Grohé and Uribe 2007, and Entekhabi (2008) offer formal arguments. For the history of thought regarding benign deflation see Selgin (1996).

p. 834) observe, “abundantly clear that deflation need not be associated with recessions, depressions, and other unpleasant conditions.”

Although the classical gold standard made deflation far more common before the Fed’s establishment than afterwards, episodes of “bad” deflation were actually less common under that regime than they were during the Fed’s first decades (ibid., p. 823). Benign deflation was the rule: downward price level trends, like that of 1873-1896, mainly reflected strong growth in aggregate supply. Occasional financial panics did, however, give rise to brief episodes of bad deflation. We take up below the question of whether the Fed has succeeded in mitigating such panics.<sup>11</sup>

Taking these findings into account, the Fed’s record with respect to deflation does not appear to compensate for its failure to contain inflation. It has, on the one hand, practically extinguished the benign sort of deflation, replacing it with persistent inflation that masks the true progress of productivity. On the other hand, it bears some responsibility for several of the most severe episodes of harmful deflation in U.S. history.

#### *V. Volatility of Output and Unemployment*

If the Fed has not used its powers of monetary control to avoid undesirable changes in the price level, has it at least succeeded in stabilizing real output? Few claim that it did so during the interwar period, which was by all accounts the most turbulent in U.S. economic experience.<sup>12</sup> In fact, according to the standard (Kuznets-Kendrick) historical GNP series, thanks to that turbulent interval the cyclical volatility of real output (as measured by the standard deviation of GNP from its Hodrick-Prescott filter trend) has been somewhat greater throughout the full Fed sample period than it was during the pre-Fed (1869-1914) period.

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<sup>11</sup> The predominance of benign over harmful deflation appears to have been still more marked in the UK and Germany, owing perhaps to those countries’ less crisis-prone banking systems (Bordo, Lane, and Redish 2003).

<sup>12</sup> On the volatility of macroeconomic series during the interwar period see especially Miron (1989), who, comparing the quarter centuries before and after the Fed’s founding, finds that stock prices, inflation, and the growth rate of output all became considerably more volatile, while average growth declined, and concludes that “the deterioration of the performance of the economy after 1914 can be attributed directly to the actions of the Fed.”

The same data also support the common claim (e.g. Burns 1960; Bailey 1978; De Long and Summers 1986; Taylor 1986) that the Fed has made output considerably more stable since WWII than it was before 1914 (Table 2, row 1 and Figure 5, first panel). Christina Romer's (1986a, 1989, 2009) influential work has, however, cast doubt even on this more attenuated claim. According to her, the Kuznets-Kendrick pre-1929 real GNP estimates overstate the volatility of pre-Fed output relative to that of later periods, in part because they are based on fewer component series than later estimates and because they conflate nominal and real values, but mainly because the real component series are almost exclusively for commodities, the output of which is generally much more volatile than that of other kinds of output. From 1947 to 1985, for example, commodity output as a whole was about two and a third times more volatile than real GNP.

According to Romer's own pre-1929 GNP series, which relies on statistical estimates of the relationship between total and commodity output movements (instead of Kuznets' naïve one-to-one assumption), the cyclical volatility of output prior to the Fed's establishment was actually lower than it has been throughout the full (1915-2009) Fed era (Table 2, row 2 and Figure 5, second panel). More surprisingly, pre-Fed (1869-1914) volatility (as measured by the standard deviations of output from its H-P trend) was also lower than post-World War II volatility, though the difference is slight.<sup>13</sup>

Complementary revisions of historical unemployment data by Romer (1986b) and J.R. Vernon (1994a), displayed here in Figure 6, likewise suggest that the post-1948 stabilization of unemployment apparent in Lebergott's (1964) standard series is an artifact of the data. Because Vernon's revised unemployment series is based on the Balke-Gordon (1986) real GNP series, which is more volatile than Romer's GNP series, and because his series includes the relatively volatile 1870s, Vernon

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<sup>13</sup> By looking at standard deviations of output after applying the Hodrick Prescott filter, rather than simply looking at the standard deviation of the growth rate of output, we allow for gradual changes in the sustainable or "potential" growth rate of real output, and thereby hope to come closer to isolating fluctuations in output traceable to monetary disturbances. Concerning the general merits of the Hedrick-Prescott filter relative to other devices for isolating the cyclical component of GNP and GDP time series see Baxter and King (1999).

finds a somewhat larger difference between 19<sup>th</sup> century and postwar unemployment volatility than that reported by Romer. Nevertheless he finds that his estimates “indicate depressions for the 1870s and 1890s which are appreciably less severe than the depressions perceived for these periods by economists such as Schumpeter and Lebergott” (ibid., p. 707).

Romer’s revisions have themselves been challenged by others, however, including Zarnowitz (1992, pp. 77-79) and Balke and Gordon (1989).<sup>14</sup> The last-named authors used direct measures of construction, transportation, and communication sector output during the pre-Fed era, along with improved consumer price estimates, to construct their own historic GNP series. According to this series, the standard deviation of real GNP from its H-P trend for 1869 to 1914 is 4.27%, which differs little from the standard-series value of 5.10%. Balke and Gordon’s findings thus appear to vindicate the traditional (pre-Romer) view (Table 2, row 3, and Figure 5, third panel).

More recent work helps to resolve the contradictory findings of Romer on one hand and Balke and Gordon on the other. Rather than rely on conventional aggregation procedures to construct historic (pre-1929) real GDP estimates, Ritschl, Sarferaz and Uebele (2008) employ “dynamic factor analysis” to uncover a latent common factor capturing the co-movements in 53 time series that have been consistently reported since 1867. According to their benchmark model, which assumes that the coefficients (“factor loadings”) relating individual series to the latent factor are constant, there was in fact “no change in postwar volatility relative to the prewar [that is, pre-World War I] period” (ibid., p. 7). Allowing instead for

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<sup>14</sup> Although Zarnowitz (1992, p. 78) agrees that, because they are based on “cyclically sensitive” series, the standard (Kuznets-Kendricks) GNP estimates “exaggerate the fluctuations in the economy at large,” he claims that, in deriving her own estimates by “simply imposing recent patterns on the old data,” Romer “precludes any possibility of stabilization, thus making her conclusion inevitable and prejudging the issue in question.” Rhode and Sutch (2006, p. 15) repeat the same criticism. But Romer’s method does not rule out the possibility of stabilization any more than that used in deriving the standard series does: both approaches take for granted a constant ratio of commodity output volatility to general output volatility. The difference is that, while Romer estimates the constant, Kuznets implicitly assumed a value of one. That Romer’s estimate necessarily reflects postwar structural relationships hardly renders her approach more restrictive than, much less inferior to, Kuznets’s.

time-varying factor loadings (and hence for gradual structural change), Ritschl *et al.* find that post-WWII volatility was a third *greater* than pre-Fed volatility (*ibid.*, p. 29, Table 1). These findings reinforce Romer's conclusions.<sup>15</sup> But Ritschl *et al.* are also able to reproduce Balke and Gordon's postwar moderation using a common factor based on their non-agricultural real time series only, which resemble the series Balke and Gordon rely upon for their GNP estimates. Here again, the moderation vanishes if factor loadings are allowed to vary. Balke and Gordon's finding of a substantial reduction in post-WWII output volatility relative to pre-Fed volatility thus appears to depend on their focus on industrial output and implicit assumption that the relative importance of different components of that output hasn't changed.

Even if one accepts the Balke-Gordon GNP estimates, it does not follow that the Fed deserves credit for (belatedly) stabilizing real output. It may be that aggregate supply shocks, the real effects of which monetary policy is unable to neutralize, were relatively more important before 1914 than they have been since World War II. The effects of this reduced role for supply shocks might then be misinterpreted as evidence of the Fed's success in limiting output variations by stabilizing aggregate demand.

Using the Balke-Gordon output series, John Keating and John Nye (1998) estimate a bivariate vector autoregression (VAR) model of inflation and output growth for the U.S. over the periods 1869 to 1913 and 1950 to 1994. They then identify aggregate demand and supply shocks by assuming, in the manner of Blanchard and Quah (1989), that supply shocks alone have permanent real effects, which allows them to decompose the variance of output into separate supply- and demand-shock components. Doing so they find that aggregate supply shocks were of overwhelming importance in the earlier period, accounting for 95% of real output's conditional forecast error variance at all horizons (Keating and Nye, Table 3, p. 246). During the post-World War II period, in contrast, the fraction of output's

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<sup>15</sup> The findings are, as one might expect, robust to the exclusion of nominal time series from the study.

forecast error variance attributable to supply shocks has been just 5% at a one-year horizon, rising to only 68% after a full decade (*ibid.*, Table 2, p. 240).

Keating and Nye (1998) themselves, however, question the validity of these findings because, according to their identification scheme, a positive pre-Fed “supply” shock causes the price level to increase rather than to decline. But this seemingly “perverse” comovement may simply reflect the tendency, under the international gold standard regime, for supply shocks involving exportable commodities, such as cotton, to translate into enhanced exports and thus into increased gold inflows (see Davis, Hanes, and Rhode 2009). A more recent study by Michael Bordo and Angela Redish (2004) allows for this possibility by extending the Keating-Nye model to include a measure of the pre-Fed money stock and by assuming that the price level is uninfluenced in the long run by either aggregate supply or aggregate demand shocks at the national level—an assumption consistent with the workings of the international gold standard. According to their estimates, which again rely upon Balke and Gordon’s quarterly output data, aggregate supply shocks accounted for 89% of pre-Fed output variance at a one-year horizon and for almost 80% of such variance after ten years. These findings differ little from Keating and Nye’s for the pre-Fed period.

Bordo and Redish examine the pre-Fed era only, and so do not offer a consistent comparison of it with the post-World War II era. To arrive at such a comparison, while shedding further light on the Fed’s contribution to postwar stability, we constructed a VAR model allowing for four distinct macroeconomic shocks—to aggregate supply, the IS schedule, money demand, and the money supply—which are identified using different and plausible identifying restrictions for the pre-Fed and post-World War II sample periods. Using this model (and relying once again on the Balke-Gordon GNP estimates) we find that aggregate supply shocks account for between 81 and 86 percent of the forecast error variance of pre-Fed output up to a three-year horizon, as opposed to less than 42% of the



variance after World War II (Table 3).<sup>16</sup> In terms familiar from recent discussions of the causes of the post-1983 “Great Moderation” in output volatility (discussed below), our findings suggest that the post-WWII period taken as a whole enjoyed better “luck” than the pre-Fed period.

Our model also shows no clear improvement after World War II in the dynamic response of output to aggregate demand shocks. Whereas one might expect the Fed, in its role as output stabilizer, to tighten the money supply in the face of positive IS (spending) shocks and to expand it in response to positive shocks to money demand, the response functions we estimate indicate instead that the Fed has tended to *expand* the money stock in response to IS shocks, causing larger and more persistent deviations of output from its “natural” level than would have occurred in response to similar shocks during the pre-Fed period (Figure 7, left-hand-side panels). At the same time, the Fed was *less* effective than the classical gold standard had been in expanding the money supply in response to unpredictable reductions in money’s velocity.

Fiscal stabilizers, whether “automatic” or deliberately aimed at combating downturns, are also likely to have contributed to reduced output volatility since the Fed’s establishment, when state and federal government expenditures combined constituted but a fifth as large a share of GDP as they did just before the recent burst of stimulus spending (Figure 8). Thus DeLong and Summers (1986) claim that the decline in U.S. output volatility between World War II and the early 1980s was due not to improved monetary policy but to the stabilizing influence of progressive taxation and countercyclical entitlements. Subsequent research (e.g. Gali 1994; Fatas and Mihov 2001; Andres, Domenech and Fatas 2008; and Mohanty and Zampolli 2009) documents a pronounced (though not necessarily linear) relationship between government size and the volatility of real output. According to

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<sup>16</sup> For details see Lastrapes and Selgin (2010). Numerous other studies employing a variety of identification schemes, also find that demand shocks have been of overwhelming importance during the post-World War II period. See for example, Blanchard and Watson (1986), Blanchard and Quah (1989), Hartley and Whitt (2003), Ireland (2004), and Cover, Enders, and Hueng (2006). A notable exception is Gali (1992) who, using a combination of short- and long-run identifying restrictions, finds that supply shocks were more important. None of these studies examines the pre-Fed period.

Mohanty and Zampoli, a 10% increase in the government's share of GDP was associated with a 21% overall decline in cyclical output volatility for 20 OECD countries during 1970-1984.<sup>17</sup>

Fiscal stabilizers appear, on the other hand, to have played no significant part in the post-1984 decline in output volatility (as well as in both the average rate and the volatility of inflation) known as the "Great Moderation." Consequently that episode seems especially likely to reflect a genuine if belated improvement in the conduct of monetary policy. We next turn to research concerning that possibility.

## *VI. The "Great Moderation"*

The beginning of Paul Volcker's second term as Fed Chairman coincided with a dramatic decline in the volatility of real output that lasted through the Greenspan era. Annual real GDP growth, for example, was less than half as volatile from 1984 to 2007 as it was from 1959 to 1983. The inflation rate, having been reduced to lower single digits, also became considerably less volatile. Many, including Blinder (1998), Romer (1999), Sargent (1999) and Bernanke (2004), have regarded this "Great Moderation" of inflation and real output as evidence of a substantial improvement in the Fed's conduct of monetary policy—a turn to what Blinder (1998, p. 49) terms "enlightened discretion."<sup>18</sup> Bernanke, conceding that the high inflation in the 1970s and early 1980s was largely due to excessive monetary expansion aimed at trying to maintain a below-natural rate of unemployment, argues similarly that Fed authorities learned over the course of that episode that they could not exploit a stable Phillips curve, while Romer (1999, p. 43) claims that after the early 1980s the Fed "had a steadier hand on the macroeconomic tiller" (Romer 1999, p. 43).

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<sup>17</sup> While government size is generally negatively correlated with the volatility of output growth, it also appears to be negatively correlated with output growth itself. Thus Afonso and Furceri (2008) find, based on estimates for the period 1970-2004, that for the OECD countries a one percentage point increase of the share of government expenditure to total GDP was associated with a .12 percentage point decline in real per capita growth. To this extent at least automatic stabilizers appear to be a poor substitute for a well-working monetary regime.

<sup>18</sup> See also Clarida, Gali, and Gertler (2000).

The “enlightened discretion” view has, however, been challenged by statistical studies pointing to moderating forces other than improved monetary policy.<sup>19</sup> A study by Stock and Watson (2002, p. 200; see also *idem.* 2005) attributes between 75% and 90% of the Great Moderation in U.S. output volatility to “good luck in the form of smaller economic disturbances” rather than improved monetary policy. Subsequent research has likewise tended to downplay the contribution of improved monetary policy, either by lending support to the “good luck” hypothesis or by attributing the Great Moderation to financial innovations, an enhanced “buffer stock” role for manufacturing inventories, an increase in the importance of the service sector relative to that of manufacturing, a change in the age composition of the U.S. population, and other sorts of structural change.<sup>20</sup> As usual, there are exceptions, prominent among which is the study of Gali and Gambetti (2009), which finds that improved monetary policy, consisting of an increased emphasis on inflation targeting in setting the federal funds target, did play an important part in the Great Moderation.

Most authorities do attribute the substantial decline in both the mean rate of inflation and in inflation volatility since the early 1980s to improved monetary policy. Yet even here the contribution of enlightened monetary policy may be less than it appears to be: according to Barro and Gordon’s (1983) theory of monetary policy in the presence of a time-inconsistent temptation to improve current-period real outcomes using surprise inflation, the higher the natural rate of unemployment, the greater the inflationary bias in the conduct of monetary policy,

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<sup>19</sup> Bernanke himself offered his thesis as a plausible conjecture only, without attempting to test it against alternatives.

<sup>20</sup> See, among many other works on the topic, McConnell and Perez-Quiros (2000), Ahmed, Levin, and Wilson (2004), Alcalá and Sancho (2004), Irvine and Schuh (2005), Dynan, Elmendorf, and Sichel (2006), Sims and Zha (2006), Arias, Hansen, and Ohanian (2007), Leduc and Sill (2007), Davis and Kahn (2008), Jaimovich and Siu (2009), Liu, Waggoner, and Zha (2009), Fernández-Villaverde, Guerrón-Quintana, and Rubio-Ramírez (2010), and Moro (2010). Besides attributing the Great Moderation to a “fantastic concatenation of [positive output] shocks” rather than to improved policy the last of these studies reaches the more startling conclusions that “there is not much evidence of a difference in monetary policy among Burns, Miller, and Greenspan,” and that, had Greenspan been in command in 70s, a somewhat *greater* rate of inflation would have been observed (*ibid.*, pp. 4 and 33).

other things equal. According to Ireland (1999) and to Chappell and McGregor (2004), both the actual course of inflation in the 1970s and afterwards and the arguments on which the FOMC based its decisions conform to the predictions of the theory of time-inconsistent monetary policy.<sup>21</sup>

In the presence of supply shocks, moreover, the time-inconsistency framework implies that higher inflation will be accompanied by a more marked “stabilization bias,” and hence by greater inflation volatility. Richard Dennis (2003; see also Dennis and Söderström 2006) explains:

to damp the inflationary effect of the adverse supply shock, central bankers have to raise interest rates more today, generating more unemployment than they would if they could commit themselves to implement the tight policy that they promised. In this scenario, the effect of the time-inconsistency is called stabilization bias because the time-inconsistency affects the central banker's ability to stabilize inflation expectations and hence stabilize inflation itself. The stabilization bias adds to inflation's variability, making inflation more difficult for households, firms, *and* the central bank, to predict.

As Chappell and McGregor observe (2004, pp. 249-50), to the extent that the Great Moderation conforms with the predictions of the theory of time inconsistency, that moderation supplies no grounds for complacency about the Fed:

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<sup>21</sup> According to King and Morley's (2007) recent estimates, the natural rate of unemployment, having peaked at over 9% in 1983, fell to less than half that level by 2000. Earlier estimates of the natural rate show a similar pattern, though with smaller amplitude.

The argument summarized here is complemented by that of Orphanides and Williams (2005) and Primiceri (2006) to the effect that a combination of a heavy emphasis on activist employment stabilization and mistakenly low estimates of the natural rate of unemployment informed monetary policy decisions that led to double digit inflation in the 70s and early 80s. In the later 80s, in contrast, the natural unemployment rate was overestimated or at least no longer underestimated. See also Surico (2008). Of course these arguments don't by themselves rule out the possibility of negative *cyclical* movements in inflation that are independent of changes to the natural rate of unemployment, such as are likely to accompany a financial crisis like the recent one.

Policy-makers may have greater appreciation for the importance of maintaining price stability, but the fundamental institutions by which monetary policy decisions are made have not changed, nor has the broader political environment. Shocks similar to those that emerged in the 1970s could do so again. While Blinder (1997) would comfort us with the argument that the time inconsistency problem is no longer relevant, a more troublesome interpretation is possible. The current time-consistent equilibrium is more pleasant than the one prevailing in the 1970s, not just because the Fed is more enlightened, but also because of a fortunate confluence of exogenous and political forces.

Recent experience has, of course, made it all too evident that prior reports of the passing of macroeconomic instability were premature. According to Todd Clarke (2009, p. 5) statistics gathered since the outbreak of the subprime crisis reveal “a partial or complete reversal of the Great Moderation in many sections of the U.S. economy” (ibid., p. 7). Clarke himself, in what amounts to the flip-side of the Stock-Watson view, characterizes the reversal as a “period of very bad luck,” asserting (ibid, p. 25) that “once the crisis subsides ... improved monetary policy that occurred in years past should ensure that low volatility is the norm” (ibid., p. 27; compare Canarella *et al.* 2010). Those who believe, in contrast, that “luck” was no less important a factor in the moderation as it has been in the recent reversal, or who (like Taylor 2009a) see the subprime crisis itself as a byproduct of irresponsible Fed policy, are unlikely to share Clarke’s optimism.

### *VII. Frequency and Duration of Recessions*

Some of the hazards involved in attempting to compare pre- and post-Federal Reserve Act measures of real volatility can be avoided by instead looking at the frequency and duration of business cycles. Doing so, Francis Diebold and Glenn Rudebusch (1992, pp. 993-4) observe, “largely requires only a qualitative sense of

the direction of general business activity” while also allowing one to draw on indicators apart from those used to construct measures of aggregate output.

The conventional (NBER) business cycle chronology suggests that contractions have been both substantially less frequent and substantially shorter on average, while expansions have been substantially longer on average, since World War II than they were prior to the Fed’s establishment. Because it is based on aggregate series that avoid the excessive volatility of conventional pre-Fed output measures (Romer 1994, p. 582 n.28), and because it only classifies contractions of some minimum duration and amplitude as business cycles, the chronology does in fact avoid some of the dangers involved in comparing pre-Fed and post-WWII output volatility.

The NBER’s chronology has nonetheless been faulted for seriously exaggerating both the frequency and the duration of pre-Fed cycles and for thereby exaggerating the Fed’s contribution to economic stability. According to Christina Romer (*ibid.*, p. 575), whereas the NBER’s post-1927 cycle reference dates are derived using data in levels, those for before 1927 are based on detrended data. This difference alone, Romer notes, results in a systematic overstatement of both the frequency and the duration of early contractions compared to modern ones.<sup>22</sup> The NBER’s pre-1927 indexes of economic activity, upon which its pre-Fed chronology depends, are also based in part on various nominal time series which (for reasons considered above) are a further source of bias (*ibid.*, p. 582; also Watson 1994).

Using both the Fed’s and an adjusted version of her and Jeffrey Miron’s indexes of industrial production (Miron and Romer 1990), Romer arrives at a new set of reference dates that “radically alter one’s view of changes in the duration of contractions and expansions over time” (*ibid.*, p. 601). According to this new

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<sup>22</sup> Decades before Romer, George W. Cloos (1963, p. 14) observed, in the course of a considerably more trenchant evaluation of the NBER’s business cycle dating methods, “that the gross national product and the Federal Reserve Board’s industrial production index are usable measures of general business activity and that peaks and troughs in these series are to be preferred to the Bureau’s peaks and troughs.”

chronology, although contractions were indeed somewhat more frequent before the Fed's establishment than after World War II (though not, it bears noting, more frequent than in the full Federal Reserve sample period), they were also almost three months *shorter* on average, and no more severe. Recoveries were also faster, with an average time from trough to previous peak of 7.7 months, as compared to 10.6 months. Allowing for the recent, 18-month-long contraction further strengthens these conclusions. And while the new dates still suggest that expansions have lasted longer since World War II than before 1914, that difference, besides depending mainly on one exceptionally long expansion during the 1960s (ibid., p. 603), is also much less substantial than is suggested by the NBER's dates.

Because the Miron and Romer industrial production series begins in 1884, Romer does not attempt to revise earlier business cycle dates. That project has, however, been undertaken more recently by Joseph Davis (2006) who, using his own annual series for U.S. industrial production for 1796 to 1915 (Davis 2004), finds no discernible difference at all between the frequency and average duration of recessions after World War II and their frequency and average duration throughout the full National Banking era. Besides suggesting that the NBER's recessions of 1869-70, 1887-88, 1890-91, and 1899-1900 should be reclassified as growth cycles (that is, periods of modest growth interrupting more pronounced expansions) Davis's chronology goes further than Romer's in revising the record concerning the length of genuine pre-Fed contractions, in part because it goes further in distinguishing negative output growth from falling prices. The change is most glaringly illustrated by the case of the recession of 1873. According to NBER's chronology, that recession lasted from October 1873 to May 1879, making it by far the longest recession in U.S. history, and therefore an important contributor to the conclusion that recessions have become shorter since the Fed's establishment. According to Davis's chronology, in contrast, the 1873 recession lasted only two years, or just six months longer than the subprime contraction.<sup>23</sup>

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<sup>23</sup> Some experts go even further than the NBER in confusing deflation with depression. For example, FRB Dallas President Richard Fisher refers during a February 2009 CSPAN interview to the "long

In comparing pre- and post-Federal Reserve Act business cycles we have again tended to set aside the interwar period, as if allowing for a long interval during which the Fed had yet to discover its sea legs. Nevertheless the Fed's interwar record, and especially its record during the Great Depression, cannot be overlooked altogether in a study purporting to assess its overall performance. And that record was, by most modern accounts, abysmal. The truth of Friedman and Schwartz's (1963, pp. 299ff.) thesis that overly restrictive Fed policies were responsible for the "Great Contraction" of the early 1930s is now widely accepted (e.g. Bernanke 2002b; Christiano, Motto, and Rostagno 2003), as is their claim that the Fed interfered with recovery by doubling minimum bank reserve requirements between August 1936 and May 1937. Romer (1992) has shown, furthermore, that although monetary growth was, despite the Fed's interference, the factor most responsible for such recovery as did take place between 1933 and 1942, that growth was based, not on any expansionary moves on the part of the Fed, but on gold inflows from abroad prompted first by the devaluation of the dollar and then by increasing European political instability.<sup>24</sup>

Some economic historians, most notably Barry Eichengreen (1992), have blamed the Great Depression in the United States on the gold standard rather than on the Fed's misuse of its discretion, claiming that the Fed had to refrain from further monetary expansion in order to maintain the gold standard. But Elmus Wicker (1996, pp. 161-2) finds that gold outflows played only a minor role in the banking panics that were the proximate cause of the monetary collapse of 1930-1933, while Bordo, Choudri, and Schwartz (2002) show that, even had there been perfect capital mobility (which was far from being the case), open market purchases on a scale capable of having prevented that collapse would not have led to gold outflows large enough to pose a threat to convertibility. Hsieh and Romer (2006),

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depression" of 1873-1896 (<http://www.c-span.org/Watch/watch.aspx?ProgramId=Economy-A-40471>). Concerning the myth of a "Great Depression" of 1873 to 1896 see Shields (1969) and, for Great Britain, Saul (1969).

<sup>24</sup> According to Robert Higgs (2009), despite the gold inflows of the '30s and unprecedented wartime government expenditures the U.S. private economy did not fully recover from the Great Depression until after World War II.



finally, draw on both statistical and narrative evidence to examine and ultimately reject the specific hypothesis that the Fed was compelled to refrain from expansionary policies out of fear that expansion would provoke a speculative attack on the dollar. Instead, they conclude (*ibid.*, p. 142), “the American Great Depression was largely the result of inept policy, not the inevitable consequence of a flawed international monetary system.”<sup>25</sup>

### *VIII. Banking Panics*

If the Fed has not reduced the overall frequency or average duration of recessions, can it nonetheless be credited with reducing the frequency of banking panics and hence of the more severe recessions that tend to go along with such panics? A conventional view holds that the Fed did indeed make panics less common by eliminating the currency shortages and associated credit crunches that were notorious features of previous panics; and Jeffrey Miron’s research (1986) appears to support this view by showing how, in its early years at least, the Fed did away with the seasonal tightening of the money market, and consequent spiking interest rates, that characterized the pre-Fed era.

However, more recent and consistent accounts of the incidence of banking panics suggest that the Fed did not actually reduce their frequency. Andrew Jalil (2009) concludes, on the basis of one such new reckoning, “that contrary to the conventional wisdom, there is no evidence of a decline in the frequency of panics during the first fifteen years of the existence of the Federal Reserve” (*ibid.*, p. 3). That is, there was no reduction between 1914 and 1930, and hence none until the conclusion of the national bank holiday toward mid March of 1933. Jali’s findings agree with Elmus Wicker’s conclusion, based on his comprehensive analyses of financial crises between the Civil War and World War II (Wicker 1996, 2000), that previous assessments had exaggerated the frequency of pre-Fed banking panics by

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<sup>25</sup> In particular, the 1930s Fed has been faulted for having regarded low nominal interest rates and high bank excess reserves as proof that money was sufficiently easy (Wheelock 1989). Scott Sumner (2009) argues that the Fed repeated the same mistake in 2008.

counting among them episodes in “money market stringency coupled with a sharp break in stock prices” or collective action by the New York Clearinghouse but no widespread bank runs or failures” (ibid. 2000, p. xii). In fact, Wicker states,

there were no more than three major banking panics between 1873 and 1907 [inclusive], and two incipient banking panics in 1884 and 1890. Twelve years elapsed between the panic of 1861 and the panic of 1873, twenty years between the panics of 1873 and 1893, and fourteen years between 1893 and 1907: three banking panics in half a century! And in only one of the three, 1893, did the number of bank suspensions match those of the Great Depression (ibid.)

In contrast, Wicker (1996) elsewhere reports, the first three years of the Great Depression alone witnessed five major banking panics. No genuine post-1913 reduction in banking panics, or in total bank suspensions, took place until after the national bank holiday of March 1933; and credit for that reduction belongs, not to the Fed, but to the RFC (which purchased \$1.1 billion in preferred stock from some 6500 banks between March 1933 and May 1934) and, starting on January 1, 1934, deposit insurance (Figure 8). “As the RFC and FDIC became more important to stabilizing the banking system,” financial historian Robert Lynn Fuller (2009, p. 535) observes, “the Federal Reserve Bank [sic] became less so...because its primary purpose—to provide liquidity to the system—had become irrelevant in a system awash in liquidity.”<sup>26</sup>

Besides supplying a more accurate account of the frequency of banking panics before and after the Fed, Jalil’s chronology of panics allows him to revise the record concerning the bearing of panics on the severity and duration of recessions.

Whereas DeLong and Summers (1986), employing their own series for the incidence of panics between 1890 and 1910, conclude that banking panics played only a small

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<sup>26</sup> Having been obliged to borrow \$3 million from the Fed to meet their legal reserve requirements in February 1932, the Fed’s member banks afterwards equipped themselves with ample excess reserves: even on the eve of the national bank holiday they held reserves equal to 112.8 percent of requirements (Fuller 2009, p. 540).

part in the pre-Fed business cycle, Jalil (2009, p. 34) finds that they were a “significant source of economic instability.” Nearly half of all business cycle downturns before World War II involved panics, and those that did tended to be both substantially more severe and longer-lasting than those that didn’t: between 1866 and 1914, recessions involving major banking panics were on average almost three times as deep, with recoveries on average taking almost three times as long, as those without major panics (*ibid.*, p. 35).<sup>27</sup> This evidence suggests that, by serving to eliminate banking panics, deposit insurance also served, for a time at least, to reduce the frequency of severe recessions. This fact in turn points to the need for a further, downward reassessment of the Fed’s post-1933 contribution to economic stabilization.

Finally, those banking panics and accompanying, severe recessions that did occur before 1914 were not inescapable consequences of the absence of a central bank. Instead, according to Wicker (2000, p. xiii) and Eugene White (1993), among others, banking panics both then and afterwards were fundamentally due to misguided regulations, including laws prohibiting both statewide and interstate branch banking. Besides limiting opportunities for diversification, legal barriers to branch banking, together with the reserve requirement stipulations of National Banking Act, encouraged interior banks to count balances with city correspondents as cash reserves. The consequent “pyramiding” of reserves in New York, combined with inflexible minimum reserve requirements and the “inelasticity” of the stock of national bank notes (which had to be more than fully backed by increasingly expensive government bonds, and which could not be expanded or retired quickly even once the necessary bonds had been purchased owing to delays in working through the Office of the Comptroller of the Currency) all contributed to frequent

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<sup>27</sup> The precise figures are: average percentage decline in output, 12.3% for recessions involving major panics, 4.5% otherwise; average length of recovery, 2.7 years for recessions involving major panics, 1 year otherwise. The length of recovery is the interval from the trough of the recession to recovery of the pre-downturn peak.

episodes of money market stringency, some of which resulted in numerous bank suspensions, if not in full-blown panics.

Other nations' experience illuminates the role that misguided regulations, including those responsible for the highly fragmented structure of the U.S. banking industry, played in making the U.S. system uniquely vulnerable to panics. Michael Bordo (1986) reports that, among half a dozen western countries he surveyed (the others being the U.K., Sweden, Germany, France, and Canada), the U.S. alone experienced banking crises; and Charles Calomiris (2000, chap. 1), also drawing on international evidence, attributes the different incidence of panics to differences in banking industry organization.

Given its proximity to and economic integration with the U.S., Canada's experience is especially revealing. Unlike the U.S., which had almost 2000 (mainly unit) banks in 1870, and almost 25,000 banks on the eve of the Great Depression, Canada never had more than several dozen banks, almost all with extensive branch networks. Between 1830 and 1914 (when Canada's entry into WWI led to a run on gold anticipating suspension of the gold standard), Canada experienced few bank failures and no bank runs. It also had no bank failures at all during the Great Depression, and for that reason experienced a much less severe contraction of money and credit than the U.S. did. Although the latter outcome may have depended on government forbearance and implicit guarantees which, according to Kryznowski and Roberts (1993), made it possible for many Canadian banks to stay open despite being technically insolvent for at least part of the Great Depression period,<sup>28</sup> the fact remains that Canada was able to avoid banking panics without resort to either a central bank or explicit insurance.<sup>29</sup>

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<sup>28</sup> Kryznowski and Roberts (1993) claim that nine out of Canada's ten banks were insolvent on a market-value basis for most of the 1930s. Wagster (2009), in contrast, concludes based on a different approach they were insolvent only during 1932 and 1933.

<sup>29</sup> The Bank of Canada was established in 1935, not in response to the prior crisis but, according to Bordo and Redish (1987), to appease an increasingly powerful inflationist lobby.

Canadian banks' relative freedom from restrictions on their ability to issue banknotes also contributed to their capacity to accommodate exceptional demands for currency. In the U.S., in contrast, national banks were unable to issue notes at all after 1935, and were severely limited in their ability to do so before the onset of the Great Depression. State bank notes had been subject to

## *IX. Last-Resort Lending*

That the Federal Reserve System was not the only solution to pre-Fed banking panics, that it may in fact have been inferior to deregulatory reforms aimed at allowing the U.S. banking and currency system to develop along stronger, Canadian lines, and that credit for the absence of panics after 1933 mainly belongs not to the Fed but to deposit insurance, doesn't rule out the possibility that the Fed has occasionally contributed to financial stability by serving as a lender of last resort (LOLR).

The traditional view of the lender of last resort role derives from Walter Bagehot (1873). In Bagehot's view a LOLR is a second-best remedy for a banking system weakened by legal restrictions, including those awarding monopoly privileges to favored banks (first-best to Bagehot was a minimally restricted and hence stronger system like Scotland's).<sup>30</sup> The LOLR can help prevent financial panics, without creating serious moral hazard, by supporting illiquid but not insolvent banks. Bagehot's classical rules for last-resort lending instructed the Bank of England to extend credit "freely and vigorously," but only to borrowers that passed a solvency test (Bagehot's was posting "good banking securities" as collateral), and only at a higher-than-normal rate of interest. As Brain Madigan, Director of the Federal Reserve's Division of Monetary Affairs, has noted, "Bagehot's dictum can be viewed as having a sound foundation in microeconomics":

Specifically, lending only to sound institutions and lending only against good collateral sharpen firms' incentives to invest prudently in order to remain solvent. And lending only at a penalty rate preserves the incentive for borrowers to obtain market funding when it is available rather than seeking recourse to the central bank (Madigan 2009, p. 1).

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a prohibitive tax since 1866. Concerning the politics behind the decision to suppress state bank notes, and the economic consequences of that decision, see Selgin (2000).

<sup>30</sup> Why, then, did Bagehot recommend that the Bank of England serve as a LOLR instead of recommending removal of its monopoly privileges? Because, as he put it at the close of *Lombard Street* (1873, p. 329), "I am quite sure that it is of no manner of use proposing to alter [the Bank of England's constitution]. ... You might as well, or better, try to alter the English monarchy and substitute a republic."

In Bagehot's day the solvency requirement was intended to protect the then-private Bank of England's shareholders from losing money on last-resort loans. Today it serves to protect taxpayers from exposure to public central bank losses.

Judged from a Bagehotian perspective, how well has the Fed performed its LOLR duties? According to Thomas Humphrey (2010), a former Federal Reserve economist and an authority on classical LOLR doctrine, it has performed them very badly indeed, honoring the classical doctrine "more in the breach than in the observance" (*ibid.*, p. 22). While Humphrey does identify episodes, including the October 1987 stock market crash, the approach of Y2K, and (in some respects) the aftermath of 9/11, in which the Fed seems to have followed Bagehot's advice, he notes that this has not been its usual practice.<sup>31</sup>

During the Great Depression, for example, the Fed departed from Bagehot's doctrine first by failing to lend to many solvent but illiquid banks, and later (in 1936-7) by deliberately reducing solvent banks' supply of liquid free reserves (*ibid.*, p. 23). Since then, it has tended to err in the opposite direction, by extending credit to insolvent institutions. The Fed made large discount window loans to both Franklin National and Continental Illinois before their spectacular failures in 1974 and 1984, respectively; and between January 1985 and May 1991 it routinely offered extended credit to banks that supervisory agencies considered in imminent danger of failing. Ninety percent of these borrowing banks failed soon afterwards (United States House of Representatives 1991; Schwartz 1992).

During the subprime crisis, Humphrey observes, the Fed "deviated from the classical model in so many ways as to make a mockery of the notion that it is a LOLR" (Humphrey 2010, p. 1). It did so by knowingly accepting "toxic" assets, most notably mortgage-backed securities, as loan collateral, or by purchasing them outright without subjecting them to "haircuts" proportionate to the risk involved,

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<sup>31</sup>Some would add the New York Fed's rescue of the Bank of New York following its November 1985 computer glitch. We instead classify this as overnight "adjustment" lending, reserving the term "last resort" for more extended lending. Concerning the Fed's last-resort lending operations after 9/11, Lacker (2004, p. 956) notes that, while these generally conformed to classical requirements, the Fed extended discount window credit at below market rates.

and by supplying funds directly to firms understood to be insolvent (ibid, pp. 24-28; see also Feldstein 2010, pp. 136-7).<sup>32</sup> As the two panels of Figure 10 show, until September 2008 the Fed also sterilized its direct lending operations through offsetting Fed sales of Treasury securities, in effect transferring some \$250 billion in liquid funds from presumably solvent firms to potentially insolvent ones—a strategy precisely opposite Bagehot’s, and one that tended to spread rather than to contain financial distress (Thornton 2009a, 2009b; also Hetzel 2009 and Wheelock 2010, p. 96). This strategy may ultimately have harmed even the struggling enterprises it was supposed to favor, for according to Daniel Thornton (2009b, p. 2), if instead of attempting to reallocate credit the Fed had responded to the financial crisis by significantly increasing the total amount of credit available to the market, “the failures of Bear Stearns, Lehman Brothers, and AIG may have been avoided and, so too, the need for TARP.” Moreover, according to several authorities, it was thanks to TARP itself, or rather to the gloom-and-doom warnings Ben Bernanke issued in his effort to secure the passage of TARP, that “[a] relatively modest contraction of economic activity due to ... the deflation of house prices became the Great Recession” (Goodfriend 2010, p. 18; also Taylor 2009a, pp. 25-30).

In September 2008 the Fed at last turned from sterilized to unsterilized lending, and on such a scale as resulted in a doubling of the monetary base over the course of the ensuing year. At the same time, however, it began paying interest on excess reserves, thereby increasing the demand for such reserves, while also arranging to have the Treasury sell supplemental bills and deposit the proceeds in a special account. Thanks in part to these special measures bank lending, nominal

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<sup>32</sup> The insolvent firms included Citigroup and AIG. The way was paved toward the recent departures from Bagehot’s “sound security” requirement for last-resort lending by a 1999 change in section 16 of the Federal Reserve Act, which allowed the Fed to receive as collateral any assets it deemed “satisfactory.” The change was originally intended to provide for emergency lending in connection with Y2K, for which it proved unnecessary.

GDP, and the CPI, instead of responding positively to the doubling of the monetary base, plummeted (Figure 11).<sup>33</sup>

Finally, rather than pursue a consistent policy—a less emphasized but not less important component of Bagehot’s advice—the Fed unsettled markets by protecting the creditors of some insolvent firms (Bear Stearns) while allowing others (Lehman Brothers) to suffer default. Former Fed Chairman Paul Volcker (2008, p. 2) remarked, in the aftermath of the Fed’s support (via its wholly owned subsidiary Maiden Lane I) of J.P. Morgan Chase’s purchase of Bear Stearns, that the Fed had stretched “the time honored central bank mantra in time of crisis—‘lend freely at high rates against good collateral’—to the point of no return.”

The Fed has been increasingly inclined to lend to insolvent banks in part because creditworthy ones have been increasingly able to secure funding in private wholesale markets. As Stephen Cecchetti and Titi Disyata (2010) observe, under modern circumstances “a bank that is unable to raise funds in the market must, almost by definition, lack access to good security for collateralized loans.” Prior to the recent crisis, the development of a well-organized interbank market ready to lend to solvent banks led many economists (Friedman 1960, pp. 50-51; Goodfriend and King 1988; Kaufman 1991; Schwartz 1992; Lacker 2004, p. 956ff.) to declare the Fed’s discount window obsolete and to recommend that it be shut for good, leaving the Fed with no lender of last resort responsibility save that of maintaining system-wide liquidity by means of open market operations, while relying upon private intermediaries to distribute liquid funds in accordance with Bagehot’s precepts. Notwithstanding Cecchetti and Disyatat’s (2010, p. 12) claim that “a systemic event almost surely requires lending at an effectively subsidized rate...while taking collateral of suspect quality,” open-market operations have in

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<sup>33</sup> Keister and McAndrews (2009), while conceding that both the unprecedented growth in banks’ excess reserve holdings and the related collapse of the money multiplier were consequences of the Fed’s October 2008 “policy initiatives,” including its decision to begin paying interest on reserves, also insist that “concerns about high levels of reserves are largely unwarranted” on the grounds that the reserve buildup “says little or nothing about the programs’ effects on bank lending or on the economy more broadly.” Perhaps: but bank lending and nominal GDP data *do* say something about the programs’ broader effects, and what they say is that, taken together, the programs were in fact severely contractionary.



fact proven capable of preserving market liquidity even following such major financial shocks as the failure of the Penn Central Railroad, the stock market crash of October 1987, the Russian default of 1998, Y2K, and the 9/11 terrorist attacks.<sup>34</sup>

The subprime crisis has, however, led many experts to conclude that it is Bagehot's precepts, rather than direct central bank lending to troubled firms, that have become obsolete. Some justify recent departures from Bagehot's rules, or at least from strict reliance on open-market operations, on the grounds that the crisis was one in which the wholesale lending market itself was crippled, so that even solvent intermediaries could not count on staying liquid had the Fed supplied liquidity through open market operations alone. "With financial institutions unwilling to lend to one another," argues Kenneth Kuttner (2008, p. 2; compare Kroszner and Melick 2010, pp. 4-5), "the Fed had no choice but to step in and lend to institutions in need of cash." Years before the crisis Mark Flannery and George Kaufman (1996, p. 821) made the case in greater detail:

The discount window's unique value arises when disarray strikes private financial markets. If lenders cannot confidently assess other firms' conditions, they may rationally withdraw from the interbank loan market, leaving solvent but illiquid firms unable to fund themselves. ...In response to this sort of financial crisis, government may need to do more than assure adequate liquidity through open market operations. Broad, short-term [N.B.] discount window lending, unsecured and at (perhaps) subsidized rates, may constitute the least-cost means of resolving some types of widespread financial uncertainties.

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<sup>34</sup> In the Penn Central case, the Fed was prepared to supply discount window loans if necessary, and even invoked the 1932 clause allowing it to lend to non-bank institutions so as to be able to lend to Penn Central itself. But it did not actually make any last-resort loans (Calomiris 1994). In that of the 9/11 attacks, the Fed supplied \$38 billion in overnight credit to banks on the day of the attacks because the Fed had not anticipated any need for open market operations. But in subsequent days the open-market desk made up the deficiency, and discount window borrowing returned to more-or-less normal levels (Lacker 2004).

But even when ordinary open-market market operations appear insufficient, it doesn't follow that direct Fed lending, let alone lending at subsidized rates to presumably insolvent firms, is necessary. Instead, the scope of Fed liquidity provision can be broadened by relaxing its traditional "Treasuries only" policy for open-market operations to allow for occasional purchases of some or all of the private securities it deems acceptable as collateral for discount window loans.<sup>35</sup> Willem Buiter and Anne Sibert (2008) argue that such a modification of the Fed's open-market policy—what they term a "market maker of last resort" policy—would have sufficed to re-liquify nonbank capital markets, and primary dealers especially, while heeding both Bagehot's principles and the stipulations of the Federal Reserve Act. It would also have avoided any need for the TAF, the TSLF, special purchase vehicles, and other such "complicated method[s] of providing liquidity" that unnecessarily exposed the Fed "to the temptation to politicize its selection of recipients of its credit" (Bordo 2009, p. 118) while compromising its independence (Thornton, Hubbard, and Scott 2009; Bordo 2010; Goodfriend 2010).<sup>36</sup>

Even the potential failure of financial institutions deemed "systematically important" doesn't necessarily warrant departures from classical LOLR precepts. Consider the case of Continental Illinois, the first rescue to be defended on the grounds that certain financial enterprises are "too big to fail." Although the FDIC claimed, in the course of Congressional hearings following the rescue, that the holding company's failure would have exposed 179 small banks to a high risk of

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<sup>35</sup> Strictly speaking, the Fed's open-market policy has been one of "Treasuries and gold and foreign exchange only." As David Marshall (2002) explains, Fed officials at one time preferred to confine its open market operations to private securities, including bankers' and trade acceptances and private bills of exchange, owing in part to their fear that extensive government debt holdings would compromise the Fed's independence. In fact the Fed first began purchasing substantial quantities of Treasury securities on the open market in response to pressure from the Treasury following U.S. entry into World War I. The "Treasuries only" policy dates from the 1930s. For further details see Marshall (*ibid*) and Small and Clouse (2005).

<sup>36</sup> According to Buiter (2010), private security purchases conducted by means of reverse Dutch auctions would guarantee purchase prices reflecting illiquid securities' fundamental values but sufficiently "punitive" to guard against both moral hazard and excessive Fed exposure to credit risk. Cecchetti and Disyatat (2010), in contrast, claim that "liquidity support will often be, and probably should be, provided at a subsidized rate when it involves a liquid asset where a market price cannot be found."

failure, subsequent assessments by the House Banking Committee and the GAO placed the number of exposed banks at just 28. A still later study by George Kaufman (1990, p. 8) found that only *two* banks would have lost more than half of their capital. The 1990 failure of Drexel Burnham Lambert had no systemic consequences, and there is no evidence, also according to Kaufman (2000, p. 236), that the failure of Long Term Capital Management eight years later “would have brought down any large bank if the Fed had provided liquidity during the unwinding period through open market operations” while also backing the counterparties’ unwinding plan.

During the subprime crisis financial enterprises far larger than either Continental or Drexel Lambert either failed or were threatened with failure. Yet there are doubts concerning whether even these cases posed systemic risks that could only be contained by direct support of the firms in question. When it was placed into FDIC receivership in September 2008, Washington Mutual was five times larger, on an inflation-adjusted basis, than Continental Illinois at the time of its failure. Still the FDIC was able, after wiping out its shareholders and most of its secured bondholders, to sell it to J.P. Morgan Chase without either inconveniencing its customers or disrupting financial markets (Tarr 2010).<sup>37</sup>

Or consider Lehman Brothers. It was one of the largest dealers in credit default swaps [CDSs]. Peter Wallison (2009a, p. 6; see also Tarr 2010) nevertheless found “no indication that any financial institution became troubled or failed” because of its failure.<sup>38</sup> Wallison explains:

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<sup>37</sup> Continental Illinois failed with \$40 billion in assets, equivalent to \$85 billion in 2008 dollars, as compared to the \$307 billion in assets of Washington Mutual and \$812 billion of Wachovia when those firms were resolved. Likewise, Drexel Burnham Lambert had \$3.5 billion in assets in 1990, or the equivalent of \$6 billion in 2008 dollars, while the assets of Lehman Brothers at the time of its failure amounted to \$639 billion.

<sup>38</sup> As Tarr (2009, p. 5) notes, the same conclusion was reached by the international Senior Supervisory Group (SSG), which reported as well that the failures of Fannie May and Freddie Mac “were managed in an orderly fashion, with no major operational disruptions or liquidity problems.” On the success of chapter 11 as a means for resolving Lehman Brothers see Whalen (2009).

Lehman's inability to meet its obligations did not result in the "contagion" that is the hallmark of systemic risk. No bank or any other Lehman counterparty seems to have been injured in any major respect by Lehman's failure, although of course losses occurred... . Although there were media reports that AIG had to be rescued shortly after Lehman's failure because it had been exposed excessively to Lehman through credit default swaps (CDSs), these were inaccurate. When all the CDSs on Lehman were settled about a month later, AIG's exposure turned out to be only \$6.2 million. Moreover, although Lehman was one of the largest players in the CDS market, all its CDS obligations were settled without incident.

Wallison's statement should be amended to allow for the fact that on the Tuesday following Lehman's Monday bankruptcy filing, the Reserve Primary money-market mutual fund, having written off its large holdings of unsecured Lehman paper (and having lacked sponsors capable of making up for the loss), had to reduce its share price below the pledged \$1 level to 97 cents. Reserve Primary's "breaking the buck" led to several days of large redemptions from other (especially institutional) prime money-market funds, and thereby to a sharp drop in the demand for commercial paper. Significantly, government money-market funds, including Treasury-only funds, experienced inflows; and it is possible that the redemptions would have subsided on their own as it became clear that most funds would remain able to meet all redemption requests at \$1 per share. The Treasury nevertheless intervened on Friday to guarantee all money-market share prices at \$1.<sup>39</sup>

In deciding not to rescue Lehman Brothers, the Fed abided by the classical rules of last-resort lending. It earlier chose, on the other hand, to rescue the creditors of Bear Stearns by paying about \$30 billion for the firm's worst assets so

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<sup>39</sup> According to Baba, McCauley, and Ramaswamy (2009, p. 76), although they benefitted from neither the U.S. Treasury guarantee or the Fed's money market fund liquidity facility established on the same day, "European-domiciled dollar MMFs generally experienced runs not much worse than those on similar US prime institutions with the same manager."

that J. P. Morgan Chase would purchase the firm and assume its debts. Later it also chose to rescue AIG. On what grounds did it determine that Bear Stearns and AIG were “too big to fail,” while Lehman Brothers was not?<sup>40</sup> Bear Stearns, like Lehman Brothers, was an investment bank, and AIG was an insurance company and CDS issuer. Both firms had played highly risky strategies and were caught out. Neither was a commercial bank involved in retail payments, and neither performed functions that couldn’t have been performed just as well by other private firms. Creditors and counterparties stood to lose, but it isn’t clear that many of the numerous broker-dealers and hedge funds that did business with Bear Stearns would not have survived its default or that the failure of some of them would have had extensive knock-on effects. In fact, the Fed has never explained the precise nature of the “systemic risk” justifying its intervention in these instances. Nor has it ever made public its criteria for determining which failures posed a systemic threat that could not be handled in classical fashion.

The Fed’s departures from classical doctrine also do not seem to have been very effective in achieving its short-run objective. The rescue of Bear Stearns did not keep Lehman or AIG from toppling. Instead, it appears to have encouraged those firms to leverage up further by persuading reassured creditors to lend to them even more cheaply. In any event, the Fed’s actions did not suffice to substantially improve conditions in the money market. The root of the problem was not a lack of liquidity but of solvency. As Kuttner (2008, p. 7) and many others have observed, “no amount of liquidity will revive lending so long as financial institutions lack sufficient capital.”

The Fed’s unprecedented violations of classical LOLR doctrine during the recent crisis threaten ultimately to further undermine financial stability both by impeding its ability to conduct ordinary monetary policy and by contributing to the moral hazard problem. Regarding the former problem Kuttner (*ibid.*, p. 12) writes,

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<sup>40</sup> Wallison (2009b, p. 3) writes that although Goldman Sachs was AIG’s largest CDS counterparty, with contracts valued at \$12.9 billion, a spokesman for Goldman declared that, had AIG been allowed to fail, the consequences for Goldman “would have been negligible.”

Saddling the Fed with bailout duties obscures its core objectives, unnecessarily linking monetary policy to the rescue of failing institutions. Moreover...loan losses could compromise the Fed's independence and thus weaken its commitment to price stability in the future.

In light of such considerations it would be better, according to Kuttner, “to return to Bagehot’s narrower conception of the LOLR function, and turn over to the Treasury the responsibility for the rescue of troubled institutions, as this inevitably involves a significant contingent commitment of public funds.”

But the most important costs that must be set against any possible short-run gains from Fed departures from classical LOLR doctrine consist of the moral hazard problems caused by such departures, including the problem of zombie institutions gambling for recovery. As Kaufman (2000, p. 237) puts it: “there is little more costly and disruptive to the economy than liquid insolvent banks that are permitted to continue to operate.” It is a common misconception to think that imposing losses on management and shareholders, while shielding counterparties and creditors, is enough to contain moral hazard. So long as bank creditors can expect high returns on the upside, with implicit government guarantees against losses on the downside, they will lend too cheaply to risky poorly diversified banks, making overly high leverage (thin capital) an attractive strategy. Normal market discipline against risk-taking is thus significantly undermined (see Roberts 2010). Already by 2002, according to one estimate (Walter and Weinberg 2002), more than 60% of all U.S. financial institution liabilities, including all those of the 21 largest bank holding companies, were either explicitly or implicitly guaranteed. Overly risky financial practices were a predictable consequence. As Charles Calomiris (2009a) observes, the extraordinary risks taken by managers of large financial firms between 2003 and 2007 were the result, not of “random mass insanity” but of moral hazard resulting in large part from the Fed’s willingness—implicit in previous practice—to depart from classical last-resort lending rules to rescue creditors of failed firms.

Likewise, according to Buiter (2010, p. 599), although unorthodox Fed programs may have succeeded in enhancing market liquidity during 2007 and 2008, some, including the TAF, the TSLF, the PDCF, the opening of the discount window to Fannie and Freddie, and the rescue of Bear Stearns, appear “to have been designed to maximize bad incentives for future reckless lending and borrowing by the institutions affected by them.”<sup>41</sup> Far from being an unquestionably worthwhile departure from classical last-resort lending rules, the unprecedented granting of support to insolvent firms during the subprime crisis may well prove the most serious of all failures of the Federal Reserve System.<sup>42</sup>

### *X. Alternatives to the Fed, Past and Present*

Our review of the Fed’s performance raises two very distinct questions: (1) might the United States have done better than to have established the Fed in 1914, and (2) might it do better than to retain it today? While the first question is of interest to economic historians, the second should be of interest to policymakers.

The questions are distinct because the choice context has changed. One major change is that the gold standard is no longer in effect. Under the gold standard, the scarcity of the ultimate redemption medium was a natural rather than a contrived scarcity. The responsibilities originally assigned to the Fed did not need to include, and in fact did not include, that of managing the stock of money or the price level. The gold standard “automatically” managed those variables under a regime of unrestricted convertibility of banknotes and deposits into gold. The Fed’s principal assignments were to maintain the unrestricted convertibility of its own liabilities and to avoid panics that threatened the convertibility of commercial bank liabilities.

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<sup>41</sup> As of April 2009, the combined value of Treasury, FDIC, and Fed capital infusions and guarantees extended in connection with the subprime crisis was \$4 trillion (Tarr 2009, p. 3).

<sup>42</sup> See also Brewer and Jagtiani 2009. The FDIC Improvement Act of 1991 endeavored to limit the problem of excessive guarantees, including excessive Fed lending to insolvent banks, by amending the Federal Reserve Act through inclusion of a new rule (10B) penalizing the Fed for making all save very short-term loans to undercapitalized banks. However, an exception was made for banks judged TBTF. In mid-2008, however, banks being operated by the FDIC were exempted from the rule, largely defeating its purpose.

Consequently it is relatively easy to identify viable alternatives to the adoption of the Federal Reserve Act in 1913. At a minimum, the continuation of the status quo was an option. In light of the severe Great Contraction of the early 1930s under the Fed's watch, worse than any of the pre-Fed panics, Friedman and Schwartz (1963, pp. 168-172 and 693-4) argued that continuing the pre-Fed status quo would have had better results. Under the pre-1908 status quo panic management was handled by commercial bank clearinghouse associations. The clearinghouses lent additional bank reserves into existence, met public demand for currency by issuing more, and when necessary coordinated suspensions of convertibility to prevent systemic contraction (Timberlake 1993, pp. 198-213). According to Elmus Wicker (2000, pp. 128-9), a "purely voluntary association of New York banks that recognized its responsibility for the maintenance of banking stability was a feasible solution to the bank panic problem." In particular, Wicker maintains, the Gilded Age might have been rendered entirely panic-free had the 1873 recommendations of New York Clearing House Association, as contained in the so-called "Coe Report" recommending that Congress formally grant the New York Clearing House Association authority to oversee the efficient allocation of member banks' reserves during crisis.

Congress did in fact implement a reform along the lines suggested by the Coe Report in the shape of the 1908 Aldrich Vreeland Act, which assigned the issue of emergency currency, which was illegal for clearinghouses but clearly helpful, to official National Currency Associations that could lawfully do what the clearinghouses had been doing without legal authority. The system of emergency currency issue by National Currency Associations had one test, when the onset of the First World War incited a sharp demand for currency in 1914 before the Fed was up and running, and it passed the test well (Silber 2007).

An alternative, deregulatory alternative to a central bank also received serious attention in the decades prior to the passage of the Federal Reserve Act. This was a plan endorsed by the American Bankers Association at its 1894 convention in Baltimore and henceforth known as "the Baltimore Plan." The



Baltimore Plan basically viewed the panic-free and less-regulated Canadian banking system as a model (Eugene White 1983, pp. 83-90; Bordo, Redish, and Rockoff 1996; Calomiris 2000, ch. 1). Under a system devised to sell government bonds during the Civil War, federally chartered (“National”) banks were required to hold backing for their notes in the form of federal bonds. The backing requirement increasingly constrained the issue of notes as the eligible bonds became increasingly scarce. (State-chartered banks were prevented from issuing notes by a prohibitive federal tax.) Reformers for good reason viewed this requirement as the source of the notorious secular and seasonal “inelasticity” of the National Bank currency (Noyes 1910; Smith 1936). Under the Baltimore Plan, federally chartered banks would have been allowed to back their note liabilities with ordinary bank assets, a reform that some proponents called “asset currency.”

The Baltimore Plan was blocked in the political arena by the power of a vested interest, the small bank lobby. Asset currency reformers worried that a surfeit of currency might arise if the existing restrictions on note-issue were lifted without any accompanying system for drawing excess currency out of circulation. They observed that Canada’s nationwide-branched banks were an efficient note-collection system, and so favored not only Canadian-style deregulation of note-issue but also deregulation of bank branching. They failed to overcome the political clout of the small bankers who were determined to block branch banking (Eugene White 1983, pp. 85-89; Selgin and White 1994).

Coming up with alternatives to the Fed today takes more imagination. Assuming that there is no political prospect of replacing the fiat dollar with a return to the gold standard or other commodity money system, for the dollar to retain its value some public institution must keep fiat base money sufficiently scarce. In this respect at least, our finding that the Fed has failed does not by itself indicate that it would be practical to entirely dispense with some sort of public monetary authority. But neither does it indicate that the only avenues for improvement are marginal revisions to Fed operating procedures or additions to its powers. On the contrary, the Fed’s poor record calls for seriously contemplating a genuine change of regime.

In particular it strengthens the case for pre-commitment to a policy rule that would constrain the discretionary powers that the Fed has used so ineffectively. Whether implementing such a new regime should be called “ending the Fed” is an unimportant question about labels.

A detailed blueprint or assessment of any particular policy rule would be out of place here, but it is useful to sketch some alternatives that merit consideration, to underscore the point that the Fed as presently constituted carries an opportunity cost.<sup>43</sup>

### *XI. Contemporary Alternatives to Discretionary Monetary Policy*

The general case for a monetary rule is well known. Milton Friedman (1961) and Robert E. Lucas, Jr. (1976) argued empirically and theoretically that the Fed lacks the informational advantage over private agents that it would need to out-forecast them and improve their welfare through activist policy. Finn Kydland and Edward Prescott (1977) made the point that even a well-informed and benevolent central bank is weakened by lack of pre-commitment when the public in forming its inflation expectations takes into account the central bank’s temptation to use surprise inflation to improve the economy’s unemployment or real output. At the most philosophical or jurisprudential level, the case for a constitutional constraint on monetary policy-makers derives from the general case for “the rule of law rather than rule by authorities.” The rule of law means constraints against arbitrary governance so that citizens can know what to expect from their government (White 2010). John Taylor (2009b, p. 6) writes: “More generally, government should set clear rules of the game, stop changing them during the game, and enforce them. The rules do not have to be perfect, but the rule of law is essential.”

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<sup>43</sup> In suggesting alternatives to the Fed that “merit consideration,” we deliberately exclude proposals that would merely transfer powers of discretionary monetary control from the Fed to Congress. Like Blinder (2010, p. 126) and many others, we believe that an independent central bank is likely to produce superior macroeconomic performance than one under Congressional influence. We disagree, on the other hand, with Professor Blinder’s suggestion that, because he wants to “End the Fed,” Congressman Ron Paul must not appreciate the advantages of an independent central bank over a dependent one.

### *XI.1. Commodity standards*

Based on its long history, the gold standard warrant consideration as an alternative to discretionary central banking.<sup>44</sup> Dismissals of the gold standard as a viable option have often been based on flawed assessments of its past performance (see Kydland and Wynn 2002, pp. 7-9). The instability in the U.S. financial system during the pre-Fed period was due to serious flaws in the U.S. bank regulatory system rather than to the gold standard. Indeed, the Federal Reserve Act, which retained the gold standard, was predicated on this view. Canada adhered to a gold standard during the same period, but with a differently regulated banking system experienced no such instability.

Perhaps the leading indictment of the gold standard today is Barry Eichengreen and Peter Temin's (2000) charge that it was "a key element—if not the key element—in the collapse of the world economy" at the outset of the Great Depression. Here it is important to distinguish a classical gold standard from the structurally flawed interwar gold exchange standard. The latter was created by European governments to assist their misguided (and ultimately futile) attempts to restore prewar gold parties despite having pushed up prices dramatically by use of printing-press finance during wartime suspensions of gold redeemability. The massive deflation that became unavoidable when France ceased to play along with the precarious postwar arrangement (Johnson 1997; Irwin 2010) was not a failing of the classical gold standard. Neither were postwar exchange controls or "beggar thy neighbor" trade policies.<sup>45</sup>

It is an automatic system like the classical gold standard that is worth reconsidering, certainly not the interwar system. The classical gold standard did

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<sup>44</sup> We forgo the opportunity to discuss proposals for multi-commodity standards, which have the disadvantage of being untried and less well understood.

<sup>45</sup> As one Bank of England official (H.R. Siepmann) observed in a 1927 memorandum, referring obliquely to the Bank of France's policies, "If one country decides to revert to the [classical] Gold Standard, it may lay claim to more gold than there is any reason to expect the gold centre to have held in reserve against legitimate Gold Exchange Standard demands. What is then endangered is not merely the working of the Gold Exchange Standard, but the Gold Standard itself. Such a violent contraction may be provoked that gold will be brought into disrepute as a standard of value" (Johnson 1997, p. 133). This is, in fact, precisely what happened.

not depend on central bank cooperation—indeed many leading participants did not even have central banks—so it was less vulnerable to defection by any particular central bank, and therefore more credible, than the interwar arrangement (Obstfeld and Taylor 2003). Although Eichengreen and Temin (2000) acknowledge the benefits of the prewar gold standard, they never explain why it was necessary to abandon the gold standard altogether rather than to simply allow for one-time devaluations by the countries that had suspended and inflated.

A second indictment of the gold standard derives from fear of secular deflation. We noted above the importance of distinguishing benign from harmful deflation, while also observing that the secular deflation that characterized much of the classical gold standard period was benign, accompanying vigorous real growth. It is true that spokesmen for the interests of farmers complained about secular deflation. They appear to have believed, mistakenly, that overall deflation was lowering their real or relative incomes, as though nominal rather than the real factors were lowering the prices of what they sold relative to the prices of what they bought. Or they were seeking a bit of unexpected inflation to reduce *ex post* the real value of the debts they had incurred in farm mechanization. Their complaints reflected misperception or special-interest pleading rather than any genuine harm being done by a benign deflation (Beckworth 2007).

A third and long-standing objection to a gold standard by economists—the main reason Keynes famously called it a “barbarous relic”—is that it needlessly incurs resource costs in extracting and storing valuable metal for monetary use. A fiat standard can in principle replicate a gold standard’s price-level stability without any such resource costs (Friedman 1953). In practice, however, fiat standards have *not* replicated gold’s price-level stability (Kydland and Wynne 2002, p. 1). Nor, ironically, have they even lowered resource costs. The inflation rates of postwar fiat standards have by themselves imposed estimated deadweight costs greater than the reasonably estimated resource costs of a gold standard (White 1999, pp. 48-49). Meanwhile, the public has accumulated gold coins and bullion as inflation hedges, adding more gold to private reserves than central banks have sold

from official reserves. The real price of gold is much higher today than it was under the classical gold standard, encouraging the expansion of gold mining (Figure 12). Thus the resource costs of gold extraction and storage for asset-holding purposes have *risen* since the world's departure from the gold standard.

At least three serious problems do confront any proposal to return to a gold standard. The first is choosing a gold definition of the dollar that avoids transitional inflation or deflation (see White 2004). The second is securing a credible commitment to gold. As James Hamilton has remarked, “[i]f a government can go on a gold standard, it can go off, and historically countries have done exactly that all the time. The fact that speculators know this means that any currency adhering to a gold standard (or, in more modern times, a fixed exchange rate) may be subject to a speculative attack” (Hamilton 2005). Hamilton (1988) has argued that a drop in the credibility of governments’ commitment to fixed parities, leading to a speculative rise in the demand for gold, contributed to the international deflation of the early 1930s. To remove the threat of speculative attack may require the further reform of moving currency redemption commitments out of monopolistic and legally immune (hence non-credible) central banks and returning them, as in the pre-Fed era, to competing private issuers constrained by enforceable contracts and reputational pressures (Selgin and White 2005).

The third problem, which argues against any nation’s unilateral return to gold, is that a principal virtue of the classical gold standard was its status as an *international* standard. A single nation’s return to gold would not reestablish a global currency area, and would achieve only a relatively limited reduction in the speculative demand for gold as an inflation hedge. As it would also fail to substantially increase the transactions demand for gold, it could not be expected to make the relative price of gold as stable as it was under the classical system (White 2008). To provide considerably greater stability than the present fiat-dollar regime,

a revived U.S. gold standard would probably need to be part of a broader international revival.<sup>46</sup>

### *XI.2 Rule-bound fiat standards*

Given that the postwar fiat standards managed by discretionary central banks have generally failed to deliver the long-run price stability that was delivered by the gold standard, Kydland and Wynne (2002, p. 1) ask whether a better fiat regime is possible. They note that the “hard pegs” of dollarization or currency boards have proven successful at delivering more stable nominal environments in countries that have adopted them. But, they naturally ask, “What about the large country, the ‘peggee’? What rule or regime can a large country such as the United States ... adopt to guarantee long-term price stability?”

A well known and very simple type of monetary rule is a fixed growth path for M2, as advocated by Milton Friedman in the 1960s. It is arguably no longer appropriate in the current environment where the velocity of M2 (or any other monetary aggregate) is no longer stable. A number of more sophisticated rules that accommodate unstable velocity have been more widely discussed in recent years.

(1) A *Taylor Rule*, which continuously updates the fed funds target according to fixed formula based on measured departures of inflation and real output from specified norms, can be viewed as a description of Fed policy over the recent past, with notable exceptions. The exceptions, the departures from the fitted Taylor Rule, appear to have been harmful (Taylor 2009a). A fed funds rate well below the Taylor-Rule path for an extended period fosters an asset bubble; a rate too high precipitates a recession. A firm commitment to a fully specified Taylor-type rule could helpfully constrain monetary policy.

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<sup>46</sup> Although prospects for any such revival can only be judged remote, World Bank President Robert Zoellick (2010) recently prompted renewed discussion of the merits of such a move by arguing that proponents of a new Bretton-Woods type world monetary system (“Bretton Woods II) should consider using the price of gold “as an international reference point of market expectations about inflation, deflation and future currency values.” Zoellick added that “Although textbooks may view gold as the old money, markets are using gold as an alternative monetary asset today.”

(2) A *McCallum Rule* is similar to a Taylor Rule, except that the monetary base (rather than the fed funds rate) is the instrument, and feedback comes from base velocity growth and nominal income growth. A McCallum Rule amounts to a type of nominal-income rule, with the corrective policy response to nominal income above or below its target level fully specified in terms of adjustment to monetary base growth. McCallum's (2000) simulation study claims that adhering to the rule would have improved the economy's macroeconomic performance over the actual performance under the Fed's discretionary policy-making.

(3) Scott Sumner (1989 and 2006; also Jackson and Sumner 2006) and Kevin Dowd (1995) have each proposed constraining monetary policy to a *nominal income target*. In contrast to McCallum's backward-looking feedback from observations on realized nominal income, they propose forward-looking feedback from the expected level of nominal income implied by futures markets indicators.

(4) Toward the end of his career Milton Friedman (1984) proposed simply freezing the monetary base, and—reminiscent of the Canadian alternative in 1913—allowing seasonal and cyclical variations in the demand for currency relative to income (variations in velocity's inverse) to be met by private note-issue.

## *XII. Contemporary Alternatives to a Public Lender of Last Resort*

An important argument for retaining a discretionary central bank is that as a lender of last resort the central bank can helpfully forestall panics or liquidity crises in the commercial banking system. In the usual understanding, a lender of last resort injects new bank reserves whenever a critical insufficiency of reserves would otherwise arise. To evaluate the argument we need to ask why the banking system might face insufficient reserves. Harry Johnson (1973, p. 97) pointed out that commercial bankers should be presumed capable of optimizing their reserve holdings:

At least in the presence of a well-developed capital market, and on the assumption of intelligent and responsible monetary management by

the central bank, the commercial banks should be able to manage their reserve positions without the need for the central bank to function as “lender of last resort.”

Johnson’s “well-developed capital market” refers to the fact that a U.S. commercial bank with low reserves due to random outflows can quickly replenish its reserves by borrowing overnight in the fed funds market. His “assumption of intelligent and responsible monetary management by the central bank” means assuming that the central bank has not sharply reduced the monetary base and thereby the total of available bank reserves. (The possibility of a crisis due to contractionary central bank policy itself hardly justifies having a central bank.) Under those conditions, a critical shortage of reserves in the banking system as a whole implies an unexpected spike in the demand for reserve money, presumably due either to banks raising their desired reserve ratios or to the public draining reserves from the banking system.

A spike in demand for reserve money, left untreated, implies the shrinkage of the money multiplier and thus of the broader monetary aggregates. What is called the “lender of last resort” can thus be viewed as an aspect of a central bank’s remit under a fiat standard to prevent the money stock from unexpectedly shrinking, though one also directed at preserving the flow of bank credit by preventing solvent financial firms from failing for want of adequate liquidity. A central bank with a target for M1 or M2 automatically injects base money as the money multiplier shrinks. A central bank pre-committed to a Taylor Rule or a nominal income target does likewise.

A central bank in a modern financial system can readily make the necessary reserve injections through open market purchases of securities. For reasons considered above, it need not and generally should not make loans to particular institutions, for the sake of avoiding moral hazard and favoritism. A central bank’s readiness to lend to troubled or otherwise favored banks, providing explicit or implicit central bank bailout guarantees, promotes bad banking.



Jeffrey Lacker (2007) reminds us that nineteenth-century writers, like Walter Bagehot who famously urged the Bank of England to *lend* to other banks in times of credit stringency, “wrote at a time when lending really was the only way the central bank provided liquidity.” He continues:

Indeed, when the Fed was founded in 1913, discount window lending was envisioned as the primary means of providing reserves to the banking system. Today, the Fed's primary means of supplying reserves is through open-market operations, which is how the federal funds rate is kept at the target rate. In fact the effect of discount window loans on the overall supply of liquidity is automatically offset, or "sterilized," to avoid pushing the federal funds rate below the target. So it is important to distinguish carefully a central bank's monetary policy function of regulating the total supply of reserves from central bank credit policy, which reallocates reserves among banks.

Given a monetary policy rule that automatically injects reserves to counteract an incipient monetary contraction, and especially allowing for occasional (but presumably rare) departures from a “Treasuries only” open-market policy, there is no need for a *lender* (as opposed to a “market maker”) of last resort. That is, the Fed’s discount window can be closed without impeding its role of maintaining financial system liquidity. A case for keeping the discount window open would have to be made on the (unpromising) grounds that the Fed should intervene in the allocation of reserves among banks, or should use the window to lend cheaply (or purchase assets at above-market prices) to inject capital into banks on the brink of insolvency.

Historical evidence indicates that official discount-window lending is not necessary to avoid banking panics, scrambles for liquidity characterized by contagious runs on solvent institutions. Panics have been a problem almost exclusively in countries where avoidable legal restrictions have weakened banks

(Selgin 1989; Benston and Kaufman 1995). The United States in the late 19th to early 20th century is the prime example of a legislatively weakened and relatively panic-prone system. Even in that system, clearinghouse associations limited the damage done by panics by organizing liquidity-sharing and liquidity-creation arrangements, including temporary resort to clearinghouse “loan” certificates, and, if necessary, by arranging for a suspension or “restriction” of payments (Timberlake 1993, pp. 207-9; Dwyer and Gilbert 1989).<sup>47</sup> Bagehot himself, as we noted previously, did not see any need for a lender of last resort in a structurally sound banking and currency system—though for him this meant a system in which currency was not fiat money and was not supplied monopolistically.

Central bank lending that, contra Bagehot, puts insolvent institutions on life support can be replaced by policies for promptly resolving financial institution insolvencies. In recent years such proposals as expedited bankruptcy and “living wills,” possibly requiring that losses be borne by holders of subordinated debt or “contingent capital certificates,” have been widely discussed (Board of Governors 1999; Calomiris 2009b; Flannery 2009). Outright bailouts, on “too big to fail” grounds, can be left to the Treasury. As Kuttner (2008, p. 12) observes:

Saddling the Fed with bailout duties obscures its core objectives, unnecessarily linking monetary policy to the rescue of failing institutions... . In view of these concerns, it would be desirable to return to Bagehot’s narrower conception of the LOLR function, and turn over to the Treasury the responsibility for the rescue of troubled institutions, as this inevitably involves a significant contingent commitment of public funds.

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<sup>47</sup> The option of suspending payments can also be a contractual feature of banking contracts, as it was in the case of early Scottish banknotes bearing a so-called “option-clause.” Concerning those, see Gherity (1995) and Selgin and White (1997). On the potential incentive-compatibility of contractual suspension arrangements—that is, their ability to rule-out panic-based runs—see Gorton (1985). Although in Diamond and Dybvig’s (1983) model and later studies based on it, including Ennis and Keister (2009), suspension is suboptimal because it entails some disruption of optimal consumption, this conclusion depends on the unrealistic assumption that people cannot shop using (suspended) bank liabilities (Selgin 1993).

Such a reform, Kuttner adds (*ibid.*, p. 13), would simplify the implementation of monetary policy by avoiding bailout-based changes to the supply of bank reserves, while reducing the risk of higher inflation or reduced Fed independence.<sup>48</sup>

### *XIII. Conclusion*

Available research does not support the view that the Federal Reserve System has lived up to its original promise. Early in its career, it presided over both the most severe inflation and the most severe (demand-induced) deflations in post-Civil War U.S. history. Since then, it has tended to err on the side of inflation, allowing the purchasing power of the U.S. dollar to deteriorate considerably. That deterioration has not been compensated for, to any substantial degree, by enhanced stability of real output. Although some early studies suggested otherwise, recent work suggests that there has been no substantial overall improvement in the volatility of real output since the end of World War II compared to before World War I. Although a genuine improvement did occur during the sub-period known as the “Great Moderation,” that improvement, besides having been temporary, appears to have been due mainly to factors other than improved monetary policy. Finally, the Fed cannot be credited with having reduced the frequency of banking panics or with having wielded its last-resort lending powers responsibly. In short, the Federal Reserve System, as presently constituted, is no more worthy of being regarded as the last word in monetary management than the National Currency System it replaced almost a century ago.

The Fed’s record suggests that its problems go well beyond those of having lacked good administrators, and that the only real hope for a better monetary system lies in regime change. What sort of change is a question beyond the scope of this paper, which has only indicated some possibilities. We hope that it will also encourage further research exploring those alternatives’ capacity to contribute to a genuinely improved monetary system.

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<sup>48</sup> See also Repullo (2000) and commentators.

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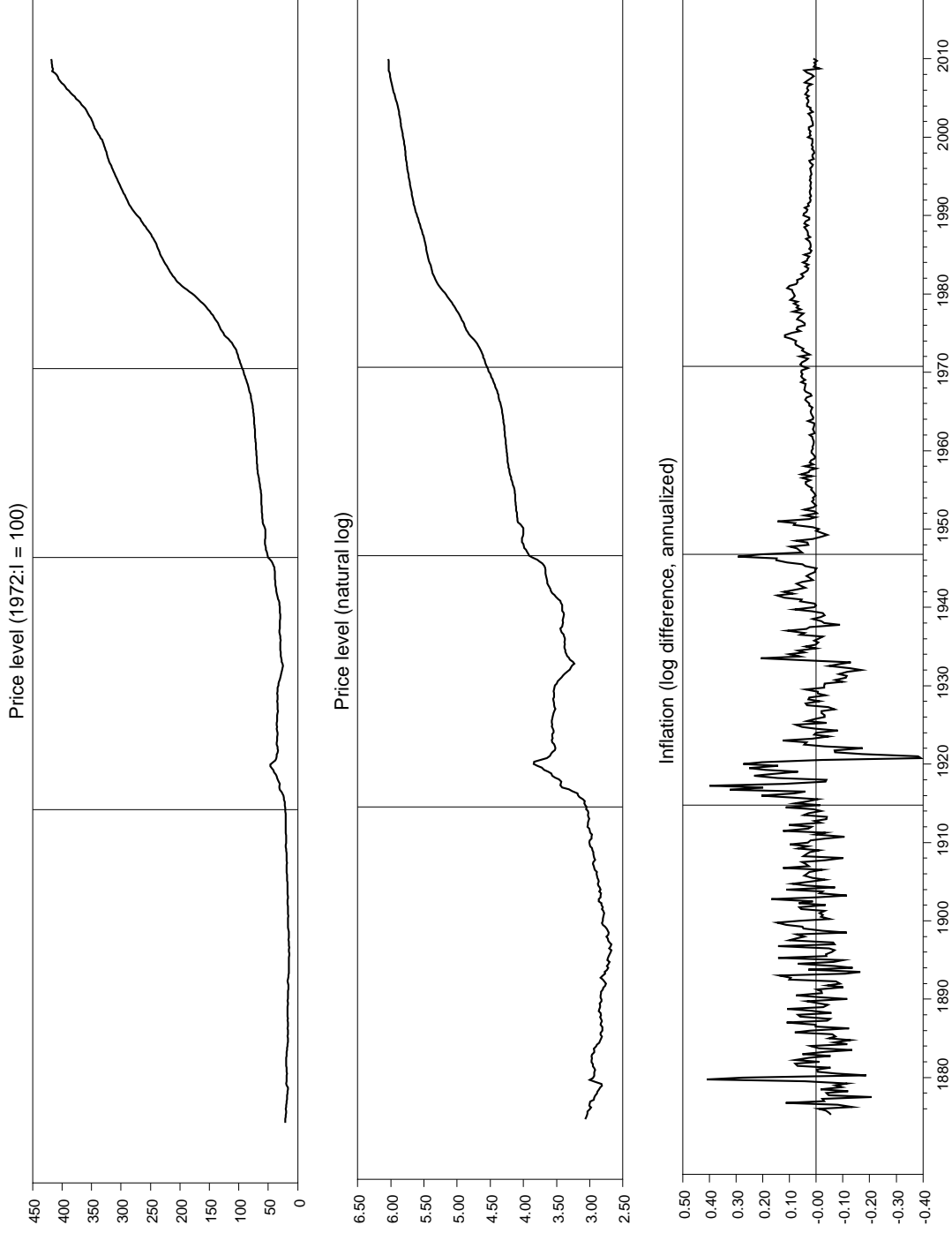
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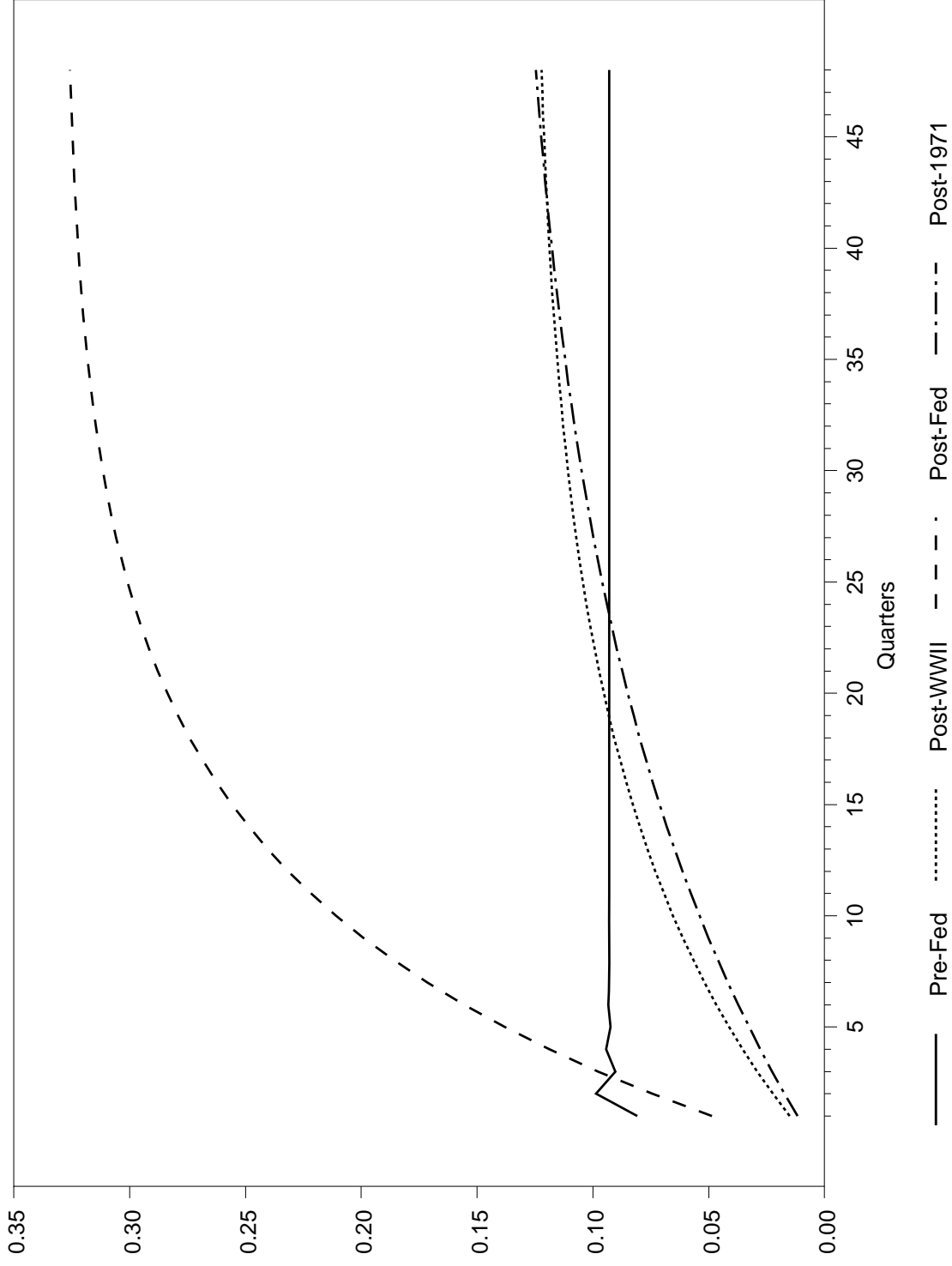
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Figure 1: Quarterly US price level and inflation rate, 1875 to 2010.



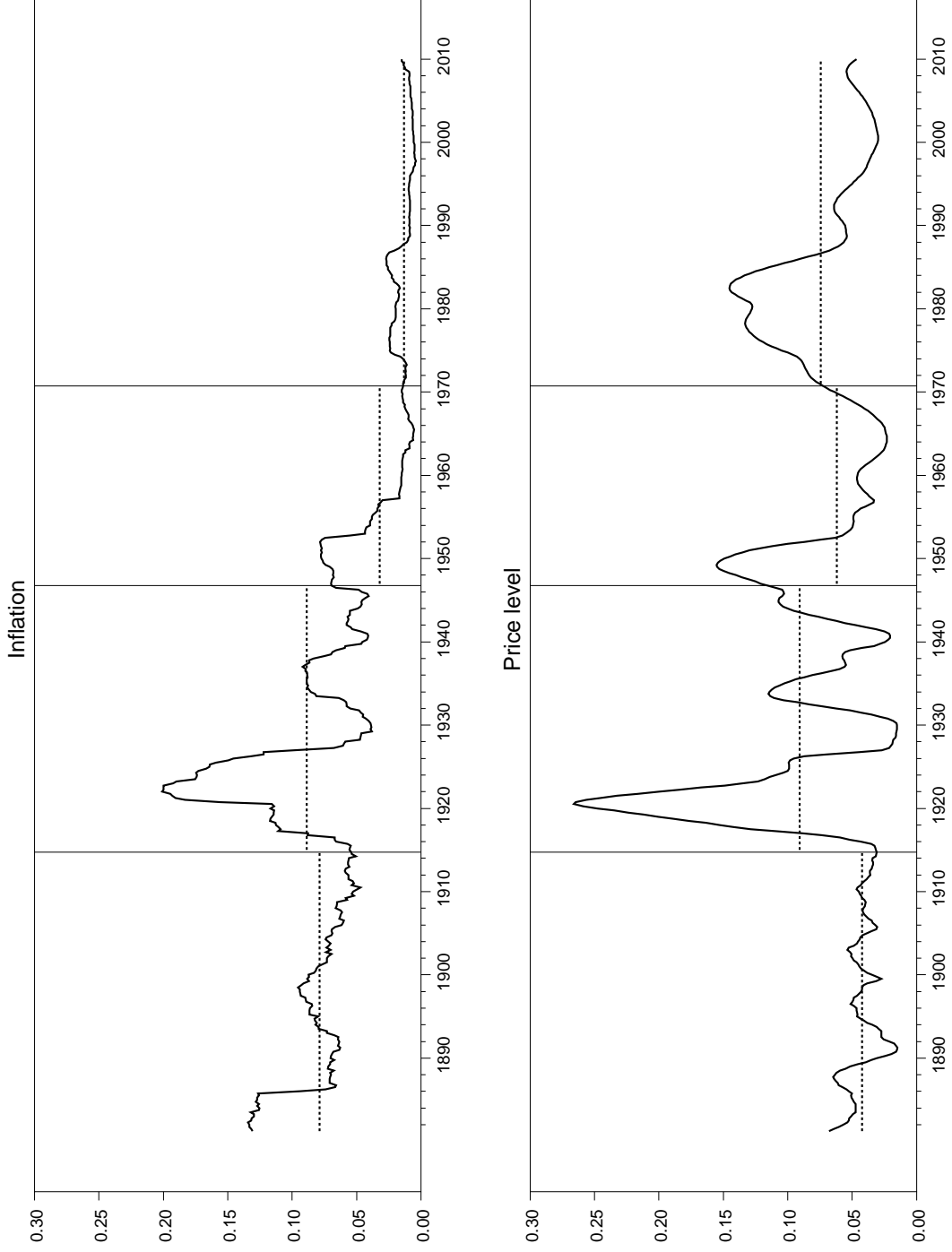
Notes: GNP deflator (Balke and Gordon 1986 series spliced to Department of Commerce series in 1946:IV). Vertical lines indicate the founding of the Fed, the end of World War II, and the effective end of the gold standard in the US.

Figure 2: Price level response to standard deviation inflation shock, various subperiods.



Notes: Impulse responses as a function of forecast horizon, implied by the ARMA coefficient estimates in Table 1.

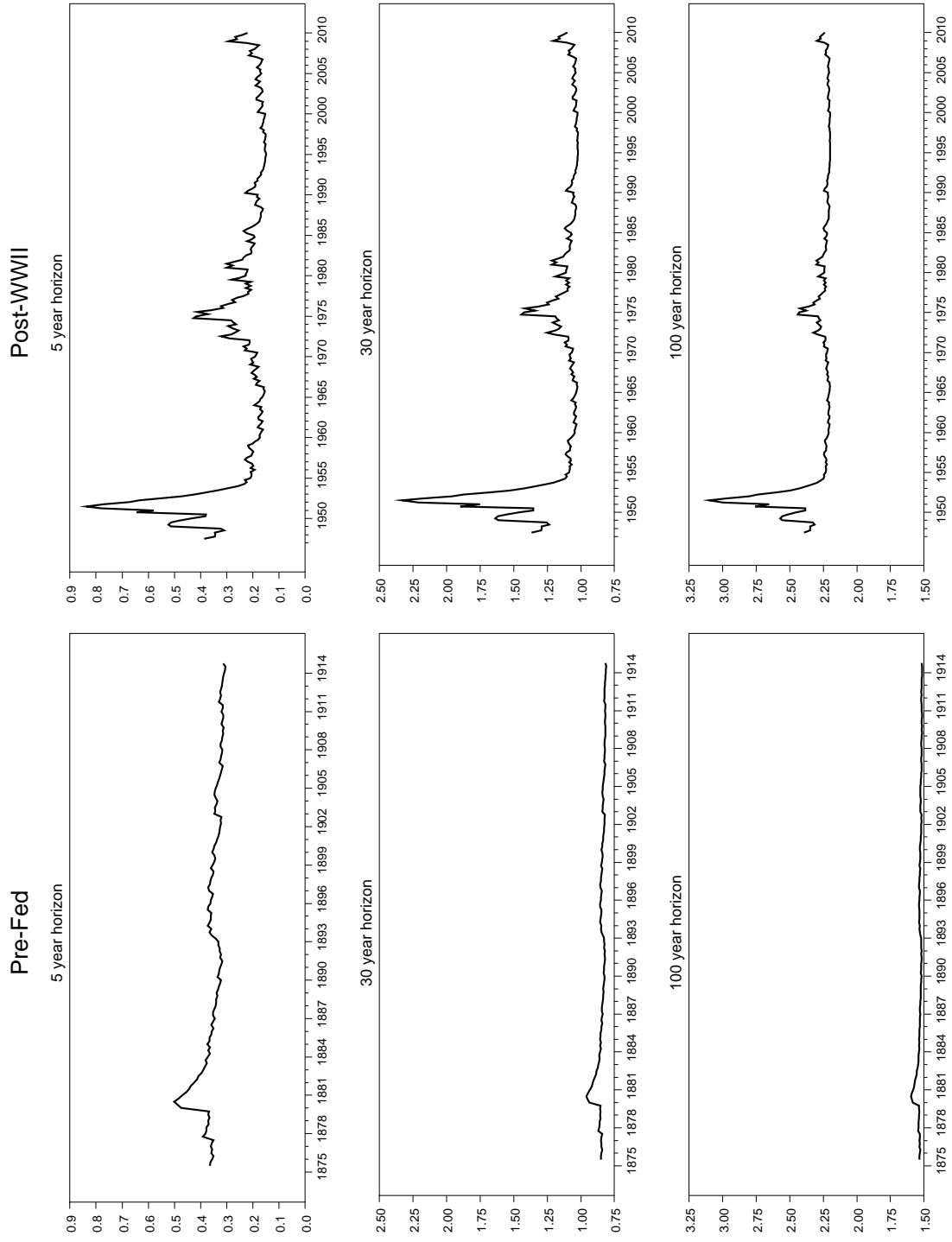
Figure 3: Price level and inflation uncertainty.



Notes: 6-year rolling standard deviations of the quarterly inflation rate and the price level, using data shown in Figure 1.

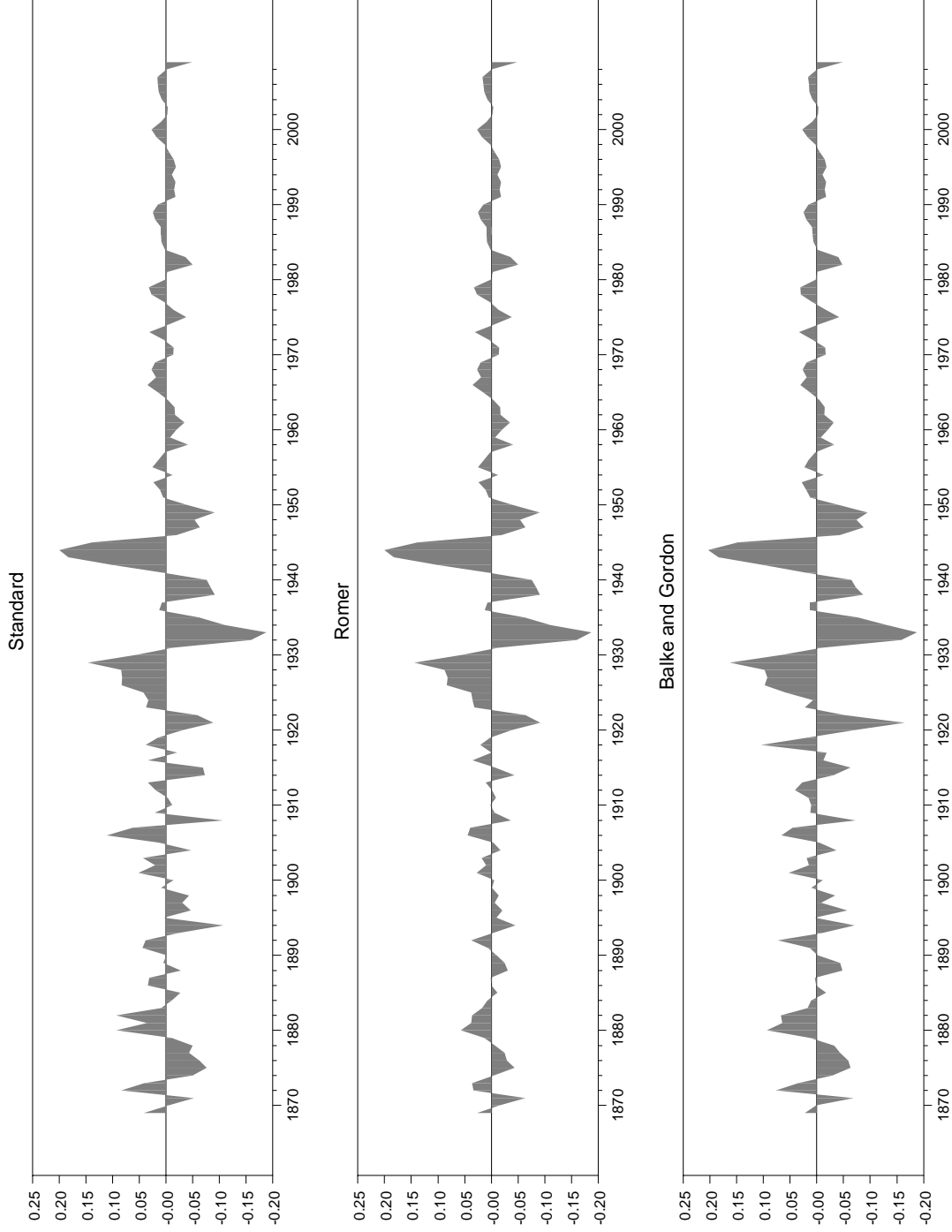


Figure 4: Conditional variances of the price level forecast errors, various horizons.



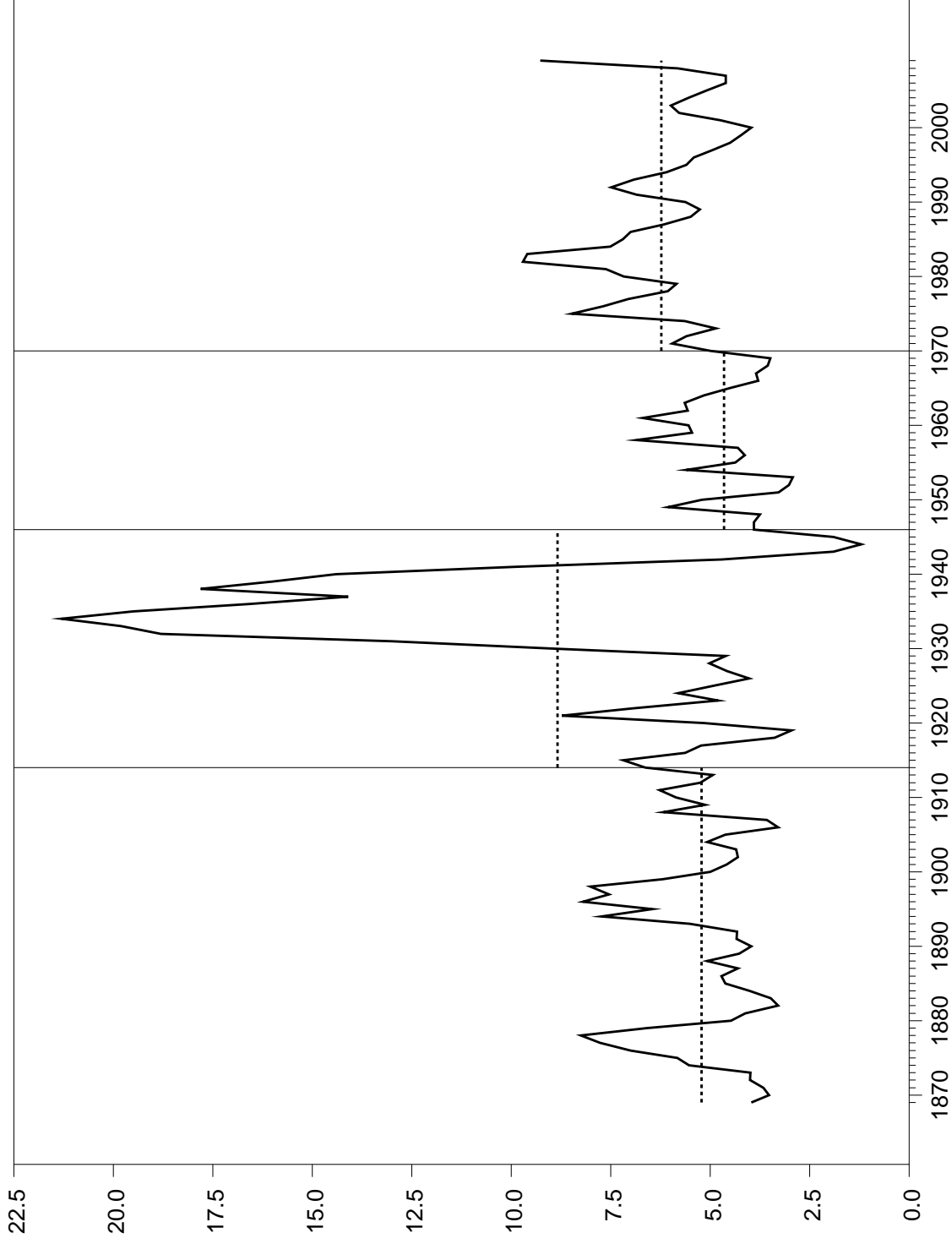
Notes: Fitted values at various horizons of conditional variance of the price level as implied by coefficient estimates in Table 1.

Figure 5: Percentage deviations of real GNP from trend.



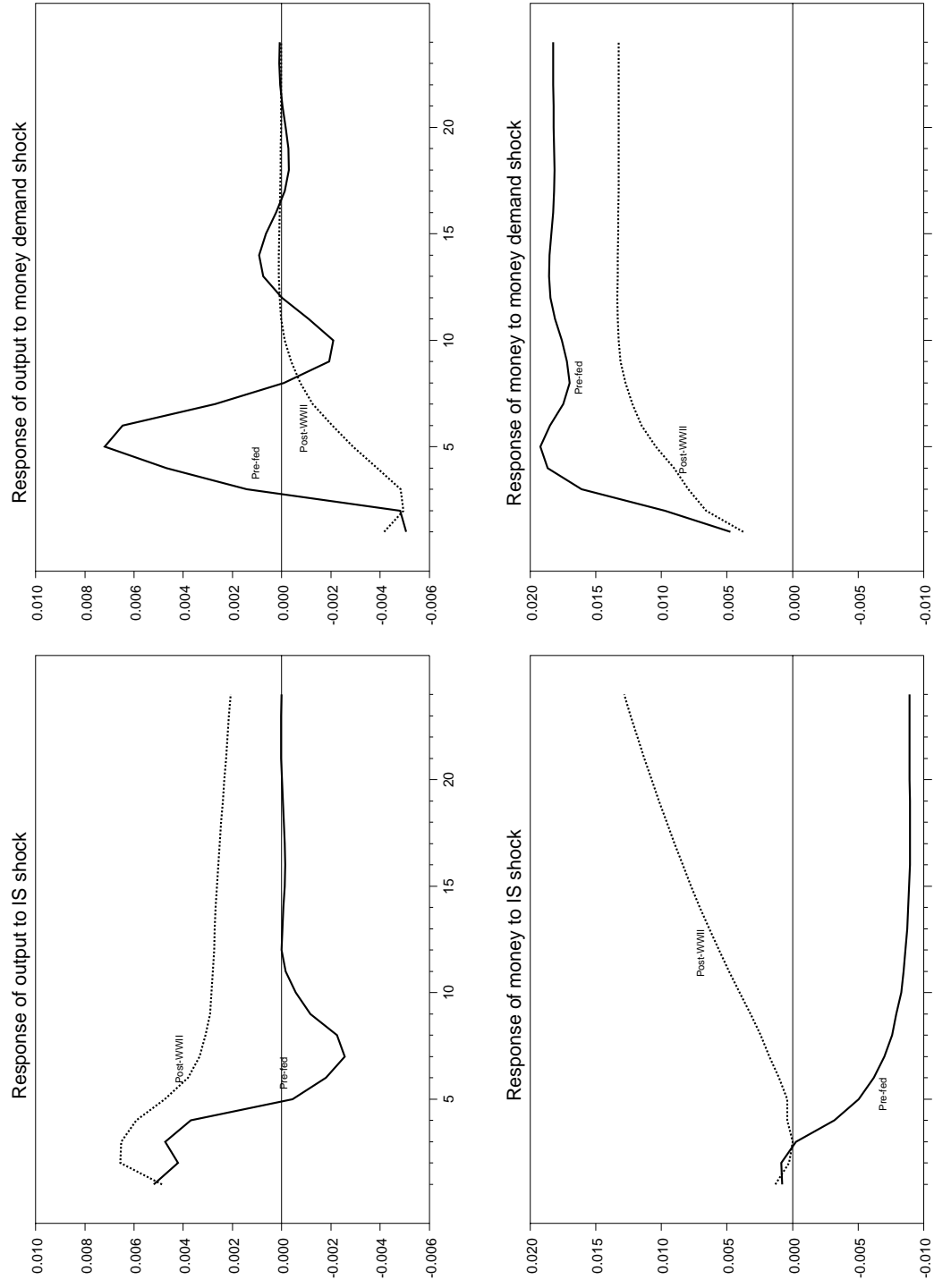
Notes: See table 2 for series definitions and sources. Shaded area is deviation from trend, where trend is measured using Hodrick-Prescott filter.

Figure 6: US unemployment rate, 1869 to 2009.



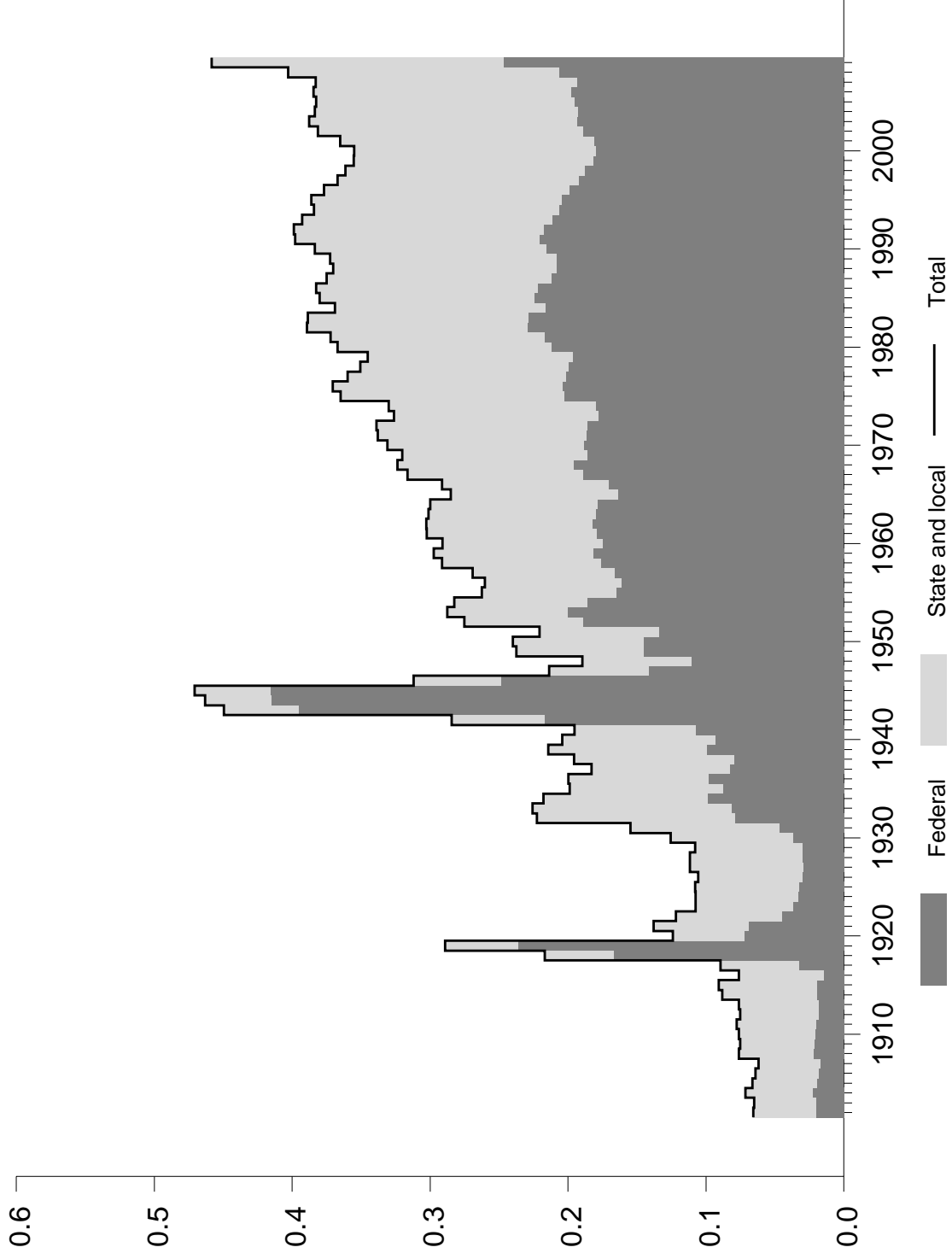
Notes: Source – 1869-99 (Vernon 1994), 1899-1930 (Romer 1986, adjusted series), 1931-40 (Coen 1973, adjusted series), 1941-2009 (BLS). Dashed lines indicate sub-period sample means.

Figure 7: Dynamic responses of output and money to aggregate demand shocks, Pre-Fed and Post-WWII.



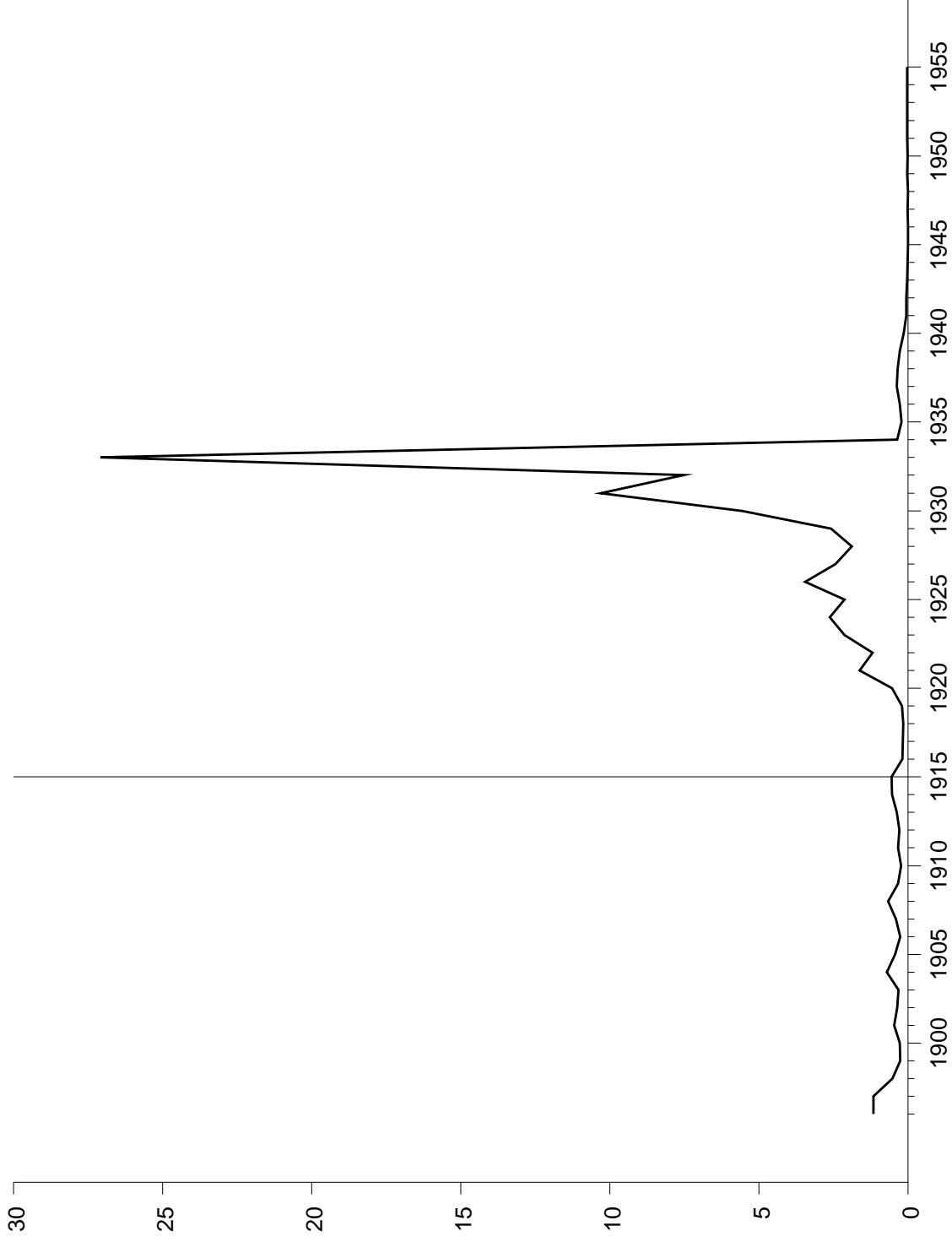
Notes: Responses to an unanticipated increase in the IS curve (aggregate spending) and to an unanticipated increase in the demand for real money balances, as a function of forecast horizon in quarter. See Lastrapes and Selgin (2010).

Figure 8: Annual federal, state and local spending relative to GDP, 1902 to 2009.



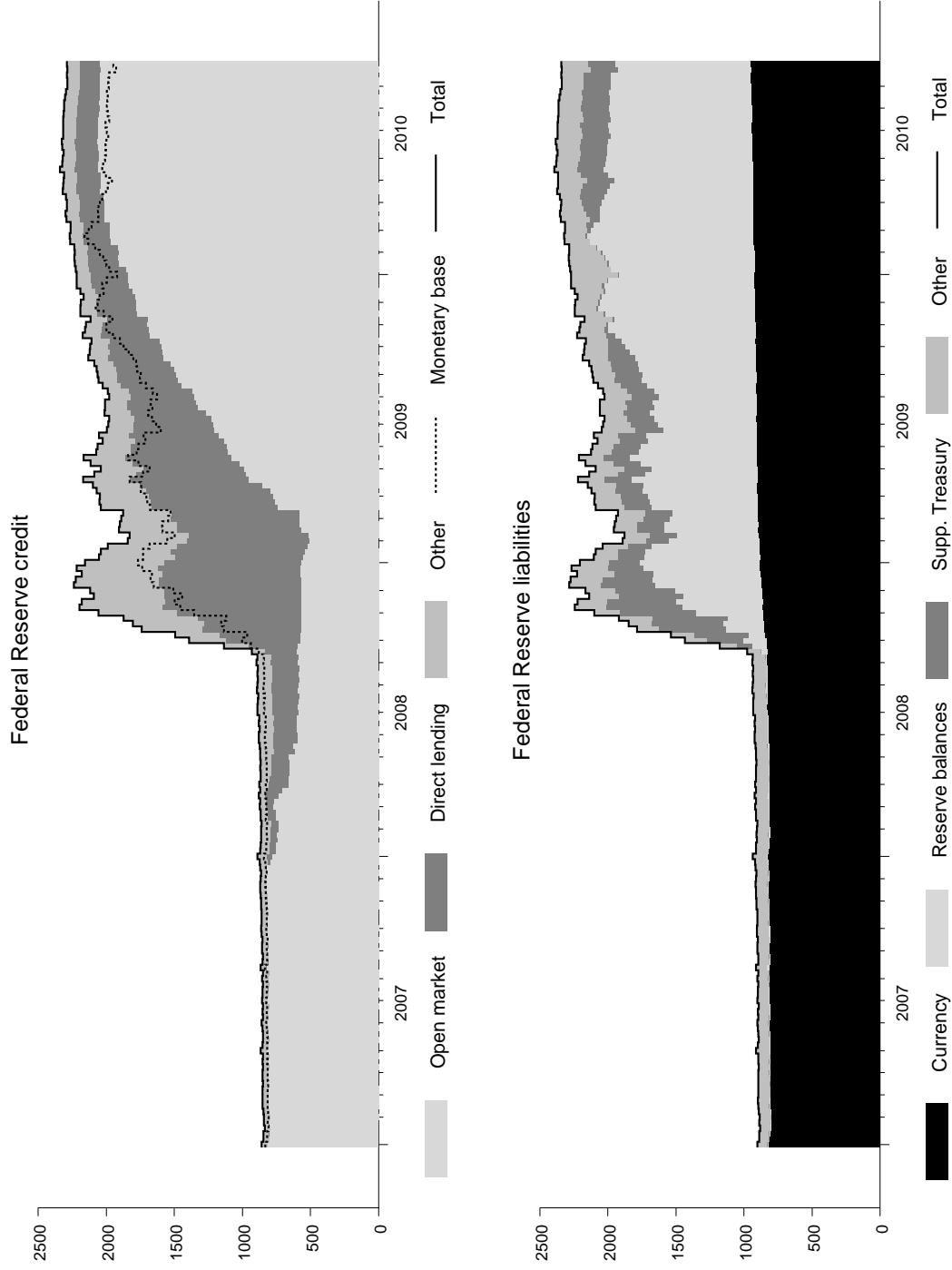
Notes: Federal spending is federal net outlays from the Office of Management and Budget (as reported by the St. Louis Federal Reserve Database) State and local expenditures are from [usgovernmentspending.com](http://usgovernmentspending.com).

Figure 9: US bank failures as percentage of all banks, 1896 to 1955.



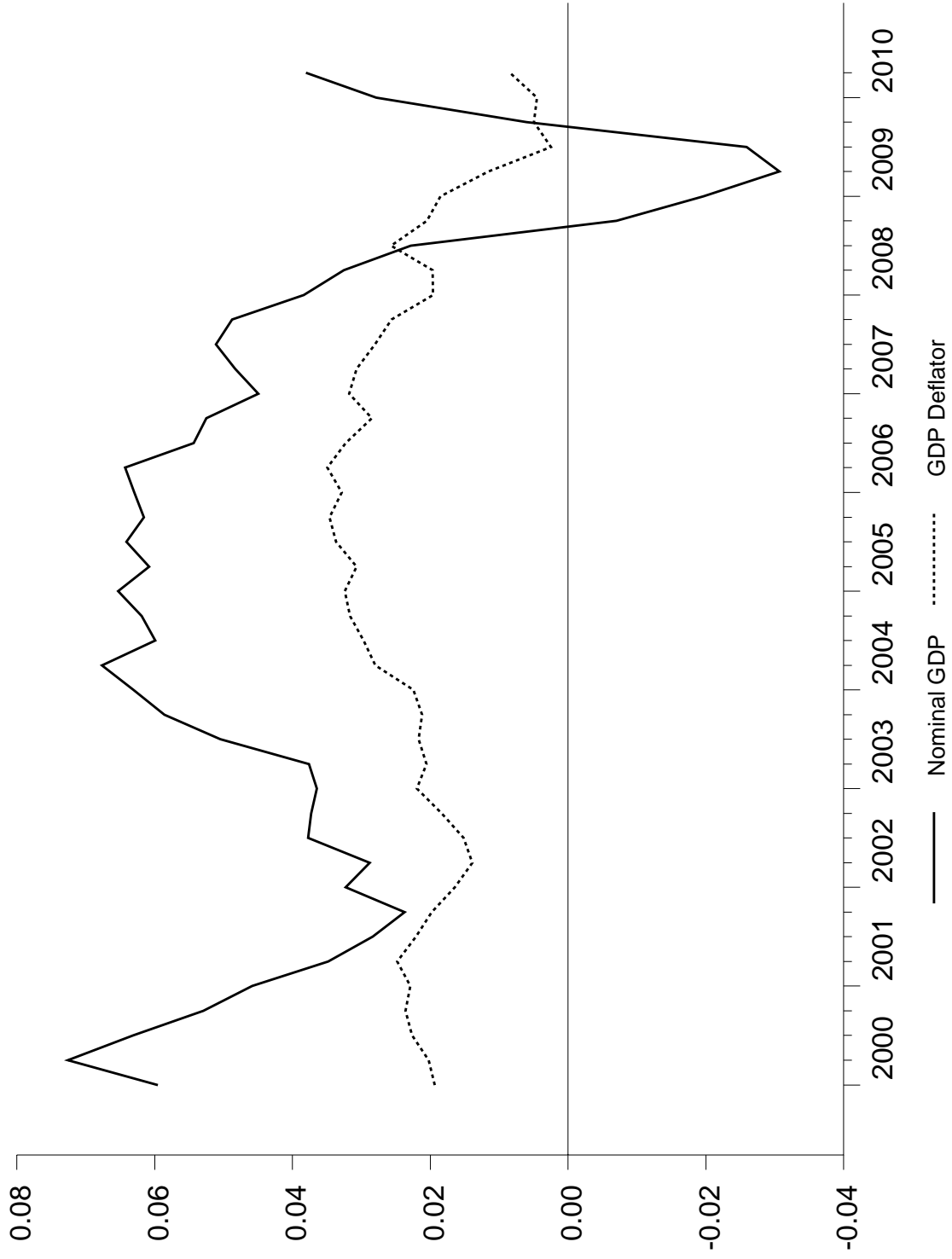
Notes: Sources: Banking and Monetary Statistics 1914-1941, Board of Governors of the Federal Reserve System; All Bank Statistics 1896-1955; Annual Report of the Comptroller of the Currency, December 3, 1917, Vol. 1.

Figure 10: Federal Reserve Credit and components, monetary base and excess reserves, 2007 to 2010.



Notes: Weekly data. 'Open market' includes all securities held outright, including mortgage-backed securities, plus repurchase agreements. 'Direct lending' includes term auction credit, all other loans, and all net portfolio holdings of the Fed's special investment vehicles. Source: St. Louis Federal Reserve Data base.

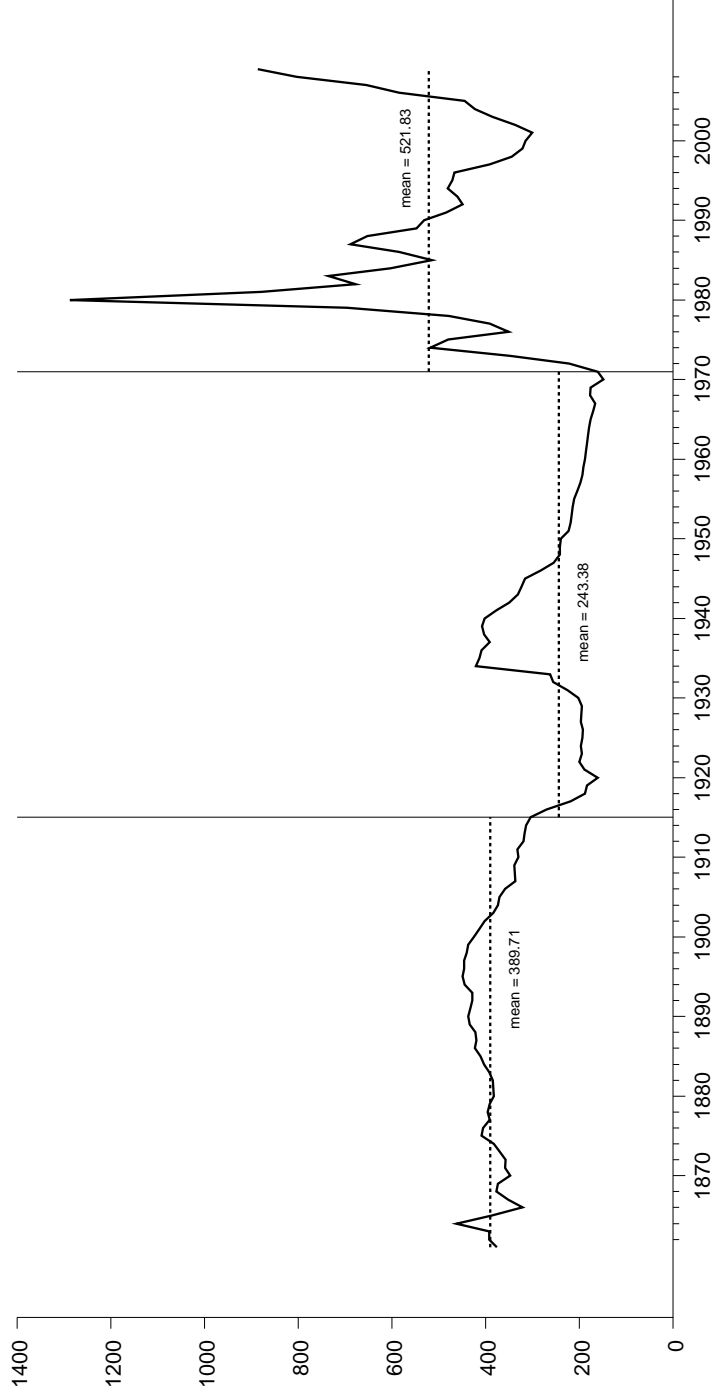
Figure 11: Nominal GDP growth and inflation, 2000 to 2010.



Notes: Quarterly data, year-to-year growth rates.



Figure 12: Real price of gold, 1861 to 2009.



Notes: Annual average gold price based on London P.M. fix relative to the GNP deflator. Source for gold prices: data from 1861 to 1899 are from Global Financial Data, average of high and low; data from 1900 to 2009 are from Global Insight.

Table 1: Characteristics of quarterly inflation.

	Sample statistics			
	1875-1914	1947-2010	1915-2010	1971-2010
mean	-0.05%	3.39%	3.16%	3.84%
standard deviation	8.33%	2.54%	6.78%	2.51%
autocorrelation, 1 lag	0.18	0.80	0.70	0.89
autocorrelation, 2 lags	-0.16	0.72	0.43	0.84
autocorrelation, 3 lags	0.01	0.65	0.29	0.81
autocorrelation, 4 lags	-0.03	0.54	0.26	0.78
autocorrelation, 5 lags	-0.04	0.49	0.19	0.71
autocorrelation, 6 lags	-0.01	0.42	0.11	0.69
autocorrelation, 7 lags	0.06	0.38	0.05	0.62
autocorrelation, 8 lags	0.10	0.41	0.02	0.60
autocorrelation, 9 lags	0.06	0.39	0.01	0.57
autocorrelation, 10 lags	0.01	0.45	0.09	0.56
autocorrelation, 11 lags	0.10	0.43	0.16	0.54
autocorrelation, 12 lags	0.13	0.43	0.16	0.52
Coefficients from ARMA(1,1)-GARCH(1,1) model				
constant	0.008	0.0015	0.0002	0.0009
AR(1)	-0.467	0.9372	0.9078	0.9567
MA(1)	0.689	-0.4530	-0.3705	-0.4616
constant in variance	0.00026	0.000006	0.000005	0.000002
ARCH(1)	0.049	0.260	0.351	0.1128
GARCH(1)	–	0.714	0.695	0.8531
Conditional variance (5yr)	0.350	0.230	–	–
Conditional variance (30yr)	0.843	1.135	–	–
Conditional variance (100yr)	1.530	2.263	–	–

Notes: Inflation is quarterly log difference of the price level, adjusted to an annual rate, using the data described in Figure 1.

Table 2: Output volatility (percentage standard deviation from trend), alternative GNP estimates.

Series	1869-1914 (1)	1915-2009 (2)	1915-1946 (3)	1947-2009 (4)	1984-2009 (5)	ratio (2)/(1)	ratio (3)/(1)	ratio (4)/(1)	ratio (5)/(1)
Standard	5.064	5.764	9.323	2.554	1.706	1.138	1.841	0.504	0.337
Romer	2.664	5.716	9.224	2.554	1.706	2.145	3.463	0.959	0.640
Balke-Gordon	4.270	6.291	10.195	2.773	1.696	1.473	2.388	0.649	0.397

Notes: Trend is measured using the Hodrick-Prescott filter. ‘Standard’ series, 1869-1929: original Kuznets series, with adjustments by Gallman and Kendrick (see Rhode and Sutch, 2006, p. 3-12). ‘Romer’ series, 1869-1929: real GNP from Romer (1989, Table 2). ‘Standard’ and ‘Romer’ series, 1929-2009: spliced to real GNP (Bureau of Economic Analysis of the Department of Commerce, taken from Federal Reserve Bank of St. Louis Database). ‘Balke-Gordon’ series, 1869-1983: real GNP from Balke and Gordon (1986, Appendix B, Table 1); 1984-2009: spliced to BEA real GNP. All data available from the *Historical Statistics of the United States, Millennium Edition On-line*, 2006.

Table 3: Contribution of aggregate supply shocks to output forecast error variance.

horizon (quarters)	Pre-Fed	Post-WWII
1	81.1373	36.2475
2	83.0815	35.2230
3	85.7569	41.2518
4	86.5508	46.4824
5	86.3244	51.7597
6	86.3275	56.7460
7	86.5984	60.9029
8	86.8482	64.2719
12	88.9045	72.8033
16	90.7820	77.4053
20	91.8888	80.4573
24	92.7255	82.7308

Notes: Source – Lastrapes and Selgin (2010).