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The Federal Response to Home Mortgage Distress: Lessons from the Great Depression

David C. Wheelock

This article examines the federal response to mortgage distress during the Great Depression: It documents features of the housing cycle of the 1920s and early 1930s, focusing on the growth of mortgage debt and the subsequent sharp increase in mortgage defaults and foreclosures during the Depression. It summarizes the major federal initiatives to reduce foreclosures and reform mortgage market practices, focusing especially on the activities of the Home Owners' Loan Corporation (HOLC), which acquired and refinanced one million delinquent mortgages between 1933 and 1936. Because the conditions under which the HOLC operated were unusual, the author cautions against drawing strong policy lessons from the HOLC's activities. Nonetheless, similarities between the Great Depression and the recent episode suggest that a review of the historical experience can provide insights about alternative policies to relieve mortgage distress. (JEL E44, G21, G28, N12, N21)

Federal Reserve Bank of St. Louis *Review*, May/June 2008, *90*(3, Part 1), pp. 133-48.

The growth in U.S. house prices peaked in 2005 and has since fallen rapidly. By late 2006, a national index began to show an outright decline in U.S. house prices, and some analysts forecast that prices could fall 10 percent or more nationally.[1] Mortgage delinquencies and foreclosures have risen sharply as the growth in house prices has slowed. As of the fourth quarter of 2007, 3.6 percent of residential mortgages, 14.4 percent of subprime mortgages, and 20.4 percent of adjustable-rate subprime mortgages were seriously delinquent (i.e., with payments at least 90 days past due or in foreclosure). In that quarter, 0.9 percent of all mortgages, 3.7 percent of subprime mortgages, and 5.7 percent of adjustable-rate subprime mortgages entered the foreclosure process.[2] Many analysts predict that house prices will continue to fall and that mortgage delinquency and foreclosure rates will remain high until 2009 or beyond.

The severe distress in housing and mortgage markets has prompted numerous proposals to stem the tide of loan defaults and foreclosures. Government officials have encouraged lenders to modify the terms of existing loans to reduce loan payments and thereby lower default rates, while

[1] In an August 2005 interview, Robert Shiller predicted U.S. house prices could fall by 40 percent (Leonhardt, 2005). The S&P/Case-Shiller U.S. National Home Price Index began to fall in the third quarter of 2006. The house price index for purchase transactions produced by the Office of Federal Housing Enterprise Oversight (OFHEO) declined for the first time (since 1993) in the third quarter of 2007. The OFHEO index is based on data for mortgages purchased by Fannie Mae and Freddie Mac, two large government-sponsored enterprises that purchase and securitize home mortgages valued below a conforming limit, which in 2007 was $417,000. The S&P/Case-Shiller index is based on data that include mortgages that exceed this limit; it thereby includes data on more-expensive homes that nationally have tended to show more-rapid price appreciation followed by more-rapid depreciation during the recent cycle than less-expensive homes.

[2] By contrast, less than 2 percent of all residential mortgages and less than 6 percent of subprime mortgages were seriously delinquent during 2005, when just 0.4 percent of all residential mortgages and 1.5 percent of all subprime mortgages entered foreclosure. These are non-seasonally adjusted data from the Mortgage Bankers Association (Haver Analytics).

David C. Wheelock is an assistant vice president and economist at the Federal Reserve Bank of St. Louis. The author thanks William Emmons and Tom Garrett for comments on a prior draft. Craig P. Aubuchon provided research assistance.

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the Federal Reserve has proposed new regulations to limit mortgage market practices that many observers believe have contributed to high default rates.[3] The Bush administration authorized expanded use of Federal Housing Administration (FHA) guarantees to refinance subprime home mortgages and requested legislation to raise FHA loan limits and ease down payment requirements for FHA-guaranteed loans.[4] Other proposals on the table include (i) directing Fannie Mae and Freddie Mac, the two main government-sponsored enterprises that purchase and securitize home mortgages, to refinance subprime mortgages; (ii) permitting states to refinance loans at risk of foreclosure through the issuance of federal tax-exempt mortgage revenue bonds; and (iii) creating a new federal corporation to purchase distressed mortgages from investors and convert them to 30-year fixed-rate mortgages.[5]

The creation of a new federal corporation to purchase distressed mortgages would mimic a similar agency, the Home Owners' Loan Corporation (HOLC), that was established to purchase delinquent home mortgages during the Great Depression. Many observers have noted that the recent increase in home mortgage defaults resembles the experience of the Great Depression, when a tidal wave of home mortgage defaults also occurred. This article takes a look back at the Great Depression experience and identifies differences and similarities with the current episode. As with the current episode, the increase in mortgage defaults during the Depression was preceded by a period of extensive home building and rising house prices and an increasing use of debt to finance house purchases. Defaults rose sharply in the early 1930s when house prices and household incomes collapsed. The tidal wave of mortgage defaults and foreclosures prompted calls for government help, and the federal government, as well as state and local governments, responded quickly with a variety of programs to alleviate the distress in mortgage markets.

This article first documents features of the housing boom of the 1920s and describes the evolution of home mortgage finance during that decade. It then examines the collapse of house prices and increase in mortgage defaults during the 1930s and describes how the federal government responded to the wave of home mortgage defaults during the Depression. Although the article summarizes each of the major initiatives, it focuses primarily on the activities of the HOLC, which was the principal vehicle by which the federal government sought to resolve delinquent home mortgages. The HOLC has been cited as a model for how the government could resolve the current wave of mortgage defaults. However, as this article points out, the conditions under which the HOLC operated were quite different from those present today and, hence, the lessons from the operation of the HOLC for the current episode are somewhat limited.

THE HOUSING BOOM AND BUST

The recent downturn in U.S. house prices and construction was preceded by a period of rapid growth. Between January 2003 and December 2005, single-family housing starts increased at an average annual rate of 8.5 percent. By contrast, between January 2006 and December 2007, housing starts fell at an average annual rate of 21.8 percent.[6] The U.S. experienced a similar boom/bust cycle in housing construction during the 1920s and early 1930s. Annual data for 1900-41 on the number of single-family housing starts are shown in Figure 1, alongside data on the value

3 The Federal Reserve proposal is summarized in a press release dated December 18, 2007: www.federalreserve.gov/newsevents/press/bcreg/20071218a.htm.

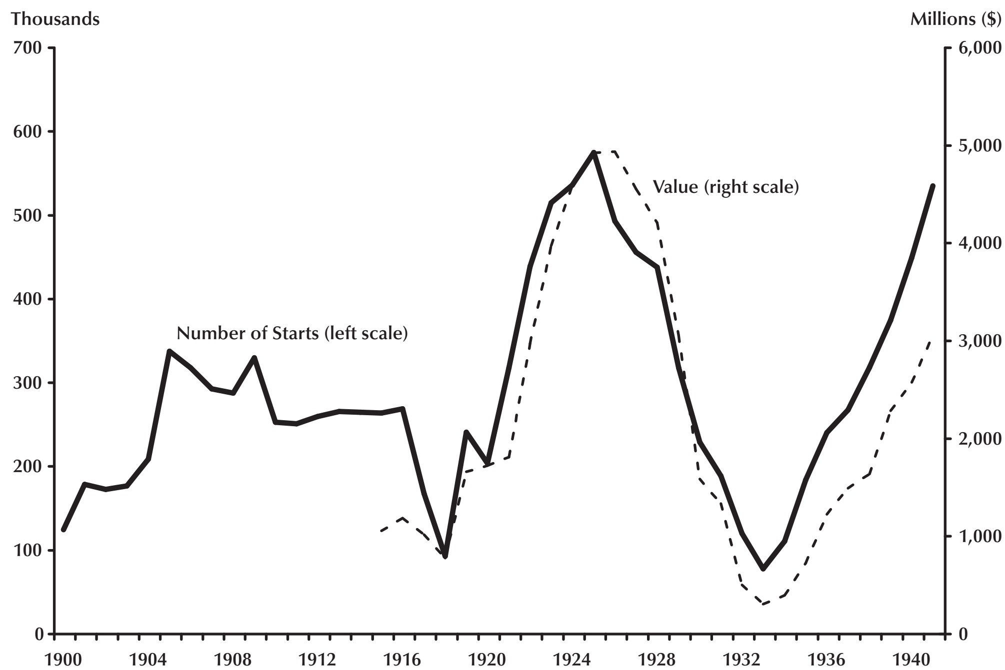
4 Details of the Administration's proposals in response to the subprime mortgage crisis are described in a speech by Treasury Secretary Paulson on December 3, 2007: www.ustreas.gov/press/releases/hp706.htm.

5 Senator Charles Schumer proposed (i) and (ii) in remarks entitled "A Call to Action on the Subprime Mortgage Crisis: Putting Common Sense Ahead of Ideology," delivered at the Brookings Institution on December 19, 2007. Proposals for the creation of a Federal Homeownership Preservation Corporation were discussed in hearings before the U.S. Senate Banking Committee on January 31, 2008. See Barr (2008) and Pollock (2008).

6 The data reported on housing starts are averages of monthly year-over-year percentage changes. The source of these data is the Department of Commerce (Haver Analytics).

Figure 1

Single-Family Housing Starts and Value of New Units, 1900-41



of new single-family housing units (from 1915, when data are first available, to 1941).[7] Construction of new single- and multi-family housing stalled during World War I and, after a brief recovery, slumped again during a recession in 1920-21.[8] Construction rebounded rapidly as the economy recovered, however, with peaks in single- and multi-family home construction reached in 1925 and 1927, respectively. Some authors have argued that the growth in housing investment during the 1920s outstripped demand. The infamous Florida land and construction boom, which ended with a hurricane in September 1926, is the most-often cited occurrence of a housing bubble.[9] However, many authors contend that real estate speculation was widespread, fueled by lax lending standards and the ease with which securities could be sold to finance construction (e.g., Gordon, 1974, p. 35).

Interest rates began to rise in 1928 when the Federal Reserve tightened monetary policy to stem speculative activity, especially in the stock market, and housing investment began to fall. Housing starts plunged sharply after the business cycle peak in mid-1929. Some authors contend that the decline in housing investment in 1928-29 contributed to the onset of the Great Depression, though that view is not widely held today.[10]

House prices, shown in Figure 2, followed a path that was similar to that of construction.

[7] *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition* (Cambridge University Press, 2006), series Dc511 and Dc257.

[8] According to Doan (1997, pp. 27-28), housing starts were at their lowest level since the 1870s during World War I and the 1920 recession, resulting in a severe housing shortage and rapidly rising rents.

[9] See, for example, Allen (1957, Chap. 11).

[10] Although Hickman (1960, pp. 320-21) and Gordon (1974, pp. 70-71) link the onset of the Depression to the downturn in housing investment, most recent studies attribute the onset of the Depression either to restrictive monetary policy (e.g., Friedman and Schwartz, 1963; Hamilton, 1987) or an unspecified adverse technology shock (e.g., Cole and Ohanian, 1999). See Parker (2007) for a survey of recent research on the causes of the Great Depression.

Figure 2

Housing Price Index, 1900-34

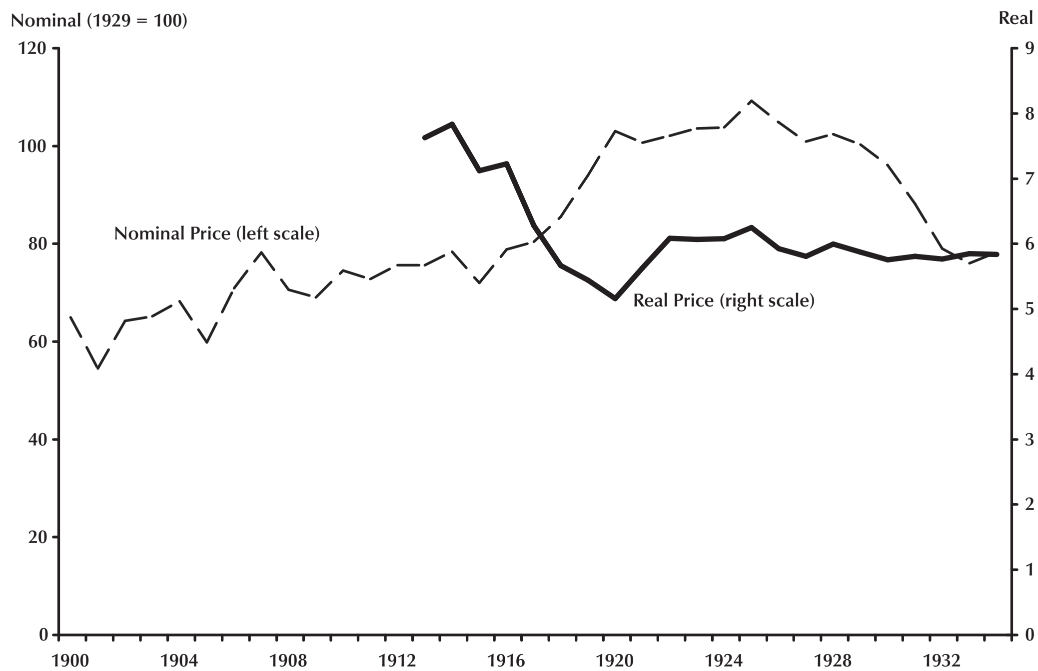


Figure 3

Mortgage Debt Outstanding

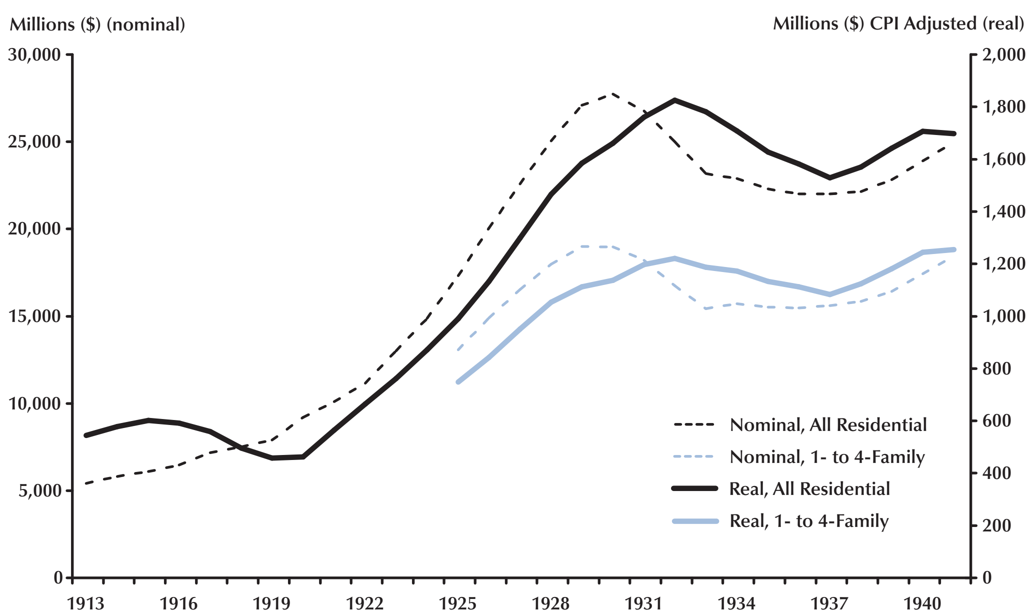
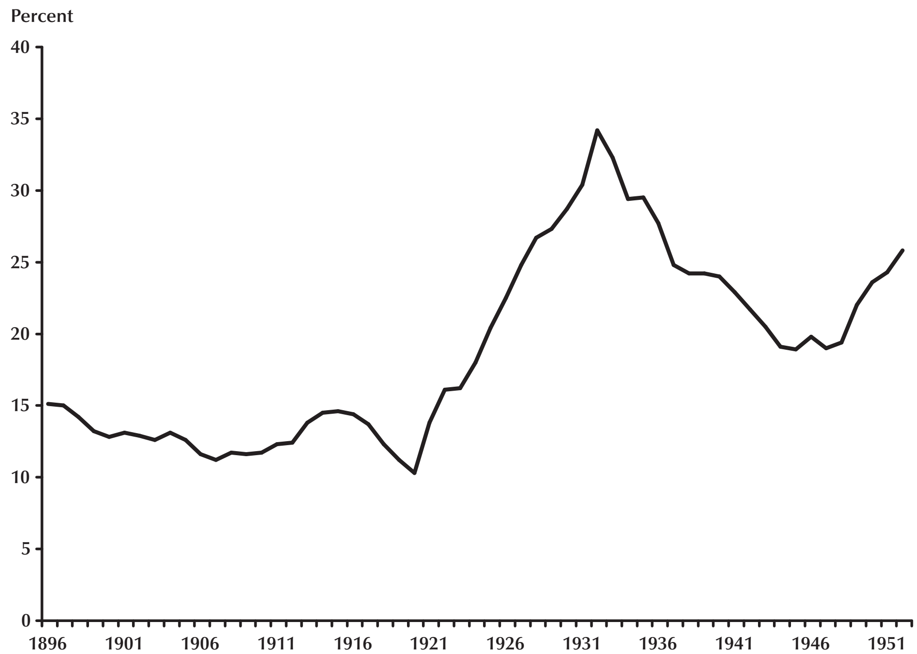


Figure 4

Nonfarm Residential Mortgage Debt as a Percentage of Nonfarm Residential Wealth



SOURCE: Grebler, Blank, and Winnick, 1956. Table L-6.

In the aggregate, house prices rose to a peak in 1925; then, after declining slowly, prices fell sharply as the Depression took hold. The decline in house prices during 1929-33 was comparable to the decline in consumer prices, however; thus, inflation-adjusted (i.e., real) house prices, also shown in Figure 2, changed little.[11]

Home mortgage debt outstanding increased rapidly during the 1920s and continued to grow even after housing starts had begun to decline and house prices had leveled off. Figure 3 plots the dollar value of outstanding mortgage debt on all residential properties from 1900 to 1941 and on 1- to 4-family properties from 1925 to 1941. (Data for 1- to 4-family properties are not available before 1925.) Data on the real value of outstanding mortgage debt are also shown in the figure. Although the nominal value of mortgage debt peaked in 1930 and then declined, deflation caused the real value of outstanding mortgage debt to continue to rise until 1932. Thus, consistent with Fisher's (1933) classic "debt-deflation" theory, the burden of outstanding mortgage debt increased sharply during the contraction phase of the Great Depression and economic recovery did not begin until the real value of outstanding debt had begun to decline.[12]

A rising level of debt does not necessarily pose a problem for households, so long as household incomes and wealth are sufficient to make loan payments. However, household incomes and wealth declined rapidly during the Depression. Moreover, falling house prices made it less likely that a homeowner who was having difficulty making his mortgage payments could sell his property

[11] The nominal house price index data shown in Figure 2 are series Dc826 from *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition* (2006). The real price index is the nominal index divided by the consumer price index (1982-84 = 100).

[12] The NBER identifies the business cycle trough as being in the first quarter of 1933. See www.nber.org/cycles/cyclesmain.html.

for more than the outstanding balance on his loan. From 1929 to 1932, personal disposable income and nonfarm residential wealth fell 41.0 percent and 25.7 percent, respectively, whereas the value of nonfarm residential debt declined by just 6.8 percent. As shown in Figure 4, relative to nonfarm residential wealth, residential mortgage debt outstanding increased sharply throughout the 1920s and continued to rise until 1932.[13] Thus, as residential property became increasingly leveraged during the 1920s, the declines in household incomes and wealth after 1929 made servicing that debt especially difficult for homeowners.

The rapid increases in building activity, house prices, and mortgage debt during the 1920s are characteristics shared with the recent U.S. housing boom. The 1920s witnessed an increase in loan-to-value ratios and frequent use of high interest rate secondary loans, which is also reminiscent of the recent experience (Doan, 1997, p. 35; Dovenmuehle, 1965, p. 2). Further, according to some commentators, lending standards in the 1920s were unusually lax (Saulnier, 1956, p. 10). Thus, on the eve of the Great Depression, many homeowners were not well positioned to withstand the substantial decline in income or house prices that would occur over the next three years.

MORTGAGE DISTRESS DURING THE DEPRESSION

As the U.S. economy contracted, loan delinquencies and foreclosures soared, fueled by falling household incomes and property values. Many home loans had terms of five years or less and often involved no, or only partial, payment of principal before a balloon payment was due when the loan matured or was refinanced.[14] Refinancing was common and easily accomplished in the 1920s, an environment of rising incomes and property values, but next to impossible during the Depression. Falling incomes made it increasingly difficult for borrowers to make loan payments or to refinance outstanding loans as they came due. The failure of thousands of banks and other lenders contributed to the difficulty of refinancing, as customer relationships were severed and the costs of credit intermediation rose.[15]

At its worst, in 1933, some 1,000 home loans were foreclosed every day (*Fifth Annual Report of the Federal Home Loan Bank Board*, 1937, p. 4). Figure 5 plots annual data on the mortgage foreclosure rate from 1926, when data are first available, to 1941. The foreclosure rate increased continuously from 1926 to 1933, then declined slowly over the remainder of the period. The foreclosure rate exceeded 1 percent (10 per 1,000 mortgages) in each year from 1931 to 1935 and did not fall below the rate for the year 1926 until 1941. The rate of foreclosures would likely have been far higher were it not for the moratoria on (and other impediments to) foreclosure imposed by several states (Poteat, 1938), as well as the actions of the federal government to refinance delinquent mortgages, which are discussed later in this article.[16]

A broader measure of home mortgage distress is the rate of mortgages with past due payments. Comprehensive data on mortgage delinquency rates do not exist for the 1930s. However, a study of 22 cities by the Department of Commerce found that, as of January 1, 1934, 43.8 percent of urban, owner-occupied homes on which there was a first mortgage were in default. The study also found that among delinquent loans, the average time that they had been delinquent was 15

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[13] Data on personal disposable income are from *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition* (2006), series Ca68. Data on nonfarm residential wealth and nonfarm residential mortgage debt are from Grebler, Blank, and Winnick (1956, Table L-6).

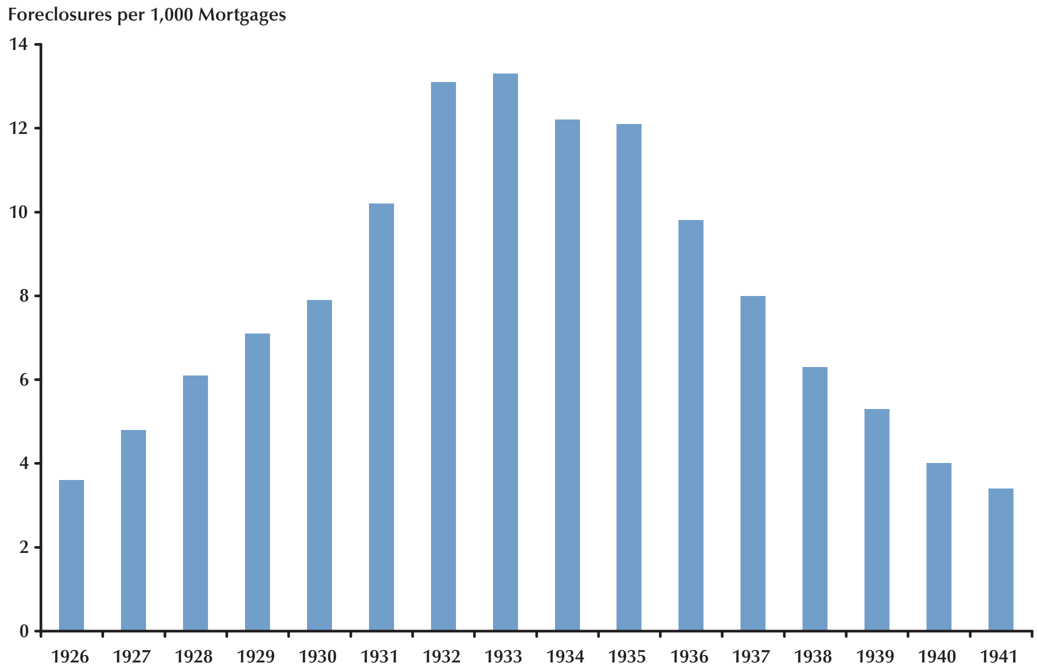
[14] Lending terms varied widely across lenders. Although mortgages made by savings and loan associations (S&Ls) were usually fully amortizing, those made by life insurance companies and commercial banks often included no, or only partial, repayment of principal over the life of the loan and were usually for shorter terms than those made by S&Ls. See Morton (1956) for more information about the mortgage market and loan characteristics during the 1920s.

[15] Bernanke (1983) argues that financial failures increase the cost of credit intermediation and finds evidence that failures contributed significantly to the decline in output during the Great Depression.

[16] Relative to delinquency rates, foreclosure rates have been far higher during the recent period than they were during the Great Depression. Some analysts contend that mortgage securitization and features of bankruptcy law discourage renegotiation of loan terms as an alternative to foreclosure. See Emmons (2008).

Figure 5

Nonfarm Real Estate Mortgage Foreclosure Rate, 1926-41



months. Among homes with a second or third mortgage, 54.4 percent were in default and the average time of delinquency was 18 months. Thus, at the beginning of 1934, approximately one-half of urban houses with an outstanding mortgage were in default (Bridewell, 1938, p. 172). For comparison, in the fourth quarter of 2007, 3.6 percent of all U.S. residential mortgages and 20.4 percent of adjustable-rate subprime mortgages had been delinquent for at least 90 days.

Although falling household incomes and house prices were the principal causes of mortgage distress during the Great Depression, lax underwriting may have contributed to the high rate of mortgage delinquency. A National Bureau of Economic Research (NBER) survey found that, during the Depression, foreclosure rates were higher for loans made later in the 1920s than for those made earlier in the decade, suggesting that underwriting standards had deteriorated over time.[17] Delinquency rates were also higher for non-amortizing and high loan-to-value loans (Morton, 1956, p. 100). Thus, although the proximate cause of the high rate of loan delinquencies and foreclosures during the 1930s was the economic depression, the likelihood of default on any given loan apparently was influenced by the characteristics of the loan itself.[18]

GOVERNMENT TO THE RESCUE

Federal, state, and local governments took many actions to provide relief from the effects of

[17] Similarly, Demyanyk and Van Hemert (2007) found that the quality of subprime mortgage loans declined monotonically during 2001-06, as the subprime loan market expanded rapidly.

[18] The NBER study found considerable differences in foreclosure rates across lender types, which might reflect differences in typical loan terms, such as amortization or other contract features, between different types of lenders. However, as Morton (1956) acknowledges, the NBER sample of loans was not random. In particular, it did not include data for lenders that failed or otherwise went out of business during the Depression.

Table 1

Federal Government Agencies Created in Response to Home Mortgage Distress in the 1930s

Federal Home Loan Bank System (FHLB)
- Authorized under Federal Home Loan Bank Act of 1932
- Established 12 regional Federal Home Loan Banks
- Created to provide a stable source of funds to member firms for residential-mortgage and economic-development loans

Home Owners' Loan Corporation (HOLC)
- Established by the Home Owners' Loan Corporation Act of 1933
- Purchased and refinanced distressed mortgages on 1- to 4-family homes, subject to income and loan qualifications
- Issued over one million loans between August 1933 and June 1936
- Liquidated in 1951

Federal Housing Administration (FHA)
- Established by the National Housing Act of 1934
- Offers home mortgage insurance on 1- to 4-family homes
- Intended to stabilize mortgage market and improve housing standards and conditions

Federal Savings and Loan Insurance Corporation (FSLIC)
- Established by the National Housing Act of 1934, administered by FHLB
- Provided deposit insurance for savings and loan associations
- Abolished under Financial Institutions Reform, Recovery and Enforcement Act of 1989

Federal National Mortgage Association (FNMA)
- Established in 1938 by the Reconstruction Finance Corporation at the request of President Roosevelt
- Created to establish a secondary mortgage market by purchasing FHA-insured loans at par and accrued interest
- 1948 National Housing Act amendment gave FNMA a federal charter to become independent of the RFC; FNMA given authority to purchase FHA and Veterans Administration (VA)–insured loans
- 1968 Chartered by Congress as a government-sponsored private corporation

SOURCE: *Annual Report of the Federal Home Loan Bank Board* (1933, 1934, 1951), Haar (1960), Harris (1951), Fannie Mae website (www.fanniemae.com/about), and Wallace (1938).

the Great Depression on housing and mortgage markets. For example, 33 states enacted legislation providing relief for those with delinquent mortgages, including 28 states that imposed moratoria on home foreclosures (Poteat, 1938). Many of the federal government's actions to alleviate the Depression affected housing and financial markets directly or indirectly. For example, legislation was enacted to stabilize the banking system and to reform securities market practices. Under the National Industrial Recovery Act of 1933, the federal government established a temporary program for the construction of low-cost housing. The United States Housing Act of 1937 replaced this program with a system of federal subsidies for local government housing projects (Doan, 1997, pp. 39-42).

In addition to programs aimed at providing affordable housing, the federal government took several steps to alleviate distress in mortgage markets. Table 1 lists the major agencies created during the 1930s to provide liquidity for home lenders, reduce the number of home loan foreclosures, and reform the mortgage market. This section describes the main objectives of each of these agencies.

Federal Home Loan Bank System and Federal Savings and Loan Insurance Corporation

The Federal Home Loan Bank System (FHLB) was established in 1932 to provide a federal lender for private institutions that specialize in home mortgage loans, including savings and loan associations (S&Ls), mutual savings banks, and life insurance companies. FHLB membership was required of all federally chartered S&Ls and was optional for state-chartered lenders. The system had an initial capitalization of $125 million and was patterned after the Federal Reserve System, with 12 regional Home Loan Banks and an oversight Board located in Washington, D.C. Member institutions were required to purchase stock in their local Home Loan Bank and could borrow from the Bank against collateral consisting of mortgages on 1- to 4-family houses or U.S. government securities (or securities fully guaranteed by the U.S. government). Home Loan Bank operations were financed from their capital and deposits of member institutions and by issuing debt. Interest on Home Loan Bank securities was exempt from federal, state, and local income taxes, but the securities were not guaranteed by the U.S. government.[19]

The FHLB began to lend in December 1932; by December 1933, it had over $85 million of loans outstanding (*Fifth Annual Report of the Federal Home Loan Bank Board*, 1937, p. 130). Through 1941, average year-end FHLB advances outstanding ranged from a low of 1.4 percent of total member S&L assets in 1934 to a high of 3.5 percent in 1933 and 1937.[20]

The Federal Savings and Loan Insurance Corporation (FSLIC) was established by the National Housing Act of 1934 and placed under the supervision of the Federal Home Loan Bank Board. The FSLIC was created to provide federal insurance for savings accounts of up to $5000 at S&Ls. Account insurance was mandatory for all federally chartered S&Ls and optional for state-chartered institutions. As with government insurance of commercial bank deposits, federal insurance for S&Ls was intended to restore the confidence of depositors in the safety of savings accounts and thereby increase the flow of deposits to savings institutions and discourage panic withdrawals. By encouraging growth in savings institution deposits, Congress sought to increase the amount of funds available for home mortgage loans.[21]

Home Owners' Loan Corporation

The Home Owners' Loan Corporation (HOLC) was created as an agency of the Federal Home Loan Bank Board by an act of Congress in 1933. The HOLC was authorized for a period of three years to purchase and refinance delinquent home mortgages, including mortgages on properties that had recently been foreclosed on. The HOLC had an initial capitalization of $200 million and was authorized to issue up to $2 billion (later increased to $4.75 billion) of bonds to purchase mortgages on 1- to 4-family properties that were in default or that had resulted in foreclosure during the previous 24 months. Interest on securities issued by the HOLC was exempt from federal, state, and local income taxes, and the payment of interest was guaranteed by the federal government.[22]

The HOLC was permitted to acquire delinquent mortgages on properties with an appraised value of up to $20,000.[23] HOLC loans were limited to 80 percent of the appraised value of the underlying property or a maximum of $14,000, whichever was less. The HOLC sometimes permitted junior liens (second mortgages) on properties against which it held the first mortgage, but refused to permit the total obligations on a prop-

[19] See Wallace (1938) for additional information about the organization and operations of the FHLB during the 1930s.

[20] Data on year-end outstanding FHLB advances and total assets of member savings and loan associations are from *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition* (2006), series Dc1140 and Cj383, respectively.

[21] See Wallace (1938) for additional information.

[22] A 1934 amendment extended the government guarantee to the principal on HOLC bonds. See Harriss (1951, pp. 152-56) for information about HOLC borrowing operations.

[23] For comparison, $20,000 in 1933 prices is equivalent to approximately $320,000 in 2007 prices, as adjusted by the consumer price index.

erty to exceed 100 percent of the appraised value. Further, the HOLC made loans only to those homeowners it deemed likely to have sufficient income to make their loan payments (Home Owners' Loan Corporation, 1936, p. 10). Nearly half of the loan applications received by the HOLC were rejected or withdrawn (Harriss, 1951, p. 1). Although many home loans at the time were short-term loans with little or no amortization of principal, the HOLC restructured the loans it acquired as 15-year, amortizing loans at a fixed maximum interest rate of 5 percent.[24]

The HOLC was authorized to conduct its own property appraisals and did so based on three considerations: (i) market value at the time of the appraisal, (ii) the cost of a similar plot of land at the time of the appraisal plus the reproduction cost of the building minus depreciation, and (iii) the value of the premises, by capitalizing the reasonable monthly rental value over a 10-year period immediately preceding the appraisal date (Harriss, 1951, p. 41). Harriss (1951, pp. 41-42) reports that appraisals were often generous, reflecting more the appraiser's view about the long-run value of a property than its current, depressed value.

Although private lenders from whom the HOLC purchased loans often suffered a loss on the nominal value of their original loans, the HOLC's liberal appraisals ensured that lenders preferred to sell many delinquent loans to the HOLC rather than attempt to recoup their losses through foreclosure. Between August 1933 and June 1935, the HOLC received nearly 1.9 million loan applications. By June 1936, the HOLC made just over one million loans totaling $3.1 billion. For comparison, the value of the private U.S. residential housing stock in 1933 is estimated to have been $89.7 billion.[25] The average HOLC loan amount was $3,039, and 75 percent were for less than $4,000. By value, the HOLC accounted for 12 percent of all new mortgages on 1- to 4-family homes in 1933, 71 percent in 1934, 26 percent in 1935, and just 6 percent in 1936—the last year it accepted applications for new loans.[26] The HOLC provided refinancing for some 10 percent of all nonfarm, owner-occupied dwellings in the United States and about 20 percent of those carrying a mortgage.

Figures 6 and 7 show the distribution of new and outstanding home mortgages across major groups of lenders for each year from 1925 to 1941.[27] Although the HOLC did not accept new applications after 1936, it continued to make loans in later years on property that it foreclosed on and later resold. The stock of outstanding mortgage debt held by the HOLC reached a peak in 1935, when it held nearly 19 percent of all mortgage debt outstanding on 1- to 4-family homes. Thereafter, the HOLC share of outstanding debt gradually declined as the economy and private lenders continued to recover. Still, as late as 1941, the HOLC held about 10 percent of the value of outstanding residential mortgage debt.

Of the approximately one million loans made by the HOLC, some 20 percent ended in foreclosure or voluntary transfer of the underlying property to the HOLC. Foreclosures peaked during the recession of 1937-38. The HOLC was not quick to foreclose on delinquent loans, being "as considerate of delinquent but deserving borrowers as its responsibility to the Federal Government and the taxpaying public will permit" (*Third Annual Report of the Federal Home Loan Bank Board*, 1935, p. 600). The HOLC often counseled delinquent borrowers and readjusted payment schedules rather than moving quickly to foreclosure when borrowers fell behind on their payments. On average, HOLC loans were delinquent for two years before foreclosure (Harriss, 1951, p. 73).

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[24] Initially, interest-only terms were granted for the first three years of a loan. Beginning in 1936, these loans were reamortized as 12-year fully amortizing loans (*Fourth Annual Report of the Federal Home Loan Bank Board*, 1936, p. 30).

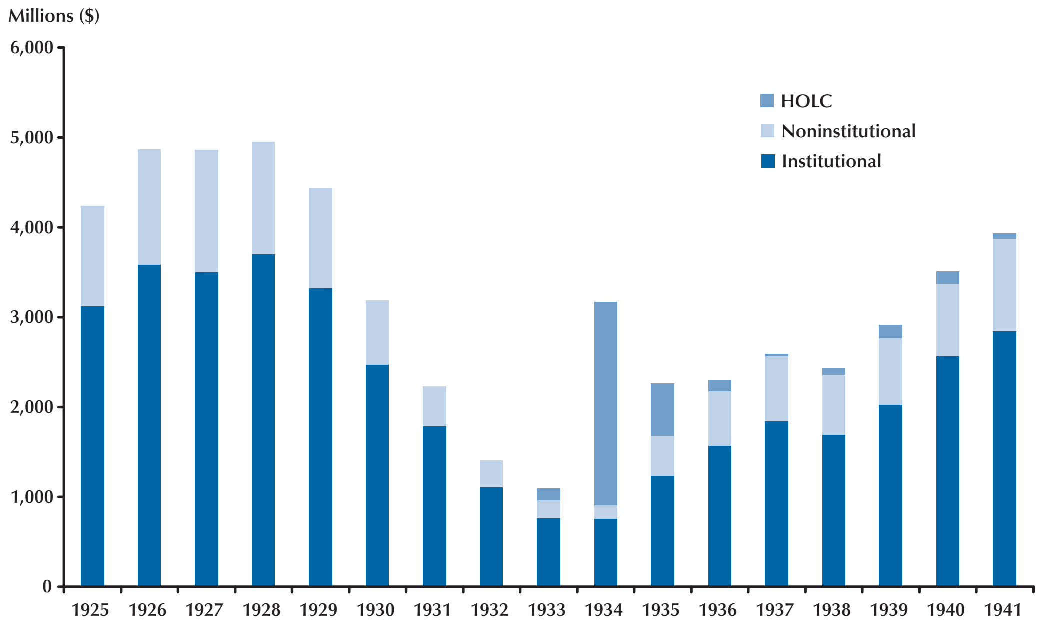
[25] *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition* (2006), Series Dc55.

[26] *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition* (2006), series Dc983-989.

[27] In the figures, institutional lenders include commercial banks, mutual savings banks, S&Ls, insurance companies, the Federal National Mortgage Association, and other institutional lenders. Non-institutional lenders include individuals, mortgage brokers, construction companies, trust departments of commercial banks, and others. Data for new and outstanding mortgages are from *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition* (2006), series Dc983-989 and series Dc914-921, respectively.

Figure 6

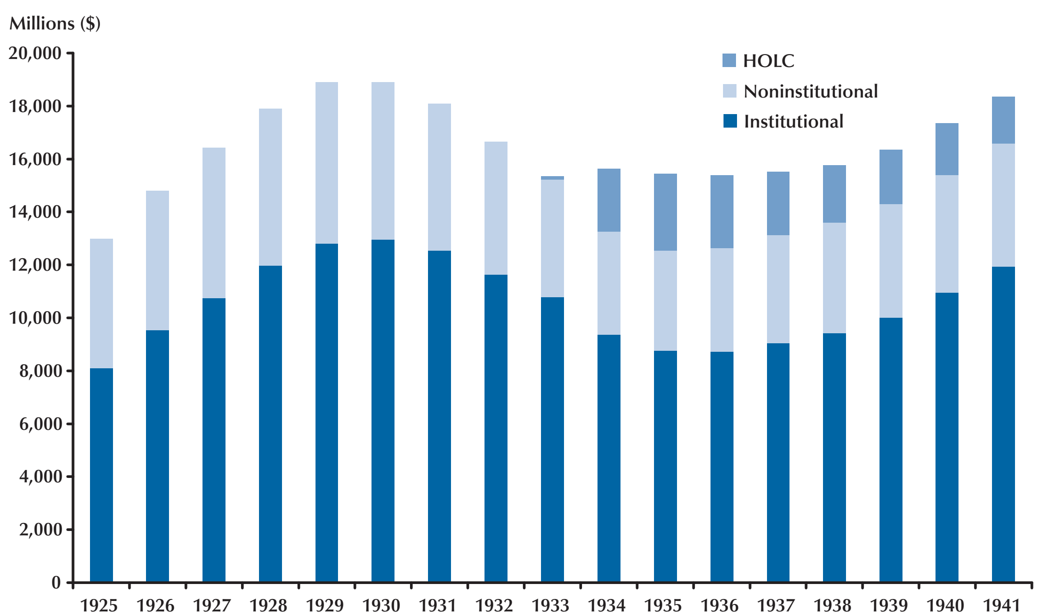
Share of New Mortgages by Lender



SOURCE: Historical Statistics of the United States, series DC983-989.

Figure 7

Outstanding Mortgage Debt by Lender, 1925-41



Because the HOLC refinanced distressed loans, its foreclosure rate was higher than that of other lenders. For example, the foreclosure rate on loans made by life insurance companies during 1933-36 was a mere 2.6 percent, compared with nearly 20 percent for the HOLC (Harriss, 1951, p. 71). The limitation that HOLC loans not exceed 80 percent of a property's appraised value probably held down the agency's foreclosure rate, as did its policy of lending only to those borrowers who had a reasonable prospect of being able to service their loan. Furthermore, most HOLC loans were made somewhat after the trough of the business cycle, and rising household incomes helped to limit loan default rates.

It is difficult to determine the extent to which the HOLC contributed to a rebound in the housing market, let alone to the macroeconomic recovery. One study of county-level data found little association between HOLC lending and changes in housing values or homeownership rates between 1930 and 1940 (Fishback, Horrace, and Kantor, 2001). Nevertheless, in helping to clear a million delinquent loans from the books of private lenders, the HOLC undoubtedly contributed to the resumption of private mortgage lending.

The HOLC was liquidated in 1951. After 1936, the bulk of its activities consisted of managing the loans it had made during 1933-36, disposing of property acquired through foreclosure—including making new loans to assist in that process—and funding its operations. The HOLC never received a Congressional appropriation other than its initial $200 million capitalization.[28] HOLC loans were funded by the agency's bond issues and operating income (interest, property rental income, etc.). Over its life, the HOLC had a net cumulative operating income of $352 million, against a cumulative capital loss of $338 million, principally from defaults on mortgage loans it had made. While the rapid growth in household incomes and property values from the mid-1930s through the 1940s held down the default rate on HOLC loans, falling interest rates reduced the HOLC's cost of funds, thereby boosting its profit margin on outstanding loans.[29]

Federal Housing Administration and Federal National Mortgage Association

The National Housing Act of 1934 created the FHA to administer a federal mortgage insurance program. The program offered insurance to approved private lenders on qualifying loans for the purchase, repair, expansion, or alteration of existing houses and for the construction of new houses. Most FHA-insured loans were required to be fully amortizing, with a maximum interest rate of 5 percent. When the program began, FHA-insured loans were limited to $16,000 or less (as compared with a median U.S. house price of $5,304) and a maximum loan-to-value ratio of 80 percent. A 1938 amendment permitted the FHA to extend insurance to mortgages with loan-to-value ratios of 90 percent on new homes with mortgages of no more than $5,400 (Carliner, 1998, p. 306).[30] The FHA offered mortgage insurance both for single-family houses and rental projects. The FHA was authorized to charge an annual insurance premium of between 0.5 and 1.0 percent of the outstanding loan principal.

Figure 8 plots annual data for 1935-41 on the dollar amount of new FHA-insured mortgages on 1- to 4-family houses and the share of all new home mortgages insured by the FHA. Private lenders were not quick to embrace FHA insurance because of the requirements imposed on FHA-insured loans, including full amortization and maximum loan interest rates and fees. By 1938, FHA-insured loans still represented less than 20 percent of all new mortgage originations.

In addition to creating the FHA and the FSLIC, the National Housing Act of 1934 authorized the creation of national mortgage associations, which

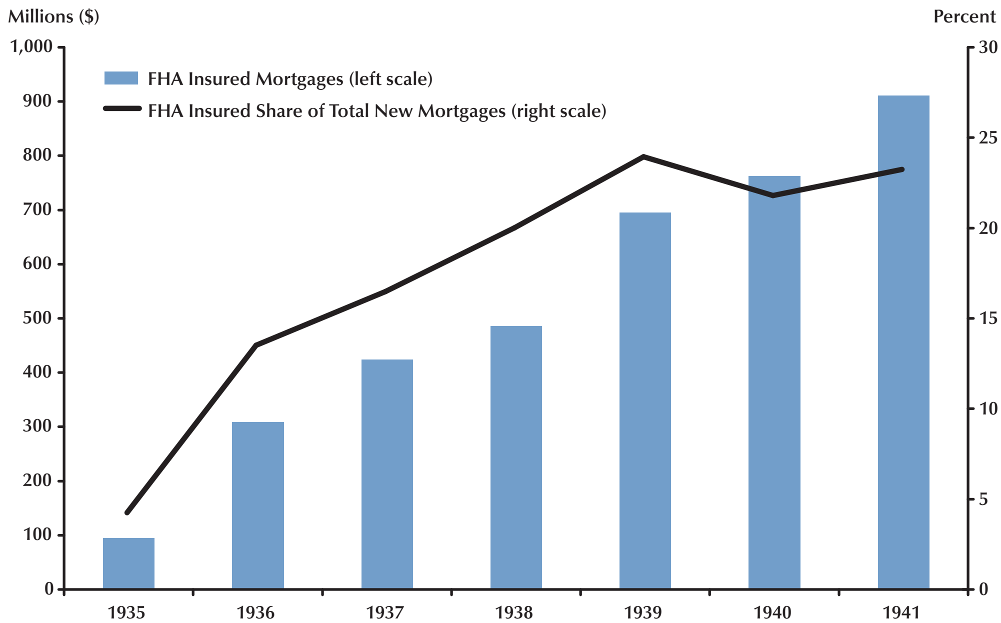
[28] Like other government agencies, however, the HOLC received free government services, such as free use of the postal system, and was exempt from paying Social Security taxes and overtime wages (Harriss, 1951, p. 161).

[29] The HOLC issued both short-term debt and callable long-term bonds. The average interest rate paid by the HOLC on its outstanding debt fell from 3.6 percent in 1934 to 2.1 percent in 1939, and to 1.1 percent in 1945-49 (Harriss, 1951, pp. 152-56). HOLC loans carried a contract interest rate of 5 percent, which was reduced for all borrowers to 4.5 percent in October 1939 (Harriss, 1951, p. 5).

[30] Initially, loans for repairs, expansion, or alterations of an existing house were capped at $2,000. By 1938, the cap was raised to $10,000. See Wallace (1938) for details about the original provisions associated with FHA insurance and changes made by 1938.

Figure 8

FHA Insured Mortgages by Dollar Amount, 1935-41



were intended to be federally chartered private organization that bought and sold qualifying first mortgages. This provision of the National Housing Act was intended to promote a liquid national market for mortgages and thereby mobilize capital for housing finance. In fact, no private mortgage associations were formed. However, the Reconstruction Finance Corporation (RFC) established two subsidiaries to purchase FHA-insured mortgages: (i) the RFC Mortgage Company, established in 1935, and (ii) the Federal National Mortgage Association (FNMA), established in 1938. The latter became the principal government purchaser of FHA-insured loans.[31]

The FNMA had an initial capitalization of $10 million and was empowered to buy or sell any mortgages insured by the FHA. The agency was authorized to sell bonds to fund its mortgage purchases; and, although the bonds were not explicitly guaranteed by the federal government, a government guarantee was implicit because the assets of the FNMA were almost entirely invested in FHA-insured mortgages. The FNMA purchased some $82 million of mortgages in 1938 and somewhat smaller amounts over the next four years. By the end of 1941, the agency held a $207 million portfolio of mortgages, which was approximately 1 percent of the total outstanding mortgages on 1- to 4-family homes at that time.[32]

CONCLUSION

The recent distress in the U.S. home mortgage market has parallels in the experience of the Great Depression. Like the recent episode, the increase in mortgage defaults during the

[31] The Reconstruction Finance Corporation (RFC) was a federal government agency established in 1932 to make loans to banks and other businesses, as well as to state and local governments. The RFC was also authorized to "assist in the reestablishment of a normal mortgage market" (quoted in Haar, 1960, p. 79).

[32] Data on FNMA purchasers are from Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition (2006), series Dc1146. See Quigley (2006) or Weicher (2006) for information about the activities of the FHA and FNMA since World War II.

Depression coincided with a sharp decline in house prices after a period of rapid gains. Also like the recent experience, mortgage defaults during the Depression were more prevalent on mortgages with unconventional terms, such as short-term, non-amortizing loans. Furthermore, mortgage underwriting standards appear to have deteriorated before the downturn of the 1930s, as they did toward the end of the recent housing boom. However, unlike the recent experience, the main cause of mortgage loan distress during the 1930s was the sharply contracting economy and falling price level. One estimate is that, on January 1, 1934, about half of all mortgages on urban, owner-occupied houses were delinquent.[33] Not surprisingly, this level of distress prompted numerous local, state, and federal actions to relieve and reform mortgage markets.

The federal government responded to the distress in mortgage markets first by creating a new federal agency, the Federal Home Loan Bank System, to provide a source of loans for mortgage lenders. The federal government then tackled the problem of delinquent loans directly by creating the Home Owners' Loan Corporation, which purchased delinquent loans from their originators. The HOLC purchased some one million loans, which it refinanced as long-term, fixed-rate, amortizing loans payable in monthly installments. Arguably, the HOLC was highly successful. Despite acquiring only delinquent loans, the HOLC ended up foreclosing on fewer than 20 percent of the loans it refinanced. Furthermore, the HOLC operated without a direct taxpayer subsidy (other than its initial $200 million capitalization, which it eventually repaid). The HOLC did, however, refuse many loans on the grounds that the borrower lacked the income to make loan payments. The HOLC also loaned no more than 80 percent of the appraised value of the underlying property, though its appraisals were often higher than the current depressed market values. The HOLC also benefited financially from an expanding economy, rising house prices, and falling interest rates, which lowered its funding costs, especially during World War II.

The sharp increase in mortgage delinquencies and foreclosures during 2007 prompted numerous calls for government intervention in housing and mortgage markets, including the creation of an HOLC-like agency to purchase delinquent mortgages. The right of lenders to foreclose on collateral is the main reason why the interest rates on secured loans, such as home mortgages, are typically much lower than those on unsecured loans, such as credit card debt. Ordinarily, mortgage foreclosures receive little notice from the public because they have little impact on parties other than the delinquent borrower. However, when the number of foreclosures is high or concentrated geographically, they can lower property values, destabilize neighborhoods, and impose other social costs. Such "externalities" can justify government intervention to reduce the number of foreclosures.

Any government response to mortgage distress would entail some cost. For example, a government purchase of delinquent mortgages, or expanded federal mortgage guarantees or insurance, could impose a substantial monetary cost on taxpayers. Some policies, including a government bailout of delinquent loans or expanded loan guarantees, could also encourage increased financial risk-taking and thereby lead to further instability in the future. Other actions, such as a government-imposed moratorium on loan foreclosures, could simply delay inevitable adjustments that are necessary to restore the functioning of mortgage and housing markets. Such direct government intervention could also increase the cost of loans for future borrowers by encouraging lenders to add a premium to loan interest rates to compensate for the risk that government officials might re-write the terms of loan contracts.[34]

A full assessment of the benefits and costs of government programs to alleviate mortgage distress during the Depression requires further research. There is scant evidence that the acquisition of delinquent mortgages by the HOLC during the 1930s encouraged risky lending. However, the Great Depression experience may not be espe-

[33] Bridewell (1938, p. 172).

[34] See Emmons (2008) for more detail on the rationale for government action to reduce foreclosures and discussion of the costs and benefits of specific types of intervention.

cially relevant for addressing how a taxpayer bailout of delinquent borrowers and their lenders would affect behavior today because of differences in the underlying causes of mortgage distress during the two periods. Conceivably, a bailout would more likely encourage risky behavior in the present situation (in which lax underwriting was an important cause of the increase in defaults) than during the Depression (when a sharp decline in economic activity was the main cause of defaults). Thus, while the federal response to mortgage distress during the Great Depression provides insights about how the government might respond to the current wave of defaults, the very different conditions underlying mortgage distress during the two periods warns against drawing strong conclusions from the historical experience for the current episode.

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FOMC Consensus Forecasts

William T. Gavin and Geetanjali Pande

In November 2007, the Federal Open Market Committee (FOMC) announced a change in the way it communicates its view of the economic outlook: It increased the frequency of its forecasts from two to four times per year, and it increased the length of the forecasting horizon from two to three years. The FOMC does not release the individual members' forecasts or standard measures of consensus such as the mean or median. Rather, it continues to release the forecast information as a range of forecasts, both the full range between the high and the low and a central tendency that omits the extreme values. This paper uses individual forecaster data from the Survey of Professional Forecasters (SPF) to mimic the FOMC's method for creating their central tendency. The authors show that the midpoint of the central tendency of the SPF is a reliable measure of the consensus, suggesting that the FOMC reporting method is also a reliable measure of consensus. For the dates when both are available, the authors also compare the relative forecast accuracy of the FOMC and SPF consensus forecasts for output growth and inflation. Overall, the differences in forecast accuracy are too small to be statistically significant. (JEL C42, E17, E37, E52)

Federal Reserve Bank of St. Louis *Review*, May/June 2008, *90*(3, Part 1), pp. 149-63.

In a November 14, 2007, press release, the Federal Open Market Committee (FOMC) announced a change in the way it communicates its view of the economic outlook. With the release of the minutes of the FOMC meeting of October 30-31 was a Summary of Economic Projections that included explicit multiyear forecasts for real gross domestic product (GDP), the fourth-quarter average unemployment rate, and two measures of consumer price inflation—the chain price index for personal consumption expenditures (PCEPI) and the same measure excluding food and energy (core PCEPI).[1] The FOMC also added a 3-year-ahead forecast. For the October meeting, they made forecasts for calendar years 2007 through 2010. The FOMC will release projections for these calendar years with the minutes of FOMC meetings held in January, March, and June. At the October 2008 FOMC meeting, they will extend the forecasts to 2011. The projections will be supplemented with summaries and explanations of the projections, including more information about the dispersion of views among the FOMC participants. This change was made to improve communication about monetary

[1] We use the term "projection" interchangeably with "forecast." There is a technical distinction: a projection is based on a policy assumption that may or may not also be the policy that the forecaster expects. Each FOMC participant conditions his or her assumption about "appropriate" monetary policy. This can be different for each participant and may be different from the policy that is actually expected. Note also that the Federal Reserve Board staff "Greenbook" forecasts were often based on a federal funds rate path that was constrained to be different from the one that the staff expected.

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policy and to further increase the transparency of the policy process.[2]

Currently, the FOMC issues a statement following each policy meeting that contains a decision about the federal funds rate target and a brief analysis of the economic risks as seen by policymakers. Market observers monitor these statements closely, looking for clues about future policy moves and the FOMC's beliefs about the economic outlook. Sack (2007) describes a recent survey in which Macroeconomic Advisors LLC asked 61 "very active players" in the fixed income market what changes they would like to see in the Fed's economic forecast.[3] They replied that they would like more of everything—more variables to be forecasted, forecasts of more years out into the future, and more details and insights about the reasons for the changes in the forecasts. The enhanced projection process should help to quantify the risks and explain the nature of uncertainty in the policy statement.

FOMC forecasts are important because they contain information about the FOMC policy preferences. Most important of these is the FOMC's implicit inflation objective. Monetary policy is the main factor determining inflation in the long run. The near-term outlook for inflation is affected by all the economic shocks hitting the economy. But the aggregate effects of such shocks decay quite rapidly if they are not accommodated by monetary policy. The newly available 3-year-ahead forecast adds more information about the FOMC's desired inflation objective because, as the horizon gets longer, the forecast becomes more a projection of these preferences. For the near term, the forecasts provide a benchmark for gauging how policymakers respond to news about inflation, output, and unemployment. The policy reactions and accompanying narrative help the public understand how the FOMC believes that policy affects the economy.

The forecasts also provide information about the FOMC's assessment of the state of the economy—assessment of the trend growth of real GDP and the natural rate of unemployment and the stage of the business cycle around these trends. This information is important for the market's assessment of the equilibrium real interest rate and the real effects of policy actions.

The information gleaned from FOMC forecasts is important for Wall Street because it provides a frame of reference for the expected neutral federal funds rate—the rate that is expected to prevail in a world with full employment and price stability. Forecasters can make better forecasts in the short run if they know the long-run trends. Knowledge of the long-run trends is also important for Main Street to help set prices in wage and supply contracts and to know what interest rates are appropriate when making savings and investment decisions.

The FOMC projections are made by the individual Federal Reserve Bank presidents and Federal Reserve governors. The new forecast information includes histograms showing the distribution of the individual forecasts. The Fed reports two summary statistics: the full range (the high and the low for each variable) as well as a smaller range (called the central tendency) that eliminates the three high and the three low forecasts, but does not include the mean, median, or the actual forecasts.[4] In this study, we define the FOMC "consensus" forecasts as the midpoints of the reported ranges.

The primary goal of this article is to evaluate the reliability of the midpoint of the central tendency as a measure of consensus. We do this by replicating the Fed's reporting method using the individual responses in the Survey of Professional Forecasters (SPF). That is, we construct the range and central tendency of the SPF individual forecasts and compare the midpoint of these ranges with the traditional measures of consensus—the median and mean response. This comparison is intended to determine whether the midpoint of the range serves as an accurate proxy for the mean and/or median. The second goal is to compare

[2] Bernanke (2007) discusses the rationale for making these changes. The minutes of the October 30-31, 2007, meeting also reported evidence from Reifschneider and Tulip (2007) about the uncertainty in the forecasts based on the history of various forecasts made between 1986 and 2006.

[3] See Sack (2007).

[4] See footnote 6 in Bernanke (2007).

the accuracy of FOMC consensus forecasts with the SPF consensus forecasts.

PREVIOUS STUDIES OF FOMC FORECASTS

Although there are many studies of the Board staff's Greenbook forecast, there are only a few studies that analyze the biannual FOMC forecasts directly.[5] The first study was McNees (1995), which tabulated how often the actual forecast fell within each of the two intervals, the full range and the central tendency. Generally, he found that the FOMC was more likely to be successful (that is, have the actual outcome fall within the forecast intervals) when the value used to measure the outcome was the first published figure and the forecast horizon was longer. He concluded that, although inherent uncertainty in the forecast rose with the length of the forecast horizon, dispersion among the FOMC member forecasts rose even faster, so that the outcome was more likely to fall within the forecast range.

Gavin and Mandal (2003) use the midpoint of the range as a consensus FOMC forecast. They compare these point forecasts of output and inflation with the Blue Chip consensus. They conclude that the Blue Chip consensus closely matches the FOMC's central tendency forecasts; and, for 1983-94, the Blue Chip consensus was as good as or a better match for the FOMC forecasts than were the Federal Reserve Board staff Greenbook forecasts. In the early years, the Blue Chip consensus real GDP growth forecast was at least as accurate as the FOMC forecast, but the inflation forecast was less accurate. These results will differ from others for two reasons. First, as we also do in this study, Gavin and Mandal (2003) define the FOMC's consensus inflation forecast as the difference between the midpoint of the range for nominal output minus the midpoint of the range for real output. Second, as in this study, they use the first-released data as the "truth" against which the forecasts were measured.

Gavin (2003) describes the history and detail of the FOMC forecasts and shows that there is not much difference between the midpoints of the full range and the central tendency. He also shows that disagreement among the FOMC members' inflation forecasts rose with the length of the forecast horizon, suggesting that, although the Committee had reached a consensus on the importance of the long-term price stability objective, they had not reached a consensus on how that long-term price stability objective mapped into a numeric inflation rate.

Gavin and Mandal (2001) show that a forward-looking Taylor rule estimated using FOMC forecasts of output and inflation fits the interest rate data quite well, but no better than one using the Blue Chip forecasts. Levy and Kretzmer (2006) provide a historical description of the FOMC forecasts, comparing the forecasts with those of the Greenbook. They use regression analysis to estimate how the FOMC changed the federal funds rate target in reaction to errors in its forecasts. Orphanides and Wieland (2007) also use regression analysis to estimate FOMC reaction functions that use the FOMC consensus forecasts for inflation and unemployment. They find that using the FOMC forecasts in forward-looking Taylor rules fit the historical federal funds rate data better than in backward-looking versions that rely on recent economic outcomes. Romer and Romer (2007) use forecast combination methods to test whether the FOMC forecasts added useful information to the Greenbook forecasts: They find that knowing the FOMC forecasts did add useful information to the Greenbook forecasts for output growth, but not for inflation or the unemployment rate.

Other studies have used the size of the range of FOMC forecasts as a measure of uncertainty. Mankiw, Reis, and Wolfers (2003) show that the size of the FOMC's range and truncated central tendency are correlated with measures of uncertainty in private sector forecasts. Dowd (2004) tests and rejects the assumption that the FOMC forecasts are independent random draws from a common density function. Although he does not discuss alternative interpretations, a more accu-

[5] An early study of Greenbook forecasts was Lombra and Moran (1980). A sample of studies since then includes Karamouzis and Lombra (1989), Jansen and Kishan (1996), Romer and Romer (2000), Joutz and Stekler (2000), Gavin and Mandal (2003), and Baghestani (2008).

rate view is that the forecasts are individual estimates of the mean of an uncertain distribution. Rich and Tracey (2006) use the SPF forecasts, which include probability densities for the individual forecasts of inflation and output, to address this issue directly. With the new FOMC forecasting process, the Summary of Economic Projections provides quantitative and qualitative information on outlook uncertainty.

THE HISTORICAL DATA

The FOMC Forecasts

Fed policymakers began reporting economic projections to Congress in response to requirements of Section 108 of the 1979 Humphrey-Hawkins Act. The first report was made in July 1979.[6] Since then, similar summaries of forecasts have been reported every February and July. The FOMC members made forecasts of annual, fourth-quarter-over-fourth-quarter growth rates for nominal GDP, real GDP, and inflation.[7] They also forecasted the average level of unemployment for the fourth quarter of the year. In February, the forecasts pertain to the current calendar year (also referred to below, simply, as the 12-month-ahead forecasts) and, since 2005, also to the next calendar year (24-month-ahead forecasts). In July, forecasts are updated for the current calendar year (6-month-ahead forecasts) and preliminary projections are made for the next calendar year (18-month-ahead forecasts). From these reports, we can construct "consensus" forecasts based on the midpoint of the respective intervals—the full range and the central tendency.

The Private-Sector Forecasts

The Blue Chip Consensus. Most of the work comparing the FOMC policymaker forecasts with private sector forecasts has been done using the Blue Chip consensus forecasts, which are updated every month and, therefore, can be closely aligned with FOMC forecasts made at the end of January and June. However, the Blue Chip does not maintain records of individual fourth-quarter-over-fourth-quarter forecasts that are needed to simulate the FOMC reporting method. Therefore, we use the SPF data for this analysis. However, the SPF makes forecasts in February, May, August, and November, and so it is not possible to align any of these forecasts with the FOMC policymaker forecasts that are made at the end of June. Consequently, we restrict the comparison to the 12-month-ahead forecast—which matches the FOMC's February forecasts.

The SPF. The SPF is a quarterly survey started by the American Statistical Association and the National Bureau of Economic Research in 1968; since the second quarter of 1990, it has been conducted by the Federal Reserve Bank of Philadelphia. The survey presents consensus forecasts, as well as individual and probabilistic forecasts, for variables including real output and inflation. As noted, forecasts are made in February, May, August, and November of each year and provide predicted values of variables for the current quarter and the next four quarters, as well as annual averages for the current and following year. Although the real GDP forecasts (real GNP before 1992) and GDP price index forecasts are for quarterly and annual average levels, consumer price index (CPI) forecasts are for annualized quarter-over-quarter percent changes in the quarterly horizon and fourth-quarter-over-fourth-quarter percent changes in the annual horizon. Beginning in the first quarter of 2007, the forecast horizon for CPI inflation was extended to report the fourth-quarter-over-fourth-quarter percent change for the current year and next two years.

The SPF's February reports serve as our source for the 12-month-ahead forecasts of real output and inflation. Like the FOMC members, the SPF respondents would have had information about fourth-quarter GDP in hand when they made this forecast. Here, we construct a central tendency range for the SPF. Because the SPF often includes more than 19 forecasts (the maximum number

6 The reporting requirements of the Humphrey-Hawkins Act expired in May 2000. The Congress amended and continued the reporting requirements in the American Homeownership and Economic Opportunity Act of 2000 (Section 1003).

7 The Fed followed the Bureau of Economic Analysis, switching from GNP to GDP in 1992.

possible for the Fed policy group), we compute the central tendency by eliminating two outliers (one high and one low) for every six forecasts. For a group the size of the FOMC, this is comparable to eliminating the top and bottom three forecasts—the method the FOMC uses to calculate its central tendency.

RESULTS

We compare the forecasts for output and inflation separately. The FOMC and the private forecasters used GNP as the measure of output until 1992, when they switched (along with the Bureau of Economic Analysis) to GDP. The FOMC switched among price indices several times: Specifically, it used the GDP deflator from 1983 through 1988, the CPI from 1989 through 1999, the PCEPI from 2000 through 2003, and finally the core PCEPI from 2004 through 2006. The SPF has included forecasts for both the GDP deflator and the CPI, but not the PCEPI or its core until recently; so we use the SPF forecast for the GDP deflator from 2000 through 2006 because it is more comparable to the PCEPI than is the CPI. Note, also, that the FOMC always made an implied forecast for inflation in the GDP deflator because, until November 2007, they had made forecasts for both nominal and real output. We match apples to apples between the FOMC and SPF projections where possible—i.e., GDP/GNP deflator to GDP/GNP deflator for either the full sample or through 1988 and the CPI to CPI from 1989 through 1999.

Output Growth Forecasts

Figures 1 and 2 show the 12-month-ahead output growth forecasts. Figure 1 shows the full range and central tendency of FOMC forecasts. Whenever the central tendency limits coincide with the limits of the full range, eliminating the three extreme values does not change the limiting value. These forecasts reflect the 1990-91 recession (with a trough in March 1991) but not the 2001 recession (trough in November 2001).

Figure 2 shows the full range and central tendency of SPF output growth forecasts. In this case, eliminating outliers makes a big difference in the size of the range. The range of SPF forecasts is much wider than that for the FOMC forecasts. The SPF group is larger, which may account for some of the difference. But it also appears that the distributions of SPF forecasts have fatter tails. A plausible explanation for the more concentrated distribution of FOMC forecasts is that the policymakers get together eight times per year at meetings that include an economic briefing by the research staff at the Board of Governors. The purpose of the staff briefing, which includes the Greenbook forecast, is to provide the FOMC a common point-of-departure for discussing the outlook and monetary policy. Furthermore, some participants may not produce forecasts from scratch but instead may use the Greenbook as a benchmark from which to generate an outlook in sync with their views.

We construct "consensus" forecasts by taking the midpoints of the range and the CT. Figure 3 plots the midpoint of the CT forecast ranges for both the FOMC and the SPF. The CTs of both the SPF and FOMC forecasts are quite similar, although the SPF forecasts are slightly more pessimistic about output growth during the late 1980s and recently. Figure 4 shows that the SPF CT aligns very well with the respective mean and median output forecast—which would be the conventional measures of consensus. This alignment suggests that the midpoint of the CT for the FOMC forecasts is probably a good measure of the group consensus for output growth. Note that, going forward, one could also construct a consensus that is an approximation to the mean using histograms (see boxed insert). We did this for the forecasts made at the October 30-31, 2007, FOMC meeting and found that this approximation was always within 5 basis points of the midpoint of the CT for all the variables forecasted and over all horizons.

To assess the accuracy of these alternative forecasts, we calculate the difference between the consensus forecasts and the real-time data that were first released. We use the first-released numbers as the actual because we believe that these data contain more news than subsequent revisions and are, therefore, more important for financial markets. It is also important to use first-

Figure 1

FOMC Output Growth Forecasts Range and Central Tendency

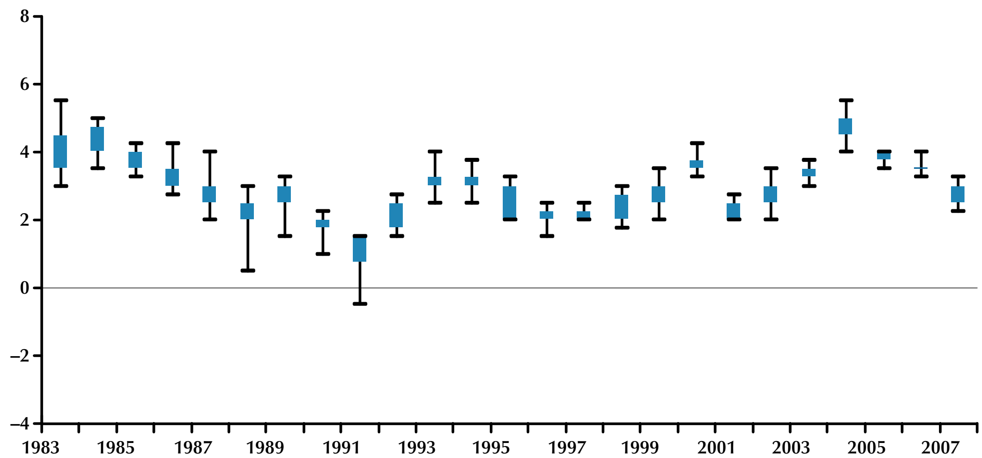


Figure 2

SPF Output Growth Forecasts Range and Central Tendency

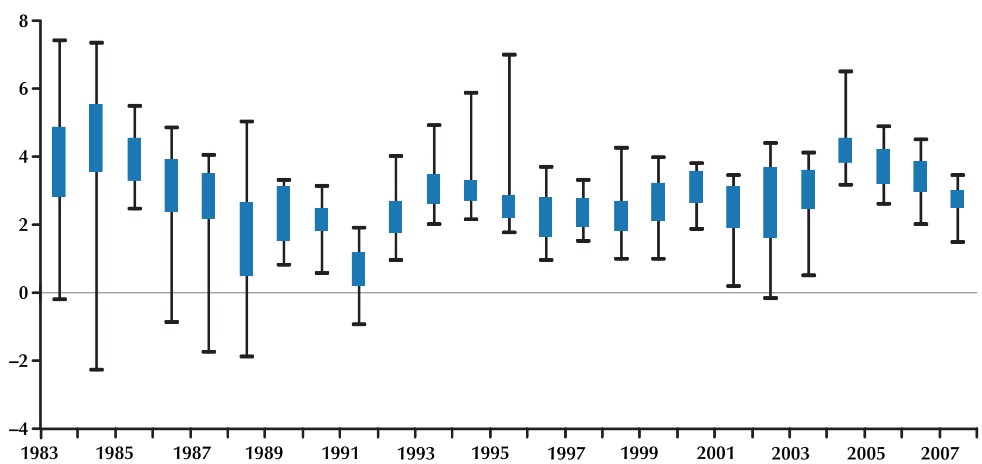


Figure 3

Consensus Forecasts of Real GDP Growth (4Q/4Q) Made in February

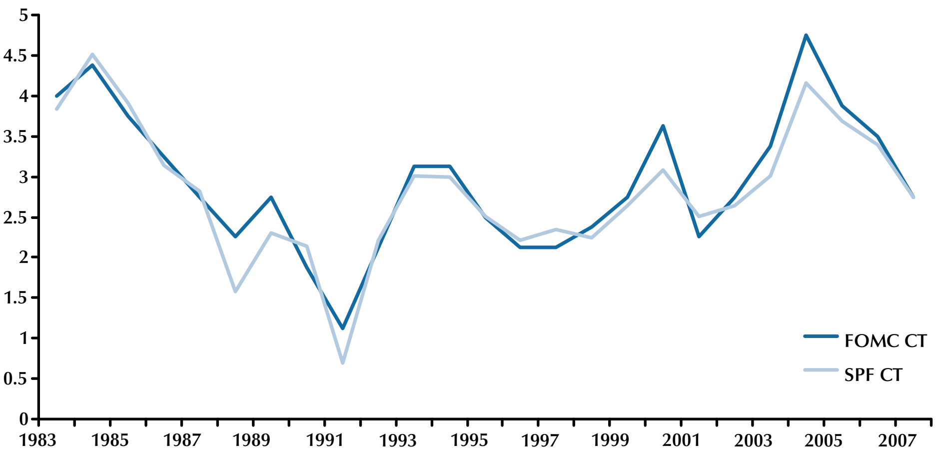


Figure 4

Measures of the Middle for Real GDP Growth (4Q/4Q) Made in February

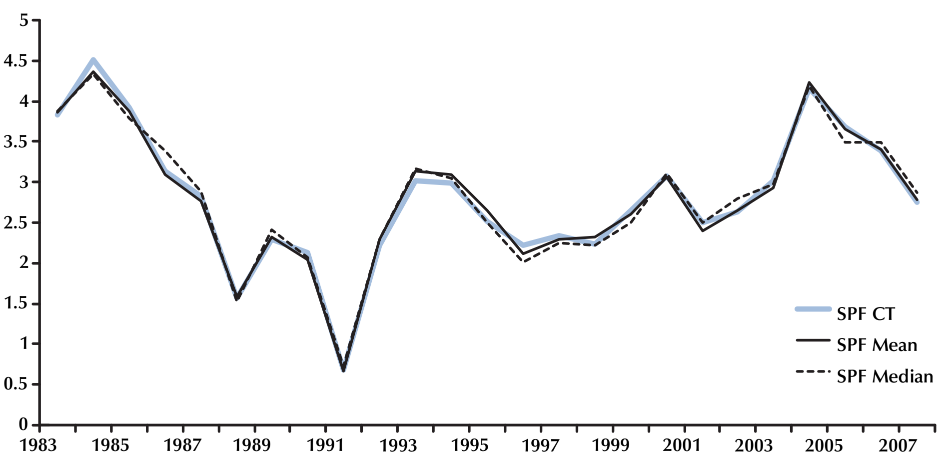


Figure 5

FOMC Inflation Forecasts Range and Central Tendency

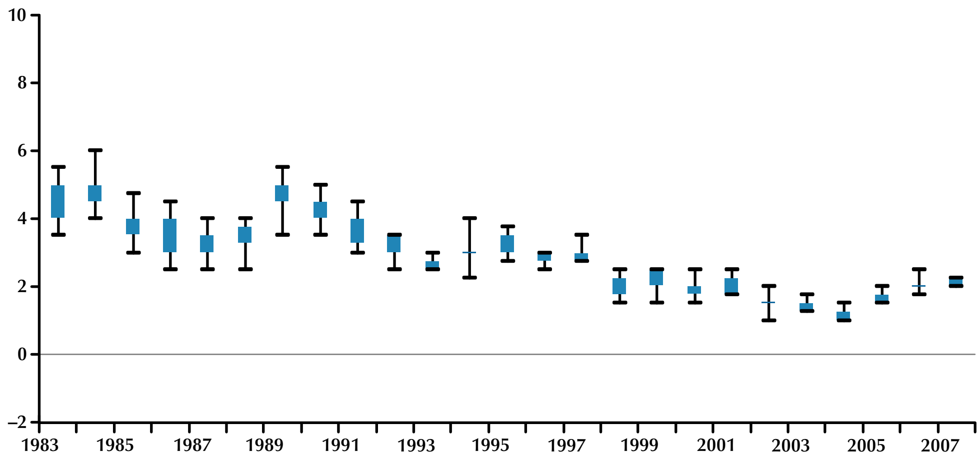


Figure 6

SPF Inflation Forecasts Range and Central Tendency

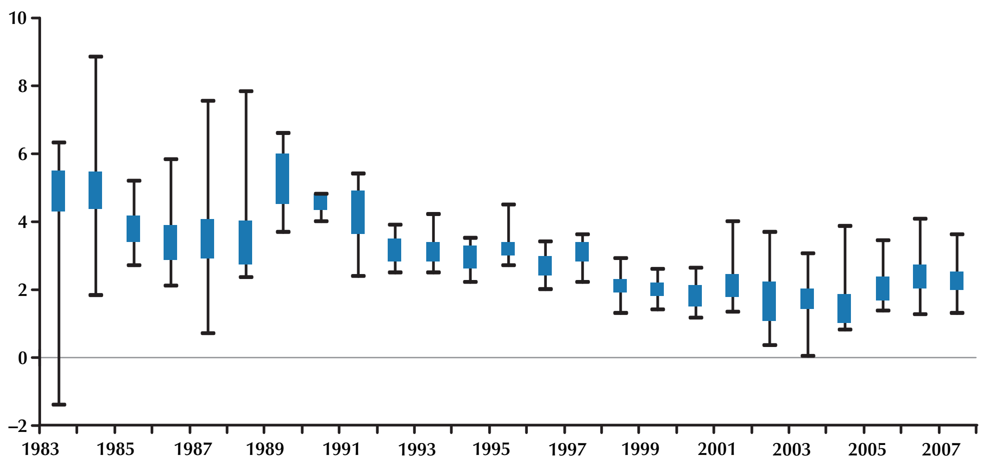


Figure 7

Inflation Forecasts (Excluding Outliers) Made in February

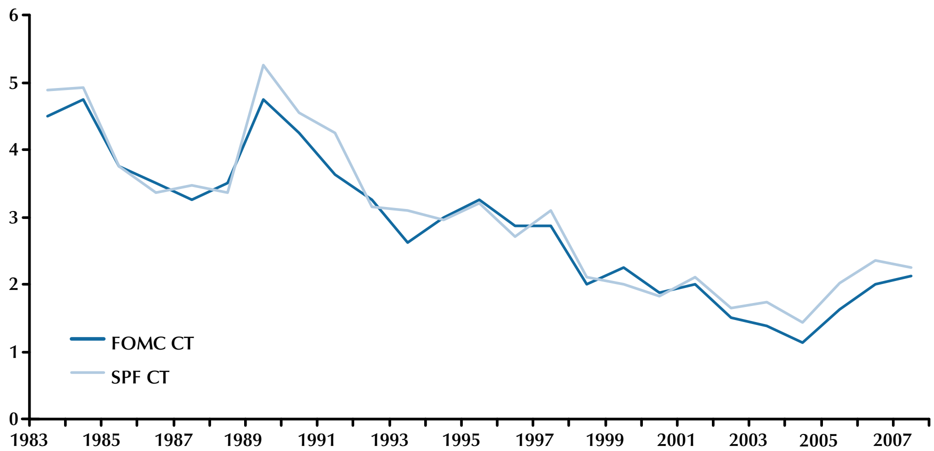
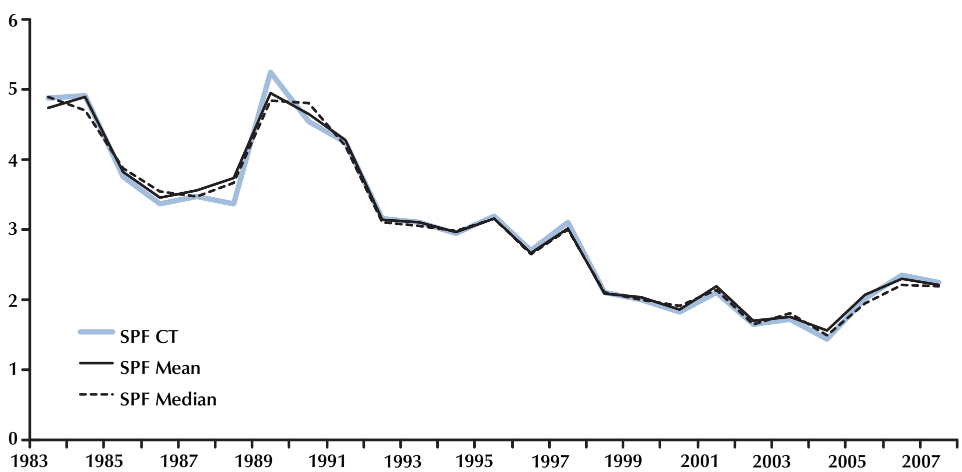


Figure 8

Measures of the Middle for Inflation (4Q/4Q) Made in February



USING THE HISTOGRAMS TO MEASURE CONSENSUS

In this box we show that one can use the histograms provided with the FOMC forecasts to construct a consensus forecast that is an approximation of the mean of the individual forecasts. In Figure B1, we show the GDP forecasts from 2007 to illustrate the method. The histogram shows the distribution of the 17 forecasts presented at the October 30-31, 2007, FOMC meeting by the governors and Bank presidents that participated in the meeting. The vertical axis shows the number of participants whose forecast fell within the different bins. The horizontal axis shows the bins within each 0.2-percentage-point range. To calculate the weighted average of the bins, we multiply the number of participants times the midpoint of the bin. So this measure of consensus for real GDP in 2007 is $2.43 = 3 \times 2.25 + 13 \times 2.45 + 1 \times 2.65$.

Note that this is almost exactly equal to the center of the central tendency. In this case it is easy to see that if we delete the top and bottom three forecasts, all the remaining forecasts are in the center bin. So the CT forecast is 2.45, the midpoint of this bin. In Table B1 we show the weighted averages of the bins in the histograms along with the midpoint of the central tendency for all of the forecasts. The largest difference is only 0.05 percentage points at an annual rate, which further suggests the usefulness of using the midpoint of the central tendency as the measure of FOMC consensus.

Figure B1

Real GDP, 2007

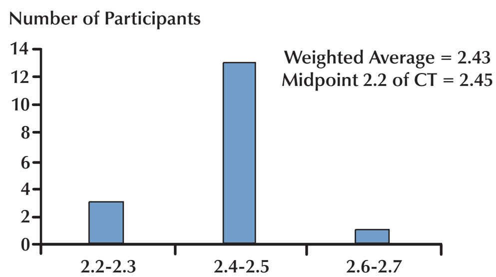


Table B1

	Real GDP		Unemployment rate		PCE inflation		Core PCE inflation	
	Weighted average	Midpoint of CT*	Weighted average	Midpoint of CT	Weighted average	Midpoint of CT	Weighted average	Midpoint of CT
2007	2.43	2.45	4.76	4.75	2.95	2.95	1.89	1.85
2008	2.18	2.15	4.87	4.85	1.94	1.95	1.84	1.80
2009	2.46	2.50	4.86	4.85	1.82	1.85	1.80	1.80
2010	2.50	2.55	4.84	4.80	1.79	1.75	1.76	1.75

NOTE: *CT is the central tendency range of forecasts reported with the minutes of the October 30-31, 2007, FOMC meeting.

Table 1

Accuracy of Output Forecasts

	RMSE			
Period	FOMC CT	SPF CT	SPF mean	SPF median
1983 to 2006	1.17	1.22	1.22	1.24
1983 to 1990	1.24	1.34	1.34	1.36
1991 to 1998	1.20	1.15	1.16	1.19
1999 to 2006	1.08	1.15	1.14	1.17

NOTE: Forecasts were made in late January or early February for the current calendar year. The SPF CT is the central tendency constructed by taking the range of individual forecasts after eliminating two outliers (one high and one low) for every six forecasts. RMSE is root mean squared error.

released data to evaluate policy decisions that are made before the data are revised.[8] We report forecast accuracy comparisons for the CT only because the SPF range was a much less accurate forecast and there is little to distinguish the FOMC range and CT forecasts. The root mean squared errors (RMSEs) of the output forecasts are shown in Table 1.

We report results for the entire period, 1983 through 2006, and for three eight-year subperiods: 1983-90, 1991-98, and 1999-2006. We break up the sample to show how distribution of individual forecasts changed over time. In all but the middle period, the RMSEs of the FOMC output forecasts were lower than those of the private sector forecasts. It is also interesting to note that the RMSE of the SPF CT output forecast was slightly lower than the SPF median (the measure of consensus used by the SPF) in all instances.

Inflation Forecasts

The FOMC inflation forecasts shown in Figure 5 reflect an ongoing decline in the trend of inflation through 2000 with temporary upward deviations in 1989, 1996, and 2006. Figure 6 shows the inflation forecast range and CT for the SPF survey. Similar to output growth, the dispersion of inflation forecasts by the SPF respondents is much wider than it is for the FOMC. Overall, the ranges have become narrower since the beginning of the sample.

Figure 7 shows that there is more variation in the spread between the FOMC and SPF CT inflation forecasts than we saw in the case for output growth. Also, the FOMC and SPF CT inflation forecasts are substantially different during the period after 2000, when the SPF was forecasting inflation in the GDP price index and the FOMC was forecasting either the PCE price index or, beginning in 2004, the core PCE price index. Figure 8 shows that the SPC CT closely matches the mean and median inflation forecasts—as was the case for the output forecasts in Figure 4.

In Table 2 we report information on inflation forecast accuracy during the two periods for which we have comparable forecasts. During the period from 1983 to 1988, both forecasted inflation in the GNP deflator. For these six years, the FOMC had the lowest RMSE, but all are within 0.08 percentage points. During the period from 1989 to 1999, both forecasted CPI inflation. For these 11 years, the SPF median forecast had the lowest RMSE, but all are within 0.09 percentage points. For the period between 2000 and 2006, the SPF did not forecast either the PCEPI or the core PCEPI, so no valid comparison can be made.

We use two approaches to deal with the problem that the SPF did not forecast the PCEPI or core measure until 2005. First, we note that

[8] The use of first-released data makes it more difficult to compare our results with those who use third-released data, such as Tulip and Reifschneider (2007). We realize that using first-released data is not the best definition of "truth" for evaluating forecast accuracy in all circumstances.

Table 2

Accuracy of Inflation Forecasts

	RMSE			
Period	FOMC CT	SPF CT	SPF mean	SPF median
1983 to 1988	0.85	0.93	0.89	0.90
1989 to 1999	0.79	0.88	0.83	0.78

NOTE: The FOMC made projections for the GNP deflator during the period 1983-88 and the CPI for 1989-99.

Table 3

Accuracy of Indirect GDP Deflator Forecasts

	RMSE	
Period	FOMC CT	SPF CT
1983 to 2006	0.77	0.71
1983 to 1990	0.97	0.90
1991 to 1998	0.60	0.67
1999 to 2006	0.68	0.47

NOTE: To make the comparison as close as possible, we calculated the CT for both the FOMC and SPF CT forecasts for the GDP/GNP deflator as the difference between the CT forecasts for nominal GDP and those for real GDP.

both the SPF and the FOMC make implicit forecasts of the GDP deflator. We construct an FOMC consensus forecast for the output deflator by taking the difference between the consensus forecasts for nominal and real output. To make the forecasts comparable, we construct an SPF CT for the GDP deflator in the same manner. Table 3 presents the results from the comparison of these forecasts. In contrast to the results in Table 2, we see that the SPF CT generally has a lower RMSE than does the FOMC CT. The difference is due in part to how the forecasts are constructed. In Table 2, both the FOMC and SPF are making explicit forecasts of the GDP deflator. In Table 3, the implicit forecasts will, in general, not yield the same value as an explicit forecast because the process of removing outliers separately from nominal and real GDP does not require that the outliers come from the same individual.

The second way that we attempt to take account of the differences in forecast accuracy that may be attributed to the difference in the indices is to document differences in the accuracy of random walk forecasts for each of the indices used by the Fed. Table 4 reports the RMSEs for the random walk forecasts for the full sample period and each of the subperiods considered in Tables 2 and 3. The top four rows construct the fourth-quarter-over-fourth-quarter forecast for the current calendar year using the real-time data fourth-quarter-over-fourth-quarter growth rate of the previous year (which is first reported in January). As far as we know, there is no record of first-released real-time data for first-released core PCEPI before August 2000.[9] Among the other three, the RMSE of the GDP deflator forecast is always lower than the RMSEs for the CPI and the PCEPI. By comparing the real-time random walk forecasts for the GDP deflator with the results in Table 3, we find, as did Atkeson and Ohanian (2001) and others, that the random walk forecast was quite good in recent periods.The CPI always has the highest RMSE, and is, in this sense, the most difficult to forecast. Except for the period 1983 to 1990, the RMSE for the core PCEPI was always lowest among these inflation measures. In this sense, it has been the easiest to predict.

We also report the RMSEs using the current vintage data (shown in the bottom four rows of Table 4). The core PCEPI has the least amount of

[9] The Federal Reserve Bank of St. Louis maintains the monthly releases for the PCEPI and core PCEPI back to the August 1, 2000, release. Quarterly releases of PCEPI are available back to the January 19, 1996, released date. See the ALFRED database at http://alfred.stlouisfed.org/category?cid=21.

Table 4

Accuracy of Random Walk Inflation Forecasts

	GDP deflator	CPI	PCEPI	Core PCEPI
Real-time data				
1983 to 2006	0.63	1.32	1.17	0.67
1983 to 1990	0.70	1.52	1.46	1.00
1991 to 1998	0.57	1.30	1.10	0.45
1999 to 2006	0.61	1.13	0.86	0.37
December 2007 vintage data				
1983 to 2006	0.68	1.32	0.90	0.57
1983 to 1990	0.83	1.52	0.93	0.72
1991 to 1998	0.52	1.30	0.99	0.50
1999 to 2006	0.64	1.13	0.76	0.45

NOTE: The forecast is equal to the real-time fourth-quarter-over-fourth-quarter inflation rate from the previous year (first available in the second half of January). The CPI is not revised so the real-time data is also current vintage. The real-time GDP deflator data are calculated from the nominal and real GDP numbers reported in the real-time data set on the Philadelphia Fed web site: www.philadelphiafed.org/econ/forecast/real-time-data/index.cfm. The CPI data are from Haver/USECON database. PCEPI data are taken directly from reports of the Survey of Current Business. We thank David Reifschneider and Peter Tulip for supplying the real time core PCEPI data. Note that, unlike the other real-time data we use, these are third-release "final" values published in March. The December 2007 vintage data are taken from the Haver/USECON database for all the measures of inflation.

uncertainty by this measure. The GDP deflator is the next-easier to predict and, again, the CPI proves most difficult. Note that the SPF has begun to publish forecasts for both PCEPI and its core measure in 2005.

CONCLUSION

By increasing the frequency of their forecasts to four times per year and by extending the forecast horizon to 3 years, Federal Reserve policymakers have taken an important step forward in providing information about their views of the current economic situation and the long-run trends.

We use the individual forecasts from the SPF to construct the range and central tendency statistics that are analogous to those reported by the FOMC. We find that the midpoint of the central tendency coincides closely with both the mean and median of the forecasts. We conclude, therefore, that the midpoint of the FOMC central tendency is probably a reliable measure of the policymakers' consensus.

Comparing the history of the year-ahead forecasts made by the FOMC participants in February to similar forecasts made by the SPF, we find mixed results when testing for relative accuracy among the alternative consensus forecasts. The sample sizes are too small for reliable tests of statistical significance. Yet, FOMC forecasts of real GDP growth perhaps are somewhat more accurate than those of the SPF, and SPF forecasts of inflation as measured by the output deflator are somewhat more accurate than those of the FOMC in the most recent period. There is less dispersion (or disagreement) among the FOMC forecasts than we see in SPF forecasts; but this policymaking body (and the number of forecasts) is smaller and, unlike the individuals in the SPF, the FOMC participants regularly attend meetings in which they receive a common economic briefing from the Federal Reserve Board staff.

Although this study addresses the issue of relative forecast accuracy, we agree with Reifschneider and Tulip (2007), who argue that too much emphasis may be put on the relative accuracy of different forecasts. Even the forecast errors of a poorly performing forecast will be positively correlated with the smaller errors of better forecasts. Making a forecast requires purposeful analysis of the details of the economy and is probably the best way to understand changes in the current stage of the business cycle. Policymakers who are also forecasters are likely to learn from their mistakes and better understand when and why policy changes are needed. In our view, there is a substantial value in the FOMC's forecasting process that lies in the knowledge it adds to those who participate in making forecasts and in the information it sends to the public about policy assumptions and objectives.

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Laffer Traps and Monetary Policy

Patrick A. Pintus

This article focuses on the interaction, in a stylized economy with flexible prices, of monetary and fiscal policy when both are active—active in the sense that how the policy instrument is set depends on the state of the economy. Fiscal policy finances a given stream of government expenditures through distortionary labor taxes, and it operates under a strict balanced-budget rule. If monetary policy is passive, the economy may occasionally switch, because of self-fulfilling expectations, from the neighborhood of a "Laffer trap" equilibrium to the saddle-path leading to the high-welfare steady state. In the low-welfare stationary state, output, investment, and consumption are low while the tax rate is correspondingly high. However, active monetary policy may, by following a rule such that the nominal interest rate responds positively to the state of the economy, push the economy toward the high-welfare equilibrium and rule out expectation-driven business cycles. (JEL E32, E63, H31)

Federal Reserve Bank of St. Louis *Review*, May/June 2008, *90*(3, Part 1), pp. 165-74.

This article focuses on the interaction, in a stylized economy with flexible prices, of monetary and fiscal policy when both are active—active in the sense that the policy instrument depends on the state of the economy. The fiscal authority has to finance a given stream of government expenditures that is constant over time, reflecting some social needs to smooth out the production of public goods. To that end, the government levies distortionary taxes on labor income, but it does so under a strict rule that imposes a balanced budget in each period. As a consequence, the tax rate is countercyclical. Suppose that monetary policy is passive (e.g., that it keeps the rate of money growth constant over time). Then the economy possesses two steady states: one with a high tax rate (a "Laffer trap" equilibrium) and one with a low tax rate. The low stationary state—where output, investment, and consumption are low—is Pareto-dominated by the high steady state and it is subject to expectation-driven business cycles. The main point of this article is to argue that switching to an active monetary policy may push the economy toward the high-welfare equilibrium and rule out expectation-driven business cycles. This happens, for instance, if the monetary authority follows a simple rule that stipulates how the nominal rate of interest responds to today's state of the economy.

This article obviously belongs to the vast literature that contrasts the effects of Friedman-type and Taylor-type monetary policy rules. It provides a simple example in which substituting a state-contingent policy for a passive rule may lead to better macroeconomic outcomes, in accord with the lesson one may draw from many articles in this area. However, in contrast with most of the recent research, the economy I focus on is not subject to the controversial sticky-price assump-

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tion. Therefore, the analysis suggests that the type of indeterminacy that is associated with passive policy (but eliminated by active policy) does not strictly depend on that assumption and may occur in a world where all prices are flexible.

I first show how a Laffer trap occurs when a given stream of government expenditures is financed by distortionary taxes and when the growth rate of the money supply is held constant over time. More precisely, I show that the economy has a low steady state, associated with a tax rate that is higher than the level that maximizes government revenues (which I call the Laffer maximal tax rate). It coexists with a high stationary state where consumption, investment, and output are higher. As a consequence, the higher stationary equilibrium is characterized by larger welfare and it Pareto-dominates the low steady state. Moreover, the high steady state is saddle-point stable while the Laffer trap is locally indeterminate, so that sunspot equilibria occur near the *low* steady state. Most importantly, regime switching occurs when the economy occasionally jumps between the saddle-path (which converges monotonically toward the high steady state) and volatile paths around the Laffer trap. The main mechanism giving rise to indeterminacy is that households supply labor today according to their expectations about the inflation rate. More precisely, labor supply is higher (lower) when expected inflation is lower (higher). Consequently, waves of optimism or pessimism turn out to be self-confirming and the economy may experience excess volatility in the absence of any shocks to "fundamentals."

Second, I show that an active monetary policy may, by committing to a rule that links the nominal interest rate to output, push the economy toward the high-welfare equilibrium and rule out expectation-driven business cycles. One may think about this second type of policy as motivated by inflation targeting, which is designed to avoid large fluctuations of the inflation rate associated with indeterminacy. Alternatively, one may view this regime as originated by a max-min criterion that guides monetary policy and that aims at eliminating the "worst" equilibrium because it has both low welfare and excess volatility.

The analysis builds upon earlier work by introducing active fiscal and monetary policies in Woodford's (1986) framework. It complements the analysis of Leeper (1991), Schmitt-Grohé and Uribe (1997), and Antinolfi, Azariadis, and Bullard (2007) in the sense that I combine all elements of these studies in a simple monetary model with capital accumulation and credit constraints, in which I embed fiscal and monetary policies.

Perhaps the closest article is Leeper (1991). However, it differs along several dimensions: In particular, I do not impose a single budget constraint for the fiscal and monetary authorities. On the contrary, I assume that the government budget is balanced and that the central bank chooses its own policy rule. Fiscal policy consists of setting the tax rate on labor income while monetary policy decides on the nominal interest rate (and maybe lump-sum transfers). Also, unlike Leeper's (1991) model, my model incorporates physical capital accumulation and borrowing constraints.

As in Leeper (1991) and Schmitt-Grohé and Uribe (1997), I focus on policies that maintain a constant level of public spending over time, which may be justified by assuming that the government wishes to smooth out the production of public goods. Moreover, this hypothesis somewhat captures in a simple way the fact that public expenditures are much less volatile than output or factor income. Lane (2003; Table 1, p. 2669), for instance, reports some evidence suggesting that total government consumption has been acyclical in most Organisation for Economic Co-operation and Development (OECD) countries over the period 1960-98. What turns out to be a key assumption here is that public spending is predetermined when private agents make their own decisions, rather than when public spending is constant over time. Similar to Antinolfi, Azariadis, and Bullard (2007), some agents are subject to borrowing constraints. However, in the present article, credit-constrained households choose to hold outside money. Finally, Antinolfi, Azariadis, and Bullard (2007) abstract from both money and fiscal policy, in contrast with this article.

Unlike the conditions in Schmitt-Grohé and Uribe (1997), in the present article indeterminacy occurs for arbitrarily small values of government spending. In addition, the steady state is unique in Schmitt-Grohé and Uribe (1997) and is associated, when locally indeterminate, with a tax rate that is lower than the Laffer maximum. In contrast, my result shows that indeterminacy and expectation-driven business cycles arise because there exists a low, Pareto-dominated steady state, where the tax rate is higher than the Laffer maximum. The existence of such a Laffer trap calls for, in the setting of this article, a Pareto-improving, active monetary policy that cannot be implemented in the non-monetary economy of Schmitt-Grohé and Uribe (1997). However, much of the sensitivity analysis of these authors applies to this article, where, for instance, adding government debt does not alter the results as long as the balanced-budget requirement is maintained.

The monetary economy I focus on may be seen as an extension of Sargent and Wallace (1981), with capital accumulation and heterogenous agents. As in the analysis of these authors, the low steady state may be indeterminate. The model is also close to a commonly used framework in the public finance literature (see, e.g., Judd, 1985; Kemp, Van Long, and Shimomura, 1993; Alesina and Rodrik, 1994; and Lansing, 1999). This article adds to the public finance models by introducing monetary policy.

A STYLIZED MONETARY ECONOMY WITH CONSTANT PUBLIC SPENDING

In this section, I briefly present Woodford's (1986) model, to which I add government expenditures, distortionary labor taxes (as in Gokan, 2006, and Pintus, 2006), and monetary policy. The economy consists of two types of agents (say, workers and producers), who consume and have perfect foresight during their infinite lifetimes. Workers consume the produced good and supply a variable quantity of labor in each period. Moreover, they face a financial constraint that prevents them from borrowing from their labor income. On the other hand, producers consume and save in each period, and, most importantly, they are assumed to be more patient than workers (that is, they have a larger discount factor). As a consequence, producers end up holding the entire capital stock (as in Becker, 1980), whereas workers own the whole stock of outside money (which is a dominated asset) at the steady state and nearby. In such a framework, Woodford (1986) has shown that although workers are infinitely long-lived, they behave like two-period living agents. More precisely, workers save their wage income in the form of money today, to be consumed tomorrow. I should emphasize that what I now present is the reduced-form model that is equivalent, near the steady state, to the infinite-horizon setting. (See the appendix.) The reader is referred to Woodford (1986) and Grandmont, Pintus, and de Vilder (1998) for more details on the derivation of this equivalence. In summary, what is key here is that workers are both more impatient and unable to borrow.

A key assumption of the analysis is that a *constant* flow of public expenditures, $g > 0$ in real terms, has to be financed in each period $t \geq 0$. This flow can be interpreted as purchases of the final good produced in the economy, which is in turn obtained by combining labor, $l_t > 0$, and the capital stock, $k_t > 0$, resulting from the previous period. The government levies distortionary labor income taxes under a strict rule that imposes a balanced budget. Therefore, the tax rate $0 < \tau_t < 1$ adjusts to meet the constraint that $g = \tau_t \omega_t l_t$ in all periods. For simplicity, I abstract from both capital income taxation (see Judd, 1985, for a justification) and public debt, although results would be similar with fixed government debt and a constant capital tax rate.

Production possibilities are given by Cobb-Douglas technology, $F(k_t, l_t) = k_t^s l_t^{1-s}$. Competitive firms take real rental prices of capital and labor as given and, accordingly, the real wage is $\omega_t = \omega(k_t/l_t) \equiv (1-s)(k_t/l_t)^s$; and the real gross return on capital is $R_t = R(k_t/l_t) \equiv s(k_t/l_t)^{s-1} + 1 - \delta$ in equilibrium, where $0 < \delta < 1$ is the depreciation rate for capital.

As described in the appendix, the representative, infinitely long-lived worker chooses next-period consumption, $c_{t+1} > 0$, and labor supply, $l_t > 0$, so as to maximize $\{U(c_{t+1}) - V(l_t)\}$ subject to

(1) $$p_{t+1}c_{t+1} = (1+\sigma_{t+1})(1-\tau_t)w_t l_t + p_{t+1}T_{t+1},$$

where $\sigma_{t+1} > 0$ and T_{t+1} represent, respectively, the nominal interest rate on money balances and lump-sum monetary transfers; $p_{t+1} > 0$ is the next-period price of output (assumed to be perfectly foreseen); and $w_t > 0$ is the nominal wage (that is, $w_t = p_t\omega_t$). The budget constraint in (1) incorporates the fact that workers save in period t their disposable wage income in the form of money, to be consumed in period t+1. That is, if m_{t+1} is money demand in period t, then the budget constraint in (1) comes from $(1 - \tau_t)w_t l_t = m_{t+1}$ and $p_{t+1}c_{t+1} = (1 + \sigma_{t+1})m_{t+1} + p_{t+1}T_{t+1}$. The utility functions $U(c)$ and $V(l)$ are increasing, respectively concave and convex. Moreover, consumption and leisure are assumed to be gross substitutes; that is, $U(c)$ is not too concave. The first-order condition of (1) is then $[c_{t+1} - T_{t+1}]U'(c_{t+1}) = l_t V'(l_t)$, together with $p_{t+1}c_{t+1} = (1 + \sigma_{t+1})(1 - \tau_t)w_t l_t + p_{t+1}T_{t+1}$.

Producers do not work, do not hold money, and maximize the discounted sum of utilities derived from the consumption in each period. In period t, they consume (and save) part of their capital income, $R_t k_t$. If the producers' utility function is logarithmic, then their optimal choice simply maintains a constant savings rate; that is, $k_{t+1} = \beta R_t k_t$, where $0 < \beta < 1$ is the producers' discount factor (see Woodford, 1986).

Because workers save their wage income in the form of money, the money market equilibrium is

(2) $$(1-\tau_t)\omega_t l_t = M_{t+1}/p_t,$$

where $M_{t+1} > 0$ is money supply. I assume that monetary creation takes the form of both proportional and lump-sum transfers; that is, $M_{t+1} - M_t = \sigma_t M_t + p_t T_t$.

How does monetary policy then affect the competitive equilibrium of such an economy? The next step in the analysis is to contrast two different types of monetary policies. I call "passive" a rule that keeps the money supply growing at a constant rate and that uses only proportional transfers (that is, $T_t = 0$) in all periods. It is passive in the sense that it does not respond to the state of the economy. In contrast, "active" monetary rules allow the rate of money creation to depend on the state of the economy and may lead to different dynamics, as I now show. More precisely, the two policies are as follows: A passive policy is such that $\sigma_t = \sigma$ is constant and $T_t = 0$, whereas an active policy sets $M_t = M$ constant and chooses a sequence for σ_t and $T_t = -\sigma_t M/p_t$.

Note that the above terminology differs somewhat from Leeper's (1991) definition of passive/active monetary policy, which is helpful to describe an economy hit by exogenous shocks. In particular, all the rules that I examine here do not depend in an explicit way on either past or expected inflation rates. Consequently, one would label them as passive according to the usage that is most common in the literature.

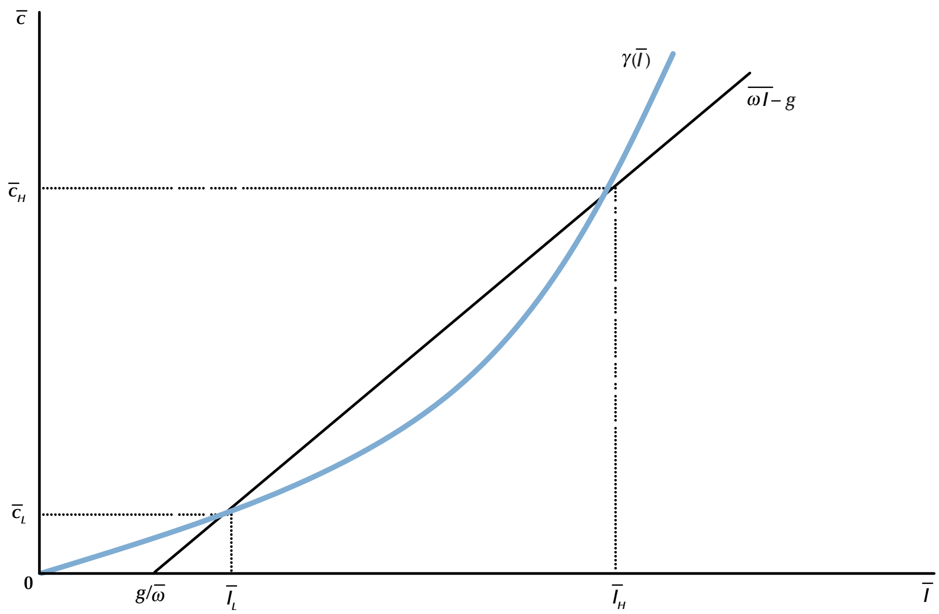
ESCAPING LAFFER TRAPS THROUGH MONETARY POLICY RULES

Passive Monetary Rules

Suppose first that monetary authorities commit to constant money growth and use proportional transfers only. In other words, $\sigma_t = \sigma$ and $T_t = 0$ in all periods. When σ is small, one may interpret this rule as resulting from high aversion to inflation. Using the budget constraint (1) and the money market equilibrium (2) with $T_t = 0$, $M_{t+1}/M_t = (1 + \sigma)(1 - \tau_t)\omega_t l_t/c_t$. If monetary authorities fix the growth rate of the money supply at $1 + \sigma = M_{t+1}/M_t$ (by controlling the nominal interest rate on money holdings), then $c_t = (1 - \tau_t)\omega_t l_t$. Moreover, by defining $u(c) \equiv cU'(c)$, $v(l) \equiv lV'(l)$, and $\gamma(l) \equiv u^{-1}[v(l)]$, the first-order condition $c_{t+1}U'(c_{t+1}) = l_t V'(l_t)$ can conveniently be written as $c_{t+1} = \gamma(l_t)$, where $\gamma(l)$ is increasing and convex. Therefore, workers' first-order condition is, in equilibrium, described by $(1 - \tau_{t+1})\omega_{t+1}l_{t+1} = \gamma(l_t)$ or, given that $g = \tau_{t+1}\omega_{t+1}l_{t+1}$, described by $\omega_{t+1}l_{t+1} = \gamma(l_t) + g$. Then, from the above equilibrium conditions, one easily deduces that all variables are known once the pair (l_t, k_t) and g are given. Note, however, that σ does not affect the dynamics: That is, predetermined proportional transfers are neutral (see Grandmont, 1986). This implies that intertemporal equilibria may be summarized by

Figure 1

Two Pareto-Ranked Steady States When Monetary Policy Is Passive



the dynamic behavior of both labor hours (which is a jump variable) and the (predetermined) capital stock, once fiscal policy is announced. In summary, an intertemporal, competitive equilibrium with perfect foresight is a sequence of positive numbers (l_t, k_t) for every period $t \geq 0$ such that, given government spending $g > 0$ and the initial capital stock $k_0 > 0$,

$$(3) \qquad \begin{cases} \omega\left(k_{t+1}/l_{t+1}\right)l_{t+1} & = & \gamma\left(l_t\right) + g, \\ k_{t+1} & = & \beta R\left(k_t/l_t\right)k_t, \end{cases}$$

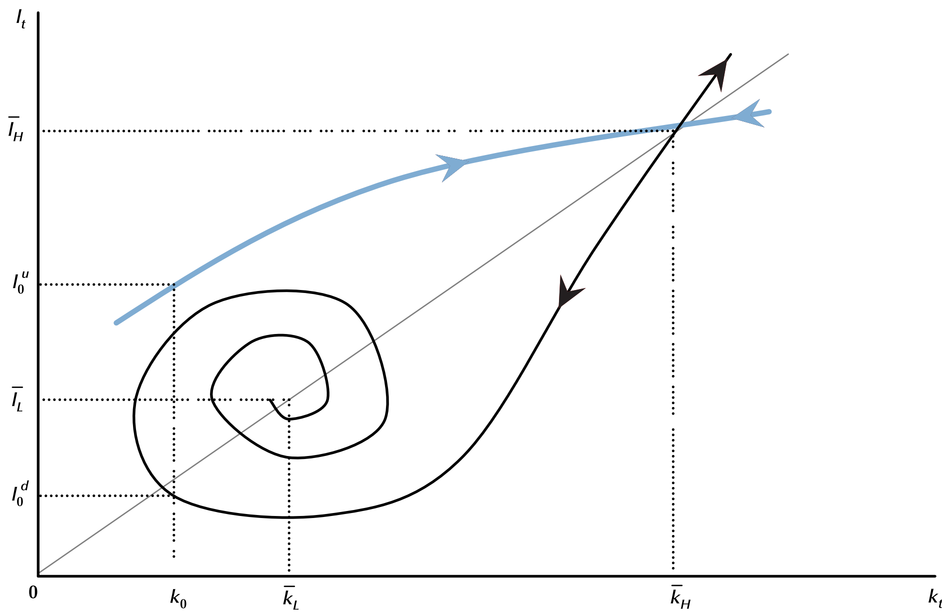
where the equations in (3) are to be remembered as the first-order conditions of, respectively, workers and producers.

It is then not difficult to derive the conditions that any steady state must satisfy. From the second equality in (3), the stationary capital-labor ratio, $\bar{k}/\bar{l} > 0$, is determined by $R(\bar{k}/\bar{l}) = 1/\beta$, which has a unique solution under the assumption of Cobb-Douglas technology. Note that $\bar{k}/\bar{l}$ is determined by both technology and producers' patience, but it is independent of fiscal and monetary policies. Moreover, steady-state labor, $\bar{l}$, solves $\overline{\omega l} = \gamma(\bar{l}) + g$, where $\bar{\omega} \equiv \omega(\bar{k}/\bar{l})$, in view of the first condition in (3). It is straightforward to show that the latter equality—which determines steady-state labor, capital, and output—has two solutions, $\bar{l}_L > 0$ and $\bar{l}_H > \bar{l}_L$ as depicted in Figure 1, provided that government spending is not too large.

As shown in Pintus (2006), the two steady states are in fact Pareto-ranked. In essence, the higher steady state produces larger income for both types of agents. The corresponding tax rates are such that $\tau_L \equiv g/(\overline{\omega l}_L) > \tau_H \equiv g/(\overline{\omega l}_H)$. Moreover, $\tau_L(\tau_H)$ is higher (lower) than the tax rate that maximizes fiscal revenues (that is, the Laffer maximal tax rate). Let us focus on parameter values such that, after linearizing (3) at steady states, the lowest steady state is indeterminate while the highest one is a saddle, as pictured in Figure 2. (See also Gokan, 2006.) In view of the fact that (3) represents the dynamics of the original economy populated by heterogenous, infinitely long-lived agents only near steady states, I now focus on parameter configurations such that both steady

Figure 2

The Low Steady State (the Laffer Trap) Is Indeterminate and the High Steady State Is a Saddle When Monetary Policy Is Passive



states are "close"; that is, they belong to a small neighborhood. Such cases are shown to arise when parameter values approach some bifurcation levels. (See Pintus, 2006, for details.)

In Figure 2, consider an initial capital stock, $k_0 > 0$, that is close enough to the low steady state, $\bar{k}_L$. Then there is a continuum, $[l_0^d, l_0^u]$, of values for labor such that the economy converges to steady state. In period 0, if labor supply l_0 happens to be equal to the highest value, l_0^u, then convergence to the high-welfare steady state is ensured. However, if today's labor supply is below the level l_0^u and larger than some l_0^d, then the economy falls into the Laffer trap. In other words, infinitely many values of labor supply are consistent, in period 0, with convergence to some steady state. Similarly, if k_0 is close to (but lower than) $\bar{k}_H$, the economy may end up converging either to the high steady state or to the Laffer trap. There is indeterminacy.

In summary, suppose that government spending, g, is not too large and that money growth is constant in all periods. Then the economy described in (3) has two steady states: $(\bar{l}_H, \bar{k}_H)$ and $(\bar{l}_L, \bar{k}_L)$, with $\bar{l}_H > \bar{l}_L$ and $\bar{k}_H > \bar{k}_L$ (see Figure 1), such that both workers and producers strongly prefer $(\bar{l}_H, \bar{k}_H)$. The low steady state $(\bar{l}_L, \bar{k}_L)$ (the "Laffer trap") is associated with a tax rate that is higher than the Laffer maximum, whereas $(\bar{l}_H, \bar{k}_H)$ is associated with a tax rate that is lower than the Laffer maximum. Moreover, $(\bar{l}_H, \bar{k}_H)$ is a saddle, whereas $(\bar{l}_L, \bar{k}_L)$ is indeterminate and subject to expectation-driven business cycles (see Figure 2). Therefore, the economy may occasionally switch, because of self-fulfilling expectations, from the neighborhood of the Laffer trap to the saddle-path leading to the high-welfare steady state.

The configuration that appears in Figure 2 turns out to be plausible, as it arises when government spending is (arbitrarily) small, in contrast with findings in Schmitt-Grohé and Uribe (1997). In their analysis, the steady state is unique and is associated, when indeterminate, with a (large enough) tax rate that is lower than the Laffer maximum. In contrast, my result shows that indeterminacy and belief-driven business cycles arise because there exists a low, Pareto-dominated steady state, where the tax rate is higher than the Laffer maximum. This is reminiscent of earlier results obtained by Sargent and Wallace (1981) in a monetary economy without capital. The existence of such a Laffer trap calls, in the setting of this article, for a Pareto-improving, active monetary policy that is assumed away in the non-monetary economy of Schmitt-Grohé and Uribe (1997).

Most importantly, regime switching occurs in Figure 2, when the economy abruptly jumps between paths converging monotonically toward the high steady state and volatile paths around the low steady state. The main mechanism giving rise to indeterminacy is that households supply labor today according to their expectations about the inflation rate. More precisely, labor supply is higher (lower) when expected inflation is lower (higher). Therefore, waves of optimism or pessimism turn out to be self-confirming and the economy experiences excess volatility in the absence of any shocks to "fundamentals." The assumption of predetermined public spending is as important here as it is in Schmitt-Grohé and Uribe (1997): This amounts to imposing a fixed cost on the economy, thereby creating a mechanism that is likely to lead, in a similar fashion as increasing returns do, to multiple equilibria and indeterminacy. In that respect, adding government debt to the model would not change the results, as long as the tax rate adjusts to balance the fiscal budget.

The multiplicity of steady states turns out to be robust also with respect to the introduction of lump-sum monetary transfers. Assume instead that money is held constant over time ($M_t = M$); that is, $T_t = -\sigma_t M_t/p_t$. Then the first-order condition of the workers becomes $(1 + \sigma)c_{t+1}U'(c_{t+1}) = l_t V'(l_t)$. Consequently, increasing (decreasing) the rate of money transfer σ shifts down (up) the $\gamma(\bar{l})$ locus in Figure 1, which cannot rule out the Laffer trap.

Active Monetary Rules

The main point of this article is to argue that an active monetary policy may rule out the Laffer trap equilibrium that is associated with active fiscal policy when that fiscal policy operates under a strict balanced budget requirement. One may think about this second policy regime as motivated by inflation targeting, which is designed to avoid large fluctuations of the inflation rate associated with indeterminacy. As illustrated in Figure 2, fluctuations between paths converging monotonically toward the high steady-state and volatile paths around the Laffer trap are associated with large swings in the inflation rate. This is because the inflation rate, given by

$$p_{t+1}/p_t - 1 = \left[(1+\sigma)(\omega_t l_t - \omega_{t+1} l_{t+1}) - \sigma g\right] / (\omega_{t+1} l_{t+1} - g),$$

moves together with l_t and k_t in the above case with passive monetary policy.

Alternatively, one may interpret this regime as originated by a max-min criterion that guides monetary policy and that aims at ruling out the "bad" equilibrium. The idea here is that monetary authorities are concerned about a "worst-case scenario" in which the economy would wander around a low-welfare steady state. In other words, monetary policy tries to avoid the low equilibrium because it is Pareto-dominated in terms of both welfare level and welfare volatility.

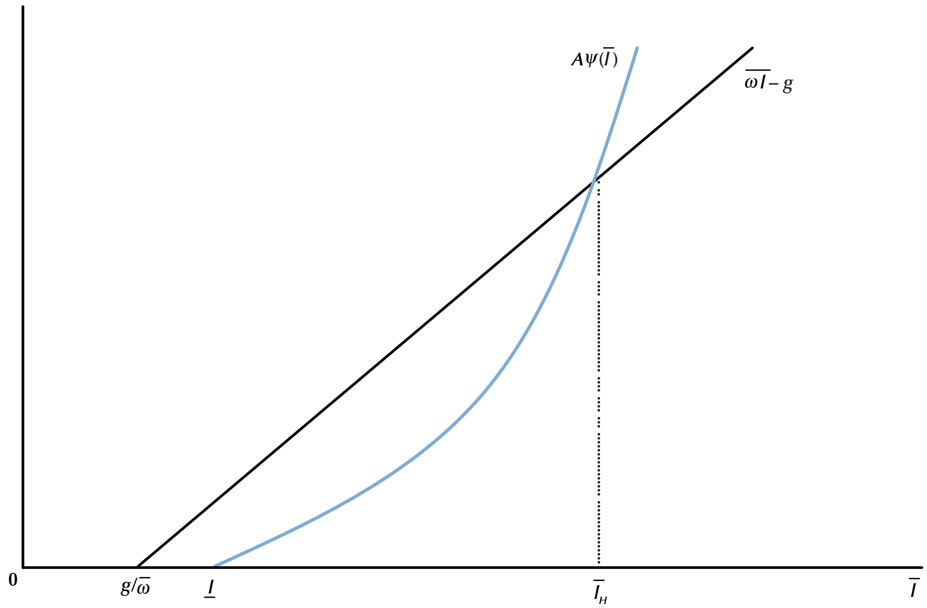
As an example of such rules, set $1 + \sigma_{t+1} = v(l_t)/u(A\psi(l_t))$ and $T_t = -\sigma_t M_t/p_t$. Then workers' first-order condition becomes $(1 + \sigma_{t+1})u(c_{t+1}) = v(l_t)$ or $c_{t+1} = A\psi(l_t)$. Figure 3 depicts a case such that $A\psi(l)$ is increasing and convex, with $A\psi(l) > 0$ only when $l > \underline{l}$, for some $\underline{l} > g/\bar{\omega}$. In addition, the scaling factor A should be appropriately chosen so that the high equilibrium is the unique steady state (see Figure 3). Then intertemporal equilibria are now given by

$$(4) \qquad \begin{cases} \omega(k_{t+1}/l_{t+1})l_{t+1} & = & A\psi(l_t) + g, \\ k_{t+1} & = & \beta R(k_t/l_t)k_t; \end{cases}$$

and it is readily shown, by linearizing (4), that the unique steady state remains a saddle point under such a rule. In other words, suppose that government spending, g, is not too large and that the rate of proportional monetary transfers, σ_t, follows a rule such that $\sigma_{t+1} = \phi(l_t)$ in all periods. Then there exists a monetary policy rule $\phi(\cdot)$ such

Figure 3

The Unique (High Welfare) Steady State with Active Monetary Policy



that the economy described in (3) has a unique, saddle-point steady state $(\bar{l}_H, \bar{k}_H)$. In other words, such a monetary policy rules out expectation-driven business cycles and implies saddle-path convergence to the Pareto-dominating steady state. Note that both money creation and inflation vanish at steady state; that is, σ tends toward zero along the transition to steady state.

Obviously, one may interpret more generally the above rules as relating the nominal interest rate to output, rather than labor, given the capital stock in the current period. In that case, money creation in period t+1 is made an increasing function of period-t output. The main intuition here is that when the nominal interest rate is announced to be an increasing function of output, this neutralizes self-confirming expectations about the inflation rate.

CONCLUSION

If fiscal policy is constrained by a strict balanced-budget requirement, a Laffer trap equilibrium coexists with a Pareto-dominating steady state. The Laffer trap equilibrium features a higher tax rate, lower and volatile macroeconomic variables, and hence lower welfare. Its mere existence makes regime switching possible, when monetary policy is passive, because the economy may abruptly jump from the saddle-path converging toward the high-welfare steady state to volatile paths around the low-welfare steady state. Such a pattern is associated with large swings in the inflation rate. The analysis of this article suggests that one way to push the economy toward the "good" steady state is to abandon passive monetary policies and adopt instead an active monetary rule. Such an active rule may take the form of a commitment to link in a positive fashion the nominal interest rate and the level of aggregate output. Under this commitment, welfare is higher in every period and expectation-driven business cycles are ruled out.

Directions for future research would be to consider, in a more systematic way, the effect of fiscal rules that aim at both redistributing income and stabilizing the economy, building on recent contributions by Christiano and Harrison (1999), Guo and Harrison (2001), Aloi, Lloyd-Braga, and Whitta-Jacobsen (2003), and Dupor (2005), among many others. This is most important in view of the fact that the existing results, taken together, are rather inconclusive and suggest that the cyclicality of government expenditures and taxes may or may not stabilize the economy, depending on the precise framework. The relevance of such a question for actual policy also originates from the available data, which show that the level of fiscal cyclicality varies much across OECD countries, as documented by Lane (2003), for instance. This article suggests that when it comes to assessing the impact of active fiscal policies, it is important to understand how they interact with independent monetary policies that may be active or passive.

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APPENDIX

In this appendix, I derive the condition under which the decision of workers reduces to a two-period problem. Workers' intertemporal utility is

$$\sum_{t=1}^{+\infty} \alpha^{t-1}\left[U(c_t) - \alpha V(l_t)\right], \tag{5}$$

where $0 < \alpha < 1$ is their discount factor. Workers face the usual budget constraint

$$(1+\sigma_t)m_t + p_t T_t + p_t R_t k_t + (1-\tau_t)w_t l_t = p_t c_t + p_t k_{t+1} + m_{t+1}. \tag{6}$$

In addition, they cannot borrow and face an intratemporal liquidity constraint such that

$$(1+\sigma_t)m_t + p_t T_t + p_t R_t k_t \geq p_t c_t + p_t k_{t+1}. \tag{7}$$

It is not difficult to verify, by manipulating the first-order conditions, that workers do not hold capital (that is, $k_t = 0$) at all dates if

$$U'(c_t) > \alpha R_{t+1} U'(c_{t+1}). \tag{8}$$

As the liquidity constraint (7) binds at steady states, condition (8) implies the following: Workers spend their money holdings, i.e., $p_t c_t = (1 + \sigma_t)m_t + p_t T_t$, and save their wage income in the form of money, i.e., $(1 - \tau_t)w_t l_t = m_{t+1}$, to be consumed tomorrow. Under (8), therefore, workers choose l_t and c_{t+1} so as to maximize

$$\left\{U(c_t) - V(l_t)\right\} \text{ s.t. } p_{t+1}c_{t+1} = (1+\sigma_{t+1})(1-\tau_t)w_t l_t + p_{t+1}T_{t+1}, \tag{9}$$

as described in the text. Finally, under the assumption that producers discount the future less heavily than workers (that is, $\alpha < \beta < 1$), condition (8) is met at steady states and nearby: $1 > \alpha R(\bar{k}/\bar{l})$ because the steady-state return on capital is given by $R(\bar{k}/\bar{l}) = 1/\beta$.

Forecasting Inflation and Output: Comparing Data-Rich Models with Simple Rules

William T. Gavin and Kevin L. Kliesen

There has been a resurgence of interest in dynamic factor models for use by policy advisors. Dynamic factor methods can be used to incorporate a wide range of economic information when forecasting or measuring economic shocks. This article introduces dynamic factor models that underlie the data-rich methods and also tests whether the data-rich models can help a benchmark autoregressive model forecast alternative measures of inflation and real economic activity at horizons of 3, 12, and 24 months ahead. The authors find that, over the past decade, the data-rich models significantly improve the forecasts for a variety of real output and inflation indicators. For all the series that they examine, the authors find that the data-rich models become more useful when forecasting over longer horizons. The exception is the unemployment rate, where the principal components provide significant forecasting information at all horizons. (JEL C32, C53, E31, E37)

Federal Reserve Bank of St. Louis *Review*, May/June 2008, *90*(3, Part 1), pp. 175-92.

Monetary policymakers focus on economic forecasts of a few key variables such as inflation, GDP, and the unemployment rate, but they look at many other variables when making these forecasts. In principle, information about other economic indicators should be useful in forecasting economic variables. A key problem is deciding which, if any, other series to include. Recent studies have shown that dynamic factor models may provide a parsimonious way to include incoming information about a wide variety of economic activity. These models use a large data set to extract a few common factors.

Many researchers, including Stock and Watson (1999, 2002), Bernanke and Boivin (2003), Bernanke, Boivin, and Eliasz (2005), and Giannone, Reichlin, and Sala (2005), have promoted the idea that dynamic factor models can be used to improve empirical macroeconomic analysis. Stock and Watson have instead focused on forecasting. Bernanke and coauthors introduced the term "data-rich environment" and have focused on applied policy models (structural vector autoregressions [VARs]).

The dynamic factor model has gained popularity for two important reasons. First, augmenting VARs with dynamic factors is a way to mitigate omitted variable bias in structural VARs. When Bernanke (1986) presented his first structural VAR model at a Carnegie-Rochester Public Policy Conference, King (1986) commented on the paper, noting that omitting any important macro variable from the policymaker's information set would result in incorrect inference about the effects of monetary policy. In small-dimension VARs, important variables are likely to be omitted. Giannone and Reichlin (2006) discuss the conditions under which using large data sets can help to identify economic structure.

The second reason for the dynamic factor model's popularity is that it provides a framework

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for empirical analysis that is consistent with the stochastic structure of dynamic general equilibrium models. That is, these models determine a large number of variables with just a small number of structural shocks. A few shocks to preferences, technology, and policy drive all the macro variables. The empirical framework fits nicely with the theoretical framework. Evans and Marshall (2006) and Boivin and Giannoni (2006) use dynamic factor techniques to estimate the parameters and shocks of general equilibrium models.

The first part of the paper introduces the dynamic factor model framework. The second part of the paper uses a Granger causality framework to test whether the data-rich models make a statistically significant improvement in the benchmark autoregressive forecasts.[1] To preview the results, we find that, for the past decade anyway, the data-rich framework provides additional information to significantly improve forecasts of inflation and real activity.

INTRODUCTION TO DYNAMIC FACTOR MODELS

To get a sense of how dynamic factor models incorporate large amounts of information, consider the makeup of the U.S. economy. As of March 2006, the U.S. economy included about 110 million households, with an average annual income of over $60,000. There were almost 9 million establishments (firm locations) as derived from quarterly tax filings and reports to various state unemployment insurance programs. Government statistical agencies collect data about prices and spending by consumers and firms to create the various price indices and spending categories that are used in compiling the national income and product accounts.

Every day the decisions of these millions of households and firms are affected by common macroeconomic factors such as technology, tax rates, interest rates, and government spending. Shocks to these common factors, both good and bad, affect spending, productivity, and work effort. The common factors and shocks to them are pervasive, affecting every economic indicator. The decisions of households and firms are also affected by idiosyncratic shocks that are particular to individual firms and households. There are good idiosyncratic shocks such as births, strokes of genius, and opportunities taken. There are also bad idiosyncratic shocks such as death, sickness, accidents, and ideas that do not work out. In contrast to shocks to the common factors that affect everyone, like unexpected monetary policy actions or oil price increases, idiosyncratic shocks affect individuals or a particular market or economic sector.

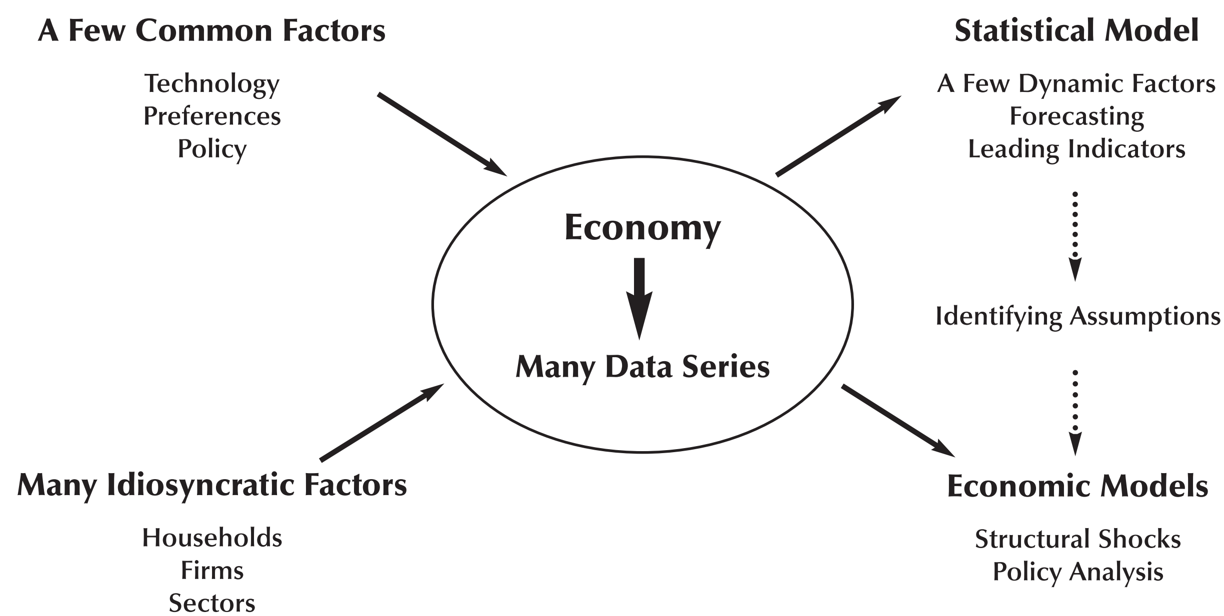
Figure 1 illustrates the nature of the problem for the macroeconomist. In the center is the economy made up of households, firms, and government embedded in physical and institutional structures. To "map" the economy, private firms and public agencies collect an enormous amount of information that is organized and reported by various public and private sources. The most important of these economic indicators are gross domestic product (over $13.5 trillion in 2007), inflation (the consumer price index [CPI] inflation trend has been rather steady around 2½ percent over the past decade), and the number of jobs (payroll employment was about 138 million at the end of 2007). These data are aggregated using thousands of bits of information coming from a sample of the households, firms, and government. In this paper we use a much smaller, yet very rich data set including 157 time series describing the evolution of production, employment, spending, inflation, interest rates, exchange rates, and asset prices. Incoming news about these time series informs us about the short-term stage of the business cycle and expected long-run trends for the major macroeconomic indicators.

On the left side of Figure 1 we sort the factors into those that are common to all the economic indicators and those that are idiosyncratic. The level of technology in science and industry, including management science, is a common factor. Recent innovations in computer technology have changed the way everyone keeps track of information and communicates with others. Other common factors include monetary and fiscal

[1] See Eickmeier and Ziegler (2006) for a survey of the large and growing literature on forecasting with dynamic factor models.

Figure 1

Schematic for Data-Rich Models



policy. Although more difficult to measure, shocks to household preferences for consumption and leisure may also appear to be economy-wide. Researchers want to measure these common factors and shocks to them because they help forecast inflation and output, but also because they are needed to understand how the economy works—which is essential for evaluating the effects of past and proposed policies.

The key assumption underlying the dynamic factor model is that each of the economic indicators is assumed to be driven by a common component made up of a small number of common factors and an idiosyncratic component. Because each of the economic indicators represents the activities of many households and firms, the idiosyncratic shocks estimated in our model may share some common elements. We assume, however, that, unlike the shocks to the common factors, the idiosyncratic shocks do not have economy-wide effects.

On the top right side of Figure 1 we see that a dynamic factor model can be used to estimate a set of common factors that affect all economic time series. The dynamic factor model is designed to extract the small number of common factors from a large set of economic indicators. Stock and Watson (1989) developed coincident and leading indicators of the business cycle using dynamic factor methods.[2] Stock and Watson (2002) also use this statistical model to make economic forecasts. Giannone, Reichlin, and Small (2005) have developed a dynamic factor model that is used by the Federal Reserve Board to make short-term forecasts for a large cross-section of data. The estimated common factors are reduced-form constructs—linear combinations of the structural factors that we would like to observe. On the bottom right side of Figure 1, we see that an economic model must be specified to identify the structural factors and the structural shocks that are of most interest to policymakers and policy advisors. Here we focus on using the information

[2] The Federal Reserve Bank of Chicago maintains this leading indicator index. See Evans, Liu, and Pham-Kantor (2002).

in the common factors to forecast indicators of inflation and output.

The basic statistical tools used are principal component and factor analysis.[3] We observe a large number of time series, $x_{i,t}$, $i = 1, 2, \ldots, n$; each is observed over T periods. The key assumption in the factor model is that each of the individual x_i's can be decomposed into a small number of primitive factors that are common to all the x's and an idiosyncratic component, $e_{i,t}$, that is uncorrelated with the primitive factors:

(1) $$x_{it} = \lambda_i' F_t + e_{it},$$

(2) $$F_t = A(L)F_{t-1} + \varepsilon_t,$$

(3) $$e_{it} = \rho_i(L)e_{it-1} + \upsilon_t,$$

where $F_t = (F_{1t}, \ldots, F_{rt})'$ is a vector containing the q common factors and

$$A(L) = \sum_{j=0}^{P} A_j L^j$$

is a polynomial in the lag operator, L. The time series x_{it} is related to the common factors by a vector of factor loadings, $\lambda_i = (\lambda_{i1}, \ldots, \lambda_{ir})'$. The disturbance term in (1), e_{it}, is the idiosyncratic component of x_{it}, while $\lambda_i' F_t$ is the common component. If the model is static then it is represented by equation (1). Dynamics may be introduced through the common factor component as in equation (2) and/or through the idiosyncratic component as in equation (3). Boivin and Ng (2005) discuss alternative methods that have been developed to estimate the factors and the factor loadings.[4] Then they evaluate the forecasting performance of alternative methods of estimating the dynamic factors. For realistic assumptions about the data, they find that the best forecasting is a simple one that uses the large information set, but does not actually estimate the dynamic factors. We use this method, which involves two steps. The first step is to approximate the factors using the q largest principal components.[5] The second step is to use these principal components in the forecasting model.

Our data matrix has 157 different monthly time series, which begin in January 1983 and end 300 months later in December 2007.[6] In this particular case, the number of observations is larger than the number of cross-section units, although that need not be the case. One of the characteristics of this literature is that the number of primitive shocks is usually estimated to be small. Bai and Ng (2007a) estimate that there are more than two and perhaps as many as seven dynamic factors using the Stock and Watson (2005a) data set. Stock and Watson report a similar result using different methods. We start with a specification that encompasses the range of estimates of the number of factors.

THE FORECASTING MODELS

We evaluate the potential of estimated factors to improve economic forecasts by nesting them within a baseline autoregressive model. We begin with two simple models: a random walk model that predicts future performance at each horizon to be equal to the average performance over the previous 12 months and a univariate regression based on the past 12 months of the relevant variable.

The first model is from Atkeson and Ohanian (2001), who show that a random walk model could predict the year-ahead inflation rate better than the standard Phillips curve model. Stock and Watson (2005b) show that this better performance for the random walk model is particular to the most recent period of stable inflation and that their dynamic factor models (they used one with 157 economic indicators and another with just 61 real variables) could do as well as the random walk model even in the most recent period. Note that we use the past 12-month average inflation

3 For detailed development of these tools, see Forni et al. (2000) and Forni and Lippi (2001).

4 See also Schumacher (2007). Forni et al. (2005) find that using the generalized factor model of Forni et al. (2000) works well in a forecasting comparison with the approach we adopt here.

5 Forni et al. (2000) derive conditions under which the largest principal components converge to the dynamic factors when there is weak correlation between e_{it} and e_{jt} for $i \neq j$.

6 The set of information variables we use is similar to those used by Stock and Watson (2005a) and Bernanke, Boivin, and Eliasz (2005).

rate as the forecast for the future—at all h horizons, 3, 12, and 24 months. Hence, if the inflation rate for the 12 months ending in December 2007 was 4 percent, the random walk forecast for the average annual inflation rate over the following 3, 12, and 24 months would be 4 percent. The Atkeson and Ohanian (AO) model for the h-month-ahead inflation rate is given as

$$(4)\quad {}_{AO}\pi_t^h = \frac{1}{12}\sum_{i=1}^{12}\pi_{t-i} + {}_{AO}u_t^h,\ \text{where } \pi_t^h = \frac{1}{h}\sum_{i=0}^{h-1}\pi_{t+i}$$

and π is the inflation rate as measured by the change in the log of the price index and adjusted to be at an annual rate. The leading subscript AO indicates that this is the forecast and the forecast error for the AO model. The subscript t and superscript h indicate that this is the forecast for the average annual inflation rate for h months beginning in month t.

The autoregressive models (AR) have the same dependent variable as above, but the weights on the 12 lags are estimated.[7] For the h-month-ahead inflation forecast, the AR model is written as

$$(5)\qquad {}_{AR}\pi_t^h = \phi_0 + \sum_{i=1}^{12}\beta_i\pi_{t-i} + {}_{AR}u_t^h.$$

We use the same 12 lags for the various horizons and we do not search across lag length for the best in-sample fit when estimating the parameters of the forecasting model.[8]

The third set of models includes the data-rich models (DRM). They use the largest principal components as estimates of the factors and add them to the AR model in equation (5)[9]:

$$(6)\quad {}_{DRM}\pi_t^h = \phi_0 + \sum_{i=1}^{12}\beta_i\pi_{t-i} + \sum_{j=1}^{q}\sum_{k=1}^{m}PC_{j,t-k} + {}_{DRM}u_t^h.$$

The model adds m lags of the first q estimated factors to the AR model. Based on the findings of Bai and Ng (2007a), we expect to find a relatively small number of primitive factors that will be spanned by a combination of primitive factors and their lags. However, in preliminary work for this study, we found that the best models sometimes had more factors and lags than suggested by tests for the number of primitive factors. Therefore, we run models with q taking values from 1 to 7 and m taking values from 1 to 12. All the principal components enter the equation with the same lag length. Note that equation (6) is similar to the forecasting model used by Stock and Watson (2002).

FORECASTING INFLATION

In this section we report results from forecasting four measures of inflation: the CPI, the chain price index for personal consumption expenditures (PCEPI), and the two versions of these indices that exclude the prices of their food and energy components—that is, the core CPI and the core PCEPI. The CPI is the most common measure of inflation and it is commonly used to escalate wages and government benefits. It is also the concept that has been most commonly used as the policy objective by central banks that target inflation. In November 2007 the Federal Reserve began releasing quarterly projections of both total and core measures of PCEPI inflation. The PCEPI is used to compute real personal consumption expenditures in the national income and product accounts.

For our empirical analysis, we chose to begin in January 1983. Our rationale follows the work of those who find a structural break in many macroeconomic variables beginning around that time period. The structural break has been attributed to improved monetary policy, changes in the way firms manufacture and distribute goods, and good luck.[10] The onset of this structural break is

7 Technically, these are not purely autoregressive models. We could have used an AR model of the 1-month-ahead inflation rate and then iterate over h horizons. However, previous research suggests that forecasting the average over the forecast interval directly as we do here often works better than iterated forecasts in realistic (that is, relatively small) sample sizes.

8 We used 12 lags to take account of seasonal regularities that remain in the data. Hansen (2008) provides theory and evidence to show that using information criteria to choose the best lag length in sample may result in choosing a model that does worst in out-of-sample prediction.

9 See the appendix for a listing of the entire data set and the transformation used to standardize each variable.

10 See, for example, Ahmed, Levin, and Wilson (2004), McConnell and Quiros (2000), or Taylor (1998).

Table 1

Comparing Data-Rich Models of Inflation with Simple Rules: RMSEs in Percent at Annual Rates

	CPI	Core CPI	PCEPI	Core PCE
3-Month				
AO	2.03	0.61	1.54	0.69
AR(12)	1.76	0.62	1.44	0.67
DRM	1.67*	0.59*	1.42	0.67
12-Month				
AO	1.15	0.48	0.84	0.40
AR(12)	0.99	0.49	0.77	0.38
DRM	0.90*	0.43*	0.71*	0.36*
24-Month				
AO	1.00	0.51	0.78	0.39
AR(12)	0.80	0.50	0.69	0.36
DRM	0.63*	0.39*	0.59*	0.33*

NOTE: *Rejects the null hypothesis that the factors do not Granger-cause the forecast variable at the 1 percent critical level.

usually termed the Great Moderation. In this data set we are using data through December 2007. Pseudo out-of-sample forecasts are produced for January 1997 using models that are estimated with the use of current vintage data. The models (and the principal components) are updated each month, producing recursive inflation forecasts with the final forecast period ending in September 2007. The beginning of the estimation period is fixed, so the number of observations used to estimate the forecasting equations grows over time. The dependent variable in each of the regressions is an average over the relevant forecast interval. The regressors enter as monthly variables.

The Results

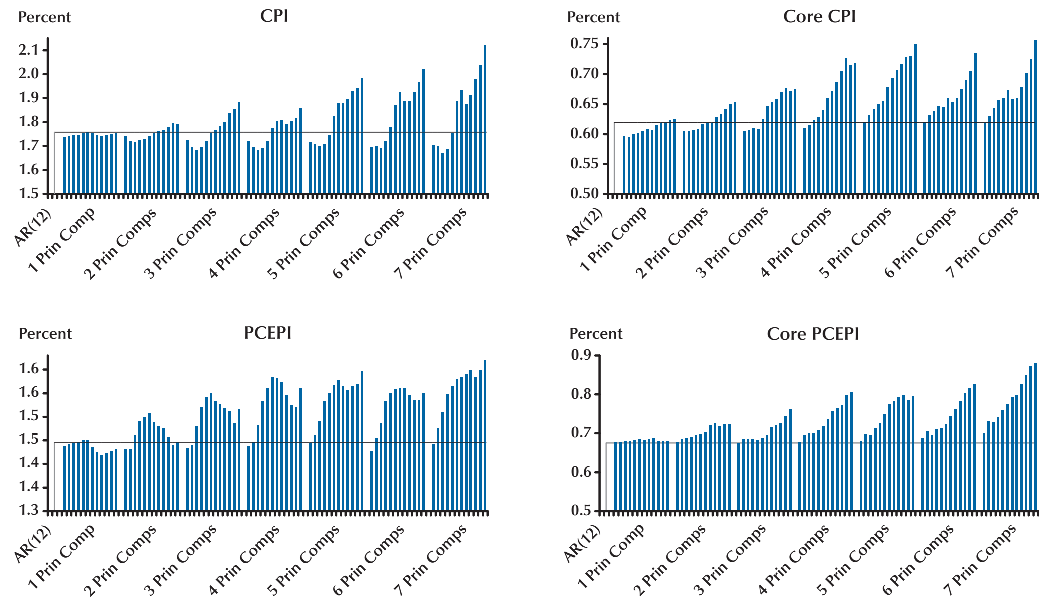
The inflation forecasting results are shown in Table 1 and Figures 2 through 4. The root mean squared errors (RMSEs) for the 3-month forecast horizon are shown in the top panel of Table 1. The first row reports the results for the AO model. This random walk model does a bit better than the AR model only for core CPI; but, even here, the difference is small. The baseline AR model is shown in the second row. The RMSE for the AR is substantially lower than the AO model for the all-item indices. The third row reports the RMSEs for the best DRMs. The inclusion of principal components significantly improves the forecasts for the CPI and its core measure, but it does not help forecast the PCEPI or the core PCEPI.[11]

Figure 2 shows the RMSEs from all the 3-month-ahead inflation forecasts. (In Figures 2 through 7, the RMSE for the benchmark AR(12) is shown by the first bar and a gray horizontal line.) The best DRM for the CPI included three lags of seven principal components, a surprising profligate model with 33 estimated parameters. We also note that the models with 2 or 3 factors and 3 lags did almost as well and might be preferred on the principle of parsimony. That is, as fresh data arrive, one might have more confidence in using the smaller model that is less vulnerable to estimation error. In all the other cases, the best models were smaller, the core CPI and the PCEPI included just one principal component; and the best core PCEPI model included just one lag of

[11] The asterisks in Tables 1 and 2 indicate that we can reject the hypothesis that the principal components do not help forecast at the 1 percent critical level using the McCracken (2007) out-of-sample test statistic.

Figure 2

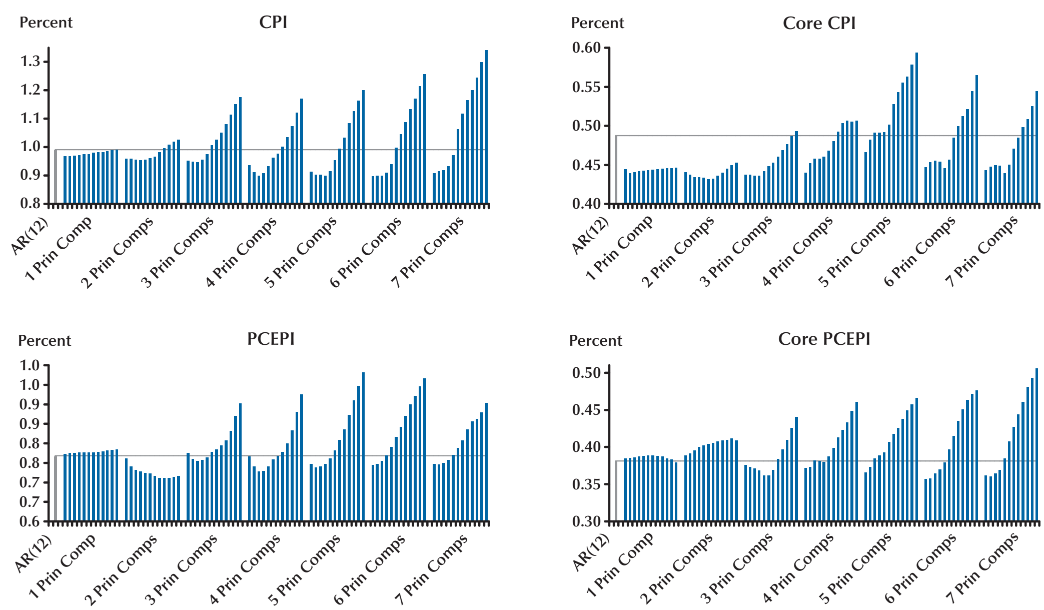
Inflation Forecast Accuracy: RMSEs of 3-Month-Ahead Forecasts



NOTE: Each group of principal components includes RMSEs from models with lags from 1 to 12.

Figure 3

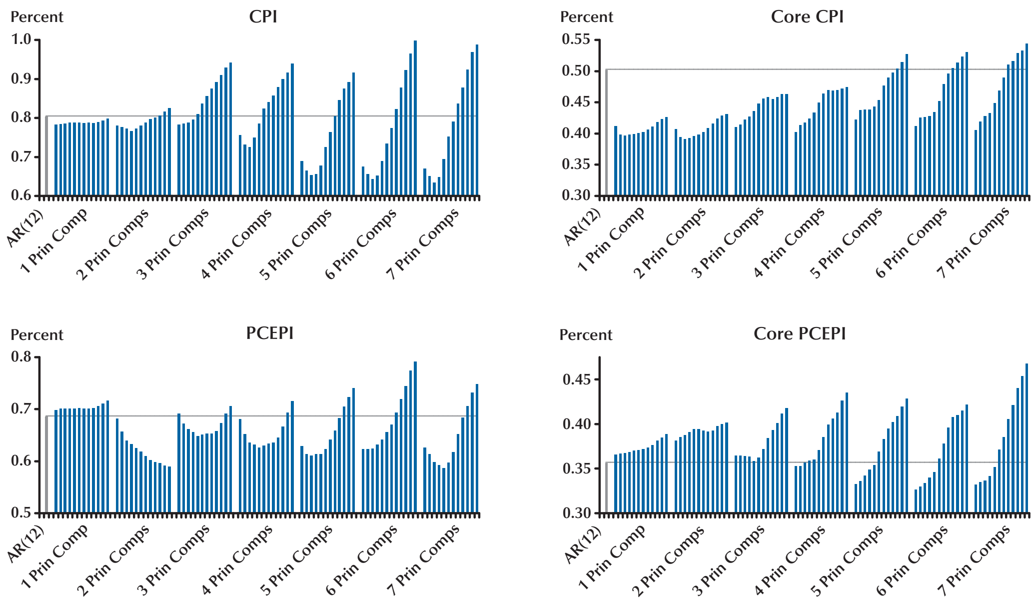
Inflation Forecast Accuracy: RMSEs of 12-Month-Ahead Forecasts



NOTE: Each group of principal components includes RMSEs from models with lags from 1 to 12.

Figure 4

Inflation Forecast Accuracy: RMSEs of 24-Month-Ahead Forecasts



NOTE: Each group of principal components includes RMSEs from models with lags from 1 to 12.

Table 2

Comparing Data-Rich Models of Economic Activity with Simple Rules: RMSEs in Percent at Annual Rates for the Coincident Indicators and Real PCE

	Coincident indicators	PMI	Real PCE	Unemployment rate
3-Month				
AO	1.65	4.21	2.19	0.070
AR(12)	1.56	2.43	2.02	0.068
DRM	1.55	2.32*	2.03	0.062*
12-Month				
AO	1.54	4.94	1.17	0.055
AR(12)	1.37	3.18	0.97	0.046
DRM	1.36	3.14	0.92*	0.040*
24-Month				
AO	1.71	4.86	1.19	0.058
AR(12)	1.34	2.73	0.87	0.040
DRM	1.22*	2.43*	0.61*	0.038*

NOTE: *Rejects the null hypothesis that the factors do not Granger-cause the forecast variable at the 1 percent critical level. PMI is measured as the average level over the forecast horizon. The unemployment rate is measured as the average monthly change over the forecast horizon.

the first three principal components. Figure 2 clearly shows that the DRMs did not contribute much to the 3-month forecasts for the PCEPI or its core measure.

The second panel in Table 1 reports the results for the 12-month-ahead inflation forecasts. Once again the AO model does better than the AR model only in the case of the core CPI. For all the other experiments reported in the paper, the AO model is worse than the AR model, which is usually worse than the model that is supplemented with the principal components. At the 12-month horizon, the information provided by the principal components is statistically significant at the 1 percent level for measures of inflation that we studied. Figure 3 shows that the DRMs do quite well when we extend the model to 12 months. For both measures of CPI inflation, the DRMs with 6 or 7 principal components did well, although the best model for the core CPI included just 2 principal components with 6 lags each. There was less improvement in the PCEPI and core PCEPI, but the improvement was statistically significant.

The bottom panel of Table 1 and Figure 4 report the results for the 24-month-ahead inflation forecasts. The results are similar to those for the 12-month forecasts, but the improvement in the forecasts over the benchmark AR model is larger. The principal components displayed significant information for all measures of inflation.

FORECASTING REAL ACTIVITY

Next, we use these models to forecast four monthly indicators of real economic activity: (i) the index of coincident indicators; (ii) the Purchasing Managers' Index (PMI), which is a diffusion index that measures activity in the manufacturing sector; (iii) real PCE; and (iv) the civilian unemployment rate.[12] The index of coincident indicators and real personal consumption expenditures are measured at annual growth rates, the ISM index is measured in levels, and the unemployment rate is measured as the first difference.

The results of the out-of sample forecasts for the real variables are presented in Table 2. The RMSEs of the random walk models are always the largest relative to the baseline AR and best DRM models. This result is not a surprise to macroeconomists and forecasters, but we report it to remind readers that the relatively good performance of the random walk model in forecasting inflation and asset prices does not carry over into measures of real economic activity. The top panel displays results for the 3-month forecast horizon. The principal components are statistically significant predictors of the PMI and unemployment rate. Figure 5 displays the RMSEs for the specifications of the DRMs of real activity at the 3-month horizon. The best DRM forecast for the PMI included 1 lag of the first 7 principal components. The best DRM forecast of the unemployment rate included just 1 lag of the first principal component, but all of the DRMs with a few lags did well in predicting the unemployment rate. Including the principal components did not help to forecast the index of coincident indicators or real PCE at the 3-month horizon.

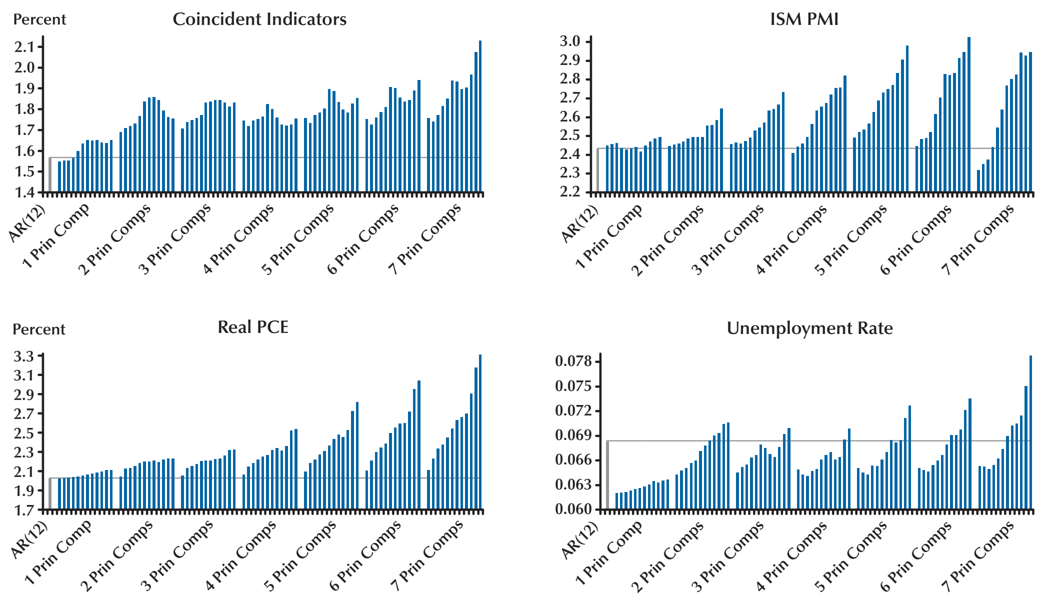
The middle panel of Table 2 reports the results for the 12-month forecast. Figure 6 shows the RMSEs for the specifications of the DRMs of real activity at the 12-month horizon. The best model for the index of coincident indicators has 4 principal components with 9 lags but is no better than the benchmark AR model. The best model for the PMI was the DRM with 4 principal components and 1 lag; but, as with the coincident indicators, the principal components do not significantly improve the forecasts. The improvements in the forecasts of real PCE growth and the unemployment rate are statistically significant. Again, the best DRM of the unemployment rate includes just the first principal components, but now includes all 12 lags rather than just the first.

The bottom panel in Table 2 and Figure 7 report results for the 24-month forecasts of real economic indicators. The best DRM for each of the variables is significantly better than the bench-

[12] The coincident index is published by the Conference Board, and it is composed of (i) nonfarm payroll employment, (ii) industrial production, (iii) real manufacturing and trade sales, and (iv) real personal income less transfer payments. The Purchasing Managers' Index is published by the Institute for Supply Management.

Figure 5

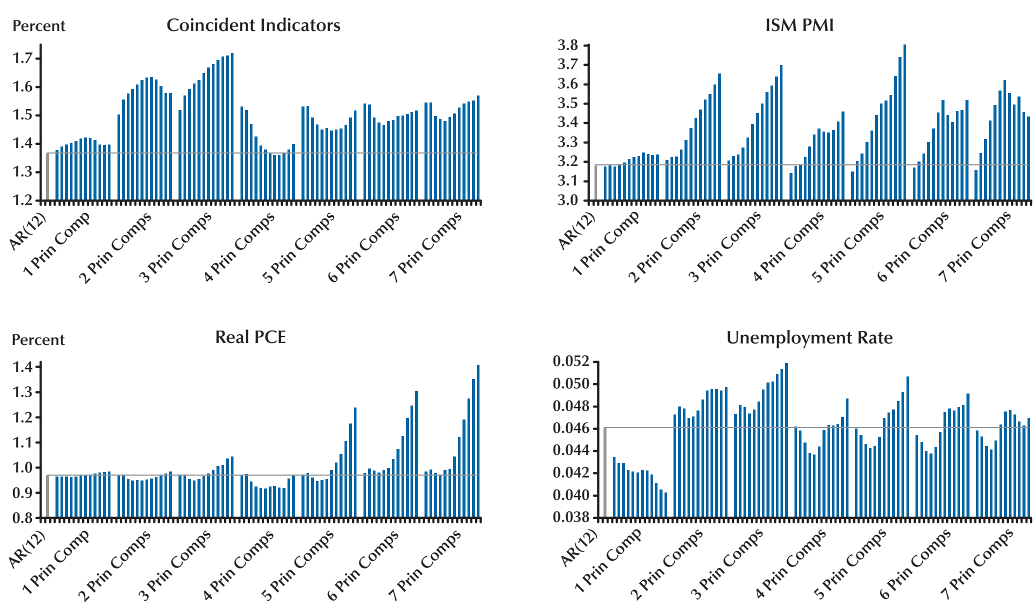
Economic Activity Forecast Accuracy: RMSEs of 3-Month-Ahead Forecasts



NOTE: Each group of principal components includes RMSEs from models with lags from 1 to 12.

Figure 6

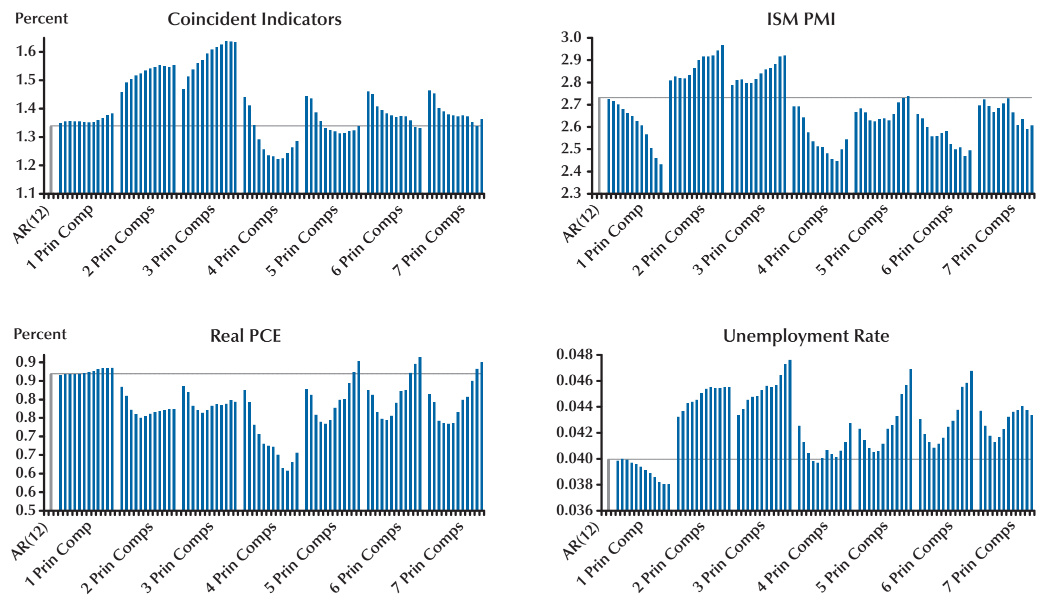
Economic Activity Forecast Accuracy: RMSEs of 12-Month-Ahead Forecasts



NOTE: Each group of principal components includes RMSEs from models with lags from 1 to 12.

Figure 7

Economic Activity Forecast Accuracy: RMSEs of 24-Month-Ahead Forecasts



NOTE: Each group of principal components includes RMSEs from models with lags from 1 to 12.

mark AR model. The pattern in the RMSEs for the index of coincident indicators is similar to the pattern in the 12-month results, but the forecasts are better relative to the benchmark AR model. There is a substantial improvement in the PMI and real PCE forecasts relative to the 12-month results. In both cases, the models with 4 lags and 8 to 10 lags do well. The 24-month unemployment rate models were a bit of an exception in that including more than 1 principal component usually made the DRM model produce a RMSE that was larger than the benchmark AR model. The results for the best out-of-sample forecasting version of equation (6) are summarized in Table 3.

CONCLUSION

In this paper we report the results of a simulated out-of-sample forecasting experiment in which we compared 85 models for each of eight economic indicators over three forecasting horizons (for a total of 2,040 models). The models were estimated over a period beginning in January 1983 and ending 2 months before the beginning of the forecast interval. We made 132 forecasts beginning in January 1997 and ending in December 2007. Generally, we find that the data-rich models can be used to improve forecasts of inflation and output. We found that using principal components to estimate the underlying common factors was useful in forecasting the CPI and its core measure at the 3-month horizon and all measures of inflation at the 12- and 24-month horizons. The factor methods were also helpful in predicting real variables. The data-rich models were useful in predicting the unemployment rate over all horizons and all the real variables over 24-month horizons.

In future research, we intend to apply these results in a real-time forecasting process. In some sense, our discovery of models that are more profligate than suggested by Bai and Ng (2007a) may be the result of data-mining in a specific 10-

Table 3

What's the Best Data-Rich Model

Inflation			Real activity		
	q^*	m		q	m
3-Month-ahead forecasts					
CPI	7	3	Coincident indicators	1	1
Core CPI	1	2	ISM PMI	7	1
PCEPI	1	9	Real PCE	1	1
Core PCEPI	3	1	Unemployment rate	1	1
12-Month-ahead forecasts					
CPI	6	1	Coincident indicators	4	9
Core CPI	2	6	ISM PMI	4	1
PCEPI	2	9	Real PCE	4	6
Core PCEPI	6	1	Unemployment rate	1	12
24-Month-ahead forecasts					
CPI	7	3	Coincident indicators	4	8
Core CPI	2	3	ISM PMI	1	12
PCEPI	7	5	Real PCE	4	10
Core PCEPI	6	1	Unemployment rate	1	12

NOTE: *q is the number of principal components and m is the number of lags in equation (6).

year sample. We are using out-of-sample forecast accuracy as a criterion for choosing which model is "best." We have not, however, applied these results in a recursive real-time forecasting application. We are confident, however, that there is persistence in the relative performance of the preferred specification that may prove useful in such an exercise. In this paper, we used a relatively unrestricted method that did not separately identify the common and idiosyncratic factors. In future research, we plan to identify the common factors and the factor loadings so that we can map the source of the information that improves forecast accuracy. We also plan to investigate the benefits of using procedures recommended in Bai and Ng (2007b) for choosing fewer, but informative predictors. They find that one can improve forecast accuracy by using such procedures for each specific variables at each specific forecasting horizon. We are also interested in using dynamic factor methods in combination with economic theory to identify structural economic shocks. This is an emerging area of research that holds promise for analyzing policy.

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APPENDIX

Data Used in the DFM Analysis, Their Transformation, and Their Source

Description	Transformation	Source
Real Output and Income		
1 IP: Total Index (SA, 2002 = 100)	DLN	FRB
2 IP: Final Products and Nonindustrial Supplies (SA, 2002 = 100)	DLN	FRB
3 IP: Final Products {Mkt Group} (SA, 2002 = 100)	DLN	FRB
4 IP: Consumer Goods (SA, 2002 = 100)	DLN	FRB
5 IP: Durable Consumer Goods (SA, 2002 = 100)	DLN	FRB
6 IP: Nondurable Consumer Goods (SA, 2002 = 100)	DLN	FRB
7 IP: Business Equipment (SA, 2002 = 100)	DLN	FRB
8 IP: Materials (SA, 2002 = 100)	DLN	FRB
9 IP: Durable Materials (SA, 2002 = 100)	DLN	FRB
10 IP: Nondurable Materials (SA, 2002 = 100)	DLN	FRB
11 IP: Manufacturing (SIC) (SA, 2002 = 100)	DLN	FRB
12 IP: Durable Mfg [NAICS] (SA, 2002 = 100)	DLN	FRB
13 IP: Nonindustrial Supplies (SA, 2002 = 100)	DLN	FRB
14 IP: Nondurable Mfg [NAICS] (SA, 2002 = 100)	DLN	FRB
15 Industrial Production: Mining (SA, 2002 = 100)	DLN	FRB
16 IP: Consumer Energy Products: Residential Utilities (SA, 2002 = 100)	DLN	FRB
17 IP: Consumer Energy Products: Fuels (SA, 2002 = 100)	DLN	FRB
18 IP: Electric and Gas Utilities (SA, 2002 = 100)	DLN	FRB
19 IP: Motor Vehicle Assemblies (SAAR, Mil.Units)	DLN	FRB
20 ISM Mfg: Production Index (SA, 50+ = Econ Expand)	LV	ISM
21 Capacity Utilization: Mfg [SIC] (SA, % of Capacity)	DLV	FRB
22 Real Personal Income (SAAR, Bil.Chn.2000$)	DLN	BEA/H

Description	Transformation	Source
23 Real Personal Income Less Transfer Payments (SAAR, Bil.Chn.2000$)	DLN	BEA/H
24 Real Disposable Personal Income (SAAR, Bil.Chn.2000$)	DLN	BEA
Employment and Hours		
25 Index of Help-Wanted Advertising in Newspapers (SA, 1987 = 100)	DLN	CNFBOARD
26 Ratio: Help-Wanted Advertising in Newspapers/Number Unemployed (SA)	DLN	CB/BLS/H
27 Civilian Employment: Sixteen Years & Over (SA, Thous.)	DLN	BLS
28 Civilian Employment: Nonagricultural Industries: 16 yr + (SA, Thous.)	DLN	BLS
29 Civilian Unemployment Rate: 16 yr + (SA, %)	DLV	BLS
30 Civilian Unemployment Rate: Men, 25-54 Years (SA, %)	DLV	BLS
31 Average {Mean} Duration of Unemployment (SA, Weeks)	DLV	BLS
32 Civilians Unemployed for Less Than 5 Weeks (SA, Thous.)	DLN	BLS
33 Civilians Unemployed for 5-14 Weeks (SA, Thous.)	DLN	BLS
34 Civilians Unemployed for 15 Weeks and Over (SA, Thous.)	DLN	BLS
35 Civilians Unemployed for 15-26 Weeks (SA, Thous.)	DLN	BLS
36 Civilians Unemployed for 27 Weeks and Over (SA, Thous.)	DLN	BLS
37 Unemployment Insurance: Initial Claims, State Programs (SA, Thous.)	DLV	DOL
38 All Employees: Total Nonfarm (SA, Thous.)	DLN	BLS
39 All Employees: Total Private Industries (SA, Thous.)	DLN	BLS
40 All Employees: Goods-producing Industries (SA, Thous.)	DLN	BLS
41 All Employees: Mining (SA, Thous.)	DLN	BLS
42 All Employees: Construction (SA, Thous.)	DLN	BLS
43 All Employees: Mfg (SA, Thous.)	DLN	BLS
44 All Employees: Durable Goods Mfg (SA, Thous.)	DLN	BLS
45 All Employees: Nondurable Goods Mfg (SA, Thous.)	DLN	BLS
46 All Employees: Service-providing Industries (SA, Thous.)	DLN	BLS
47 All Employees: Trade, Transportation & Utilities (SA, Thous.)	DLN	BLS
48 All Employees: Wholesale Trade (SA, Thous.)	DLN	BLS
49 All Employees: Retail Trade (SA, Thous.)	DLN	BLS
50 All Employees: Financial Activities (SA, Thous.)	DLN	BLS
51 All Employees: Government (SA, Thous.)	DLN	BLS
52 Aggregate Weekly Hours Index: Total Private Industries (SA, 2002 = 100)	DLN	BLS
53 Average Weekly Hours: Goods-producing Industries (SA, Hrs)	LV	BLS
54 Average Weekly Hours: Overtime: Mfg (SA, Hrs)	DLV	BLS
55 Average Weekly Hours: Mfg (SA, Hrs)	DLV	BLS
56 ISM Mfg: Employment Index (SA, 50+ = Econ Expand)	LV	ISM
Real Retail, Manufacturing, and Trade Sales		
57 Mfg & Trade Sales (SA, Mil.Chn.2000$)	DLN	CNFBOARD
58 Mfg & Trade Inventories (EOP, SA, Bil.Chn.2000$)	DLN	CNFBOARD
59 Mfg & Trade: Inventories/Sales Ratio (SA, Chn.2000$)	DLN	CNFBOARD
60 Mfrs Shipments of Mobile Homes (SAAR, Thous.Units)	LN	CENSUS
61 Real Retail Sales & Food Services	DLN	AUTHORS
Inventories and Orders		
62 ISM Mfg: Inventories Index (SA, 50+ = Econ Expand)	LV	ISM

Description	Transformation	Source
63 ISM Mfg: New Orders Index (SA, 50+ = Econ Expand)	LV	ISM
64 Mfrs New Orders: Durable Goods (SA, Mil.Chn.2000$)	DLN	CNFBOARD
65 Mfrs New Orders: Nondefense Capital Goods (SA, Mil.1982$)	DLN	CNFBOARD
66 Mfrs Unfilled Orders: Durable Goods (SA, EOP, Mil.Chn.2000$)	DLN	CNFBOARD
Consumption		
67 Real Personal Consumption Expenditures: Durable Goods (SAAR, Bil.Chn.2000$)	DLN	BEA
68 Real Personal Consumption Expenditures: Nondurable Goods (SAAR, Bil.Chn.2000$)	DLN	BEA
69 Real Personal Consumption Expenditures: Services (SAAR, Bil.Chn.2000$)	DLN	BEA
70 Real Personal Consumption Expenditures (SAAR, Bil.Chn.2000$)	DLN	BEA
Housing Starts and Sales		
71 Housing Starts (SAAR, Thous.Units)	LN	CENSUS
72 Housing Starts: Northeast (SAAR, Thous.Units)	LN	CENSUS
73 Housing Starts: Midwest (SAAR, Thous.Units)	LN	CENSUS
74 Housing Starts: South (SAAR, Thous.Units)	LN	CENSUS
75 Housing Starts: West (SAAR, Thous.Units)	LN	CENSUS
76 New Pvt Housing Units Authorized by Building Permit (SAAR, Thous.Units)	LN	CENSUS
77 Housing Units Authorized by Permit: Northeast (SAAR, Thous.Units)	LN	CENSUS
78 Housing Units Authorized by Permit: Midwest (SAAR, Thous.Units)	LN	CENSUS
79 Housing Units Authorized by Permit: South (SAAR, Thous.Units)	LN	CENSUS
80 Housing Units Authorized by Permit: West (SAAR, Thous.Units)	LN	CENSUS
81 Total Public Construction (SAAR, Mil.Chn.1996$)	DLN	AUTHORS
82 Private Construction: Nonresidential (SAAR, Mil.Chan.1996$)	DLN	AUTHORS
Stock Prices		
83 Stock Price Index: S&P 500 Composite (1941-43 = 10)	DLN	WSJ
84 Stock Price Index: S&P 500 Industrials (1941-43 = 10)	DLN	FINTIMES
85 S&P 500 Composite, Dividend Yield (%)	DLV	S&P/H
86 S&P 500 Composite, P/E Ratio, 4-Qtr Trailing Earnings (Ratio)	DLN	S&P/H
87 Stock Price Index: NASDAQ Composite (Feb-5-71 = 100)	DLN	WSJ
Exchange Rates		
88 Nominal Broad Trade-Weighted Exchange Value of the US$ (Jan-97 = 100)	DLN	FRB
89 Real Broad Trade-Weighted Exchange Value of the US$ (Mar-73 = 100)	DLN	FRB
90 Foreign Exchange Rate: Switzerland (Franc/US$)	DLN	FRB
91 Foreign Exchange Rate: Japan (Yen/US$)	DLN	FRB
92 Foreign Exchange Rate: United Kingdom (US$/Pound)	DLN	FRB
93 Foreign Exchange Rate: Canada (C$/US$)	DLN	FRB
Interest Rates		
94 Federal Funds [effective] Rate (% per annum)	DLV	FRB
95 3-Month Nonfinancial Commercial Paper (% p.a.)	DLV	FRB
96 3-Month Treasury Bills, Secondary Market (% p.a.)	DLV	FRB
97 6-Month Treasury Bills, Secondary Market (% p.a.)	DLV	FRB
98 1-Year Treasury Bill Yield at Constant Maturity (% p.a.)	DLV	FRB
99 5-Year Treasury Note Yield at Constant Maturity (% p.a.)	DLV	FRB
100 10-Year Treasury Note Yield at Constant Maturity (% p.a.)	DLV	FRB

Description	Transformation	Source
101 Moody's Seasoned Aaa Corporate Bond Yield (% p.a.)	DLV	FRB
102 Moody's Seasoned Baa Corporate Bond Yield (% p.a.)	DLV	FRB
Yield Spreads		
Eight Series Listed Below Minus the Federal Funds Rate		
103 3-Month Nonfinancial Commercial Paper (% per annum)	LV	FRB
104 3-Month Treasury Bills, Secondary Market (% p.a.)	LV	FRB
105 6-Month Treasury Bills, Secondary Market (% p.a.)	LV	FRB
106 1-Year Treasury Bill Yield at Constant Maturity (% p.a.)	LV	FRB
107 5-Year Treasury Note Yield at Constant Maturity (% p.a.)	LV	FRB
108 10-Year Treasury Note Yield at Constant Maturity (% p.a.)	LV	FRB
109 Moody's Seasoned Aaa Corporate Bond Yield (% p.a.)	LV	FRB
110 Moody's Seasoned Baa Corporate Bond Yield (% p.a.)	LV	FRB
Money and Credit Quantity Aggregates		
111 Money Stock: M1 (SA, Bil.$)	DLN	FRB
112 Money Stock: M2 (SA, Bil.$)	DLN	FRB
113 Money Stock: Institutional Money Funds (SA, Bil.$)	DLN	FRB
114 Real Money Stock: M2 (SA, Bil.Chn.2000$)	DLN	FRB/BEA/H
St. Louis Adjusted Monetary Base		
115 Adj Monetary Base incl. Deposits to Satisfy Clearing Bal Contracts (SA, Bil.$)	DLN	FRBSTL
116 Adjusted Reserves of Depository Institutions (SA, Mil.$)	DLN	FRB
117 Adjusted Nonborrowed Reserves of Depository Institutions (SA, Mil.$)	DLN	FRB
118 Real Commercial and Industrial Loans Outstanding (SA, Mil.Chn.2000$)	DLN	FRB/BEA/H
119 C&I Loans in Bank Credit: All Commercial Banks (SA, Bil.$)	DLN	FRB
120 Consumer Revolving Credit Outstanding (EOP, SA, Bil.$)	DLN	FRB
121 Nonrevolving Consumer Credit Outstanding (EOP, SA, Bil.$)	DLN	FRB
122 Ratio: Consumer Installment Credit to Personal Income (SA, %)	DLV	FRB/BEA/H
Price Indices and Wages		
123 PPI: Finished Goods (SA, 1982 = 100)	DLN	BLS
124 PPI: Finished Consumer Goods (SA, 1982 = 100)	DLN	BLS
125 PPI: Finished Goods: Capital Equipment (SA, 1982 = 100)	DLN	BLS
126 PPI: Intermediate Materials, Supplies and Components (SA, 1982 = 100)	DLN	BLS
127 PPI: Crude Materials for Further Processing (SA, 1982 = 100)	DLN	BLS
128 PPI: Fuels and Related Products and Power (NSA, 1982 = 100)	DLN	BLS
129 PPI: Industrial Commodities Less Fuels & Power (NSA, 1982 = 100)	DLN	BLS
130 Reuters/Jefferies CRB Futures Price Index: All Commodities (1967 = 100)	DLN	CRB
131 CPI-U: All Items (SA, 1982-84 = 100)	DLN	BLS
132 CPI-U: Apparel (SA, 1982-84 = 100)	DLN	BLS
133 CPI-U: Transportation (SA, 1982-84 = 100)	DLN	BLS
134 CPI-U: Medical Care (SA, 1982-84 = 100)	DLN	BLS
135 CPI-U: Housing (SA, 1982-84 = 100)	DLN	BLS
136 FRB Cleveland Median CPI (SAAR, %chg)	LV	FRBCLV
137 CPI-U: Commodities (SA, 1982-84 = 100)	DLN	BLS
138 CPI-U: Durables (SA, 1982-84 = 100)	DLN	BLS

Description	Transformation	Source
139 CPI-U: Services (SA, 1982-84 = 100)	DLN	BLS
140 CPI-U: All Items Less Food and Energy (SA, 1982-84 = 100)	DLN	BLS
141 CPI-U: All Items Less Food (SA, 1982-84 = 100)	DLN	BLS
142 CPI-U: All Items Less Shelter (SA, 1982-84 = 100)	DLN	BLS
143 CPI-U: All Items Less Medical Care (SA, 1982-84 = 100)	DLN	BLS
144 PCE: Chain Price Index (SA, 2000 = 100)	DLN	BEA
145 PCE: Durable Goods: Chain Price Index (SA, 2000 = 100)	DLN	BEA
146 PCE: Nondurable Goods: Chain Price Index (SA, 2000 = 100)	DLN	BEA
147 PCE: Services: Chain Price Index (SA, 2000 = 100)	DLN	BEA
148 PCE less Food & Energy: Chain Price Index (SA, 2000 = 100)	DLN	BEA
149 Avg Hourly Earnings: Goods-producing Industries (SA, $/Hr)	DLN	BLS
150 Avg Hourly Earnings: Construction (SA, $/Hr)	DLN	BLS
151 Avg Hourly Earnings: Mfg (SA, $/Hr)	DLN	BLS
152 New 1-Family Houses: Median Sales Price ($)	DLN	CENSUS
153 NAR Median Sales Price: Existing 1-Family Homes, United States ($)	DLN	REALTOR
Miscellaneous		
154 ISM Mfg: Supplier Deliveries Index (SA, 50+ = Slowe)	LV	ISM
155 University of Michigan: Inflation Expectations	LV	UMICH/FRED
156 University of Michigan: Consumer Expectations (NSA, Q1-66 = 100)	DLV	UMICH
157 ISM Mfg: PMI Composite Index (SA, 50+ = Econ Expand)	LV	ISM

NOTE:

Nomenclature: By Transformation

DLN: Change in logs, annualized

DLV: Change in levels

LV: Levels

Nomenclature: By Data Source

AUTHORS: Calculation by authors

BEA: Bureau of Economic Analysis

BLS: Bureau of Labor Statistics

CENSUS: U.S. Department of the Census

CB/CNFBOARD: The Conference Board

CRB: Commodity Research Bureau

DOL: Department of Labor

FINTIMES: *Financial Times*

FRB: Board of Governors of the Federal Reserve System

FRBCLV: Federal Reserve Bank of Cleveland

FRBSTL: Federal Reserve Bank of St. Louis

FRED: Federal Reserve Economic Data, Federal Reserve Bank of St. Louis

H: Haver Analytics

IP: Industrial Production

ISM: Institute for Supply Management

REALTOR: National Association of Realtors

S&P: Standard & Poor’s

UMICH: University of Michigan Survey Research Center

WSJ: *The Wall Street Journal*

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