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Data Dependence

William Poole

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I am very pleased to participate in the Annual Outlook Conference here at Middle Tennessee State University. However, perhaps strangely, I'll not say much about the outlook. Others are better qualified than I to discuss that subject. My topic is how the Fed adjusts policy when the economy departs from the central tendency outlook. Of course, forecasters commonly have somewhat different views, but each forecaster's central tendency, or baseline, forecast provides his or her best guess as to how the economy will evolve. However, forecasters also need to be able to say something about probabilities of other outcomes. The probability distribution of possible outcomes is substantially affected by policy responses to deviations from the baseline outlook if and when those deviations occur. And, although I say "if and when," everyone in the forecasting business knows that our knowledge of forecast errors requires that we put much more weight on the "when" than the "if."

The views I express here are mine and do not necessarily reflect official positions of the Federal Reserve System. I thank my colleagues at the Federal Reserve Bank of St. Louis for their comments. Bill Gavin, vice president in the Research Division, provided special assistance.

Let me also note at the outset that this speech is something of a companion to another speech I gave recently, "Understanding the Fed," which was published in the St. Louis Fed's *Review* and is available on our web site.[1]

SOME BACKGROUND

More than three years ago now, in June 2003, the Federal Open Market Committee (FOMC) set its federal funds rate target at a 40-year low of 1 percent, completing, as it turned out, a series of reductions from a rate of 6½ percent in 2000. The policy statement accompanying the change in the policy target concluded with a concern about an "unwelcome substantial fall in inflation." The decline in the inflation rate was only one of a string of surprises to which the FOMC reacted as it brought its target rate down. The most shocking of the surprises, of course, was the terrorist attack on the United States on September 11, 2001. It would be time consuming, but not difficult, to recount this history, pointing to the data releases and events that led the FOMC to reduce its target rate between early 2001 and June 2003; such an account would provide a clear illustration of what is meant by "data dependence."

[1] William Poole "Understanding the Fed," Federal Reserve Bank of St. Louis *Review*, January/February 2007, *89*(1), pp. 3-13; http://research.stlouisfed.org/publications/review/past/2007/.

William Poole is the president of the Federal Reserve Bank of St. Louis. The author appreciates comments provided by colleagues at the Federal Reserve Bank of St. Louis. William T. Gavin, vice president in the Research Division, provided special assistance. The views expressed are the author's and do not necessarily reflect official positions of the Federal Reserve System.

The roughly two-year period after June 2003 was quite different in the sense that monetary policy does not appear to have been very data dependent. Following its meeting on August 12, 2003, the FOMC issued a statement that said, among other things, that "the Committee believes that policy accommodation can be maintained for a considerable period." The funds rate target remained at 1 percent for a full year. The era of a 1 percent target ended when the FOMC raised the target to 1¼ percent on June 30, 2004, a policy adjustment the FOMC had signaled at its previous meeting in May. By then, as the economy's recovery continued, there was no doubt that the FOMC would have to raise its policy target by a substantial amount to support its long-term inflation objective.

In each of the next 16 consecutive meetings, the FOMC voted to raise the target for the federal funds rate by 25 basis points, finally pausing at 5¼ percent in August of 2006. It appeared to some that policy was on autopilot, as the FOMC raised the target by 25 basis points meeting after meeting, apparently independent of incoming information. That view, I believe, was mistaken. When the FOMC began the series of rate increases, in June 2004, the statement included this sentence: "Nonetheless, the Committee will respond to changes in economic prospects as needed to fulfill its obligation to maintain price stability." Similar language has appeared in every statement since, and the minutes of the meetings have emphasized the same point. What happened over the 18 months after June 2004 was, basically, that incoming data indicated that the economy was so close to the track expected earlier that there was no reason to depart from the "measured pace" of rate increases of 25 basis points at every meeting.

My purpose today is to discuss in a systematic fashion the dependence of policy on new information. I can give you a feel, though not a formula, for why policy decisions are sometimes more data dependent than at other times. When the target rate was at 1 percent, or only modestly above, it was clear that rates had to rise, but a sufficiently large surprise would have led the FOMC to stop, slow, or accelerate the increase. In the event, data surprises were minimal and the FOMC raised the target by 25 basis points 17 times in a row. Increasingly, though, as the FOMC raised the target funds rate, policymakers became more sensitive to the possibility that data surprises could alter the policy course. As it turned out, the decision to stop raising rates was determined, in my mind, less by data surprises than by the economy's slowing more or less as had been expected many months before. The August FOMC meeting turned out to be a good time to pause to take stock of where the economy stood and the likely course of events going forward. Whether the August decision to hold the target funds rate unchanged will turn out to be a pause in the process of raising rates, a longer-lasting stop, or even the peak, will depend on the economy's evolution in coming months.

THE MODEL

To operate monetary policy effectively and to understand how policy actions affect the economy, the Federal Reserve relies heavily on economic theory developed over the span of many decades. The theoretical framework is complicated in its technical form and implementation but quite straightforward in its bare-bones abstract framework. The real economy evolves along a trend that is buffeted by a variety of economic shocks. Inflation evolves along a trend that is determined by monetary policy and also buffeted by these same economic shocks. Although these shocks drive the business cycle and make the near-term uncertain, expectations about longer-term trends in both real output growth and inflation have become quite stable.

Long-run output growth has almost always been fairly predictable because its trend is determined by the trends in the growth of real factors such as the labor force, the capital stock, and the level of technology in science, industry, and management. These trends evolve slowly; since World War II, real growth has fluctuated around a 3½ percent average and forecasts of future growth tend to be centered on that number or perhaps somewhat lower because labor force growth is slowing as baby boomers retire.

Inflation, on the other hand, has not always been so predictable. Before 1987, there were wide swings in the inflation trend and, unlike the case for real gross domestic product (GDP), long-horizon forecasts of inflation were actually more uncertain than short-horizon forecasts.[2] Today, after a quarter century of effort by the Fed to actively contain inflation, inflation has also become more predictable over all horizons; and forecasts over longer horizons are now much more accurate than those over shorter horizons.[3] Evidence that long-term inflation has become more predictable is important, because it means that the Fed has found a way to anchor the inflation trend.

Thus, our basic model is of an economy in which both real growth and the inflation rate are buffeted by economic shocks in the short run but then tend to return to predictable long-term trends. The fluctuations of both output and inflation around trends have moderated a great deal over the past 25 years, partly and importantly because of better monetary policy. This better policy is due to the Fed concentrating on its objective for long-run price stability through a more systematic reaction to incoming information about the economic shocks.

At one time, many economists believed that there was an inherent tension between stabilizing inflation and stabilizing the real economy. Over the past 25 years, we have learned that a condition for stabilizing the real economy is stabilizing long-run inflation expectations. Thus, one of the most important things to understand about the dependence of monetary policy actions on arriving information is that the Federal Reserve has a deep commitment to achieving a long-run outcome for inflation that is in accord with its price stability objective. Put another way, short-run policy is strongly motivated by long-run considerations.

MONETARY POLICY

A fundamental component of monetary policy is the decision about the long-run policy objective for inflation. This aspect of policy should not be data dependent. It is possible that an advance in economic knowledge will teach that we should have a different long-run inflation objective. No such advance is on the horizon; but even if it were, it would not be an exception to the rule that the policy objective should be independent of incoming information about the current state of the economy. The policy objective determines the long-run inflation trend in our model and, more importantly, the nominal anchor for the economy.

The reaction of policy to incoming news depends on the state of the economy relative to the trends. The private sector needs to know the Federal Reserve's inflation objective so that it knows how to view fluctuations around the trend. Recently, several individual FOMC members have characterized the long-run inflation goal as a "comfort zone of 1-2 percent inflation" as measured by inflation in the chain price index for personal consumption expenditures. Although the FOMC itself has not adopted a formal, quantitative inflation objective, several members, including me, have said that they believe that greater clarity about the long-run objective would help both the Committee and the markets to make more informed decisions.

It is much easier to agree on a long-run inflation objective than on short-run policy actions consistent with the objective. There is agreement on two conflicting principles. First, it is all too easy to overreact to short-run developments. Agreement on that principle is reflected in the FOMC's emphasis on core inflation—inflation measures excluding volatile food and energy prices—as a guide to short-run policy. Moreover, above-trend inflation may be acceptable under some circumstances, provided we are confident that past policy actions have been sufficient to slow inflation in the future. Nevertheless, there is also agreement on a second principle: It is all too easy to allow wishful thinking on inflation to delay necessary tough policy decisions. The FOMC does its best to make the right choices

[2] See Stephen K. McNees, "How Accurate Are Macroeconomic Forecasts?" Federal Reserve Bank of Boston *New England Economic Review*, July/August 1988, pp. 15-36.

[3] See evidence on forecast errors over 3-, 12-, and 24-month intervals from 1997 through 2006 in William T. Gavin and Kevin L. Kliesen, "Forecasting Inflation and Output: Comparing Data-Rich Models with Simple Rules," Federal Reserve Bank of St. Louis Working Paper 2006-054A, September 2006.

when, as is often the case, "all too easy to overreact" collides with "all too easy to allow wishful thinking on inflation."

In one sense, long-run policy is the accumulation of individual short-run policy decisions. However, if individual decisions reflect only reactions to short-run developments in the economy, then there is no telling where long-run policy will go. The right way for the Fed to think about short-run policy decisions is that they have to be part of, or fit into, a coherent long-term plan. The market's understanding of this plan is central to the determination of long-term interest rates. In general, the rate on any bond depends on expected short rates over the horizon of the bond. Thus, the 10-year Treasury bond rate depends on expectations of short-term interest rates over the 10-year horizon.

Market expectations about future interest rates depend on the interaction of two interrelated sources of influence. One, obviously, concerns Federal Reserve decisions on the intended federal funds rate. Also important are expectations as to the demands for and supplies of funds in the private market. For example, with simultaneous investment and housing booms, credit demands will be high and interest rates will tend to be bid up. In pursuing its policy goals, the FOMC will be adjusting the federal funds rate as needed to keep the inflation rate low and stable. Thus, the market forms expectations about the underlying state of the economy that will bear on Fed decisions.

The Federal Reserve is constantly evaluating the situation in the markets and trying to adjust the intended federal funds rate to produce a satisfactory equilibrium in the economy. When we put the Federal Reserve's and the market's decisions and expectations together, we have a macroeconomic equilibrium.

The interaction between the Federal Reserve and the markets may be confusing at first sight, and indeed was confusing to economists for generations until conceptual breakthroughs in the 1960s and 1970s clarified the issue. Market behavior depends on expectations as to what the Federal Reserve is going to do, and what the Federal Reserve is going to do depends on what the market and the economy are anticipated to do. The full rational expectations macroeconomic equilibrium occurs when the market behaves as the Federal Reserve expects and the Federal Reserve behaves as the market expects. In both cases we assume that the expectations are fully rational, by which we mean that the expectations are fully informed on the basis of all available information. The abstraction of a full rational expectations macroeconomic equilibrium provides a powerful starting point for analysis of a data-dependent policy.

CAN THE MARKET PREDICT DATA DEPENDENCE?

The "Taylor rule" is a stylized view of the Fed's reaction to incoming information. In 1993, Stanford economist John Taylor proposed a simple formula relating the federal funds rate to (i) a long-run inflation target and (ii) short-run deviations of inflation from that target and short-run deviations of real GDP from a measure of "potential real GDP."[4] Taylor suggested that his simple relationship characterized in broad outline the actual behavior of the federal funds rate in the early years of the Greenspan FOMC. The essence of this relationship is that in the long-run the FOMC seeks to keep the federal funds rate roughly consistent with a level that is believed to produce a target level of inflation. Taylor assumed a target rate of inflation of 2 percent per year measured by the total consumer price index (CPI). In the short run, the relationship implies that the FOMC adjusts the target federal funds rate up as either the observed inflation rate exceeds its target or real GDP exceeds potential real GDP. Conversely, under the Taylor rule, the FOMC reduces the target federal funds rate when inflation falls below its target and/or real GDP falls short of potential real GDP.

The Taylor rule reflects the primacy of a long-run inflation objective while incorporating short-

[4] John B. Taylor, "Discretion versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy*, 39, December 1993, pp. 195-214. Taylor compared the values of his formula against the observed history of the funds rate from 1987 through 1992.

run stabilization efforts. The rule provides a formula for computing a baseline, or reference, interest rate that is consistent with policy achieving the Fed's objectives for both output stabilization and price stability. I discussed the Taylor rule in some detail in the speech I mentioned earlier, "Understanding the Fed," and refer you to its published version in this *Review* if you want to dig into the subject more deeply.

Now I'll turn to some comments on future Fed policy, but I want to remind you that I am speaking for myself—other FOMC participants may have different views about how future policy adjustments will depend on arriving information. All economic indicators may have implications for the evolution of the real economy and inflation. I emphasize "may" because we have to filter out as best we can possible data errors and inconsistencies across various indicators.

Before I discuss future Fed policy in any detail, I begin with a warning. New information drives both market adjustments and policy changes, but new information is inherently unpredictable. To gain a sense of the impact of new information on interest rates, I've analyzed data from the eurodollar futures market and discussed the results in some detail in "Understanding the Fed." The bottom line of that analysis is that forecasts embedded in the eurodollar futures market explain 42 percent of the variance of fluctuations in the actual eurodollar yield three months ahead. Thus, unpredictable events even over a three-month horizon are responsible for 58 percent of the variance of the eurodollar yield. Over a six-month horizon, unpredictable events are responsible for more than 70 percent of the variance. Thus, I can discuss various scenarios but have no way of knowing which scenario will come to pass.

Let's start with the outlook for the rest of 2006. Forecasts made by FOMC members and transmitted to Congress in July were 3¼ to 3½ percent growth for real GDP and an increase for the core personal consumption expenditures (PCE) chain price index of 2¼ to 2½ percent. As for 2007, the central tendency of the FOMC members' GDP forecasts is 3 to 3½ percent. This growth outlook should be consistent with keeping the economy close to full employment, based on the Congressional Budget Office forecast of potential GDP growth of 3.24 percent in 2007. As for inflation, the central tendency forecast of FOMC participants for 2007 is 2 to 2¼ percent. Thus, inflation is expected to recede only very slowly from its current level.

There are two cases in which the economic news will pretty clearly predict a change in the Fed's policy stance. If incoming economic indicators show that both output and inflation are rising above these forecasts, then, in the absence of any other information, we can expect that the FOMC will increase its target federal funds rate. On the other hand, if both output and inflation come in weaker than expected, we are unlikely to see further increases in the federal funds target; indeed, if economic weakness is pervasive enough, the FOMC will at some point reduce the target funds rate.

The most interesting—not to mention controversial and difficult—cases are those in which the outlook for inflation and output move in opposite directions. In such cases, the FOMC has to call on all its experience and judgment to reach a decision. It is very difficult for me to be precise about the judgments I am likely to reach based on incoming information because a host of considerations, some of which I cannot foresee, may enter the calculus. But I'll make a stab at how things could play out to illustrate my thought process.

A critically important consideration in my mind concerns the inflation process and the importance of the Fed's commitment to low and stable inflation. It is my conviction that temporizing on actions to control inflation is an invitation to trouble. Accepting higher inflation, or even a continuation of the current rate of inflation, in an effort to sustain current employment levels will only lead to more grief later. Once inflation and inflation expectations rise, the economy will become less stable and reducing inflation from an elevated rate will be more costly than taking the medicine now. Having said that, if inflation pressures are easing, even if only gradually, and there is a genuine prospect that inflation will return to the comfort zone, then I see no reason to accelerate the decline in inflation by maintain-

ing a restrictive policy in the face of declining employment. Policy needs to be as disciplined as necessary to get the job done, but not more so.

The long-run inflation goal and the attitude I've expressed about what risks to take suggest that I will have a bias in the way I interpret incoming information. If data on the real economy come in weaker than expected—if it appears that the economy is falling below the baseline forecast path—then my bias will be in the direction of wanting to be sure that the data paint a consistent picture before I'll advocate a policy easing. But if the picture *is* consistent, and inflation risk *is* receding, then I'll not hesitate to advocate policy easing.

What I hope the FOMC can accomplish is to retain full market confidence that the long-run rate of inflation will remain in the comfort zone. I hope that forecasters assign very low probability to inflation outcomes over the medium term of 3 to 5 years outside the comfort zone no matter what the incoming data look like. Although I am talking about inflation over a horizon well beyond the usual forecast horizon of 1 to 2 years, the long-run inflation outlook has a direct bearing on the forecast. The long bond rate today depends critically on expected inflation over the maturity of the bond. Thus, rates that enter importantly into any economic forecast, such as mortgage and corporate bond rates, depend on the long-run inflation outlook. This outlook has been quite stable in recent years, and that fact is evidence of a major monetary policy success.

With long-run inflation contained, the FOMC has flexibility to respond, vigorously if necessary, to economic weakness should it arise. The FOMC brought the target federal funds rate down aggressively in 2001 in response to incoming information. Aggressive easing kept the recession mild. If the economy comes in below the baseline forecast in coming quarters, the FOMC will have room to act as aggressively as required. I have no idea what scale of easing might be appropriate, for that will depend on the nature of the incoming information. Still, I believe forecasters should assign a relatively low probability to deep recession precisely because of the FOMC's demonstrated willingness to act aggressively as necessary.

I've given you my take on what data dependence means and the attitudes that underlie my likely responses. I've also emphasized that an efficient rational expectations equilibrium requires that the market behave as the policymakers expect and policymakers behave as the market expects. The market's evaluation of the prospects for policy is revealed in the futures markets for federal funds and eurodollar deposits. Current futures prices predict that the federal funds target is expected to begin moving down. Because these market quotes change day by day in response to new information, I do not want to attempt to be particularly precise as to the timing—anything I write as I draft these remarks may be out of date by the time I deliver them or within a few weeks, anyway. What I can safely note is that the market's expectation of future policy easing has been taking hold gradually since late June, say, in response to data on the real economy suggesting that real growth is slowing and inflation data suggesting that the worst may be over on that front.

Although expectations about future policy actions are revealed transparently in the futures market for short-term interest rates, I want to underscore my earlier point about the limited accuracy of those forecasts. Some of the forecast misses have been pretty dramatic. For example, in December 2000, the futures market forecasts were for a decline in the eurodollar yield of 35 basis points over the following three months and a total of 67 basis points over the six-month period. Instead, the FOMC acted aggressively to lower the funds rate target starting in January and continuing through May 2001 by a total of 250 basis points. The FOMC acted aggressively as incoming information pointed to growing weakness in economic activity. Both the FOMC and the markets were surprised by incoming information indicating that the economy was weakening quickly and significantly.

Although I cannot predict unpredictable new information, I've tried to provide a sense of how I might respond to new information as it arrives. I note, however, that it is rare that a single data report is decisive. The economic outlook is determined by numerous pieces of information. Important data such as the inflation and the employment

reports are cross-checked against other information. The FOMC is aware of the possibility of data revisions and short-run anomalies. Sometimes data ought to be discounted because of anomalous behavior.

An example was the increase in tobacco prices in late 1998. Tobacco prices had a transitory impact on measured inflation, both total and core indices, during December 1998 and January 1999, but produced no lasting effect on trend inflation. Similarly, information about real activity sometimes arrives that indicates transitory shocks to aggregate output and employment. An example of such a transitory shock is the strike against General Motors in June and July 1998. Similarly, the September 2005 employment report reflected the impact of Hurricane Katrina, which was expected to be, and turned out to be, temporary from a national perspective.

Transitory and anomalous shocks to the data are ordinarily rather easy to identify. Both Fed and market economists develop estimates of these aberrations in the data shortly after they occur. The principle of looking through aberrations is easy to state but probably impossible to formalize with any precision. We know these shocks when we see them, but could never construct a completely comprehensive list of such shocks ex ante.

Policymakers piece together a picture of the economy from a variety of data, including anecdotal observations. When the various observations fit together to provide a coherent picture, the Fed can adjust the intended rate with some confidence. The market generally understands this process, as it draws similar conclusions from the same data.

So, given policy objectives, and given a view about how policy decisions affect the economy, the central bank can in principle specify a policy rule, or response function, that guides policy adjustments in response to incoming information. To achieve a good result, the general public and market participants need to understand the objectives and the response function so that the private economy can determine its activities with full knowledge of how the central bank will act. Of course, uncertainty is an inherent characteristic of the economic world. What should be predictable are the central bank's responses to the never-ending sequence of surprises that characterize the economic environment.

Market commentary often indicates frustration that the FOMC does not lay out a clearer path for policy, arguing that the FOMC is unpredictable. That view, I believe, is off base. Typically the FOMC cannot be predictable with regard to the path of the target federal funds rate because new information driving policy adjustments is not predictable. All of us would like to be able to predict the future. We in the Fed do the best we can, but the markets should not complain that the FOMC lacks clairvoyance! What the FOMC strives to do is to respond systematically to the new information. There is considerable evidence that the market does successfully predict FOMC responses to the available information at the time of regularly scheduled meetings.[5]

CONCLUDING COMMENT

To say that policy is data dependent means that policy changes will depend on the incoming news about the state of the economy, both real growth and inflation. That the policy setting is data dependent is a good sign. It means that policy is in a range than can be considered neutral—that is, thought to be consistent with the Fed's longer-run policy objectives. It is important to remember that the long-run inflation objective should not be data dependent. If the objective is well understood, people will know whether the current inflation rate is above or below the desired trend. They will know how to interpret incoming information to gauge what it means for the policy stance. I believe that is just about exactly where we are today.

[5] See, for example, William Poole, "How Predictable Is Fed Policy?" Federal Reserve Bank of St. Louis *Review*, November/December 2007, *87*(6), pp. 659-68; http://research.stlouisfed.org/publications/review/past/2005/.

Data, Data, and Yet More Data

William Poole

This article was originally presented as a speech at the Association for University Business and Economic Research (AUBER) Annual Meeting, University of Memphis, Memphis, Tennessee, October 16, 2006.

Federal Reserve Bank of St. Louis *Review*, March/April 2007, *89*(2), pp. 85-89.

I've long had an interest in data, and I think that this topic is a good one for this conference. The topic is also one I've not addressed in a speech.

A personal recollection might be a good place to begin. In the early 1960s, in my Ph.D. studies at the University of Chicago, I was fortunate to be a member of Milton Friedman's Money Workshop. Friedman stoked my interest in flexible exchange rates, in an era when mainstream thinking was focused on the advantages of fixed exchange rates and central banks everywhere were committed to maintaining the gold standard. Well, I should say central banks almost everywhere, given that Canada had a floating-rate system from 1950 to 1962. Friedman got me interested in doing my Ph.D. dissertation on the Canadian experience with a floating exchange rate, and later I did a paper on nine other floating rate regimes in the 1920s. For this paper I collected daily data on exchange rates from musty paper records at the Board of Governors in Washington.

What was striking about the debates over floating rates in the 1950s is that economists were so willing to speculate about how currency speculators would destabilize foreign exchange markets without presenting any evidence to support those views. In this and many other areas, careful empirical research has resolved many disputes. Our profession has come a long way in institutionalizing empirical approaches to resolving empirical disputes. The enterprise requires data, and what I will discuss is some of the history of the role of the Federal Reserve Bank of St. Louis in providing the data.

Before proceeding, I want to emphasize that the views I express here are mine and do not necessarily reflect official positions of the Federal Reserve System. I thank my colleagues at the Federal Reserve Bank of St. Louis for their comments. Robert H. Rasche, senior vice president and director of research, provided special assistance.

ORIGINS

The distribution of economic data by the Research Division of the Federal Reserve Bank of St. Louis can be traced back at least to May 1961. At that time, Homer Jones, then director of research, sent out a memo with three tables attached showing rates of change of the money supply (M1), money supply plus time deposits, and money supply plus time deposits plus short-term government securities. His memo indicated that he "would be glad to hear from anyone who

William Poole is the president of the Federal Reserve Bank of St. Louis. The author thanks colleagues at the Federal Reserve Bank of St. Louis. Robert H. Rasche, senior vice president and director of research, provided special assistance. The views expressed are the author's and do not necessarily reflect official positions of the Federal Reserve System.

thinks such time series have value, concerning promising applications or interpretations." Recollections of department employees from that time were that the mailing list was about 100 addressees.

Apparently Homer received significant positive feedback, since various statistical releases emerged from this initial effort. Among these were *Weekly Financial Data*, subsequently *U.S. Financial Data*; *Bank Reserves and Money*, subsequently *Monetary Trends*; *National Economic Trends* (1967) and *International Economic Trends* (1978), all of which continue to this date. In April 1989, before a subscription price was imposed, the circulation of *U.S. Financial Data* had reached almost 45,000. A *Business Week* article published in 1967 commented about Homer that "while most leading monetary economists don't buy his theories, they eagerly subscribe to his numbers." As an aside, as a Chicago Ph.D., I both bought the theories and subscribed to the data publications. By the late 1980s, according to Beryl Sprinkel (1987, p. 6), a prominent business economist of the time, "weekly and monthly publications of the Research Division, which have now become standard references for everyone from undergraduates to White House officials, were initially Homer's products."

Why should a central bank distribute data as a public service? Legend has it that Homer Jones viewed as an important part of his mission providing the general public with timely information about the stance of monetary policy. In this sense he was an early proponent, perhaps the earliest proponent, of central bank accountability and transparency. While Homer was a dedicated monetarist, and data on monetary aggregates have always figured prominently in St. Louis Fed data publications, data on other variables prominent in the monetary policy debates at the time, including short-term interest rates, excess reserves, and borrowings, were included in the data releases.

Early on, the various St. Louis Fed data publications incorporated "growth triangles," which tracked growth rates of monetary aggregates over varying horizons. Accompanying graphs of the aggregates included broken trend lines that illustrated rises and falls in growth rates. This information featured prominently in monetarist critiques of "stop-go" and procyclical characteristics of monetary policy during the Great Inflation period.

Does the tradition of data distribution initiated by Homer Jones remain a valuable public service? I certainly believe so. But I will also note that the St. Louis Fed's data resources are widely used within the Federal Reserve System. This information is required for Fed research and policy analysis; the extra cost of making the information available also to the general public is modest.

RATIONAL EXPECTATIONS MACROECONOMIC EQUILIBRIUM

The case for making data readily available is simple. Most macroeconomists today adhere to a model based on the idea of a rational expectations equilibrium. Policymakers are assumed to have a set of goals, a conception of how the economy works, and information about the current state and history of the economy. The private sector understands, to the extent possible, policymakers' views and has access to the same information about the state and history of the economy as policymakers have.

An equilibrium requires a situation in which (i) the private sector has a clear understanding of policy goals and the policymakers' model of the economy and (ii) the policy model of the economy is as accurate as economic science permits. Based on this understanding, market behavior depends centrally on expectations concerning monetary policy and the effects of monetary policy on the economy, including effects on inflation, employment, and financial stability. If the policymakers and private market participants do not have views that converge, no stable equilibrium is possible because expectations as to the behavior of others will be constantly changing.

The economy evolves in response to stochastic disturbances of all sorts. The continuous flow of new information includes everything that happens—weather disturbances, technological developments, routine economic data reports, and the like. The core of my policy model is that

market responses and policy responses to new information are both maximizing—households maximize utility, firms maximize profits, and policymakers maximize their policy welfare function.

A critical assumption in this model is the symmetry of the information that is available to both policymakers and private market participants. In cases where the policymakers have an informational advantage over market participants, policy likely will not unfold in the way that markets expect, and the equilibrium that I have characterized here will not emerge. Hence, public access to current information on the economy at low cost is a prerequisite to good policy outcomes.

THE EVOLUTION OF ST. LOUIS FED DATA SERVICES

Data services provided by the Federal Reserve Bank of St. Louis have evolved significantly from the paper publications initiated by Homer Jones. The initial phase of this evolution began in April 1991 when FRED®, Federal Reserve Economic Data, was introduced as a dial-up electronic bulletin board. This service was not necessarily low cost. For users in the St. Louis area, access was available through a local phone call. For everyone else, long-distance phone charges were incurred. Nevertheless, within the first month of service, usage was recorded from places as wide ranging as Taipei, London, and Vancouver.[1] FRED was relatively small scale. The initial implementation included only the data published in *U.S. Financial Data* and a few other time series. Subsequently, it was expanded to include the data published in *Monetary Trends*, *National Economic Trends*, and *International Economic Trends*. At the end of 1995, the print versions of these four statistical publications contained short histories on approximately 200 national and international variables; initially FRED was of comparable scope.

The next step occurred in 1996 when FRED migrated to the World Wide Web. At that point, 403 national time series became available instantaneously to anyone who had a personal computer with a Web browser. An additional 70 series for the Eighth Federal Reserve District were also available. The data series were in text format and had to be copied and pasted into the user's PC. In July 2002, FRED became a true database and the user was offered a wider range of options. Data can be downloaded in either text or Excel format. Shortly thereafter, user accounts were introduced so that multiple data series can be downloaded into a single Excel workbook, and data lists can be stored for repeated downloads of updated information. In the first six months after this version of FRED was released, 3.8 million hits were recorded to the web site. In a recent six-month period, FRED received 21 million hits from over 109 countries around the world. FRED currently contains 1,175 national time series and 1,881 regional series. FRED data are updated on a real-time basis as information is released from various statistical agencies.

After 45 years, Homer Jones's modest initiative to distribute data on three variables has developed into a broad-based data resource on the U.S. economy that is available around the globe at the click of a mouse. Through this resource, researchers, students, market participants, and the general public can reach informed decisions based on information that is comparable to the information policymakers have.

In the past year, we have introduced a number of additional data services. One of these, ALFRED® (Archival Federal Reserve Economic Data), adds a vintage (or real-time) dimension to FRED. The ALFRED database stores revision histories of the FRED data series. Since 1996, we have maintained monthly or weekly archives of the FRED database. All the information in these archives has been populated to the ALFRED database, and the user can access point-in-time revisions of these data.[2] We have also extended the revision histories of many series back in time using data that were

[1] *Eighth Note* (1991, p. 1).

[2] We do not maintain histories of daily data series in ALFRED. Interest rates and exchange rates appear at daily frequencies in FRED. In principle, these data are not revised, though occasional recording errors do slip into the initial data releases. Such reporting errors are corrected in subsequent publications, so there is sometimes a vintage dimension to one of these series.

recorded in *U.S. Financial Data*, *Monetary Trends*, and *National Economic Trends*. For selected quarterly national income and product data, we have complete revision histories back to 1959 for real data and 1947 for nominal data. Revision histories are available on household and payroll employment data back to 1960. A similar history for industrial production is available back to 1927.

Preserving such information is crucial to understanding historical monetary policy. For example, Orphanides (2001, p. 964) shows "that real-time policy recommendations differ considerably from those obtained with ex-post revised data. Further, estimated policy reaction functions based on ex-post revised data provide misleading descriptions of historical policy and obscure the behavior suggested by information available to the Federal Reserve in real time." Orphanides concludes that "reliance on the information actually available to policy makers in real time is essential for the analysis of monetary policy rules."

Such vintage information also is essential for analysis of conditions at subnational levels. For example, in January 2005 the Bureau of Labor Statistics estimated that nonfarm employment in the St. Louis MSA had increased by 38.8 thousand between December 2003 and December 2004. This increase was widely cited as evidence that the MSA had returned to strong employment growth after four years of negative job growth. However, these data from the Current Employment Statistics were not benchmarked to more comprehensive labor market information that is available only with a lag.[3] The current estimate of nonfarm employment growth in the St. Louis MSA for this period, after several revisions, is only 11.6 thousand, less than 30 percent of the increase originally reported.

Another data initiative that we launched several years ago is FRASER®—the Federal Reserve Archival System for Economic Research. The objective of this initiative is to digitize and distribute the monetary and economic record of the U.S. economy. FRASER is a repository of image files of important historical documents and serial publications. At present we have posted the entire history of *The Economic Report of the President*, *Economic Indicators*, and *Business Conditions Digest*. We have also posted images of most issues of the *Survey of Current Business* from 1925 through 1990 and are working on filling in images of the remaining volumes. The collection also includes *Banking and Monetary Statistics* and the *Annual Statistical Digests* published by the Board of Governors, as well as the *Business Statistics* supplements to the *Survey of Current Business* published by the Department of Commerce. We are currently working, in a joint project with the Board of Governors, to create digital images of the entire history of the *Federal Reserve Bulletin*. Finally, we are posting images of historical statistical releases that we have collected in the process of extending the vintage histories in ALFRED back in time. These images should allow scholars, analysts, and students of economic history to reconstruct vintage data on many series in addition to those we are maintaining on ALFRED.

TRANSPARENCY, ACCOUNTABILITY, AND INFORMATION DISTRIBUTION

As just indicated, the scope of the archival information in FRASER extends beyond numeric data. Ready access to a wide variety of information is essential for transparency and accountability of monetary authorities and the public's full understanding of policy actions. Since 1994, the Federal Reserve System and the FOMC have improved the scope and timeliness of information releases. I have discussed this progress in previous speeches.[4] Currently, the FOMC releases a press statement at the conclusion of each scheduled meeting and three weeks later follows up with the release of minutes of the meeting. The press release and the minutes of the meetings record the vote on the policy action. The policy statement and minutes give the public a clear understanding of the action taken and insight into the rationale for the action.

Contrast the current situation with the one in 1979. At that time, actions by the Board of

[3] Wall and Wheeler (2005).

[4] See, for example, Poole (2005).

Governors on discount rate changes were reported promptly, but there was no press release subsequent to an FOMC policy action and FOMC meeting minutes were released with a 90-day delay. On September 19, 1979, the Board of Governors voted by the narrow margin of four to three to approve a ½-percentage-point increase in the discount rate, with all three dissents against the increase. This information generated the public perception that Fed officials were sharply divided and, therefore, that the Fed was not prepared to act decisively against inflation. John Berry (1979, p. A1), a knowledgeable reporter at the *Washington Post*, observed that "the split vote, with its clear signal that from the Fed's own point of view interest rates are at or close to their peak for this business cycle, might forestall any more increases in market interest rates." However, the interpretation of the "clear signal" was erroneous. On that same day, the FOMC had voted eight to four to raise the range for the intended funds rate to 11¼ to 11¾ percent. More importantly, three of the four dissents were in favor of a more forceful action to restrain inflation (see Lindsey, Orphanides, and Rasche, 2005, pp. 195-96). Neither the FOMC's action, the dissents, nor the rationale for the dissents were revealed to the public under the disclosure policies then in effect. The result was to destabilize markets, with commodity markets, in particular, exhibiting extreme volatility.

CONCLUSION

The tradition of data services was well established when I arrived in St. Louis in 1998, and I must say that I am proud that leadership in the Bank's Research Division has extended that tradition. Data are the lifeblood of empirical research in economics and of policy analysis. Our rational expectations conception of how the macroeconomy works requires that the markets and general public understand what the Fed is doing and why. Of all the things on which we spend money in the Federal Reserve, surely the return on our data services is among the highest.

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Stock Market Booms and Monetary Policy in the Twentieth Century

Michael D. Bordo and David C. Wheelock

This article examines the association between stock market booms and monetary policy in the United States and nine other developed countries during the 20th century. The authors find, as was true of the U.S. stock market boom of 1994-2000, that booms typically arose during periods of above-average growth of real output and below-average inflation, suggesting that booms reflected both real macroeconomic phenomena and monetary policy. They find little evidence that booms were fueled by excessive liquidity. Booms often ended within a few months of an increase in inflation and consequent monetary policy tightening. They find few differences across the different monetary policy regimes of the century. (JEL E300, E520, G180, N100, N200)

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Extended periods of rapidly appreciating equity, housing, and other asset prices in the United States and elsewhere since the mid-1990s have brought increased attention to the effects of monetary policy on asset markets and the appropriate response, if any, of monetary policy to asset price booms. Some economists argue that financial markets are inherently volatile and that market prices often stray from fundamentals, suggesting that policymakers could improve welfare by attempting to deflate asset price booms, especially if sudden declines in asset prices are likely to depress economic activity. Other economists contend that financial markets process information efficiently. These economists tend to believe that policymakers usually cannot determine when assets are mispriced and, hence, that they cannot enhance aggregate welfare by reacting to asset price movements.[1]

The U.S. stock market boom of the late 1990s arose during a period of increased productivity growth, which many observers hailed as evidence of a "New Economy" that justified rapid appreciation of equity prices. The period was also marked by low and stable inflation, which may have contributed to the boom by foreshadowing strong growth of economic activity and corporate profits. Some analysts have argued, however, that the rapid rise in equity prices was simply a manifestation of loose monetary policy that happened to generate asset price inflation rather than consumer price inflation.[2] The end of the boom did coincide with a tightening of monetary policy. This tightening seems to have been in response to rising consumer price inflation and inflation expecta-

[1] See Kohn (2006) for a recent comparison of alternative monetary policy strategies in response to asset price booms. See also Bordo and Wheelock (2004).

[2] Rapid growth of asset prices amid low consumer price inflation renewed interest in the question of whether monetary policy should target measures of inflation that include asset prices as well as consumer prices. Proponents of broader inflation measures include Goodhart and Hofmann (2000) and Bryan, Cecchetti, and O'Sullivan (2002).

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tions, though some studies conclude that the Fed also sought to contain the booming stock market.[3]

The purpose of this article is to discern whether the patterns of output and productivity growth, inflation, and monetary policy observed during the U.S. boom of the 1990s were similar to those of other stock market booms in the United States and elsewhere during the 20th century. We are especially interested in whether these patterns differed across monetary policy regimes. Monetary neutrality implies that monetary policy should not affect the price of stocks, which are claims on real assets, in the long run. Empirical studies conclude, however, that policy actions affect stock prices in the short run, and many researchers contend that the form of policy rule used by monetary authorities can also affect asset markets over longer horizons. In particular, some argue that use of a monetary rule involving a clearly specified, credible inflation objective could lessen instability in financial markets, though others contend that such rules can promote "imbalances" that may lead to financial instability. This article seeks to identify similarities or differences in the association of monetary policy and stock market booms across different monetary policy environments. In so doing, we hope to gain insight into the role of monetary policy in supporting or ending asset booms.[4]

We construct monthly, real (i.e., inflation-adjusted) stock price indices for the United States and nine other countries for which the necessary data are available over most of the 20th century. We then identify extended periods of unusually rapid appreciation in the indices for each country, which we define as booms. Finally, we use a simple event methodology to examine the behavior of important macroeconomic and monetary policy variables during stock market booms, and we compare U.S. experiences with those of the other countries in our sample. We find that 20th century stock market booms typically were associated with the business cycle, arising when output (real gross domestic product [GDP]) growth was above average and ending as output growth slowed. We also find that booms tended to arise when consumer price inflation was low and end after a period of monetary policy tightening associated with an actual or threatened rise in inflation. These patterns differ little across time and, therefore, across the different policy regimes in place over the 20th century. Finally, the patterns we observe for U.S. stock market booms also appear broadly similar to those of other countries in our data.

The next section of this article briefly discusses how monetary policy might affect stock prices. We then present information about the stock market booms in our data. Subsequent sections examine the macroeconomic conditions under which 20th century stock market booms occurred in the United States and other countries. The final section summarizes our observations and conclusions.

MONETARY POLICY AND STOCK PRICES

The basic efficient-markets present-value model posits that stock prices reflect discounted expected future dividends and, hence, that price changes reflect changes in expected dividends and/or the discount rate (proxied by the real interest rate). Because stocks are claims on real assets, monetary neutrality implies that policy should not affect real stock prices in the long run. Monetary policy actions might affect stock prices over shorter horizons, however, by altering the path of expected dividends, the discount rate, or the equity premium.[5] Early models of the effects of monetary policy on asset prices focused on the impact of changes in liquidity on the demand

[3] For contrasting views on whether the Fed adjusted policy in response to the stock market during this period, see Cecchetti (2003), Rigobon and Sack (2003), Hayford and Malliaris (2004), and Meyer (2004).

[4] Bordo and Wheelock (2004) investigate the association of nominal U.S. stock prices with output, inflation, and money stock growth over the 19th and 20th centuries. The present article, by contrast, focuses on periods of rapid appreciation of real stock prices and compares the U.S. experience with the experiences of other countries.

[5] The equity premium is the excess return for holding equities over short-term debt securities, which in the United States averaged about 3 percent over the 19th and 20th centuries. The premium provides compensation for uncertainty about the timing and magnitude of future cash flows associated with ownership of equities rather than fixed-income securities.

for various assets that comprise the portfolio of the private sector. Policy actions that increase liquidity cause asset prices to rise and returns to fall as households adjust their portfolios in response to an increase in central bank liabilities. Other models focused on the impact of policy on the cost of capital and, hence, the expected growth rates of corporate dividends or earnings.[6]

Several studies have found evidence that monetary policy actions affect stock prices in the short run. Bernanke and Kuttner (2005), for example, estimate that during 1989-2002 an unanticipated 25-basis-point increase in the Federal Reserve's target for the federal funds rate produced a 1 percent decline in equity prices. Further, they find that the impact of unanticipated monetary policy actions on stock prices occurred mainly through their impact on expected future dividends and excess returns (i.e., the equity premium) rather than the real interest rate.

Although monetary policy actions appear to affect stock prices in the short run, many economists contend that the form of policy rule used by monetary authorities can affect the performance of asset markets over longer horizons. Some economists argue that monetary policies that result in persistent or highly variable inflation destabilize financial markets (e.g., Schwartz, 1995). Rules that stabilize the price level, however, are commonly thought to lessen the chance of asset price bubbles (e.g., Woodford, 2003). Some economists argue, however, that a commitment to low inflation can foster imbalances that lead to asset price bubbles by generating *overly* optimistic expectations of future economic growth (e.g., Borio and Lowe, 2002). Federal Reserve Chairman Alan Greenspan made this claim at a Federal Open Market Committee (FOMC) meeting in 1996:

> We have very great difficulty in monetary policy when we confront stock market bubbles. That is because, to the extent that we are successful in keeping product price inflation down, history tells us that price-earnings ratios under those conditions go through the roof. What is really needed to keep stock market bubbles from occurring is a lot of product price inflation, which historically has tended to undercut stock markets almost everywhere. There is a clear tradeoff. If monetary policy succeeds in one, it fails in the other. (FOMC, September 24, 1996, pp. 30-31)

Historically, U.S. stock market returns have been negatively correlated with inflation (Fama and Schwert, 1977). Goodfriend (2003) argues that prior to the 1980s, monetary policy was an important source of both macroeconomic and financial market instability, which could explain the negative relationship between stock returns and inflation. An increase in inflation would tend to depress stock returns because long-term interest rates would rise in response to higher expected inflation and tighter monetary policy and because tighter policy would also slow economic activity and thereby reduce current and future corporate earnings. A reversal of policy in response to a weak economy and lower inflation would tend to reduce interest rates and boost stock returns.

Goodfriend (2003) contends that asset price movements are less likely to be correlated with policy actions if monetary policymakers are firmly committed to maintaining price stability. Under such a regime, he argues, long-term interest rates will be more firmly anchored and real activity, corporate profits, and real interest rates will exhibit less cyclical variability. Hence, under a policy rule that maintains a stable price level, movements in asset prices are likely to be less correlated with specific monetary policy actions. One objective of this article is to determine whether stock market booms in the United States and other countries typically have been associated with low inflation, especially with changes in monetary policy that foster price stability, and whether we can observe differences in the relationships over time that might be associated with differences in policy regimes.

STOCK MARKET BOOMS

There is, of course, no precise definition of an asset boom, and researchers have imposed a number of filters to identify specific episodes that

[6] See Bordo and Wheelock (2004) for additional discussion and references.

Table 1

Stock Market Booms

Country	Boom start: local market minimum	Boom end: local market peak	Average annual % change from month after trough to peak	When prior 25-month peak surpassed
Australia	Dec. 1920	Feb. 1929	10.7	July 1921
	Sept. 1930	Mar. 1937	17.8	Oct. 1934
	July 1956	July 1960	15.8	Aug. 1957
	Oct. 1966	Dec. 1969	21.8	Oct. 1967
	Aug. 1977	Nov. 1980	21.9	Sept. 1979
	July 1982	Sept. 1987	25.2	Mar. 1986
	Dec. 1990	Jan. 1994	18.9	Oct. 1993
	Aug. 1998	June 2000	13.4	Jan. 1999
Canada	Dec. 1920	Sept. 1929	17.4	n/a
	June 1932	Mar. 1937	28.0	n/a
	Oct. 1953	July 1956	24.6	July 1954
	Oct. 1977	Nov. 1980	22.1	n/a
	July 1984	July 1987	17.9	July 1985
	Jan. 1995	Apr. 1998	19.2	Nov. 1995
	Aug. 1998	Aug. 2000	34.7	Dec. 1999
France	Nov. 1920	July 1924	20.9	n/a
	Nov. 1926	Feb. 1929	40.4	Dec. 1927
	Dec. 1950	Apr. 1955	28.4	n/a
	Aug. 1958	Apr. 1962	20	July 1960
	June 1981	Apr. 1987	24.4	Jan. 1985
	Feb. 1995	Aug. 2000	23.6	Jan. 1997
Germany	June 1957	Sept. 1960	43.6	Aug. 1958
	Aug. 1982	Apr. 1986	31.8	July 1983
	Mar. 1995	Feb. 2000	23.9	Sept. 1996
Italy	May 1932	July 1935	27.5	n/a
	July 1950	Sept. 1955	18.5	Aug. 1952
	June 1958	Aug. 1960	56.4	Oct. 1958
	Dec. 1977	May 1981	35.0	n/a
	Dec. 1982	Aug. 1986	38.2	Mar. 1986
	Nov. 1995	Feb. 2000	33.6	July 1997

NOTE: *Market decline ended less than 12 months after boom peak; [a]comparison Jan. 1915–Dec. 1940; [b]comparison Jan. 1947–Dec. 2004; [c]comparison Feb. 1920–Dec. 1940; [d]comparison Jan. 1920–Dec. 1939; [e]comparison Jan. 1950–Dec. 2004; [f]comparison Feb. 1921–Dec. 1938; [g]comparison Feb. 1923–Dec. 1940; [h]comparison March 1920–Dec. 1939; [i]comparison Feb. 1917–Dec. 1940; [j]comparison Feb. 1916–Dec. 1939; [k]comparison Jan. 1947–Sep. 2004.

Months duration after prior peak surpassed	Average annual % change from month after prior peak	Comparison average annual % change during period	Percent decline 12 months after peak	Percent decline to next minimum
91	9.1	3.6[a]	–20.1	–41.0
30	13.7	3.6	–12.2	–31.6
35	15.9	2.4[b]	–11.6	–20.2*
26	17.5	2.4	–24.8	–42.2
14	32.1	2.4	–27.2	–47.2
18	39.3	2.4	–35.8	–46.3*
3	36.9	2.4	–23.8	–23.8
18	6.5	2.4	–0.8	–23.8
n/a	n/a	3.7[c]	–37.5	–75.1
n/a	n/a	3.7	–35.6	–35.6
25	23.5	3.4[b]	–9.2	–32.4
n/a	n/a	3.4	–25.2	–52.5
24	15.3	3.4	–18.5	–26.7*
29	20.1	3.4	–10.0	–28.2*
8	42.0	3.4	–36.0	–43.6
n/a	n/a	2.5[d]	–16.1	–34.7
14	37.9	2.5	–12.0	–57.0
n/a	n/a	2.8[b]	–17.4	–11.1*
21	14.3	2.8	–18.7	–54.1
25	36.2	2.8	–32.8	–45.0
43	26.8	2.8	–29.5	–60.1
25	54.1	6.0[e]	–24.0	–49.3
33	28.8	6.0	–18.4	–44.7
41	27.8	6.0	–25.4	–69.9
n/a	n/a	0.4[f]	–13.4	–20.0*
37	22.7	3.1[e]	–16.6	–22.2*
23	58.7	3.1	–17.6	–17.6
n/a	n/a	3.1	–46.8	–54.1
5	34.3	3.1	–26.7	–47.9
31	34.9	3.1	–18.8	–56.5

Table 1, cont'd

Country	Boom start: local market minimum	Boom end: local market peak	Average annual % change from month after trough to peak	When prior 25-month peak surpassed
Japan	Oct. 1930	Feb. 1934	28.6	Feb. 1932
	Jan. 1950	Jan. 1953	54.3	Jan. 1952
	Dec. 1957	June 1961	36.3	Oct. 1958
	Sept. 1982	Dec. 1989	23.9	Mar. 1983
Netherlands	July 1924	Feb. 1929	10.9	Jan. 1926
	June 1932	Mar. 1937	26.6	n/a
	Apr. 1952	June 1957	20.3	Nov. 1954
	Dec. 1957	Mar. 1961	22.2	May 1959
	Sep. 1981	July 1987	22.0	Mar. 1983
	Jan. 1991	Aug. 2000	17.4	June 1993
Sweden	Mar. 1922	July 1929	16.9	n/a
	May 1932	Mar. 1937	23.2	n/a
	Mar. 1958	Aug. 1961	15.1	Aug. 1958
	Sept. 1980	Mar. 1984	36.8	May 1981
	Sept. 1992	Feb. 2000	31.4	Sept. 1995
United Kingdom	June 1932	Dec. 1936	15.4	Feb. 1936
	June 1952	July 1955	20.0	July 1954
	Feb. 1958	Apr. 1961	25.4	Dec. 1958
	Sept. 1981	July 1987	21.3	Oct. 1982
	June 1994	Dec. 1999	12.6	Apr. 1996
United States	Oct. 1923	Sept. 1929	23.7	Dec. 1924
	Mar. 1935	Feb. 1937	39.7	Oct. 1935
	Sept. 1953	Apr. 1956	28.8	Mar. 1954
	June 1962	Jan. 1966	13.3	Dec. 1963
	July 1984	Aug. 1987	22.9	Feb. 1985
	Apr. 1994	Aug. 2000	17.1	Mar. 1995

Months duration after prior peak surpassed	Average annual % change from month after prior peak	Comparison average annual % change during period	Percent decline 12 months after peak	Percent decline to next minimum
24	26.1	1.8[g]	–12.0	–16.6
12	93.1	6.9[e]	–30.0	–36.4
32	38.7	6.9	–23.0	–52.7
81	22.5	6.9	–41.0	–47.6*
36	6.1	–1.8[h]	–15.7	–71.8
n/a	n/a	–1.8	–18.2	–31.5
31	15.4	4.1[b]	–19.8	–32.1*
22	15.0	4.1	–10.5	–31.2
52	20.1	4.1	–17.2	–36.7*
74	19.6	4.1	–26.8	–65.4
n/a	n/a	–1.8[i]	–13.1	–73.3
n/a	n/a	–1.8	–12.2	–12.2
36	13	5.7[b]	–15.3	–20.2
34	34.7	5.7	–24.6	–29.3
53	30.6	5.7	–31.2	–67.2
10	5.4	–0.4[j]	–23.6	–44.2
12	16.4	2.8[b]	–17.3	–31.4
28	19.6	2.8	–17.8	–31.0
57	21.5	2.8	–23.4	–34.8*
44	12.7	2.8	–10.6	–50.2
57	24.4	2.4[a]	–30.1	–80.6
16	30.2	2.4	–39.0	–45.8
25	29.3	4.4[k]	–9.6	–20.1
25	10.3	4.4	–12.5	–20.1*
30	21.6	4.4	–22.3	–27.5*
64	18.7	4.4	–22.8	–46.8

they then define as booms. We adapt the methodology of Pagan and Sossounov (2003) to identify sustained periods of rising real stock prices in the United States and nine other developed countries (Australia, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, and the United Kingdom).[7] First, we calculate a monthly index of real stock prices for each country by deflating a nominal stock price index by a consumer price index. We list our data and sources in the appendix. Next, we identify real stock price index peaks and troughs within rolling, 25-month windows. We require that peaks and troughs alternate, and so eliminate all but the highest maximum that occurred before a subsequent trough and all but the lowest minimum that occurred before a subsequent peak. We classify as booms all periods of at least three years from trough to peak with an average annual rate of increase in the real stock price index of at least 10 percent. We also classify as booms a few episodes of exceptional real stock price appreciation that were shorter than three years.[8]

Table 1 lists the episodes we define as booms for each country in our sample. For each boom, we include information about the average annual percentage increase in the market index from the market trough to its peak. Because several booms began as recoveries from market declines, we also note when the real stock price index surpassed its prior 25-month peak and report the average annual percentage increase in the index after that date.

For comparison, Table 1 also reports information about long-run average annual rates of change in the real stock price index for each country. For example, the U.S. real stock price index increased at an average annual rate of 2.4 percent during 1915-40 and 4.4 percent during 1947-2004. Thus, the periods we define as booms were characterized by rates of appreciation that were substantially higher than long-run averages. Finally, Table 1 also includes information about the extent to which the real stock price index declined during the 12 months following a market peak and from the market peak to the next market trough. Almost all booms were followed by real declines of at least 10 percent within 12 months. Not all booms ended with a spectacular crash, however, and the lengths and sizes of market declines after booms varied widely.

Cross-country comparisons of real stock price index growth rates are problematic because of differences in the composition of the stock market indices of individual countries. For the interwar period, cross-country comparisons are further complicated by differences across countries in (i) the dates when monthly data on a nominal stock price index and inflation are first available and (ii) the nature and the availability of stock price data for the late 1930s associated with when countries became involved in World War II.

For the post-World War II period, we report average growth rates for 1947-2004 for all countries in the sample except Germany, Italy, and Japan, for which we report growth rates over 1950-2004. The real stock price indices for these three countries exhibit rapid growth during the 1950s compared with average growth rates for subsequent decades. Among the other sample countries, we note considerable variation in average real stock price growth rates, ranging from 2.4 percent for Australia to 5.7 percent for Sweden. Again, however, such long-run cross-country comparisons are problematic because the performance of stock markets varied considerably over time within countries, as well as because of differences in the coverage of industries and firms in the stock market indices of individual countries.

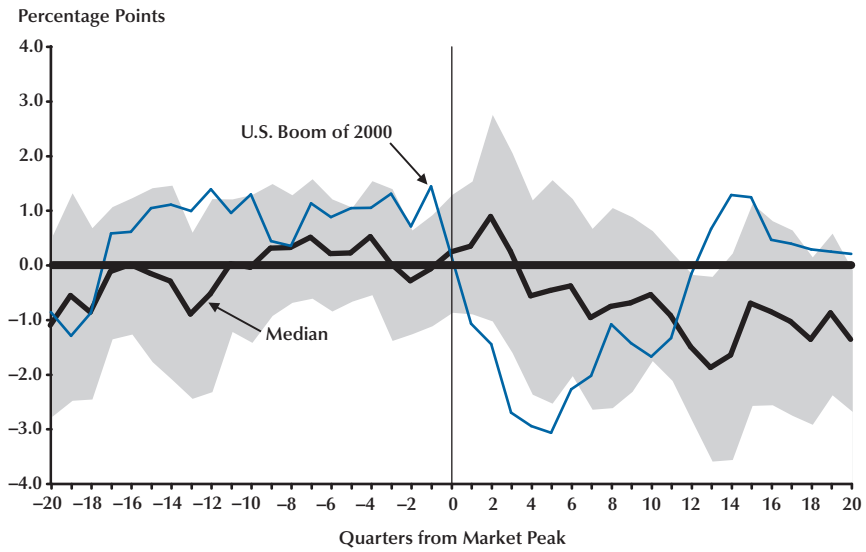
Not surprisingly, we find considerable coincidence in the occurrence of stock market booms across sample countries. For example, most countries experienced a substantial increase in real stock prices during the 1920s and a market peak in 1929. Several countries also had booms in the mid-1930s as their economies climbed out of the Great Depression. More recently, most countries

[7] We selected our sample countries based on the availability of historical data on a stock market index and key macroeconomic series, which obviously gives rise to possible sample selection bias. We are unsure of the extent to which our findings would differ if our sample included recently developed or emerging market economies.

[8] Helbling and Terrones (2004) use a similar procedure to identify booms and busts. Specifically, they identify turning points in the log-level of real equity prices over five-quarter windows and define booms (busts) as the largest one-fourth of all price increases (declines).

Figure 1

Real GDP Growth Relative to Its Long-Run Average: Post-1970 Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

in our sample had booms in the 1980s and again in the 1990s. Several countries experienced a market peak within a few months of the U.S. peak in August 1987; and, among our sample, only Japan failed to experience a stock market boom in the 1990s, leading to a peak in 1999 or 2000.[9]

THE U.S. STOCK MARKET BOOM OF 1994-2000

This article seeks to discern whether patterns observed during the U.S. stock market boom of the 1990s were similar to those observed during prior booms in the United States and other countries. U.S. stock prices rose rapidly during the second half of the 1990s, which many analysts attributed to advances in information-processing technology and increased productivity growth. Both current U.S. output (GDP) and productivity growth were high during these years, whereas inflation was low.

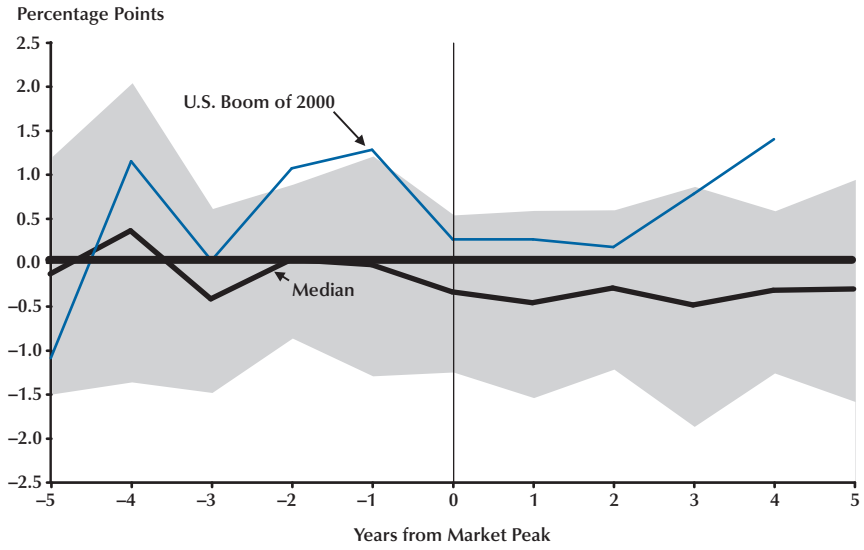
Figure 1 plots data on U.S. real GDP growth relative to its long-run average during the 20 quarters before and after the peak in real stock prices in the third quarter of 2000 (quarter "0"). Real GDP growth exceeded its long-run average by approximately 1 percentage point during the 17 quarters preceding 2000:Q3, then declined sharply as the U.S. economy entered a recession in 2000:Q4. Figure 1 also plots the median growth rates of real GDP (relative to its long-run average) during market peak quarters and in the 20 quarters before and after market peaks across all post-1970 stock market booms among our sample countries, including the U.S. boom of 1994-2000.[10] Across all booms, median output growth was much closer to its long-run average than U.S. output growth was during the 1994-2000 boom. The decline in output after the "typical" market peak also began later and was much less steep than was experienced after

[9] See Bordo and Wheelock (2006) for further evidence on the coincidence of stock market booms and correlation of market returns across countries during the 20th century. See also Goetzmann, Li, and Rouwenhorst (2001).

[10] We define long-run average GDP growth as the average annual rate during 1960-2001.

Figure 2

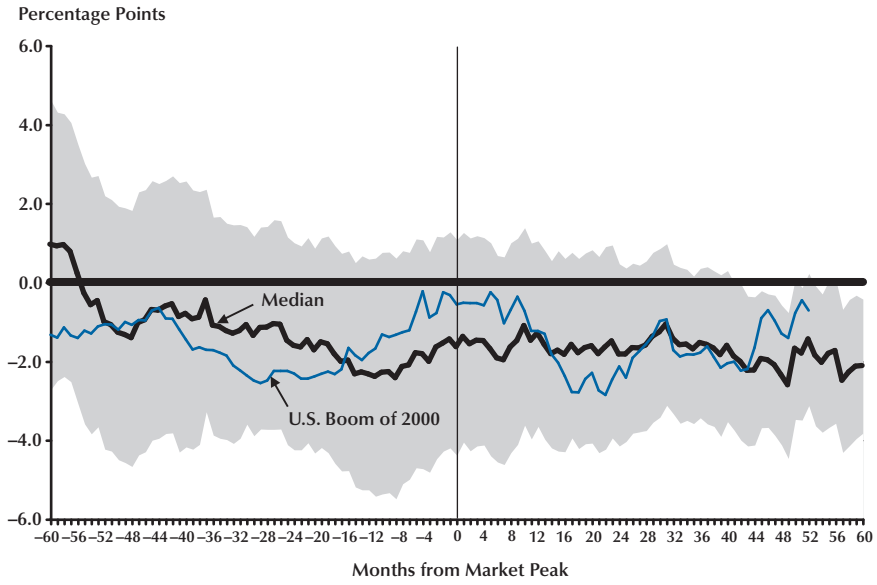
Labor Productivity Growth Relative to Its Long-Run Average: Post-1970 Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

Figure 3

Inflation Relative to Its Long-Run Average: Post-1970 Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

the U.S. stock market peak in 2000:Q3. Figure 1 also displays the mean absolute deviation of real GDP growth (relative to its long-run average) in each quarter across all post-1970 booms. Real GDP growth varied widely during post-1970 booms, and even more so in the quarters after market peaks.[11]

Market analysts frequently attributed the stock market boom of the late 1990s to advances in information technology and an increase in productivity growth that seemed to justify expectations of elevated corporate profits and dividends. Figure 2 plots data on labor productivity growth during the U.S. boom of 1994-2000 and the median across all post-1970 stock market booms.[12] Whereas U.S. labor productivity growth exceeded its long-run average during four of five years between 1996 and 2000, across all booms, median productivity growth hovered near its long-run average.[13] Hence, in occurring during a period of above-average productivity growth, the U.S. boom of 1994-2000 was somewhat unusual among recent stock market booms.

While output and productivity growth were both unusually rapid during the U.S. stock market boom of the late 1990s, inflation was unusually low. Consumer price inflation (CPI) hovered between 2.5 and 3 percent from 1992 to 1996, then held below 2 percent from late 1997 to early 1999.

Figure 3 plots monthly data on CPI inflation (relative to its long-run average) during the U.S. boom of 1994-2000, as well as the median across all post-1970 booms.[14] The figure shows that inflation was below its long-run average throughout the 60 months preceding the August 2000 peak in U.S. real stock prices. Further, the figure shows a decline in the inflation rate that occurred in 1997 and early 1998 (months "44" to "29") and an increase during 1999 and the first half of 2000 (approximately the last 20 months of the boom period). Across all post-1970 booms, median inflation was below average and declining until some 12 months before a stock market peak month, when inflation began to rise. Thus, both the U.S. stock market boom of 1994-2000 and the "typical" post-1970 boom arose when inflation was below average and ended after several months of rising inflation.

The U.S. stock market boom of 1994-2000 attracted considerable attention from Federal Reserve officials and other policymakers. Fed officials feared that rapid gains in stock market wealth would cause rapid growth in spending and inflation, but officials were perhaps even more concerned that a sudden decline in the market could lead to a recession.[15] Policymakers were uncertain about how to respond to the booming stock market, while financial markets were acutely sensitive to any statements or actions by the Fed that signaled possible changes in the direction of policy. Although the Fed was becoming increasingly transparent about its policies, it neither specified an inflation objective nor explained how it might react to the booming stock market.

In December 1996, Federal Reserve Chairman Greenspan made his famous "irrational exuberance" speech, in which he wondered publicly how to determine when equity prices are too high in relation to fundamentals (Greenspan, 1996). Stock prices fell briefly after the Chairman's speech on fears that the Fed would tighten monetary policy or take other actions to slow the growth of stock prices. Indeed, at an FOMC meeting in February 1997, Greenspan suggested that the Fed might want to tighten policy in response to rising stock prices. He argued that the prevailing level of equity prices, along with unusually narrow interest rate credit spreads, "suggest[s] that product prices alone should not be the sole criterion [for conducting monetary policy] if we are going to maintain

[11] For example, several countries had stock market booms that coincided with the U.S. boom of 1994-2000. Among them, Australia, Canada, Sweden, and the United Kingdom experienced real GDP growth rates that were consistently higher than their long-run averages; but France, Germany, and Italy had growth rates that were near or below average.

[12] Throughout the paper, for all figures plotting annual data, we define the market peak year "0" as the year prior to the actual peak if the peak occurred in the first half of a year.

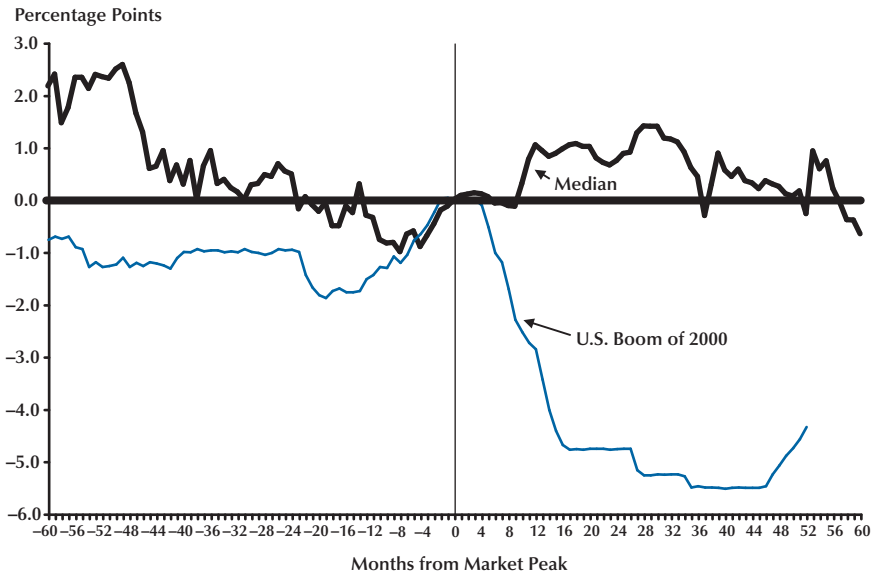
[13] Here we define the long-run average productivity growth rate as the average annual growth rate for 1970-2004.

[14] Here we define the long-run average inflation rate as the average rate during 1947-2004.

[15] See Meyer (2004) for an interesting account of Federal Reserve policymaking during this period.

Figure 4

Short-Term Interest Rate Relative to Its Rate in Peak Month: Post-1970 Booms



a stable, viable financial system whose fundamental goal…is the attainment of maximum sustainable economic growth" (FOMC, February 4-5, 1997, p. 103).

The FOMC increased its federal funds rate target by 25 basis points in March 1997, but then left the target unchanged over the remainder of the year. Inflation was falling, which puzzled Fed officials who struggled to understand the decline amid rapid economic growth and falling unemployment.[16] Chairman Greenspan was an early proponent of the view that advances in information processing technology had increased the potential growth rate of output, but most Fed officials and staff were skeptical.[17] Despite their misgivings about the stock market, however, Fed officials chose not to raise their funds rate target as long as inflation continued to fall. Of course, in not cutting their target, Fed officials permitted the (ex post) real funds rate to rise as the inflation rate fell.

Figure 4 plots data on the federal funds rate during the U.S. stock market boom of 1994-2000, and the median level of short-term interest rates across all post-1970 booms in our dataset.[18] Both the funds rate and the median are shown relative to their levels in the months of stock market peaks (month "0"). Figure 5 plots the level of the real interest rate, defined as the nominal short-term interest rate minus the trailing year-over-year inflation rate, during the U.S. stock market boom of 1994-2000 and the median level across all booms. Finally, Figure 6 plots the spread between the yield on long-term Treasury securities and the short-term interest rate for boom periods. The real interest rate and the term spread are two measures that economists often monitor to gauge the stance of monetary policy.

Figures 5 and 6 show that the real funds rate rose and the term spread fell during 1997 (months "–43" to "–32"), and, hence, by these measures,

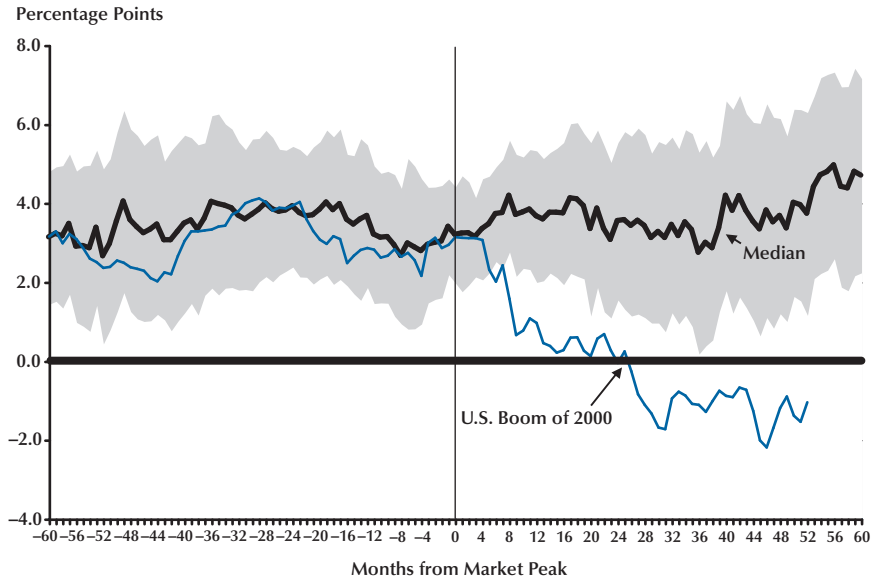
[16] Meyer (2004, pp. 79-80).

[17] Meyer (2004, pp. 80-84, 123-25).

[18] For countries for which data are available, we use an overnight interest rate similar to the U.S. federal funds rate. Otherwise, we use another short-term money market interest rate. See the appendix for details.

Figure 5

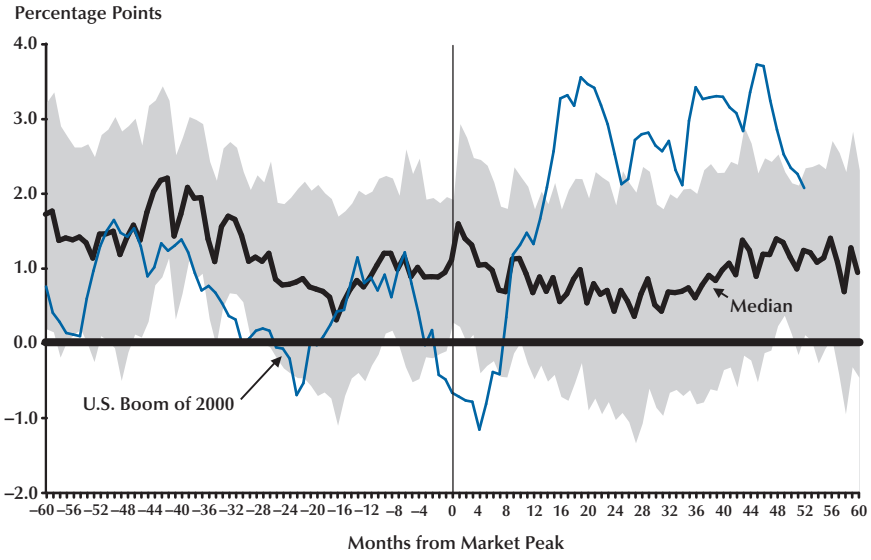
Real Interest Rate: Post-1970 Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

Figure 6

Interest Rate Term Spread: Post-1970 Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

monetary policy tightened. Concern about stock market speculation and rapid economic growth kept the Fed from cutting its funds rate target, even as inflation fell, which effectively allowed policy to tighten.

The next major move in monetary policy came in response to a sudden demand for liquidity in the wake of a Russian government bond default and spreading financial crisis in Asia during the summer and fall of 1998. The Fed cut its funds rate target by 75 basis points between September and November 1998 (months "–23" and "–21"), and the real interest rate fell. The spread between long-term Treasury security yields and short-term interest rates also rose as the demand for liquidity abated.

Inflation began to rise in 1999; citing "a significant risk of rising inflation," the FOMC began to raise its federal funds rate target in June (Board of Governors of the Federal Reserve System, 1999, p. 242). Over the subsequent year, the Committee increased its target by a total of 175 basis points.[19] For the most part, however, increases in the federal funds rate merely kept pace with the rising inflation rate, which left the real interest rate essentially unchanged. Fed officials sought to contain inflation throughout the period, but resisted the temptation to increase the funds rate faster than the inflation rate because they desired to accommodate a perceived increase in the potential growth rate of the economy associated with higher productivity growth. Fed officials also worried that aggressive tightening could cause a sharp decline in the stock market and a substantial slowing of economic activity.[20]

By mid-2000, Fed officials had decided to act more aggressively against inflation. At their May 2000 meeting, FOMC members concluded that demand growth was continuing to exceed even the increased rate of potential output growth and that more aggressive tightening was necessary: "A more forceful policy move...was desirable in light of the extraordinary and persisting strength of overall demand, exceeding even the increasingly rapid growth of potential supply" (Board of Governors of the Federal Reserve System, 2000, p. 224). Thus, rather than increasing their funds rate target by the usual 25-basis-point increment, Fed officials voted to raise their target by 50 basis points to 6.5 percent, where it remained throughout the rest of 2000. As shown in Figures 5 and 6, the real interest rate rose and the term spread declined sharply during the six months preceding the August 2000 peak in real stock prices. Hence, by conventional measures, the stock market boom ended after several months of increasingly tighter monetary policy.[21]

Figures 5 and 6 also plot the median real interest rate and term spread levels across all post-1970 booms in our dataset. The pattern followed by the median real rate level is similar to that of the real federal funds rate during the U.S. boom of 1994-2000: After peaking near 4 percent some 24 months before a stock market peak, the median real rate fell approximately 1 percentage point before rising again during the year preceding the market peak. The median term spread does not, however, exhibit the decline observed in the U.S. term spread during the last months of the U.S. boom of 1994-2000. Nevertheless, it appears that, like the U.S. stock market boom of 1994-2000, the end of the "typical" post-1970 boom followed some tightening of monetary policy associated with rising inflation.

MONETARY POLICY AND STOCK MARKET BOOMS BEFORE 1970

Next we examine the economic and monetary policy conditions under which stock market booms occurred earlier in the 20th century. The historical approach enables us to examine the association of booms with macroeconomic con-

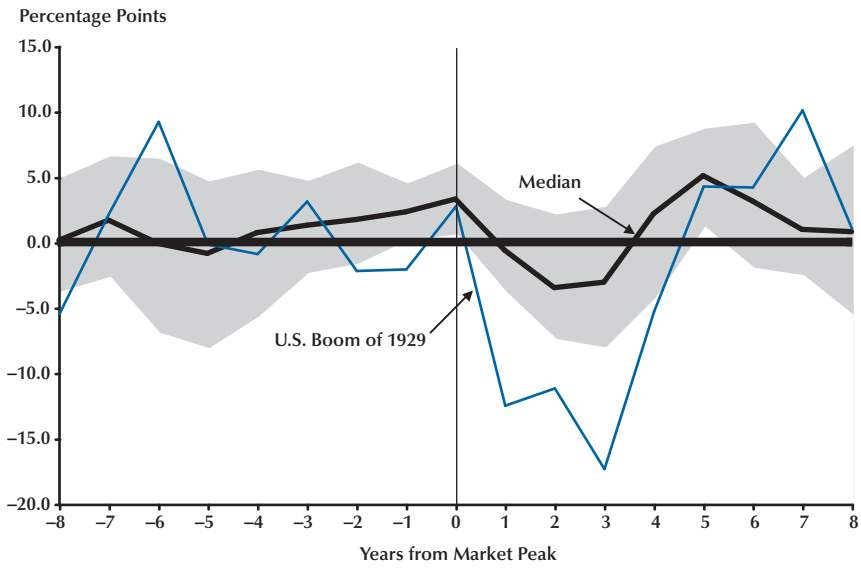
[19] The target had been reduced from 5 percent to 4.75 percent on November 17, 1998. The target was raised to 5 percent on June 30, 1999, and elevated in five more steps to 6.5 percent as of May 16, 2000.

[20] Meyer (2004, pp. 162-63).

[21] The specific ending date of the boom is ambiguous. Although we date the end of the boom as the month that the inflation-adjusted S&P 500 composite index reached its peak (based on monthly averages of daily closing values), the peak in the nonadjusted index occurred on March 24. The dates on which other indices peaked include the Dow Jones industrial average on January 14, the New York Stock Exchange composite index on September 1, and the NASDAQ composite index on March 10.

Figure 7

Real GDP Growth Relative to Its Long-Run Average: Prewar Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

ditions and monetary policy under different monetary and financial regulatory regimes.

Pre-World War II Booms

The stock market booms of 1923-29 and 1994-2000 stand out among all U.S. booms in terms of their length and the extent to which stock prices rose, and they have often been compared to one another. Like the 1990s boom, the U.S. boom of 1923-29 arose during a period of above average economic growth and low inflation. As with the recent boom, in the 1920s, many analysts attributed the booming stock market to advances in technology and business management techniques that promised rapid growth of economic activity and corporate profits.[22] Technological breakthroughs of the late-19th and early-20th centuries, especially in electric power distribution and motors, were widely adopted by American industry in the 1920s (David, 1990). Productivity growth increased sharply, especially in the manufacturing sector. For the private domestic economy as a whole, total factor productivity and labor productivity grew at average annual rates of 2.0 percent and 2.2 percent, respectively, during 1919-29, compared with rates of 1.1 percent and 1.5 percent during 1909-19 and 1.6 and 1.8 percent during 1929-37 (Kendrick, 1961, p. 72).[23]

Figure 7 plots U.S. real GDP growth relative to its long-run average during 1929 (year "0") and the 16 surrounding years.[24] The figure also plots median real GDP growth (relative to its long-run average) across all prewar booms in our dataset, including the U.S. boom of 1923-29. U.S. output growth was especially rapid at the start of the

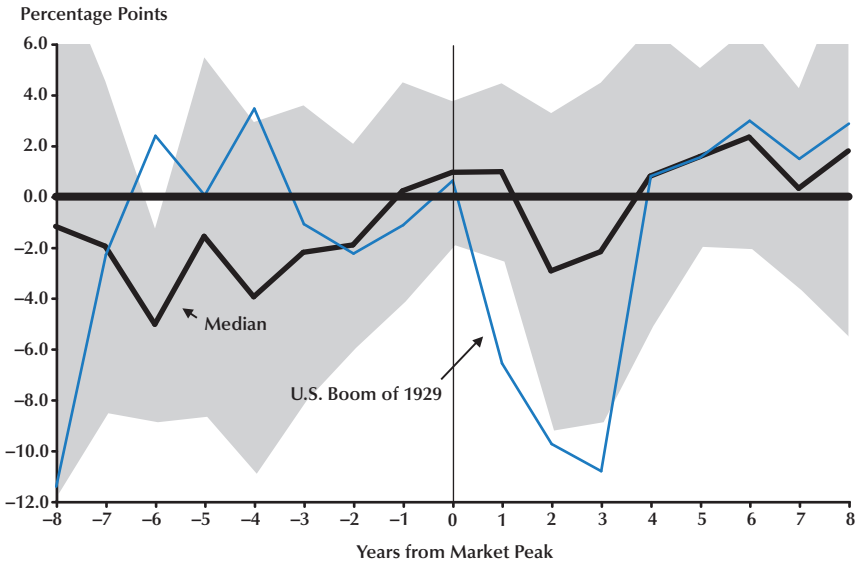
[22] See Bordo and Wheelock (2006) and White (2006) and the references therein.

[23] Annual data suggest, however, that productivity growth was slower toward the end of the 1920s when the stock market boom was in full swing than it had been earlier in the decade. Total factor productivity growth and labor productivity growth averaged 2.6 and 3.0 percent during 1920-24 and 1.3 and 1.7 percent during 1925-29 (Kendrick, 1961, Table A-XXII). Productivity change is, however, more correctly measured between similar points in the business cycle.

[24] We define the long-run average real GDP growth rate as the average annual rate for 1871-1939.

Figure 8

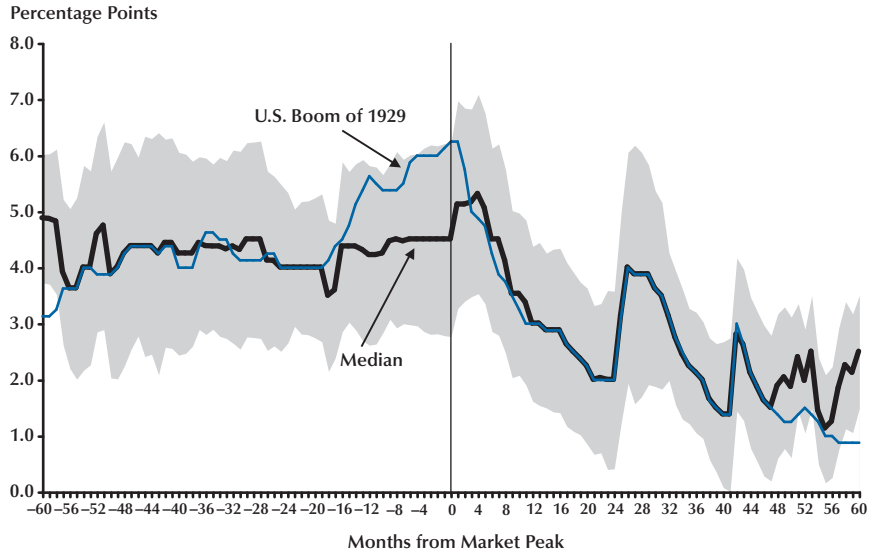
Inflation Rate Relative to Its Long-Run Average: Prewar Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

Figure 9

Commercial Paper Rate: 1920s Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

boom in 1923 (year "–6") and also in 1929 (year "0"), when output growth exceeded its long-run average by 2.8 percentage points. Output growth was below its long-run average, however, in 1927 and 1928.[25] By contrast, median output growth across all booms exceeded its long-run average during both market peak years and the three years preceding the peak.

Figure 8 shows the behavior of inflation during the U.S. boom of 1923-29, as well as the median inflation rate across all prewar booms in our dataset. U.S. inflation was below average during 1926-28 and approximately equal to its long-run average during 1929. The modest increase in the inflation rate during the last year of the boom is similar to the pattern observed during the U.S. boom of 1994-2000 and in the median across all post-1970 booms. Figure 8 also shows an increase in the median rate of inflation toward the end of prewar booms in general. Thus, like the typical post-1970 stock market boom, the typical prewar boom arose when inflation was below average and ended within a year or two of higher inflation.

The Federal Reserve System was established in 1914, and monetary policy was still in its infancy during the 1920s. World War I disrupted the international gold standard, but the United States only briefly suspended gold payments during the war. The Federal Reserve Act required the System to maintain a gold reserve, but by the early 1920s, the Fed's gold reserves were sufficient to allow policymakers to pursue discretionary monetary policy. Fed officials successfully resisted attempts by Congress to impose an explicit inflation objective on the Fed, and Fed officials made few public statements about their policy objectives or tactics. The Fed pursued a strategy aimed at manipulating bank reserves and market interest rates to achieve an evolving set of objectives, which by 1928 included control of the booming stock market.[26]

The Federal Reserve tightened monetary policy aggressively in 1928-29, prompted by the rapid rise in stock prices and a perception that Federal Reserve credit was being used to finance speculative activity. Fed officials viewed speculation in stocks, commodities, and other assets as a manifestation of inflation that called for a tightening of credit conditions.

Figure 9 plots the interest rate on commercial paper of four- to six-month maturity during the stock market boom of 1923-29, as well as the median level of short-term interest rates across all booms of the 1920s in our data set.[27] The figure shows a sharp increase in U.S. short-term interest rates during the 18 months ending in September 1929, coinciding with the Fed's tightening. The median interest rate level across all booms rose much less.

Figure 10 plots the real commercial paper interest rate during the stock market boom of 1923-29 and the median level of interest rates across all booms of the decade. The U.S. real rate increased from an average of 4.7 percent during 1926-27 to an average of 6.0 percent between January 1928 and September 1929. The median across all 1920s booms followed a somewhat different pattern, first declining some 18 months before the stock market peak, then rising in the six months before the market peak.[28]

The Fed's monetary policy tightening of 1928-29 is also evident in the behavior of the money stock. Figure 11 plots the growth rate of the money stock relative to its long-run average during the U.S. boom of 1923-29 and the median growth rate across all prewar booms.[29] U.S. money stock growth fell below its long-run average in 1926 and trended downward to a low point in 1932.

[25] Throughout this article we use annual real GDP data from Maddison (2003), which are adjusted to be comparable across countries. Quarterly estimates of U.S. real gross national product from Balke and Gordon (1986) indicate that output growth exceeded its long-run (i.e., 1875-1939) average by 0.9 percentage points during 1923:Q1–1929:Q3 and by 3.5 percentage points during 1928:Q1–1929:Q3.

[26] See Chandler (1958), Friedman and Schwartz (1963), Meltzer (2003), Wheelock (1991), and Wicker (1966) for discussion and evidence on the Fed's policy objectives and strategy during the 1920s.

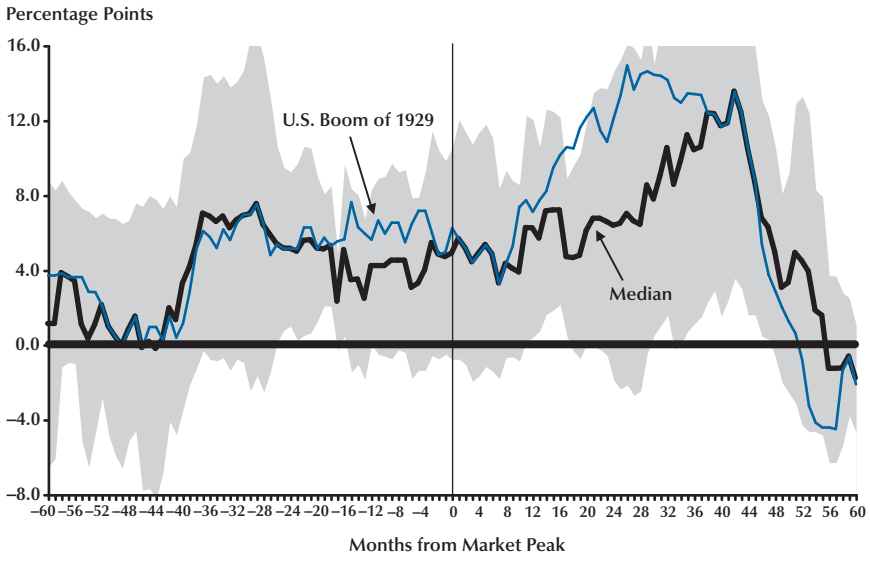
[27] We lack commercial paper rate data for Australia and Canada for the prewar period.

[28] We do not include a figure with the term spread because market yield data on both a short- and long-term government security are not available for many countries during the 1920s. U.S. short-term interest rates rose relative to long-term rates over the 18 months ending in September 1929, with the commercial paper rate rising from about 100 basis points above the long-term U.S. Treasury bond yield to about 250 basis points above the Treasury yield. Hence, the yield curve became increasingly inverted.

[29] Here we define the long-run average money stock growth rate as the average rate during 1881-1939.

Figure 10

Real Commercial Paper Rate: 1920s Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

Figure 12 shows that the growth of the real money stock also declined relative to its long-run average, especially in 1929. By contrast, median nominal and real money stock growth rose during the year of market peaks, as Figures 11 and 12 also show. Thus, the Fed's policy tightening over the 18 months before the stock market peak in September 1929 was considerably more aggressive than the tightening that occurred toward the end of the typical prewar boom.

Although the Federal Reserve provided substantial liquidity following the October 1929 stock market crash, monetary conditions tightened again in 1930 and the U.S. economy plunged into a depression. Real interest rates soared (see Figure 10), and both the nominal and real money stocks collapsed (see Figures 11 and 12). Real GDP and the price level both fell sharply (see Figures 7 and 8). Although concerned about the economy, the Federal Reserve failed to mount an aggressive response to the Depression, in part because policymakers were fearful of reigniting stock market speculation.[30] In the event, the real value of the Standard and Poor's composite stock price index fell some 80 percent from its 1929 peak to its low in 1932.

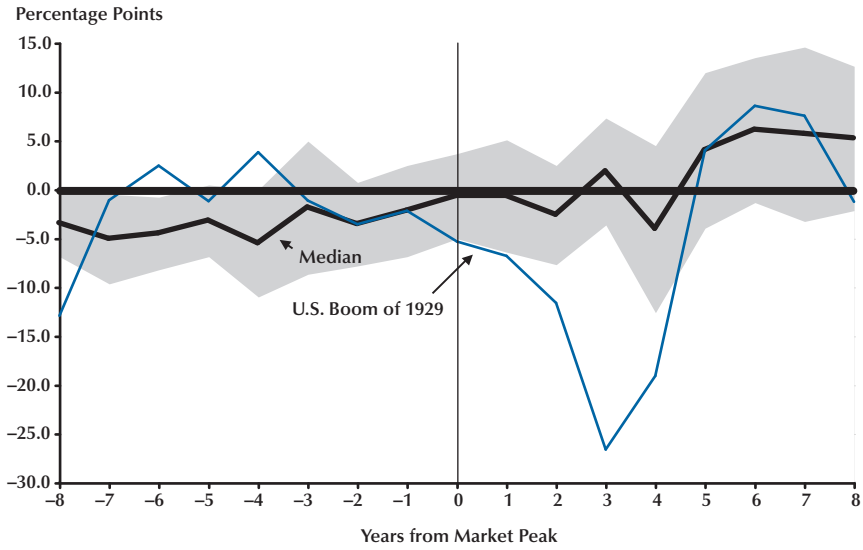
Many countries experienced significant declines in economic activity and stock prices during the Great Depression. Several, including the United States, also experienced a stock market boom as their economies recovered. In many countries, recovery began when their currency was devalued or the country abandoned the gold standard (Eichengreen, 1992). Stock markets recovered and boom periods were characterized by rapid output and money stock growth and moderate inflation.

U.S. stock prices rose rapidly during the mid-1930s: The Standard and Poor's composite index rose at an inflation-adjusted rate of nearly 40 percent per year between March 1935 and February 1937. The boom ended abruptly in early 1937, however, and the U.S. economy entered a recession. Once again, the end of the boom coincided with a tightening of monetary conditions.

[30] See Friedman and Schwartz (1963), Meltzer (2003), and Wheelock (1991 and 1992) and the references therein for explanations of the Fed's behavior during the Great Depression.

Figure 11

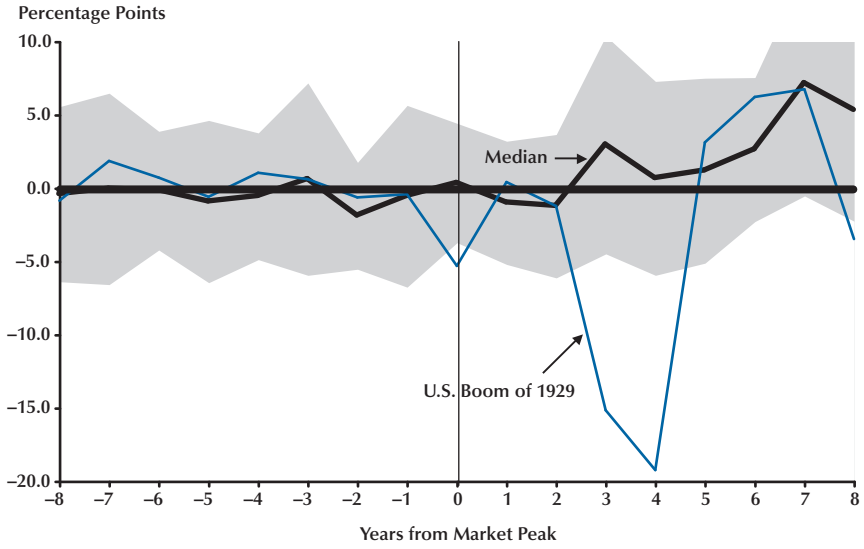
Money Stock Growth Relative to Its Long-Run Average: Prewar Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

Figure 12

Real Money Stock Growth Relative to Its Long-Run Average: Prewar Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

The Federal Reserve had largely stayed on the sidelines as the U.S. economy pulled out of the Depression and the pace of economic activity accelerated. As the recovery continued, however, Fed officials became increasingly concerned about the potential for inflation. Beginning in 1933, gold inflows caused bank reserves and the money stock to grow rapidly, and banks built up huge stocks of reserves in excess of legal requirements. Fed officials feared that the accumulation of excess reserves posed an inflationary threat and took a series of steps to reduce them: The Federal Reserve Board increased reserve requirements by 50 percent in August 1936; the Treasury Department began to neutralize gold inflows in December 1936; and the Fed hiked reserve requirements again on January 30, 1937. Following these actions, money stock growth slowed (from 13 percent in 1936 to 4 percent in 1937), interest rates rose, and the stock market peaked and began to fall as the boom ended.

Early Postwar Booms

We examine stock market booms of the 1950s and 1960s separately from those of the 1970s to 1990s because of sharp differences in the regulatory and monetary regimes that prevailed in the two periods. In addition, for some countries, high-frequency economic and financial data are not available for the 1950s and 1960s.

Many countries adopted new regulations on financial markets and international capital flows in response to the financial disruptions of the Great Depression. The Great Depression also effectively ended the international gold standard, as countries either abandoned the standard altogether or imposed exchange controls that limited its functioning (Eichengreen, 1992). World War II brought even tighter controls, especially in Europe, that included restrictions on the issuance of private securities and the movement of capital across international borders. The postwar international monetary system was defined by the Bretton Woods system of fixed exchange rates and capital controls. Wartime controls were gradually relaxed over time, but deregulation was protracted. The pace of deregulation quickened in the 1970s and 1980s as countries sought to keep their financial markets competitive in the face of advances in information-processing technology that encouraged financial innovation and globalization. At the same time, the international monetary regime changed dramatically with the collapse of the Bretton Woods system in 1971.[31]

The United States experienced two stock market booms during the 1950s and 1960s, one ending in April 1956 and another ending in January 1966. Figure 13 plots data on U.S. real GDP growth relative to its long-run average during these two episodes. The figure also plots the median growth rates across all booms of the 1950s and 1960s in our data set, as well as the mean absolute deviation of observations around the median.

U.S. output growth was highly variable during the boom of 1953-56. As shown in Figure 13, real GDP contracted by almost 1 percent in 1954 (year "–1"), but expanded by nearly 7 percent in 1955 (year "0").[32] Output growth was less variable during the stock market boom of 1962-66 and exceeded its long-run average throughout the period. Output growth exceeded its long-run average by nearly 3 percentage points in 1965 (year "0") and continued to grow rapidly after the peak in the real stock price index in January 1966. Median real GDP growth exceeded its long-run average across all booms of the 1950s and 1960s, and rose during the final two years of booms. Output growth was unusually rapid during the 1950s and 1960s, especially among European countries and Japan. Whereas U.S. output growth fell below its long-run average within a year of the U.S. stock market peaks in April 1956 and January 1966, median output growth remained above its long-run average after the "typical" stock market boom of the 1950s and 1960s had ended.[33]

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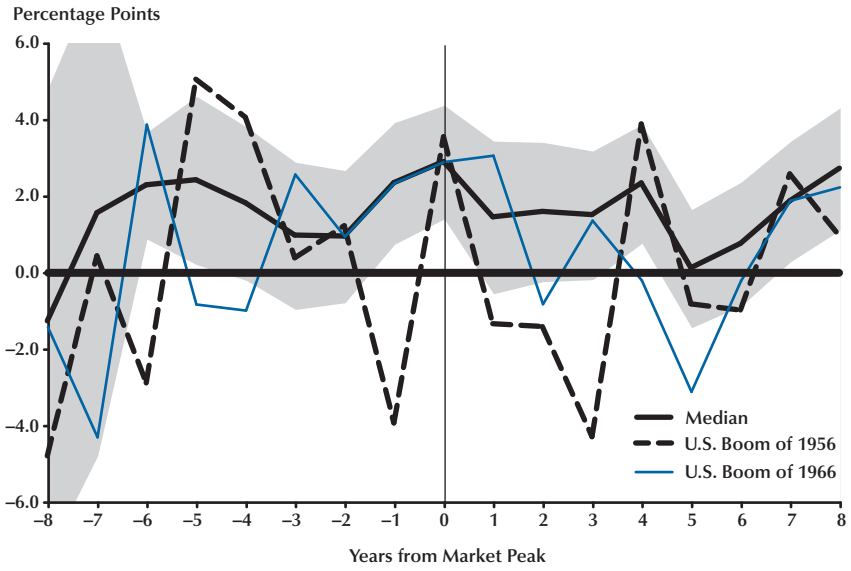
[31] See Bordo and Wheelock (2006) for additional discussion and evidence on changes over time in the coincidence of stock market booms and correlation of stock returns across our sample countries. See also Goetzmann, Li, and Rouwenhorst (2001) and Obstfeld and Taylor (1998) for evidence on the international integration of financial markets throughout the 20th century.

[32] As noted previously, in figures that present annual data, we define year "0" as the year prior to the actual market peak if the peak occurred during the first half of a calendar year.

[33] On the "Golden Age" of European economic growth before 1973, see Crafts and Toniolo (1996).

Figure 13

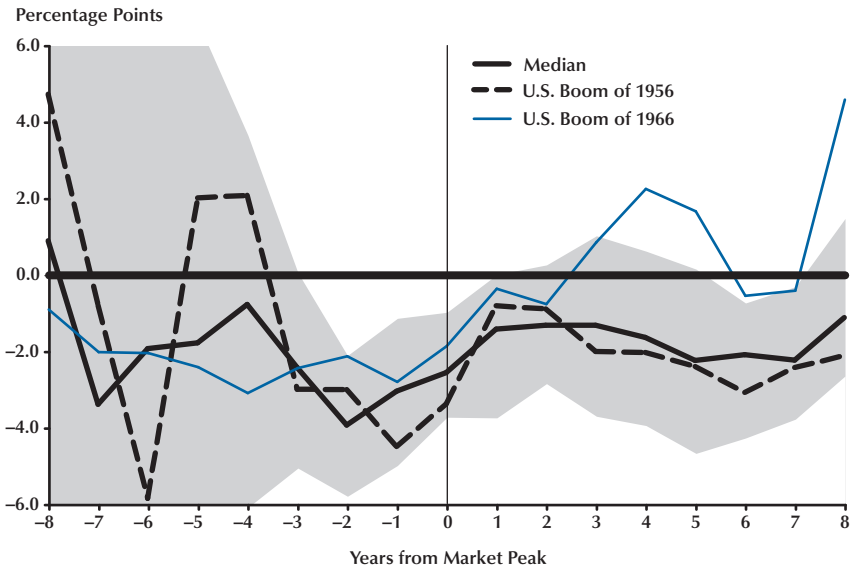
Real GDP Growth Relative to Its Long-Run Average: 1950s-60s Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

Figure 14

Inflation Rate Relative to Its Long-Run Average: 1950s-60s Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

Figure 15

Short-Term Interest Rate Relative to Its Rate in Peak Month: 1950s-60s Booms

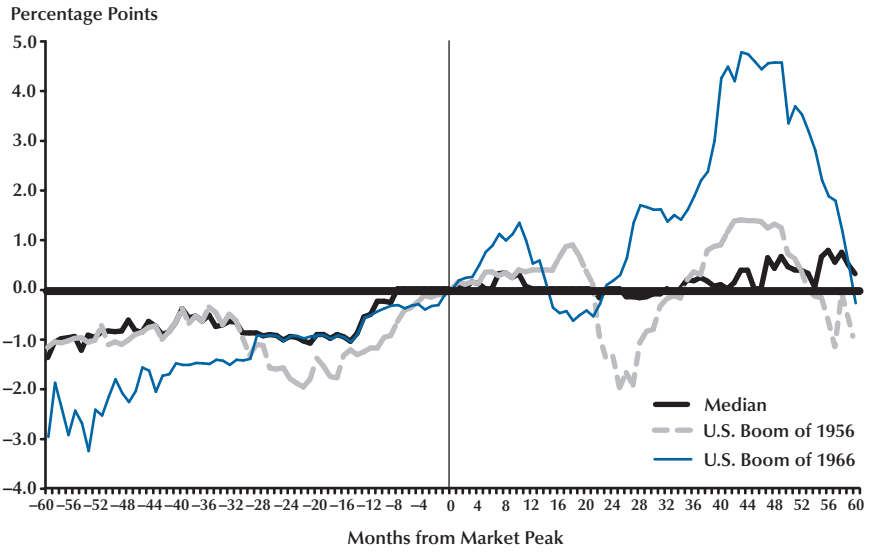


Figure 14 plots inflation rates (relative to their long-run averages) during the two U.S. stock market booms of the 1950s and 1960s, alongside median inflation across all booms of the period and the mean absolute deviation of observations around the median. As during both the prewar and post-1970 periods, during the 1950s and 1960s stock market booms typically arose when inflation was below its long-run average and ended after inflation had risen. The U.S. booms of the 1950s and 1960s were no exception. After a burst of inflation during the Korean War, the U.S. inflation rate stayed below 1 percent per year throughout 1952-55, before rising to 3 percent in 1956-57. Inflation then fell back and remained below 2 percent in each year from 1958 to 1965. Inflation rose again in 1965, however, and reached 3.4 percent in 1966.

Resembling the patterns of both prewar and post-1970 booms, the increases in inflation before the U.S. stock market peaks in 1956 and 1966 were accompanied by higher interest rates and other evidence of monetary tightening. Figure 15 plots data on short-term interest rates during the two U.S. booms and the median across all booms of the 1950s and 1960s.[34] The figures show the level of the interest rate in each month relative to its level in the month when the real stock price index reached its peak (month "0").

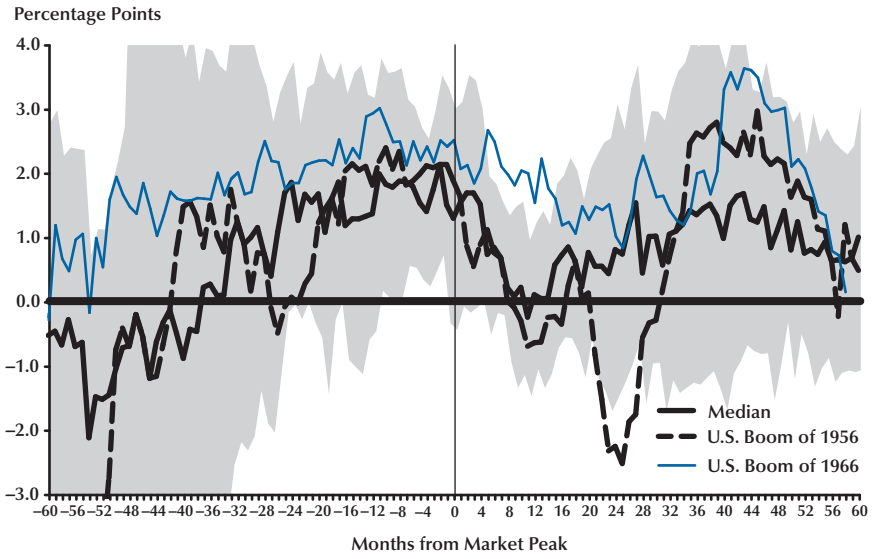
Short-term interest rates rose some 2 percentage points over the 24 months ending in April 1956, reflecting actions by the Federal Reserve to ward off inflation and curb the flow of credit to the stock market. The Fed began a series of tightening steps in 1954 that included open-market operations and hikes in the discount rate and margin requirements.[35] Fed officials continued to focus on inflation during 1955 and 1956 and frequently discussed the importance of preventing inflation from rising. For example, at an FOMC

[34] When available, we use an overnight interest rate, such as the U.S. federal funds rate, in constructing the interest rate series for this period. Otherwise, we use a short-term Treasury security yield. Monthly data on the federal funds rate are not available until July 1954, for example, and so we use the yield on 3-month Treasury bills for earlier months.

[35] The Securities Exchange Act of 1934 empowered the Federal Reserve Board to regulate margin requirements on loans granted by banks and securities firms for the purpose of purchasing or owning stocks. The margin requirement establishes the minimum percentage of a stock purchase that must be self-financed rather than financed by borrowing.

Figure 16

Real Short-Term Interest Rate: 1950s-60s Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

meeting in January 1955, Chairman William McChesney Martin Jr. stated that "[w]hat we are wrestling with at the moment is the possibility that inflationary seeds may be germinating, and that when they come to full bloom it will be difficult to restrain them...We want to nip inflation in the bud" (Federal Open Market Committee, January 11, 1955, pp. 7-8). Martin also expressed concern about the booming stock market, arguing that "we ought to be considering the possibility of another signal to the stock market either through a further increase in the margin or, preferably through the discount rate" (p. 9).

Fed officials expressed concern about the booming stock market throughout 1955, occasionally associating movements in stock prices with general price inflation. For example, at an FOMC meeting in August, Chairman Martin commented that "all danger signals are now flashing red. Inflation is a thief in the night and if we don't act promptly and decisively we will always be behind...A move such as we had in General Motors (stock) of fifteen points in one day would be disastrous if it developed over the whole price level" (Federal Open Market Committee, August 2, 1955, p. 13).

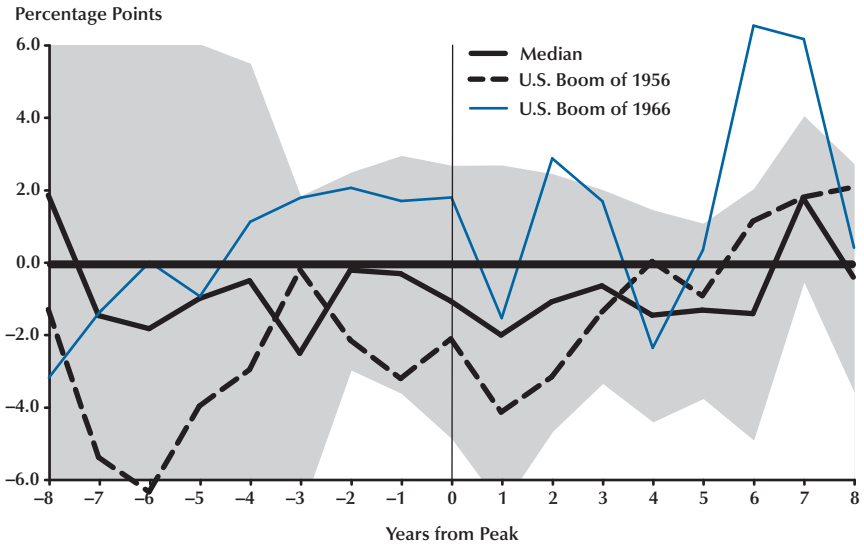
In the event, inflation remained low throughout 1954 and 1955 and, consequently, the increase in short-term interest rates during these years resulted in a similar-sized increase in the real interest rate, as shown in Figure 16. Money stock growth also slowed, as shown in Figure 17, though real money stock growth remained slightly above its long-run average, as shown in Figure 18.[36]

Monetary conditions did not tighten as sharply before the U.S. stock market peak in January 1966 as they had before the April 1956 peak. As shown in Figure 15, the federal funds rate rose by approximately 0.5 percentage points

[36] Calomiris and Wheelock (1998) note a close, negative correlation between the level of free reserves and inflation during the 1950s. Further, they note that growth of the money stock (M1) was positively correlated with the level of free reserves during the 1950s, but not during the 1960s, which could explain the Fed's apparent success in maintaining low inflation during the 1950s, but not during the 1960s. Romer and Romer (2002) find that Fed policy was consistent with the "Taylor principle" during the 1950s, but not during the 1960s, in that movements in the real interest rate were sufficient to stabilize inflation during the 1950s, but not during the 1960s.

Figure 17

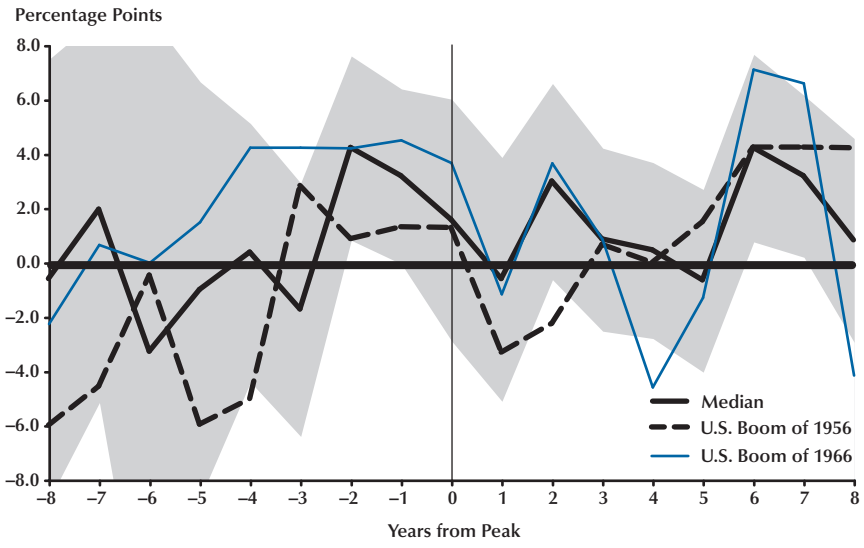
Money Stock Growth Relative to Its Long-Run Average: 1950s-60s Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

Figure 18

Real Money Stock Growth Relative to Its Long-Run Average: 1950s-60s Booms



NOTE: The shaded area comprises the median ± the mean absolute deviation.

in late 1964 (months "–15" to "–13"), but changed little during 1965. The real funds rate, shown in Figure 16, peaked in early 1965 (month "–11"), then declined in the second quarter when inflation began to rise. The real funds rate then changed little over the remainder of the year. Further, both nominal and real money stock growth remained above their long-run average rates during 1965 (year "0" in Figures 17 and 18).

The January 1966 stock market peak did, however, occur shortly after a highly publicized monetary policy action. The increase in inflation in the second quarter of 1965 persisted through the remainder of the year, and by the fourth quarter Fed officials were convinced that monetary policy had to tighten. Memoranda from the FOMC meeting in November state that Chairman Martin argued that "the country was in a period of creeping inflation...In short, he thought the economy was growing too fast at the moment" (FOMC, November 23, 1965, p. 85). Fed officials then took steps to tighten, including a highly publicized discount rate increase in early December that sparked a sharp rebuke from President Johnson.[37] The stock market peak occurred shortly thereafter, and the boom of 1962-66 was over.

Other countries that had booms during the 1950s and 1960s experienced interest rate and money stock growth patterns that were similar to those of the two U.S. booms. The median level of short-term interest rates across all booms rose by 1 percentage point during the 8 to 15 months before stock market peaks. The median real interest rate level fluctuated widely, with little trend during the 24 months before market peaks; but both nominal and real money stock growth declined during the last two years of booms, indicating that some monetary policy tightening preceded the end of the typical boom.

OBSERVATIONS AND CONCLUSIONS

The U.S. stock market boom of 1994-2000 arose during a period of unusually rapid growth of output and productivity and low inflation. Technological advances and higher productivity growth convinced many observers that corporate profits would continue to grow rapidly and justify soaring equity prices. Further, shrinking government budget deficits and low inflation suggested that interest rates would remain low. Eventually, however, inflation began to rise, monetary policy tightened, and the boom ended.

Our review of earlier stock market booms in the United States and nine other developed countries during the 20th century indicates that the patterns observed during the U.S. boom of 1994-2000 were similar to those of earlier booms. Stock market booms typically arose when output growth exceeded its long-run average and when inflation was below its long-run average. There were, however, exceptions. Notably, we find that across all post-1970 booms the median growth rates of real GDP and productivity did not substantially exceed their long-run averages.[38] We find less variation in the association of booms with low inflation than we do in the association of booms with rapid output or productivity growth. Further, we find that both nominal and real money stock growth were typically below average during booms, suggesting that booms did not result from excessive liquidity.[39]

We find that 20th century stock market booms often ended following an increase in inflation and a tightening of monetary conditions. All U.S. booms ended after explicit tightening by the Federal Reserve in response to actual or threatened inflation. The Fed tightened policy in 1928-29 because policymakers believed that asset price appreciation was a form of inflation that required an aggressive response. During subsequent booms,

[37] See Maisel (1973, pp. 69-77).

[38] Bordo and Wheelock (2006) speculate that increased financial globalization since the 1970s may have weakened the connection between stock market performance and domestic output growth in some countries. Further, among European countries, stock market performance in the 1990s may have been heavily influenced by steps taken to integrate national economies, especially monetary union.

[39] Some analysts have argued that asset booms reflect excessive growth of credit. We have been unable to locate data on credit that are comparable across all of the countries in our sample, especially for earlier periods. A cursory review of what data we have obtained, however, shows no consistent association of booms with credit growth.

the Fed's principal goal was to halt an incipient rise in consumer price inflation, though concern about stock market speculation appears to have been a secondary reason for tightening in some cases.

Although the U.S. monetary policy regime changed substantially over time, we find little variation in the association of stock market booms with inflation or in the end of booms with monetary policy actions to control inflation. Even under the gold standard of the 1920s, however, the Fed had considerable latitude in pursuing discretionary monetary policy and conceivably the absence of a clear statement of objectives contributed to instability in asset markets. Recent research suggests that the form of rule used by monetary authorities, including its communication strategies, can influence how policy actions affect economic activity.[40] Additional research is needed, however, to determine whether a clear statement of objectives and strategy to achieve those objectives would alter the association of asset booms with low inflation or the effect that policy actions to control inflation have on asset markets.

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[40] Bordo et al. (2005), for example, examine three major U.S. disinflations since the Civil War and conclude that both policy institutions and central bank communication strategies affect expectations of disinflation and subsequent economic activity.

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APPENDIX

This appendix provides information about the data and sources used in this article. It describes the stock price index data that are used and then provides information about the data used in each figure in the article.

STOCK PRICE INDEX (nominal, monthly data)

For all countries except the United States, the stock price data are from Global Financial Data (www.globalfinancialdata.com). The following lists the Global Financial Data series identifier and description for each country:

Australia:	AORDM, Australia ASX All-Ordinaries
Canada:	GSPTSEM, Canada S&P/TSX 300 Composite
France:	SBF250M, France SBF-250 Index
Germany:	FWBXXM, Germany CDAX Composite Index
Italy:	BCIIM, Banca Commerciale Italiana Index
Japan:	N225M, Japan Nikkei 225 Stock Average
Netherlands:	AAXM, Netherlands All-Share Price Index
Sweden:	SWAVM, Sweden Affarsvarlden General Index
United Kingdom:	FTASM, UK FT-Actuaries All-Share Index
United States:	NBER Macro History Database, series m11025a (1871:01–1920:12); Standard & Poor's 500 Composite Index (1941-43 = 10), monthly average of daily data obtained from Haver Analytics (1921:01–2004:12)

REAL STOCK PRICE (monthly)

We use consumer price index data to deflate nominal stock prices to obtain a real stock price. For all countries except the United States, our consumer price index data are from Global Financial Data. The following lists the Global Financial Data consumer price index series identifier for each country. Monthly observations are available beginning from the month listed in parentheses.

Australia:	CPAUSM (1912:01)
Canada:	CPCANM (1914:01)
France:	CPFRAM (1915:01)
Germany:	CPDEUM (1923:12)
Italy:	CPITAM (1920:01)
Japan:	CPJPNM (1922:01)
Netherlands:	CPNLDM (1919:01)
Sweden:	CPSWEM (1916:01)
United Kingdom:	CPGBRM (1914:01)
United States:	BLS, series ID: CUUR0000SA0, CPI–all urban consumers, U.S. city average, all items, not seasonally adjusted, 1982-84 = 100 (1913:01–2004:12)

NOTES ABOUT THE FIGURES

We compute all growth rates using log first differencing, unless otherwise noted. For all figures displaying annual data, if the peak month of a boom occurred in the first six months of a year, we

attribute the peak to the prior calendar year. Otherwise, we attribute the peak to the calendar year that it occurred. For figures displaying monthly or quarterly data, we attribute the peak to the actual month or quarter that it occurred.

Figure 1

Real GDP: Quarterly data were downloaded from the OECD (Organisation for Economic Co-operation and Development) NEQ database of Haver Analytics. Data are available beginning in the quarter listed in parentheses: Australia (1960:Q1); Canada (1961:Q1); France (1978:Q1); Germany (1991:Q1); Italy (1980:Q1); Japan (1980:Q1); Netherlands (1977:Q1); Sweden (1980:Q1); United Kingdom (1960:Q1); United States (1960:Q1). We compute growth rates as year-over-year growth rates for each quarter. We define the long-run average growth rate as the average growth rate for 1960-2001, calculated using the annual data from Maddison (2003, Tables 1B, 2B, and 5B).

Figure 2

Labor Productivity: Annual data on GDP per hour worked obtained from the OECD productivity database (July 2005). The data for all countries span the years 1970-2004. We define the long-run average growth rate as the average growth rate for 1970-2004.

Figures 3, 8, and 14

Inflation: The sources for consumer price index data are listed above. We compute annual inflation rates by averaging annualized monthly growth rates. For booms ending prior to 1940, we define the long-run average growth rate as the average growth rate from the first available observation through 1939 (first available observations: Australia, 1902; Canada, 1911; France, 1872; Germany, 1924; Italy, 1871; Japan, 1871; Netherlands, 1882; Sweden, 1871; United Kingdom, 1871; United States, 1870). For booms ending after 1940, we define the long-run average growth rate as the average growth rate for 1947-2004.

Figure 4

Short-Term Interest Rate: Except as noted, monthly data on an overnight interest rate were downloaded from the International Financial Statistics (IFS) database of the International Monetary Fund. The IFS series identifier and description are listed below. The month of the first available observation is listed in parentheses.

Australia:	C193IM, short-term, weighted average of loans outstanding (1969:07)
Canada:	C156IM, money market (MMkt) overnight financing rate (1975:01)
France:	C132IM, MMkt opening rate: day-to-day loans against private bills (1965:01)
Germany:	C134IM, interbank overnight (1965:01)
Italy:	C136IM, 3-month interbank deposits, daily average (1971:01)
Japan:	C158IM, Tokyo overnight call money (1965:01)
Netherlands:	C138IM, MMkt rate on bankers' call loans (1965:01–1998:12)
Sweden:	C144IM, day-to-day interbank loans (1965:12)
United Kingdom:	C112IM, interbank overnight offer rate (1972:01)
United States:	C111IM, interbank overnight federal funds (1965:01)

Figure 5

Real Interest Rate: We compute the real short-term interest rate as the difference between the nominal short-term interest rate and CPI growth in the given month, and we compute CPI growth as the year-over-

year change in the CPI for that month. Monthly data are from sources listed above. Monthly data on government security yields were downloaded from the IFS database. The IFS series identifier and description are listed below.

Figure 6

Interest Rate Term Spread: We compute the term spread as the difference between the yields on long-term government securities and the short-term interest rate used to construct Figure 4. Monthly data on government security yields were downloaded from the IFS database. The IFS series identifier and description are listed below.

Australia:	C193IB, 10-year government nonrebate bond yield
Canada:	C156IB, 10-or-more-year government bond yield to maturity
France:	C132IB, 5-or-more-year government bond yield to maturity
Germany:	C134IB, 3-or-more-year government & agency bond yield, weighted average
Italy:	C136IB, 9-to-10-year government bond yield
Japan:	C158IB, yield to maturity of all ordinary government bonds
Netherlands:	C138IB, 10-year government bond yield: most recent bond
Sweden:	C144IB, 9-year government bond yield
United Kingdom:	C112IB, 20-year government bonds issued at par
United States:	C111IB, 10-year government bond yield at constant maturity

Figures 7 and 13

Real GDP: Data are from Maddison (2003, Tables 1B, 2B, and 5B) for 1871-2001 and the OECD for 2001-04. For booms ending prior to 1940, we define the long-run average growth rate as the average growth rate for 1871-1939. For booms ending after 1940, we define the long-run average growth rate as the average growth rate for 1960-2001.

Figures 9 and 10

Commercial Paper Interest Rate: Monthly data were obtained from Global Financial Data, except as noted. There are no data for Australia, Canada, or Germany for the prewar period, and hence the medians plotted in the figure exclude these countries. The following lists the Global Financial Data series identifier and description for each country. Data availability is listed in parentheses.

France:	IPFRAW, private discount rate (1922:01–1940:06)
Italy:	IPITAW, private discount rate (1922:01–1939:09)
Japan:	IPJPN3D, private bills 3-month discount rate (1900:01–1945:06)
Netherlands:	IPNLDW, private discount rate/advances (1919:01–1940:05)
Sweden:	IPSWEW, private discount rate (1926:01–1941:12)
United Kingdom:	IPGBR3D, U.K. private discount rate (1900:01–2004:12)
United States:	U.S. commercial paper interest rate (4- to 6-month), Federal Reserve Board, *Banking and Monetary Statistics* (1943, Table 120, pp. 450-51) (1919:01–1941:12)

Figures 11 and 17

Money Stock: Except as noted below, our data are for a broad money stock measure and come from Bordo et al. (2001, Appendix A). Recent data, which we obtained from Haver Analytics, are from the OECD. Data for euro area countries end in 1998. We do not include these countries in the calculation of median growth rates after 1998. For booms ending prior to 1940, we define the long-run average

growth rate as the average growth rate for 1881-1939. For booms ending after 1940, we define the long-run average growth rate as the average growth rate for 1947-2004.

Australia:	Haver Analytics series C193FM3@OECDMEI, M3 (1998-2004)
Canada:	Haver Analytics series C156FM1@OECDMEI, M1 (1996-2004)
France:	Haver Analytics series C132FM3@OECDMEI, M3 (1990-1998)
Germany:	Haver Analytics series C134FM2@OECDMEI, M2 (1990-1998)
Italy:	Haver Analytics series C136FM2@OECDMEI, M2 (1996-1998)
Japan:	Haver Analytics series C158FM2@OECDMEI, M2 + CDs (1998-2004)
Netherlands:	Haver Analytics series C138FM3N@OECDMEI, M3 (1990-1998)
Sweden:	Haver Analytics series C144FM3N@OECDMEI, M3 (1996-2004)
United Kingdom:	Haver Analytics series C112FM4@OECDMEI, M4 (1998-2004)
United States:	Friedman and Schwartz (1963, Table A1, column 8) (1882-1959); Haver Analytics series C111FM2@OECDMEI, M2 (1960-2004)

Figures 12 and 18

Real Money Stock: We compute real money stock growth as the difference between the growth rates of the nominal money stock and consumer price index. For booms ending prior to 1940, we define the long-run average growth rate as the average growth rate from the first available observation through 1939 (first available observations: Australia, 1902; Canada, 1911; France, 1881; Germany, 1926; Italy, 1881; Japan, 1881; Netherlands, 1882; Sweden, 1881; United Kingdom, 1881; United States, 1881). For booms ending after 1940, we define the long-run average growth rate as the average growth rate for 1947-2004.

Figures 15 and 16

Short-Term Interest Rate: Except as noted, monthly data on an overnight interest rate and/or Treasury bill rate were obtained from Global Financial Data. The following lists the Global Financial Data series identifier and description for each country. Data availability is listed in parentheses.

Australia:	ITAUS3D, 3-month T-bill yield (1928:07–2004:12)
Canada:	ITCAN3D, 3-month T-bill yield (1934:03–1956:12); IMCAND, overnight MMkt rate (1957:01–2004:12)
France:	ITFRA3D, 3-month T-bill yield (1931:01–1936:04; 2002:01–2004:12); IMFRAD, call money rate (1936:05–2001:12)
Germany:	ITDEUM, 3-month T-bill yield (1953:01–1954:02; 2002:01–2004:12); IMDEUD, call money rate (1954:03–2001:12)
Italy:	ITITA3M, 3-month T-bill yield (1946:04–1978:05; 2002:01–2004:12); IMITAD, interbank overnight rate (1978:06–2001:12)
Japan:	IMJPND, overnight lending rate (1949:01–2004:12)
Netherlands:	IMNLDD, overnight interbank rate (1929:01–2001:12); ITNLDD, 3-month T-bill yield (2002:01–2004:12)
Sweden:	ITSWE3D, 3-month T-bill yield (1955:01–1965:07); IMSWED, overnight interbank rate (1965:08–2004:12)
United Kingdom:	IMGBRD, overnight interbank rate (1945:12–2004:12)
United States:	ITUSA3SD, 90-day T-bill secondary market (1920:01–1954:06); overnight federal funds rate, Federal Reserve Bank of St. Louis FREDII database (1954:07–2004:12)

Trends in Neighborhood-Level Unemployment in the United States: 1980 to 2000

Christopher H. Wheeler

Although the average rate of unemployment across U.S. metropolitan areas declined between 1980 and 2000, the geographic concentration of the unemployed rose sharply over this period. That is, residential neighborhoods throughout the nation's metropolitan areas became increasingly divided into high- and low-unemployment areas. This paper documents this trend using data on more than 165,000 U.S. Census block groups (neighborhoods) in 361 metropolitan areas over the years 1980, 1990, and 2000; it also examines three potential explanations: (i) urban decentralization, (ii) industrial shifts and declining unionization, and (iii) increasing segregation by income and education. The results offer little support for either of the first two explanations. Rising residential concentration of the unemployed shows little association with changes in population density, industrial composition, or union activity. It does, however, show a significant association with both the degree of segregation according to income as well as education, suggesting that decreases in the extent to which individuals with different levels of income and education live in the same neighborhood may help account for this trend. (JEL J11, J64, R20, R23)

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The rate of unemployment is one of the most basic indicators used to gauge the state of the economy. High rates, of course, tend to occur in recessionary periods when levels of economic activity decline, whereas lower rates tend to prevail in times of expansion when employers typically increase the size of their payrolls. Over time, as the economy fluctuates between periods of expansion and recession, we see corresponding changes in the rate of unemployment.

Although this temporal variation in unemployment is widely known, there is also a fair amount of variation geographically. At any point in time, unemployment can differ substantially across states, cities, and counties as a result of differences in industrial compositions, labor market demographics, and region-specific shocks.

Geographic variation even extends down to extremely small areas: Census tracts and block groups (i.e., neighborhoods).[1] Hence, within the same metropolitan area, some neighborhoods have a much higher incidence of unemployment than others.

To be sure, residential areas in the United States have long exhibited a tremendous amount of heterogeneity with respect to the characteristics of the households that inhabit them. Some neighborhoods, quite simply, tend to be populated by households with high levels of income and wealth, whereas others are inhabited by relatively poor households. It is therefore not at all surprising that, within any local labor market, there would be neighborhoods with high levels of unemployment and those with low levels.

[1] As noted here, these are extremely small areas. In the year 2000, tracts encompassed roughly 1.3 square miles and 1,600 households on average, whereas block groups averaged approximately 0.33 square miles and 500 households.

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However, what is particularly interesting about the extent to which individuals sort themselves by characteristics, such as the incidence of unemployment, concerns the potential implications for various labor market outcomes. In particular, a large literature examining "social interactions" has argued that the characteristics of individuals' residential areas greatly influence their economic outcomes. Case and Katz (1991), for instance, find strong peer effects characterizing a variety of behaviors, including criminal activity, drug and alcohol use, schooling, and employment status within a sample of residential areas in Boston. Similarly, Topa (2001) finds evidence of local spillovers in unemployment across Census tracts in Chicago: High levels of unemployment within a neighborhood tend to have a negative influence on the employment prospects of individuals residing within or near that neighborhood. Wilson (1987) suggests that neighborhood effects of this sort form the basis of the rise in inner city poverty in the United States in recent decades. As successful workers have gradually left inner cities, those who remain are surrounded by rising levels of poverty and joblessness, which makes it increasingly less likely that the residents of these areas will find work.

Understanding the extent to which individuals are segregated, therefore, is an important topic. However, although existing research has looked at residential segregation based on race (e.g., Cutler, Glaeser, and Vigdor, 1999) and income (e.g., Wheeler, 2006), relatively little work has studied the segregation of the unemployed from the employed.[2]

This paper seeks to do so by examining the distribution of unemployment across metropolitan area–level neighborhoods, defined by Census block groups, over the years 1980, 1990, and 2000. The primary findings indicate that the extent to which unemployed workers are concentrated residentially increased dramatically over this period. For example, in 1980, the 90th percentile of the distribution of neighborhood unemployment rates averaged 11 percent over the 361 U.S. metropolitan areas in the sample, whereas the 10th percentile averaged 3.7 percent. By 2000, the 90th percentile had risen to 12.5 percent while the 10th percentile had dropped to 1.3 percent, suggesting that neighborhoods in the United States have become increasingly polarized into high- and low-unemployment areas.[3]

What accounts for this trend? Although these are not intended to be a comprehensive set of potential explanations, I consider three possibilities. First, the process of urban decentralization (i.e., the gradual movement of metropolitan populations in the United States from central cities to suburban locales) may have reduced the employment opportunities of households that continue to reside in historical city centers. That is, just as Wilson (1987) has argued, sprawl may have created a steadily rising gap between rates of unemployment in central cities and those in suburbs. Second, changes in the labor market, such as declining union activity and the shift of employment away from manufacturing toward other sectors, may have reduced the employment opportunities for workers in particular neighborhoods more so than it has for others. For instance, if a city's low- to middle-income neighborhoods are populated primarily by manufacturing workers, whereas the residents of its high-income neighborhoods are employed in professional services, a decline in the manufacturing sector (or a rise in the professional services sector) may result in a rising differential between neighborhood unemployment rates. Third, there may have been an increase in the extent to which skilled and unskilled workers are segregated across residential areas. That is, independent of either urban decentralization or shifts in union and industrial activity, the degree to which high- and low-skill workers live in the same neighborhoods may have decreased over time, thus leading to rising concentration of unemployment.

To summarize briefly, the findings offer little support for either of the first two explanations.

[2] The studies surveyed above, especially Case and Katz (1991) and Topa (2001), focus on estimating the strength of peer effects rather than documenting the evolution of segregation.

[3] These are unweighted statistics. If the percentiles are calculated by weighting each neighborhood by the size of its labor force, the average 90th percentile increased from 10.7 to 11.2 percent over this period while the 10th percentile dropped from 3.8 to 1.5 percent.

The change in the amount of unemployment concentration across neighborhoods shows little association with changes in population density (a proxy for urban decentralization), changes in the local rate of union coverage, or changes in the shares of employment accounted for by nine broad industrial sectors (including manufacturing). The results do, however, reveal a strong positive association between unemployment concentration and measures of segregation according to income and (college) education across neighborhoods. As such, the findings suggest that rising concentration of unemployment is related to an increase in the extent to which households have sorted themselves residentially by income and education.

DATA AND MEASUREMENT

The data are taken from the decennial U.S. Census of Population as compiled by GeoLytics.[4] These files identify a variety of characteristics of the households residing in a host of geographic units, including counties, tracts, and neighborhoods, throughout the entire country. The primary advantage of the GeoLytics files is the consistency of the spatial units for which the data are identified: GeoLytics maintains a constant set of definitions in computing aggregate statistics for neighborhoods, tracts, counties, and all other geographic entities. As a result, the statistics reported for each spatial unit are directly comparable from one year to the next.

From these data, I create a number of variables at the metropolitan area–level, including population demographics, density (i.e., residents per square mile), and industrial composition. I also construct a rate of union coverage for each metropolitan area using the state-level rates reported by Hirsch, Macpherson, and Vroman (2001).[5] These quantities are intended to help identify the characteristics that are associated with changes in the geographic distribution of unemployment within a city.[6]

The primary object of interest—the degree to which unemployment is spatially concentrated—is measured in two fundamental ways. First, I compute the differences between three percentiles (90th, 50th, and 10th) of the distribution of neighborhood-level unemployment rates.[7] Higher values of these three differentials (90-10, 90-50, 50-10) indicate greater disparity (i.e., higher concentration) among neighborhood-level unemployment rates.

Second, I calculate an index of dissimilarity, which measures the degree to which the members of a particular group (in this case, unemployed individuals) are unevenly distributed throughout a city's neighborhoods. This index is given as follows:

$$(1) \quad Dissimilarity = \frac{1}{2}\sum_{i=1}^{N}\left|\frac{unemp_i}{unemp_{total}} - \frac{emp_i}{emp_{total}}\right|,$$

where $unemp_i$ is the number of unemployed individuals in neighborhood i, $unemp_{total}$ is the number of unemployed individuals in the metropolitan area, emp_i is the number of employed individuals in neighborhood i, emp_{total} is the number of employed individuals in the metropolitan area, and N is the total number of neighborhoods in the metropolitan area.

As described by Cutler, Glaeser, and Vigdor (1999), the index of dissimilarity ranges between 0 (least concentrated) and 1 (most concentrated) and is commonly interpreted as the fraction of unemployed individuals that would need to move (i.e., change neighborhood of residence) in order for the unemployed to be uniformly distributed across a city's neighborhoods. This particular metric has been widely used in the literature studying trends in racial segregation, but it can be applied readily to the analysis of segregation based on any binary indicator.

[4] More information about these data is available at www.geolytics.com.

[5] These data are available at www.unionstats.com. Metropolitan area–level unionization rates are calculated as weighted averages of the state-level rates, where the weights are given by the fraction of each metro area's labor force located in each state.

[6] Metropolitan areas are the local labor markets examined throughout the analysis. The terms "city" and "metropolitan area" are used interchangeably for expositional purposes.

[7] The 90th percentile, for example, represents the unemployment rate that is greater than the unemployment rates of 90 percent of the neighborhoods.

Table 1

Summary Statistics: Unemployment Concentration

Year	Variable	Mean	Standard deviation	Minimum	Maximum
1980	Dissimilarity	0.18	0.04	0.047	0.3
	90-10 Difference	0.073	0.029	0.007	0.18
	90-50 Difference	0.046	0.022	0.001	0.126
	50-10 Difference	0.027	0.011	0.005	0.082
	90th Percentile	0.11	0.038	0.03	0.252
	50th Percentile	0.064	0.022	0.019	0.147
	10th Percentile	0.037	0.017	0	0.106
1990	Dissimilarity	0.27	0.04	0.16	0.38
	90-10 Difference	0.113	0.039	0.051	0.268
	90-50 Difference	0.074	0.03	0.025	0.211
	50-10 Difference	0.039	0.013	0.016	0.097
	90th Percentile	0.131	0.043	0.051	0.303
	50th Percentile	0.057	0.018	0.026	0.137
	10th Percentile	0.018	0.009	0	0.052
2000	Dissimilarity	0.31	0.05	0.15	0.5
	90-10 Difference	0.112	0.037	0.049	0.271
	90-50 Difference	0.076	0.029	0.031	0.206
	50-10 Difference	0.037	0.012	0.015	0.092
	90th Percentile	0.125	0.042	0.054	0.3
	50th Percentile	0.049	0.018	0.022	0.132
	10th Percentile	0.013	0.009	0	0.047

NOTE: Unweighted statistics calculated from 361 metropolitan areas in each year.

I define neighborhoods as block groups, which are the smallest geography for which detailed Census data are publicly available. As noted here previously, block groups are quite small: In the year 2000, they averaged approximately 500 households and covered roughly a third of a square mile. Households within the same neighborhood, then, can reasonably be expected to have some sort of interaction with one another (e.g., passing on the street). Conceptually, this feature of neighborhoods matches well with the theoretical literature on neighborhood effects (e.g., Benabou, 1993), which treats neighborhoods as areas over which economic agents come into contact with one another.

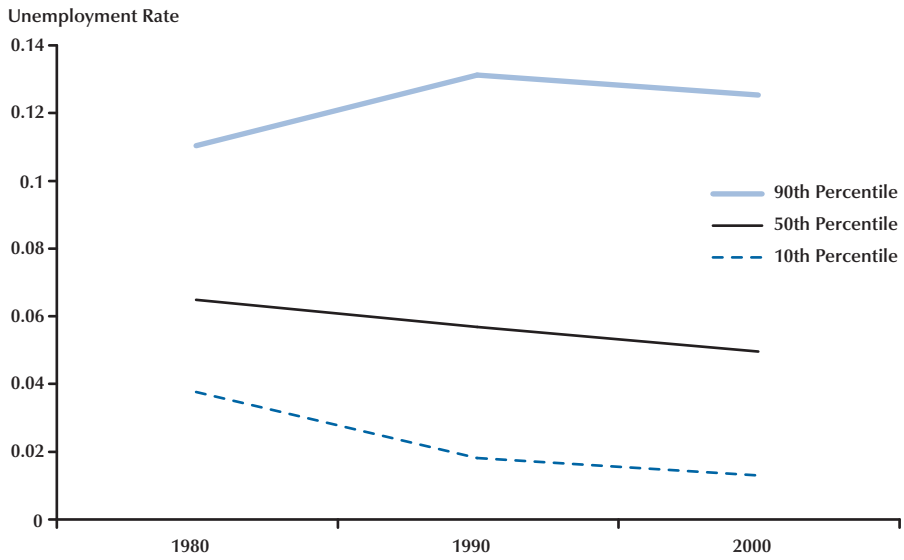
BASIC TRENDS

Between 1980 and 2000, the unemployed became increasingly concentrated in relatively few residential areas. For example, in 1980, the median unemployed worker lived in a neighborhood with an unemployment rate of 7.5 percent (i.e., the unemployment rate within a worker's own neighborhood of residence was 7.5 percent or greater for at least 50 percent of all unemployed workers).[8] Two decades later, the median unemployed worker lived in a neighborhood with an unemployment

[8] This figure is calculated by taking a weighted median across all neighborhoods within a metropolitan area, where the weights are the number of unemployed individuals within each neighborhood.

Figure 1

Neighborhood Unemployment Percentiles



rate of 7.9 percent. This trend is particularly striking in light of the fact that the average metropolitan area unemployment rate declined from 6.9 percent to 5.9 percent over this period.

Rising residential concentration of the unemployed is also apparent from the index of dissimilarity (1) and the percentile differentials. Summary statistics appear in Table 1.[9] On average, the dissimilarity index increased from 0.18 in 1980 to 0.31 in 2000. Again, interpreting this index as the fraction of unemployed workers that would need to relocate in order for the unemployed to be uniformly distributed in a metropolitan area, these results reveal an enormous increase in the concentration of unemployment. An additional 13 percent of all unemployed workers would have needed to relocate in 2000 to equalize unemployment across all neighborhoods.

The percentile differences reveal a qualitatively similar pattern. In 1980, the average difference between the neighborhoods at the 90th and 10th percentiles of the unemployment distribution was 7.3 percentage points. Two decades later, the difference was 11.2 percentage points. Based on the 90-50 and 50-10 differences, it is clear that this increase occurred at both the top and bottom of the neighborhood unemployment distribution, although the majority of the increase in the 90-10 gap was associated with an increase of the 90th percentile relative to the median. The average 90-50 gap increased by 3 percentage points between 1980 and 2000, whereas the mean 50-10 gap increased by 1 percentage point.

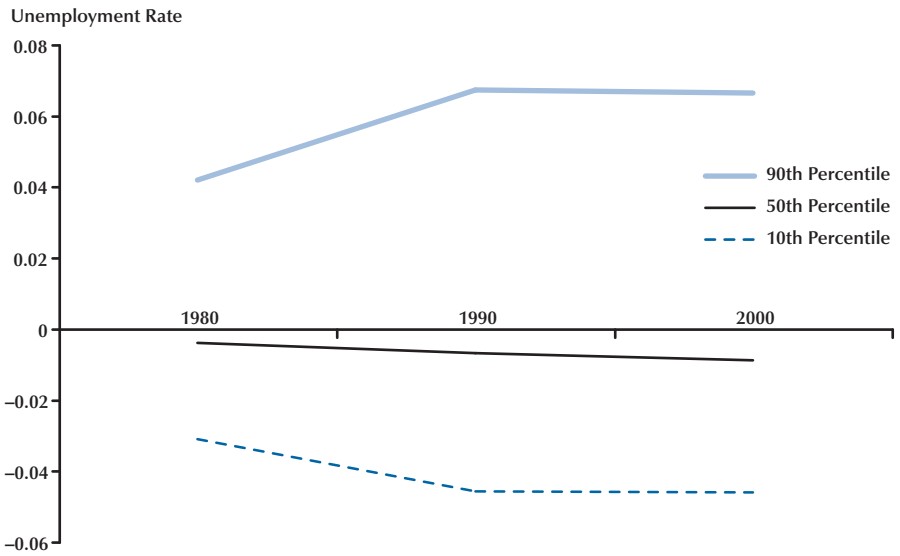
Figure 1 plots the average values of the 90th, 50th, and 10th percentiles between 1980 and 2000. Much of the widening of neighborhood unemployment distributions within the urban areas of the United States took place between 1980 and 1990, when the average 90th percentile increased while the 50th and 10th percentiles decreased. Between 1990 and 2000, all three percentiles actually decreased by similar amounts, leaving the three differentials mostly unchanged between 1990 and 2000.[10]

[9] A list of the metropolitan areas in the sample appears in the appendix.

[10] The decrease in each percentile is very likely associated with the general decrease in unemployment during the 1990s. Recall, the average metropolitan area–level unemployment rate decreased from 6.4 percent to 5.9 percent between 1990 and 2000.

Figure 2

Normalized Neighborhood Unemployment Percentiles



Although doing so does not influence the magnitudes of the percentile differences, it is also worthwhile to examine the evolution of each unemployment percentile after controlling for each metropolitan area's overall unemployment rate. That is, Figure 1 may be somewhat difficult to interpret because the percentiles may be higher (or lower) in one year than another simply because overall rates of unemployment have risen (or fallen). As an alternative, I calculate a set of "normalized" percentiles by taking the deviations of each metro area's percentiles from its overall rate of unemployment. That is, instead of reporting the three raw percentiles, I report each percentile minus the unemployment rate for the entire metropolitan area. The averages of these normalized percentiles appear in Figure 2. What they show, of course, is very much the same pattern: an increase in the rate of unemployment among neighborhoods with already high levels of unemployment and a decrease among neighborhoods with already low levels.[11]

[11] The normalized 90th, 50th, and 10th percentiles were 0.042, –0.004, and –0.031, respectively, in 1980. In 2000, they were 0.066, –0.009, and –0.046.

SOME POSSIBLE EXPLANATIONS

What might account for the increase in the geographic concentration of unemployment? This section considers three straightforward hypotheses that might help to explain this trend: the movement of city populations toward suburban areas (sprawl), changes in industrial composition and union activity, and rising segregation of individuals by income and education.

Sprawl

One of the most prominent theories in urban economics over the past half century suggests that the movement of population and employment away from city centers toward suburban locales has created an underclass of unemployed workers in central cities. This idea, known widely as the spatial mismatch hypothesis, was first studied by Kain (1968).

The basic rationale behind this theory is straightforward. As city populations and employers move away from traditional central business districts, it becomes more difficult for workers who choose to remain in those central cities to

find and secure jobs. Increased spatial isolation from employment opportunities, presumably, increases commuting costs and makes the job search process more difficult. In addition, increased distance may limit access to information about available jobs or create negative attitudes about central city workers among employers. Thus, as employers move farther away, it becomes less likely that the residents of historical city centers will be able to locate and maintain a job.

Although somewhat mixed, the evidence does provide some support for this idea. Weinberg (2000) finds that job centralization, measured by the fraction of jobs located within the central city of a metropolitan area (relative to the fraction of residents in the central city), is strongly, positively associated with the employment rate of black workers. These workers, on average, represent large fractions of central-city dwellers. Ihlanfeldt and Sjoquist (1989) find that the earnings of both black and white low-skill workers tend to decrease with job decentralization, which is consistent with the idea that sprawl has made it more difficult for individuals in certain neighborhoods to find work.

Quantifying sprawl, however, tends to be somewhat difficult because the term does not have a precise definition. There are, of course, a variety of measures that attempt to capture the basic concept that individuals and employers move from dense cores toward less-populated suburban peripheries. Such measures include the fraction of a metropolitan area's population or employment located in a central city, the fraction within certain distances of the historical city center, or overall metropolitan area density. As it happens, many of these measures turn out to be positively correlated with one another (see Glaeser and Kahn, 2004).

In this paper, I quantify urban decentralization within a metropolitan area using population density, which is constructed as a weighted average of neighborhood-level densities. The weights in this case are given by each neighborhood's share of total metropolitan area population. Hence, a metropolitan area's density is taken to be the density of the neighborhood in which the average resident lives. Because suburban locales tend to have much lower residential densities than urban cores, lower levels of population density ought to be associated with more extensive sprawl.[12]

Summary statistics describing levels of population density among the 361 metropolitan areas in the sample in each year appear in Table 2. Between 1980 and 2000, the average metropolitan area saw its density decrease from 3,080 to 3,004 residents per square mile. Although average density did increase slightly during the 1980s, it dropped during the 1990s, leaving the residential density faced by a typical metropolitan resident lower in 2000 than in two decades earlier.[13] This pattern is generally consistent with the long-standing trend for U.S. populations to spread out geographically.

Industrial Shifts and Unionization

The past several decades have been characterized by decreasing employment in certain sectors, but increasing employment in others. Most notably, manufacturing employment has decreased while service employment has increased. In addition, rates of unionization have fallen substantially.

Some of these changes can be seen in the summary statistics reported in Table 2. Between 1980 and 2000, the average share of manufacturing in total employment declined from 22 percent to 14 percent across the 361 metropolitan areas in the sample, whereas the fractions of workers employed in education and health services rose from 17 percent to 20 percent. Rates of unionization decreased from an average of 24 percent in 1980 to 14 percent in 2000.

How might these changes influence the geographic distribution of unemployment within a metropolitan area? If workers in certain neighborhoods tend to be employed in similar types of industries, or if unionization is relatively con-

[12] In the year 2000, the average central city population density was 2,716 residents per square mile. Suburban densities that year averaged 208 residents per square mile. See Hobbs and Stoops (2002).

[13] Looking at median changes rather than mean changes, metropolitan area density actually decreased between 1980 and 1990. The median change was –75 residents per square mile, indicating that density actually decreased in the majority of metropolitan areas during the 1980s.

Table 2

Summary Statistics: Unemployment Covariates

Year	Variable	Mean	Standard deviation	Minimum	Maximum
1980	Population density	3,080.4	2,508.9	349.4	34,719.7
	% Manufacturing	0.22	0.1	0.03	0.54
	% Agriculture, forestry, fisheries	0.05	0.04	0.006	0.24
	% Construction	0.06	0.02	0.03	0.15
	% Wholesale trade	0.04	0.01	0.01	0.09
	% Retail trade	0.17	0.02	0.11	0.24
	% FIRE	0.05	0.02	0.02	0.14
	% Public administration	0.06	0.04	0.2	0.28
	% Education services	0.1	0.04	0.05	0.38
	% Health services	0.07	0.02	0.03	0.22
	Unionization rate	0.24	0.08	0.09	0.37
	Education segregation	0.29	0.07	0.026	0.49
	Income segregation	0.07	0.04	0.003	0.24
1990	Population density	3,083.4	2,613.2	607.1	35,993.8
	% Manufacturing	0.18	0.08	0.03	0.48
	% Agriculture, forestry, fisheries	0.04	0.03	0.008	0.19
	% Construction	0.06	0.02	0.04	0.12
	% Wholesale trade	0.04	0.01	0.01	0.11
	% Retail trade	0.18	0.02	0.12	0.26
	% FIRE	0.06	0.02	0.03	0.16
	% Public administration	0.05	0.03	0.2	0.22
	% Education services	0.09	0.04	0.05	0.38
	% Health services	0.09	0.02	0.04	0.22
	Unionization rate	0.17	0.07	0.06	0.32
	Education segregation	0.34	0.06	0.19	0.51
	Income segregation	0.135	0.05	0.04	0.31
2000	Population density	3,004.1	2,674.6	641.7	37,377.7
	% Manufacturing	0.14	0.07	0.02	0.44
	% Agriculture, forestry, fisheries	0.02	0.02	0.002	0.15
	% Construction	0.07	0.01	0.03	0.13
	% Wholesale trade	0.03	0.008	0.01	0.08
	% Retail trade	0.12	0.01	0.08	0.17
	% FIRE	0.06	0.02	0.03	0.2
	% Public administration	0.05	0.03	0.02	0.19
	% Education services	0.09	0.04	0.05	0.37
	% Health services	0.11	0.02	0.06	0.27
	Unionization rate	0.14	0.06	0.04	0.27
	Education segregation	0.33	0.056	0.19	0.47
	Income segregation	0.13	0.05	0.02	0.38

NOTE: Unweighted statistics calculated from 361 metropolitan areas in each year. "FIRE" is the financial, insurance, and real estate sector.

centrated among the residents of certain neighborhoods, these changes may have produced differential rates of unemployment across different areas within a city. In other words, rather than a change occurring in the way residents of a metropolitan area sort themselves across neighborhoods (e.g., into areas populated primarily by either high-skill or low-skill workers), it may simply be that changes in the labor market have affected workers in different neighborhoods in different ways.

Segregation by Income and Education

The increase in concentration of unemployment may, on the other hand, be the product of greater segregation of individuals by income and education. If the manner by which individuals sort themselves into residential areas has created neighborhoods with concentrations of either high- or low-skill individuals, we should see increasing disparity between the unemployment rates of different neighborhoods. Low-skill individuals, after all, tend to experience higher rates of unemployment than high-skill individuals.[14]

On the surface, this explanation seems related to the urban decentralization hypothesis sketched above. Indeed, previous work has suggested that as city populations spread out, households become increasingly sorted into high- and low-income neighborhoods (e.g., Glaeser and Kahn, 2004). Recent work, however, challenges this view. In particular, Wheeler (2006) finds little association between the extent to which urban populations spread out and the income differentials they exhibit across either neighborhoods or tracts.

To quantify income segregation, I compute the extent of variation between neighborhoods as follows:

$$\text{(2)} \qquad \textit{Income Variation} = \sum_{i=1}^{N} \omega_i \left(\bar{y}_i - \bar{y}\right)^2,$$

where $\bar{y}_i$ is the average household income of neighborhood i, $\bar{y}$ is the average household income in the city, ω_i is the share of the metropolitan area's households living in neighborhood i, and N is the number of neighborhoods in the metropolitan area. This quantity reflects the extent of heterogeneity in the average income levels of different residential areas.

To measure educational segregation, I compute an index of dissimilarity for college graduates.[15] Recall, the resulting values represent the fraction of a city's population with a bachelor's degree or more that would have to relocate for these individuals to be uniformly distributed throughout the city.

Summary statistics describing the evolution of these two segregation measures appear in Table 2. Clearly, both quantities increased between 1980 and 2000. On average, the amount of between-neighborhood income variation nearly doubled over this period, although essentially all of the increase took place during the decade of the 1980s. The dissimilarity index for college graduates rose from 0.29 to 0.34 between 1980 and 1990. It then showed a modest decline during the 1990s, dropping to 0.33 by 2000.

EMPIRICAL ANALYSIS

Specification and Primary Results

To test the hypotheses outlined here, I consider the following statistical model in which the degree of neighborhood unemployment heterogeneity (or concentration) in city c in year t, s_{ct}, is expressed as follows:

$$\text{(3)} \qquad s_{ct} = \delta_c + \delta_t + \beta X_{ct} + \varepsilon_{ct},$$

where δ_c is a city-specific effect intended to represent any time-invariant characteristics that may influence the extent of variation in unemployment across a city's neighborhoods (e.g., a long-standing history of residential segregation), δ_t is a year-specific effect designed to pick up time trends that influence all cities, X_{ct} is a vector of time-varying city-level characteristics, and ε_{ct} is a statistical residual.

[14] For example, the Bureau of Labor Statistics reports that the average rate of unemployment tends to decrease with education attainment. See www.bls.gov/news.release/empsit.t04.htm.

[15] Studies of human capital and skills typically define an individual as having a "high" or "low" level of education based on whether he or she has a four-year college degree or not. Hence, I define educational segregation (i.e., the extent to which high- and low-education individuals do not live with one another) based on college completion.

Table 3

Correlates of Unemployment Concentration

Regressor	Dependent variable			
	Dissimilarity	90-10 Difference	90-50 Difference	50-10 Difference
% College	0.32* (0.09)	–0.17* (0.04)	–0.1* (0.04)	–0.08* (0.02)
% Female	–0.35 (0.24)	–0.006 (0.11)	0.15 (0.1)	–0.16* (0.05)
% Black	–0.1 (0.13)	0.12* (0.06)	0.14* (0.06)	–0.02 (0.03)
% Under 24	0.43* (0.14)	–0.03 (0.07)	0.004 (0.06)	–0.03 (0.03)
% Over 65	0.44* (0.17)	0.03 (0.08)	0.02 (0.07)	0.009 (0.04)
% Foreign-born	–0.27* (0.08)	–0.03 (0.04)	–0.05 (0.04)	0.01 (0.02)
% Manufacturing	0.18* (0.09)	–0.03 (0.04)	–0.02 (0.04)	–0.008 (0.02)
% Agriculture, forestry, fisheries	0.27* (0.15)	0.1 (0.07)	0.07 (0.07)	0.03 (0.03)
% Construction	0.33* (0.17)	–0.02 (0.08)	–0.005 (0.07)	–0.02 (0.04)
% Wholesale trade	0.09 (0.22)	–0.001 (0.1)	0.05 (0.09)	–0.06 (0.05)
% Retail trade	0.19 (0.13)	0.02 (0.06)	0.03 (0.06)	–0.02 (0.03)
% FIRE	0.27 (0.2)	–0.09 (0.1)	–0.06 (0.09)	–0.02 (0.04)
% Public administration	0.25 (0.15)	–0.1 (0.07)	–0.01 (0.07)	–0.08* (0.03)
% Education services	–0.4* (0.17)	0.14* (0.08)	0.08 (0.08)	0.06* (0.04)
% Health services	0.07 (0.17)	0.14* (0.08)	0.11 (0.08)	0.03 (0.04)
Unemployment rate	0.23* (0.11)	0.96* (0.05)	0.64* (0.05)	0.33* (0.02)
Unionization rate	0.03 (0.07)	0.05 (0.03)	0.04 (0.03)	0.016 (0.014)
Education segregation	0.25* (0.05)	0.1* (0.02)	0.05* (0.02)	0.05* (0.01)
Income segregation	0.42* (0.07)	0.18* (0.03)	0.14* (0.03)	0.04* (0.014)
Log population density	0.016 (0.011)	–0.004 (0.005)	–0.002 (0.005)	–0.002 (0.002)
R^2	0.66	0.71	0.58	0.59

NOTE: Standard errors are reported in parentheses. All regressions include time dummies for the years 1980 and 1990 and interactions of these dummies with three U.S. Census region indicators; * indicates significance at the 10 percent level or better. "FIRE" is the financial, insurance, and real estate sector.

The vector of characteristics, X_{ct}, includes the following: log population density; the proportions of the city's resident population that are (i) female, (ii) black, (iii) foreign-born, (iv) under the age of 24, and (v) over the age of 65; the share of total employment in each of nine broad sectors; the city's overall unemployment rate; the proportion of the city's labor force that is covered by a union contract; and measures of segregation of households by income and education across neighborhoods.[16] I also include three region dummies that are interacted with the year indicators, δ_t.

Many of these variables are intended to account for some basic economic and demographic factors that may influence the distribution of unemployment within a city's neighborhoods. Unemployment might, for example, vary significantly across neighborhoods as a result of the racial, gender, or age composition of the local population. In addition, some neighborhoods may be more sensitive to changes in the local business cycle than others. Hence, the unemployment rate and the six region-year interactions are included

[16] The nine industries are manufacturing; agriculture, forestry, fisheries; construction; wholesale trade; retail trade; finance, insurance, real estate; public administration; education services; and health services. Because of changes in the industrial classification system between 1990 and 2000, these were the only broad sectors that could be constructed on a consistent basis from the GeoLytics data.

to control for the influence of fluctuations in local and regional economic activity.

The remaining covariates are included to assess the hypotheses sketched above. In particular, population density is a rough proxy for urban decentralization; the industry shares and unionization rate quantify changes in the labor market facing workers; and the segregation measures represent the degree of income and educational sorting across a city's neighborhoods.

Estimation of equation (3) is accomplished using the within-estimator, whereby all variables are expressed as deviations from averages taken within metropolitan areas. The parameters are then estimated by ordinary least squares. The results appear in Table 3. Each column lists the coefficients for a particular measure of unemployment concentration.

Beginning with the unemployment dissimilarity index in the first column of estimates, it is evident that a number of the demographic characteristics are significantly associated with the geographic concentration of unemployment. Cities with larger fractions of individuals either under 24 or over 65 years of age tend to have more unequal distributions of unemployed workers across neighborhoods. Cities in which these two groups are heavily represented may, for example, be strongly segregated by age. College towns, for instance, have large fractions of relatively young households clustered in certain neighborhoods. If these individuals also experience relatively high rates of unemployment, the dissimilarity index would be especially high in these cities. The significantly positive coefficient on the college fraction, which tends to be especially high in college towns, may reflect this same effect. The results also suggest that a higher fraction of the resident population that is foreign born corresponds to less unemployment concentration. This finding may simply indicate that cities with large numbers of immigrants have rapidly growing economies and, hence, a low incidence of unemployment among all individuals. It could also be a reflection of the fact that immigrants tend to be more active labor force participants than domestic workers, at least among those who have relatively little education (Aaronson et al., 2006).

Moving on to the three hypothetical causes for the rise in unemployment concentration, it is apparent that sprawl shows little systematic association with the dissimilarity index. The coefficient on the logarithm of population density is statistically negligible. In addition, the union coverage rate and five of the nine industry shares are insignificant. Moreover, based on the signs of the four significant industry share coefficients, none supports the hypothesis sketched in the section "Industrial Shifts and Unionization." In particular, the decline of manufacturing and rise of professional services (e.g., education) should be associated with the displacement of relatively low-skill workers but rising employment opportunities for high-skill workers. To the extent that these types of workers reside in different neighborhoods, these changes should generate greater concentration of unemployment. According to the results in Table 3, these changes tend to be associated with *decreases* in unemployment concentration.

Changes in the extent of residential segregation by income and education, by contrast, correlate strongly with changes in the geographic concentration of unemployment. There is, of course, likely to be some endogeneity associated with the income segregation variable. After all, as the distribution of unemployed households becomes more uneven within a metropolitan area, the distribution of income will very likely become more uneven, too, because income tends to be strongly tied to employment status. As a result, the coefficient on income segregation likely exhibits some upward bias. Nevertheless, the positive association between these two quantities is at least broadly consistent with the income-sorting hypothesis.

Moreover, the estimates also demonstrate a significant connection between unemployment concentration and the segregation of college graduates, which is less obviously endogenous with respect to the dependent variable. Unlike income differentials across neighborhoods, there is little reason to believe that an increase in the concentration of unemployed households should cause highly educated households to become more segregated residentially. This suggests that

any bias in the estimated coefficient on the education dissimilarity index may be small.

The estimates in the next three columns of Table 3, where the dependent variables are the unemployment percentile differences, offer many of the same conclusions. The greater the change in the extent of between-neighborhood income variation or the separation of college graduates from individuals with less education, the larger the differentials in the unemployment rates of different residential areas. Neither the unionization rate nor the log of population density shows a significant association with any of the differentials, and only a few of the industry shares produce significant coefficients.

As one might expect, changes in a metropolitan area's overall unemployment rate are strongly associated with the dissimilarity index and all three unemployment rate differentials, suggesting that the local business cycle is an important determinant of the geographic distribution of unemployment. Again, if economic downturns simply affect workers in certain neighborhoods (say, low-skill workers in relatively low-income areas) more than others, then one would expect to see all four measures of unemployment concentration move directly with the overall rate of unemployment. That is precisely what the estimates in Table 3 indicate. Interestingly, however, even after having accounted for this effect, there remains strong evidence that rising concentration of unemployment has been driven by changes in the extent to which households are segregated by income and education. Thus, although local business cycle effects are clearly important, they cannot completely account for the trends in neighborhood-level unemployment.

Results Using Weighted Percentiles

Because the percentiles used above are computed in an unweighted fashion, it is possible that they provide misleading inferences about the extent to which unemployed workers are spatially concentrated. For example, certain neighborhoods may be extremely small, possessing only a few households, the majority of whom happen to be unemployed. These neighborhoods may then help to create extremely large values for a 90-10 or 50-10 difference. Yet, because they only contain an extremely small share of a metropolitan area's total stock of unemployed individuals, unemployment concentration might, in actuality, be somewhat modest in this metro area.

A similar problem does not influence the dissimilarity index because, as shown in equation (1), the index implicitly gives less weight to neighborhoods with smaller numbers of employed and unemployed individuals. Hence, an extremely small neighborhood with a very high unemployment rate will contribute relatively little to the index value because its shares of unemployed and employed workers will be small.

In this section, I examine weighted percentiles, where the weights are given by the size of each neighborhood's labor force. After computing these percentiles, I simply create 90-10, 90-50, and 50-10 differences and estimate the same regressions as those reported in Table 3.

Summary statistics indicate that these weighted measures of unemployment concentration did rise, although not as sharply as the unweighted measures. On average, the 90-10, 90-50, and 50-10 differences stood at 0.069, 0.044, and 0.026, respectively, in 1980. By 2000, they had risen to 0.096, 0.065, and 0.031.

The regression results for these weighted differentials are presented in Table 4. For the most part, they generate similar conclusions to those drawn earlier. There is little evidence of the importance of industrial shifts and changes in union activity. Population density does, in this case, show a significant association with the 90-10 and 90-50 differences. However, the coefficients are positive, indicating that rising sprawl (i.e., falling density) is associated with *less* unemployment concentration rather than more.

On the other hand, there is once again strong evidence that the rising segregation of individuals by educational attainment—specifically, the separation of college graduates from those with less education—and increasing income variation across neighborhoods are associated with rising unemployment concentration. Cities characterized by larger increases in residential sorting along these two dimensions have seen, on average, larger increases in their levels of unemployment concentration.

Table 4

Robustness-Weighted Percentile Difference

	Dependent variable		
Regressor	Weighted 90-10 difference	Weighted 90-50 difference	Weighted 50-10 difference
% College	–0.13* (0.04)	–0.07* (0.04)	–0.06* (0.02)
% Female	0.09 (0.09)	0.14 (0.1)	–0.05 (0.05)
% Black	0.004 (0.05)	0.05 (0.05)	–0.04* (0.03)
% Under 24	0.05 (0.05)	0.07 (0.05)	–0.02 (0.03)
% Over 65	0.06 (0.07)	0.03 (0.07)	0.02 (0.03)
% Foreign-born	–0.02 (0.03)	–0.04 (0.03)	0.02 (0.02)
% Manufacturing	0.007 (0.04)	–0.005 (0.03)	0.01 (0.02)
% Agriculture, forestry, fisheries	0.05 (0.06)	0.009 (0.06)	0.04 (0.03)
% Construction	0.02 (0.07)	–0.006 (0.07)	0.02 (0.03)
% Wholesale trade	–0.015 (0.09)	0.000004 (0.08)	–0.01 (0.04)
% Retail trade	0.06 (0.05)	0.04 (0.05)	0.02 (0.03)
% FIRE	–0.07 (0.08)	–0.01 (0.08)	–0.06 (0.04)
% Public administration	–0.007 (0.06)	0.006 (0.06)	–0.01 (0.03)
% Education services	0.07 (0.07)	0.001 (0.07)	0.07* (0.03)
% Health services	0.16* (0.07)	0.14* (0.07)	0.02 (0.03)
Unemployment rate	0.94* (0.05)	0.63* (0.04)	0.3* (0.02)
Unionization rate	–0.01 (0.03)	–0.02 (0.03)	0.006 (0.01)
Education segregation	0.09* (0.02)	0.04* (0.02)	0.05* (0.01)
Income segregation	0.13* (0.03)	0.11* (0.03)	0.02* (0.01)
Log population density	0.01* (0.005)	0.008* (0.004)	0.003 (0.002)
R^2	0.78	0.65	0.55

NOTE: Standard errors are reported in parentheses. All regressions include time dummies for the years 1980 and 1990 and interactions of these dummies with three U.S. Census region indicators; * indicates significance at the 10 percent level or better. "FIRE" is the financial, insurance, and real estate sector.

CONCLUSION

This paper has documented a rise in the extent to which unemployed households throughout 361 U.S. metropolitan areas have become concentrated residentially. In 1980, the median unemployed worker resided in a neighborhood with an unemployment rate of 7.5 percent; by 2000, that rate was 7.9 percent. Again, this is particularly striking in light of the fact that, on average, unemployment rates were lower in 2000 than in 1980. Other measures of residential concentration of the unemployed—an index of dissimilarity and differences between three percentiles (either weighted or unweighted) of the neighborhood unemployment distribution—show similar qualitative trends. Hence, although the overall rate of unemployment has not trended upward over time, there is evidence of an upward trend in the spatial concentration of the unemployed within the country's urban labor markets.

Among three plausible explanations, I find the greatest support for the idea that increased segregation of households by income and educational attainment underlies this trend. There is less consistent evidence that sprawl or structural changes in the labor market are responsible.

As noted in the introduction, these results

are especially interesting because the literature on neighborhood effects suggests that a number of labor market outcomes are tied to the characteristics of one's place of residence. Indeed, following this general premise, rising unemployment concentration may help to account for two additional trends that have been observed in the United States over the past three decades: (i) rising inequality in both income and earnings and (ii) an increase in the expected duration of unemployment. Both are well documented.

Between 1971 and 1995, the amount by which the 90th percentile of the U.S. wage distribution exceeded the 10th percentile grew from 266 percent to 366 percent (Acemoglu, 2002).[17] This increase has been accompanied by growing dispersion among the earnings of individuals of different "skill" groups (e.g., as defined by education and experience) as well as those within the same group. Although there has not been a long-run trend in the overall rate of unemployment, Abraham and Shimer (2001) report that the mean unemployment duration rose by roughly 20 percent (from 10 weeks to 12 weeks) between 1980 and 2000. Much of this rise can be linked to an increase in what they call "very long-term" unemployment (more than 26 weeks), which has more than tripled as a share of the labor force since 1969.

As one might expect, research studying these two patterns has identified some of the most likely culprits. Rising inequality is very likely related to skill-biased technological change, changes in the institutional makeup of the labor market (e.g., declining union activity and minimum wage changes), and growth in international trade and immigration. Longer spells of unemployment are probably tied to demographic changes, especially the aging of the working population and an increase in the fraction of women participating in the labor force. Older workers and women tend to experience somewhat longer periods of unemployment (Abraham and Shimer, 2001).

Very little work, however, has considered that there may be a spatial aspect to these phenomena. With rising concentration of the unemployed, workers in search of a job might find it increasingly difficult to locate one. Recall that Topa (2001) finds evidence consistent with local spillovers in unemployment status across Census tracts in Chicago. Again, this result may be the product of an adverse network effect (i.e., if workers find jobs through neighborhood contacts) or employers simply avoiding workers from high-unemployment neighborhoods due to a social stigma. Rising concentration of unemployment in certain neighborhoods may, then, give rise to growing unemployment durations among workers living in these neighborhoods and further decrease their income and labor earnings relative to the rest of the labor force over time.

It is interesting to note that, over the sample period studied here, the majority of the increase in the geographic concentration of unemployment took place during the 1980s, when much of the rise in both income inequality and unemployment duration took place. Although far from conclusive, the fact that the timing of these phenomena matches closely certainly suggests that there may be a connection among them.

[17] Similar evidence has been reported in many other studies, including Levy and Murnane (1992), Katz and Murphy (1992), and Juhn, Murphy, and Pierce (1993).

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APPENDIX

Metropolitan Areas

Abilene, TX
Akron, OH
Albany, GA
Albany-Schenectady-Troy, NY
Albuquerque, NM
Alexandria, LA
All MSAs
Allentown-Bethlehem-Easton, PA-NJ
Altoona, PA
Amarillo, TX
Ames, IA
Anchorage, AK
Anderson, IN
Anderson, SC
Ann Arbor, MI
Anniston-Oxford, AL
Appleton, WI
Asheville, NC
Athens-Clarke County, GA
Atlanta–Sandy Springs–Marietta, GA
Atlantic City, NJ
Auburn-Opelika, AL
Augusta-Richmond County, GA-SC
Austin-Round Rock, TX
Bakersfield, CA
Baltimore-Towson, MD
Bangor, ME
Barnstable Town, MA
Baton Rouge, LA
Battle Creek, MI
Bay City, MI
Beaumont–Port Arthur, TX
Bellingham, WA
Bend, OR
Billings, MT
Binghamton, NY
Birmingham-Hoover, AL
Bismarck, ND
Blacksburg-Christiansburg-Radford, VA
Bloomington, IN
Bloomington-Normal, IL
Boise City–Nampa, ID
Boston-Cambridge-Quincy, MA-NH
Boulder, CO
Bowling Green, KY
Bremerton-Silverdale, WA
Bridgeport-Stamford-Norwalk, CT
Brownsville-Harlingen, TX
Brunswick, GA
Buffalo–Niagara Falls, NY
Burlington, NC
Burlington–South Burlington, VT
Canton-Massillon, OH
Cape Coral-Fort Myers, FL
Carson City, NV
Casper, WY
Cedar Rapids, IA
Champaign-Urbana, IL
Charleston, WV
Charleston–North Charleston, SC
Charlotte-Gastonia-Concord, NC-SC
Charlottesville, VA
Chattanooga, TN-GA
Cheyenne, WY
Chicago-Naperville-Joliet, IL-IN-WI
Chico, CA
Cincinnati-Middletown, OH-KY-IN
Clarksville, TN-KY
Cleveland, TN
Cleveland-Elyria-Mentor, OH
Coeur d'Alene, ID
College Station–Bryan, TX
Colorado Springs, CO
Columbia, MO
Columbia, SC
Columbus, GA-AL
Columbus, IN
Columbus, OH
Corpus Christi, TX
Corvallis, OR
Cumberland, MD-WV
Dallas–Fort Worth–Arlington, TX
Dalton, GA
Danville, IL
Danville, VA
Davenport-Moline–Rock Island, IA-IL
Dayton, OH
Decatur, AL
Decatur, IL

Deltona–Daytona Beach–Ormond Beach, FL
Denver-Aurora, CO
Des Moines, IA
Detroit-Warren-Livonia, MI
Dothan, AL
Dover, DE
Dubuque, IA
Duluth, MN-WI
Durham, NC
Eau Claire, WI
El Centro, CA
El Paso, TX
Elizabethtown, KY
Elkhart-Goshen, IN
Elmira, NY
Erie, PA
Eugene-Springfield, OR
Evansville, IN-KY
Fairbanks, AK
Fargo, ND-MN
Farmington, NM
Fayetteville, NC
Fayetteville-Springdale-Rogers, AR-MO
Flagstaff, AZ
Flint, MI
Florence, SC
Florence–Muscle Shoals, AL
Fond du Lac, WI
Fort Collins–Loveland, CO
Fort Smith, AR-OK
Fort Walton Beach–Crestview-Destin, FL
Fort Wayne, IN
Fresno, CA
Gadsden, AL
Gainesville, FL
Gainesville, GA
Glens Falls, NY
Goldsboro, NC
Grand Forks, ND-MN
Grand Junction, CO
Grand Rapids–Wyoming, MI
Great Falls, MT
Greeley, CO
Green Bay, WI
Greensboro–High Point, NC
Greenville, NC
Greenville, SC
Gulfport-Biloxi, MS
Hagerstown-Martinsburg, MD-WV
Hanford-Corcoran, CA
Harrisburg-Carlisle, PA
Harrisonburg, VA
Hartford–West Hartford–East Hartford, CT
Hattiesburg, MS
Hickory-Lenoir-Morganton, NC
Hinesville–Fort Stewart, GA
Holland–Grand Haven, MI
Honolulu, HI
Hot Springs, AR
Houma–Bayou Cane–Thibodaux, LA
Houston–Sugar Land–Baytown, TX
Huntington-Ashland, WV-KY-OH
Huntsville, AL
Idaho Falls, ID
Indianapolis, IN
Iowa City, IA
Ithaca, NY
Jackson, MI
Jackson, MS
Jackson, TN
Jacksonville, FL
Jacksonville, NC
Janesville, WI
Jefferson City, MO
Johnson City, TN
Johnstown, PA
Jonesboro, AR
Joplin, MO
Kalamazoo-Portage, MI
Kankakee-Bradley, IL
Kansas City, MO-KS
Kennewick-Richland-Pasco, WA
Killeen-Temple–Fort Hood, TX
Kingsport-Bristol-Bristol, TN-VA
Kingston, NY
Knoxville, TN
Kokomo, IN
La Crosse, WI-MN
Lafayette, IN
Lafayette, LA
Lake Charles, LA
Lakeland, FL
Lancaster, PA
Lansing–East Lansing, MI
Laredo, TX
Las Cruces, NM

Las Vegas–Paradise, NV
Lawrence, KS
Lawton, OK
Lebanon, PA
Lewiston, ID-WA
Lewiston-Auburn, ME
Lexington-Fayette, KY
Lima, OH
Lincoln, NE
Little Rock–North Little Rock, AR
Logan, UT-ID
Longview, TX
Longview, WA
Los Angeles–Long Beach–Santa Ana, CA
Louisville, KY-IN
Lubbock, TX
Lynchburg, VA
Macon, GA
Madera, CA
Madison, WI
Manchester-Nashua, NH
Mansfield, OH
McAllen-Edinburg-Mission, TX
Medford, OR
Memphis, TN-MS-AR
Merced, CA
Miami–Fort Lauderdale–Miami Beach, FL
Michigan City-La Porte, IN
Midland, TX
Milwaukee-Waukesha–West Allis, WI
Minneapolis–St. Paul–Bloomington, MN-WI
Missoula, MT
Mobile, AL
Modesto, CA
Monroe, LA
Monroe, MI
Montgomery, AL
Morgantown, WV
Morristown, TN
Mount Vernon–Anacortes, WA
Muncie, IN
Muskegon–Norton Shores, MI
Myrtle Beach–Conway–North Myrtle Beach, SC
Napa, CA
Naples-Marco Island, FL
Nashville-Davidson-Murfreesboro, TN
New Haven–Milford, CT
New Orleans–Metairie-Kenner, LA
New York–Northern New Jersey–Long Island, NY-NJ-PA
Niles–Benton Harbor, MI
Norwich-New London, CT
Ocala, FL
Ocean City, NJ
Odessa, TX
Ogden-Clearfield, UT
Oklahoma City, OK
Olympia, WA
Omaha–Council Bluffs, NE-IA
Orlando-Kissimmee, FL
Oshkosh-Neenah, WI
Owensboro, KY
Oxnard–Thousand Oaks–Ventura, CA
Palm Bay–Melbourne-Titusville, FL
Panama City–Lynn Haven, FL
Parkersburg-Marietta-Vienna, WV-OH
Pascagoula, MS
Pensacola–Ferry Pass–Brent, FL
Peoria, IL
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
Phoenix-Mesa-Scottsdale, AZ
Pine Bluff, AR
Pittsburgh, PA
Pittsfield, MA
Pocatello, ID
Port St. Lucie–Fort Pierce, FL
Portland–South Portland–Biddeford, ME
Portland-Vancouver-Beaverton, OR-WA
Poughkeepsie-Newburgh-Middletown, NY
Prescott, AZ
Providence–New Bedford–Fall River, RI-MA
Provo-Orem, UT
Pueblo, CO
Punta Gorda, FL
Racine, WI
Raleigh-Cary, NC
Rapid City, SD
Reading, PA
Redding, CA
Reno-Sparks, NV
Richmond, VA
Riverside–San Bernardino–Ontario, CA
Roanoke, VA
Rochester, MN
Rochester, NY

Rockford, IL
Rocky Mount, NC
Rome, GA
Sacramento–Arden-Arcade–Roseville, CA
Saginaw-Saginaw Township North, MI
Salem, OR
Salinas, CA
Salisbury, MD
Salt Lake City, UT
San Angelo, TX
San Antonio, TX
San Diego–Carlsbad–San Marcos, CA
San Francisco–Oakland-Fremont, CA
San Jose–Sunnyvale–Santa Clara, CA
San Luis Obispo–Paso Robles, CA
Sandusky, OH
Santa Barbara–Santa Maria, CA
Santa Cruz–Watsonville, CA
Santa Fe, NM
Santa Rosa–Petaluma, CA
Sarasota-Bradenton-Venice, FL
Savannah, GA
Scranton–Wilkes-Barre, PA
Seattle-Tacoma-Bellevue, WA
Sheboygan, WI
Sherman-Denison, TX
Shreveport–Bossier City, LA
Sioux City, IA-NE-SD
Sioux Falls, SD
South Bend–Mishawaka, IN-MI
Spartanburg, SC
Spokane, WA
Springfield, IL
Springfield, MA
Springfield, MO
Springfield, OH
St. Cloud, MN
St. George, UT
St. Joseph, MO-KS
St. Louis, MO-IL
State College, PA
Stockton, CA
Sumter, SC
Syracuse, NY
Tallahassee, FL
Tampa–St. Petersburg–Clearwater, FL
Terre Haute, IN
Texarkana, TX-Texarkana, AR
Toledo, OH
Topeka, KS
Trenton-Ewing, NJ
Tucson, AZ
Tulsa, OK
Tuscaloosa, AL
Tyler, TX
Utica-Rome, NY
Valdosta, GA
Vallejo-Fairfield, CA
Vero Beach, FL
Victoria, TX
Vineland-Millville-Bridgeton, NJ
Virginia Beach–Norfolk–Newport News, VA-NC
Visalia-Porterville, CA
Waco, TX
Warner Robins, GA
Washington-Arlington-Alexandria, DC-VA-MD-WV
Waterloo–Cedar Falls, IA
Wausau, WI
Weirton-Steubenville, WV-OH
Wenatchee, WA
Wheeling, WV-OH
Wichita Falls, TX
Wichita, KS
Williamsport, PA
Wilmington, NC
Winchester, VA-WV
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