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SHORTER Recessions and LONGER Expansions

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Does Inflation Depress the Stock Market?

*Robert H. DeFina**

The daily ups and downs of the stock market are sources of joy and frustration for people in all walks of life. When nightly newscasters report "The market fell 50 points today," even the financially naive can feel twinges of concern. For although many individuals are unfamiliar with the details of stock markets, most realize that stocks represent ownership in a firm, a piece of the American Dream. Falling stock prices are thus thought to signal lower profitability, a weaker economy, and the chance of unemployment.

From the link between stock prices and business fortunes has emerged a curious statistical finding: during the past four decades, stock prices have tended to fall on average as inflation has accelerated, and vice versa. Casual observation is suggestive. During the 1970s, when inflation accelerated rapidly, stocks languished, falling almost 50 percent in real (inflation-adjusted) terms. In contrast, equity values rose markedly in the 1980s, a period of

* Robert H. DeFina is an Assistant Professor of Economics at Villanova University and a former Research Officer at the Federal Reserve Bank of Philadelphia.

disinflation. The inverse relation, which runs counter to conventional wisdom that stocks hold their real value during inflation, has been confirmed by technical, academic studies.

The tendency of stock prices to deteriorate as inflation worsens suggests that inflation might somehow make firms less profitable. There are practical reasons to believe that view. For example, parts of the tax code become more burdensome to corporations as inflation accelerates. Inflation can thus reduce a firm's real *after-tax* profitability, dragging equity values down with it. Still, the relation between stocks and inflation is a matter of debate, and some would argue that the observed link is spurious.

Whether and how inflation affects firms' profitability—and, hence, the value of stocks—have great relevance for public policy. If profitability does decline with higher inflation, investors will be less willing to provide firms with the funds needed to update aging machines and buildings. And outdated plant and equipment retard growth in the economy's capacity to produce and in the nation's living standards. As a result, policymakers might want to respond in ways that mitigate inflation's effects. For fiscal policy, that might mean altering parts of the tax code that allow inflation to harm equity values. For monetary policy, it means retaining and perhaps strengthening the resolve to contain inflation.

THE IMPACT OF INFLATION ON STOCK PRICES

How Are Stock Prices Set? When a person buys a share of stock, he or she obtains a claim on current and future profits of a firm.[1] The price paid for that profit stream determines the stock's *rate* of return—that is, the return to the owner per dollar invested. The more someone pays for a given stream of real profits, the lower his or her real rate of return.

Stocks, of course, are not the only investment opportunity available. Indeed, financial markets are quite diverse and competitive, offering investors a variety of alternatives. And given the competitive environment, market forces will set a stock's real price so that its real rate of return coincides with those on other investments of similar risk.

Nominal Contracts: The Key to Inflation's Impact on Stocks? Does inflation fit in the foregoing explanation of stock price determination? It could. The most prominent theory focuses on firms' use of nominal contracts.[2] Nominal contracts are those that hold costs or prices fixed at some current-dollar level for a period of time. An example is a wage contract that fixes a worker's pay at $8 per hour for the next two years.

To understand why nominal contracts matter, consider first a situation in which contracts are absent. Imagine a firm that produces shirts for $8 apiece and sells them for $10, earning profits of $2 per shirt. The firm had been expecting zero inflation, but unexpectedly inflation rises to 5 percent. The relevant question is, "How will the unexpected inflation affect the firm's future real profits?" The answer: "It will have no effect."

With inflation now at 5 percent per year, the firm anticipates that its costs, unencumbered by contracts, will grow 5 percent per year. However, it also expects shirt prices to rise 5 percent per year, along with all other prices in the economy.[3] Thus, it will cost $8.40 to produce a shirt next year that the firm will sell for

[1]This description is based on a standard theory of asset pricing. Fortune (1991) provides an extended discussion and explanations of alternative views.

[2]An alternative explanation based on investor irrationality has been offered by Modigliani and Cohn (1979). Their theory has been downplayed, since its basic premise runs counter to standard assumptions of rational, informed investors. Moreover, numerous empirical studies reject their hypothesis.

$10.50. While current-dollar, or nominal, profits rise 5 percent, to $2.10 per shirt from $2, *real* profits remain $2. The 5 percent increase in nominal profits just compensates the firm for the 5 percent increase in the price of everything else. The purchasing power of the firm's profits will not change even though 5 percent inflation was not expected.

A different outcome arises when nominal contracts exist. Suppose that the shirt firm signs nominal contracts that fix revenues at current levels for the next two years. In signing such contracts, firms generally account for inflation expected during the term of agreement to ensure their contracts' real values. This contract makes no provision for inflation, however, since none is forecast. Again, "How will the unexpected inflation affect the firm's real profits?" This time, the answer is, "Real profits will decline."

When inflation rises to 5 percent, the firm will expect costs to rise 5 percent next year, to $8.40, knowing that revenues will remain at $10. Future nominal profits thus fall 20 percent, to $1.60 from $2. After accounting for 5 percent inflation, real profits decline 25 percent. And once investors expect the firm to be less profitable in real terms than they did before, they will shun its stock. The stock's real price will then be bid down.

The foregoing example illustrates a general point. Real profits equal real revenues less real costs. And absent nominal contracts, both prices and costs can freely adjust to inflation, even if it is unexpected. Neither real revenues nor real costs change. Prices and costs cannot freely adjust when nominal contracts exist, however. Unforeseen inflation, which existing contracts cannot reflect, consequently alters real revenues, real costs, and real profits. In the example, nominal revenues are fixed and, so, surprise inflation reduces real revenues. The result is lower real profits and a real stock price decrease.

Inflation's Impact Depends on the Types of Contracts in Force. How unforeseen inflation actually affects real profits depends on the characteristics of existing contracts. For example, since firms hold contracts that fix both revenues and costs, the net effect of unexpected inflation will turn on the relative amounts of revenues and costs held constant. Contract lengths likewise play a key role. As contract maturities lengthen, the period in which real profits can differ from anticipated levels lengthens as well.

In theory, then, unanticipated inflation could either raise or lower a firm's real stock price, depending on the characteristics of existing contracts. The same holds true for inflation's link with overall stock price measures, such as the Dow Jones average or the S&P 500: inflation's aggregate impact is simply an average of its effects on individual firms.

Some Examples of Important Nominal Contracts. Firms face an array of nominal contracts in their normal operations. Familiar examples are accounts payable and receivable, contracts to sell products and lease equipment at fixed prices, and labor and materials contracts. And while all such contracts allow inflation to affect stock prices, two types merit special attention: corporate tax rules concerning depreciation and inventory accounting, and nominal financial assets issued or owned by firms.[4] Both

[3]Typically during a period of inflation, individual prices change by different amounts. The text abstracts from such relative price changes for simplicity's sake.

[4]Inflation interacts with the tax code to affect real tax burdens in numerous, complex ways. The tax treatment of nominal realized capital gains, the deductibility of firms' interest costs, and "bracket creep," in addition to provisions discussed above, can each play a role. This article focuses on corporate depreciation and inventory accounting rules since they are emphasized in the relevant literature. For a comprehensive theoretical overview of how inflation interacts with the tax code, see Feldstein (1980).

could, according to nominal contract theorists, provide the main link between inflation and the stock market.

Corporate Tax Rules. Taxes were omitted from the previous discussion of how stock prices are set, but only for illustrative purposes. In reality, taxes figure importantly since potential investors care about firms' real *after-tax* profits—that is, real revenues less real costs and real taxes.

The corporate tax code holds special interest because certain of its elements permit unforeseen inflation to alter real corporate tax burdens and, hence, real after-tax profits. One such provision regulates the treatment of depreciation. Tax rules allow firms to deduct the value of wear and tear on plant and equipment when figuring taxable income. The real value of that deduction makes real profits higher than they would otherwise be, since it lowers a firm's real tax liability. The amount deducted, however, is based on the *original* cost of the plant and equipment. So when surprise inflation occurs, the real value of the deduction falls unexpectedly and real tax liabilities rise unexpectedly.

Suppose that machines cost $10,000 and tax rules allow annual depreciation deductions equaling 10 percent of cost. If no one foresees inflation, then everyone expects the annual real value of deductions to be $1,000. Firms' real stock prices are set accordingly. But if inflation turns out to be 5 percent, the annual real values of the deduction fall unexpectedly. In the first year, for example, the real value drops to $952.38. Firms thus experience unforeseen jumps in real tax liabilities, and real stock prices fall. The tax rule essentially represents a nominal contract between firms and the government that fixes the nominal depreciation deduction at $1,000. And like other nominal contracts, depreciation rules allow unforeseen inflation to alter real profits.

Tax provisions concerning inventory valuation also permit inflation to change real profits. When calculating tax liabilities, businesses may deduct from income the cost of producing the goods they sell. Firms have some choice about how to value their inventories, and the so-called first-in, first-out (FIFO) option is especially relevant. FIFO rules assume that goods leave inventory in the order that they arrive and, thus, use prices that prevailed when the items were first acquired. By relying on past prices, FIFO rules fix the nominal value of deductions, allowing unforeseen inflation to erode the real value of a firm's tax deductions.[5]

Nominal Assets Issued and Held by Firms. Unforeseen inflation can also affect real stock prices because firms both issue and hold nominal assets. Such assets are contracts between a firm and another party (an individual, another firm, the government) to make or receive periodic payments fixed in nominal terms. When a firm issues nominal assets, it commits to make periodic payments to others. When a firm holds nominal assets, other parties commit to make periodic payments to it. Examples of nominal assets issued and held by firms include conventional 30-year mortgages, commercial paper, and Treasury bills and bonds.

As with other nominal contracts, entities that issue or obtain nominal assets will account for expected inflation when setting the size of periodic payments. But once the payments are fixed in nominal terms, surprise inflation implies new expectations of real payments. Unexpectedly higher inflation, for instance, trans-

[5]Another permissible inventory valuation option, last-in, first-out (LIFO), also allows inflation to affect real tax liabilities, but to a much lesser extent than does the FIFO approach. Under LIFO, items most recently added to inventory are assumed to leave first. Unless firms substantially reduce their inventories—in a close-out sale, say—the cost of goods sold will largely reflect recent prices, and inflation will not substantially increase real tax liabilities. If large inventory reductions do occur and items acquired long ago are sold, then inflation will push up real tax liabilities as under FIFO rules.

lates into smaller real payments than previously thought. Nominal asset holders thus suffer an unexpected decline in real profits, while issuers enjoy a gain. And both the decline and the gain will be reflected in the real stock prices of affected firms.

DO NOMINAL CONTRACTS EXPLAIN THE LINK BETWEEN STOCK PRICES AND INFLATION?

Firms' use of nominal contracts implies that unforeseen inflation could affect real stock prices. But whether such contracts cause inflation to *depress* the stock market is less clear. As mentioned, surprise inflation could leave real stock prices higher, lower, or unchanged, depending on the types and mix of contracts held. And even if inflation leads to lower real stock prices, contracts might play only a small part. Inflation's negative effects might largely be offset by its positive effects. Or nominal contracts might simply be a minor aspect of a typical firm's operations. If so, then the main source of inflation's link with the stock market lies elsewhere.

"Simulation studies strongly suggest that inflation's interaction with nominal contracts depresses real stock prices."

To break the conceptual deadlock, researchers have provided detailed empirical findings on how surprise inflation *actually* interacts with nominal contracts. Evidence partly comes from simulation and statistical studies that reveal whether and to what extent contracts cause inflation to depress the stock market. It also comes from studies that pit the nominal contract theory against a plausible alternative. In sum, nominal contracts seem to underlie at least part of the negative relation between inflation and real stock prices.

Simulation Studies. Some attempts at measuring the practical importance of contracts rely on simulation models. To develop them, researchers use standard notions of how real stock prices are set. Included are tax provisions that interact with inflation, and nominal assets issued and held by firms, since each is considered a main way by which unexpected inflation affects stock prices. Given the structures of their models, analysts assign realistic values to model parameters and simulate how surprise inflation affects stock prices.

Available studies, which reflect tax rules of the 1970s, indicate that unforeseen inflation can substantially reduce real stock prices. That is, losses from tax rules and nominal assets held appear to easily offset gains from nominal assets issued. Marcelle Arak, for example, found that 4 percentage points of unexpected inflation lowered real stock prices by almost 17 percent.[6] If, as she suggests, inflation exceeded expectations by 6 percentage points during the 1970s, real stock prices would have fallen 25 percent in response. That figure represents *half* of the decade's total decline. Richard Kopcke found an even larger effect: 6 percentage points of unexpected inflation would have decreased

[6]Arak found that inflation's interaction with the tax system reduces real stock prices by 21.6 percent. Inflation's net interaction with nominal assets held and issued raises real stock prices 4.8 percent. Overall, then, 4 percentage points of unexpected inflation reduce real stock prices by 16.8 percent. Kopcke's study, which follows in the text, found that the tax system causes real stock prices to fall 27 to 40 percent for each 4 percentage points of unexpected inflation. Inflation's net interaction with nominal assets raises prices by 5 to 10 percent. Overall, the unforeseen inflation reduces real stock prices by 22 to 30 percent.

real equity values by between 30 percent and 45 percent, or the majority of the decade's total loss.[7] Martin Feldstein, Jerry Green, and Eytan Sheshinski provide estimates roughly in line with Arak and Kopcke. Overall, simulation studies strongly suggest that inflation's interaction with nominal contracts depresses real stock prices. Inflation's effects, moreover, appear quite powerful.

Statistical Tests of the Nominal Contracting Hypothesis. As an alternative to simulation models, some researchers have measured the importance of nominal contracts statistically using data from large samples of individual firms. These samples are representative, so the conclusions are generally applicable to the economy as a whole.

The approach involves estimating statistical models that allow unforeseen inflation and other variables to affect a firm's real stock price. The models allow each firm to react differently to surprise inflation, depending on the types of contracts held. With estimated models in hand, analysts can compute the typical response of each firm's stock price to a rise in unexpected inflation, along with the average response for the entire sample. They can also isolate the part of the overall response arising from inflation's interaction with nominal contracts. And if the nominal contracting view has validity, that fraction should be large.

Two early studies, one by Kenneth French, Richard Ruback, and G. William Schwert and another by Victor Bernard, found that nominal contracts had little to do with the inflation/stock price link. But each has empirical shortcomings that bring their conclusions into question. Examples are the way in which unexpected inflation is measured, the exclusion of several important nominal contracts, and the use of restrictive statistical frameworks. A later study, by Douglas Pearce and V. Vance Roley, overcame many of the difficulties encountered by earlier research. And in contrast to the previous studies, their more comprehensive approach revealed that about half the reaction of real stock prices to inflation is due to nominal contracts.

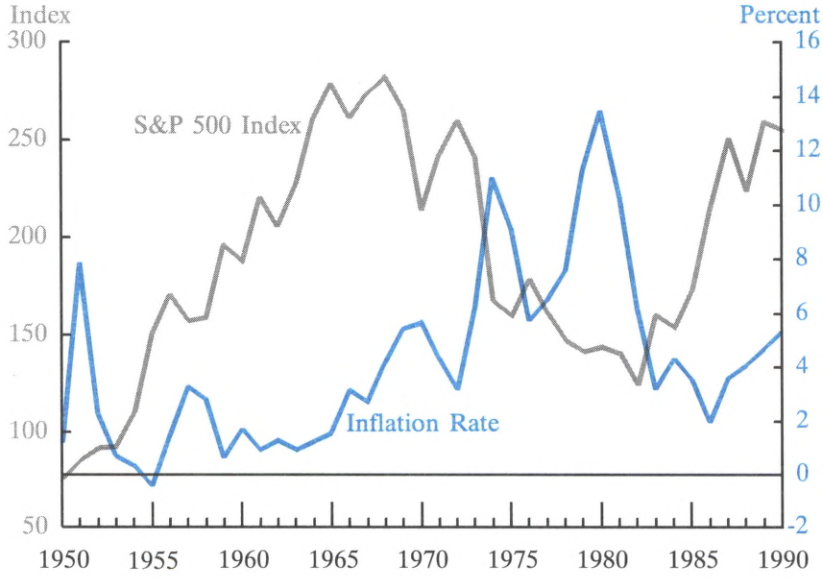
Could the Inflation/Stock Price Link Be Spurious? While the Pearce and Roley study indicates that nominal contracts play a significant role, it also suggests that additional factors might help explain the aggregate inflation/stock price link. One possibility that has received much attention is that most, if not all, of inflation's observed link with stock prices is spurious. In this view, inflation's interaction with nominal contracts has minimal importance in the aggregate. Surprise inflation appears to matter only because it often coincides with more fundamental changes that do affect real stock prices.

The economy's future prospects are especially important. Suppose, for example, that oil prices jump. People can then expect higher inflation and a weaker economy in the future than they did before. The bleaker outlooks for the economy and profits soon cause real stock prices to fall. But since inflation happened to rise unexpectedly at the same time the economic outlook worsened, people wrongly conclude that surprise inflation caused real stock prices to decline.[8]

[7]Bear in mind that inflation's interaction with nominal contracts need not explain the entire decline in real stock prices in order to validate the nominal contracting hypothesis. Other factors, such as falling productivity, can also reduce real stock prices and compound inflation's effects. The key issue is whether inflation's interaction with nominal contracts has a substantial impact on real stock prices, other things equal.

[8]The potential role of oil price shocks in explaining the inflation/stock price link is developed by Kaul and Seyhun (1990). Alternative versions of the proxy hypothesis are offered by Fama (1981) and Geske and Roll (1983). The common thread, however, is that inflation serves as a proxy for changes in expected output, whatever the source of the change.

The Negative Link Between Inflation and Real Stock Prices



The chart above plots the level of the inflation-adjusted S&P 500 against inflation as measured with the Consumer Price Index. The S&P 500, an average of 500 stock prices, is often used to track overall movements in the stock market.

The figures in the chart suggest that real stock prices and inflation have had an inverse relation for most of the 1950-90 period. During the early 1950s, for example, inflation steadily declined as real stock values rose. The inverse relation is especially noticeable since the mid-1960s. After peaking around 1965, real stock prices fell dramatically throughout the 1970s. At the same time, inflation trended higher, rising from about 3 percent to a high of 14 percent. The reverse occurred in the 1980s, as inflation fell back down to around 4 percent and real stock prices skyrocketed.

The inverse relation suggested by the chart has been documented by various researchers using different statistical methods, different indexes of inflation and stock prices, and even data from different countries. Selected relevant studies of U.S. data include Bodie (1976), Nelson (1976), Jaffe and Mandelker (1979), Fama (1981), French, Ruback, and Schwert (1983), Hasbrouck (1984), Pearce and Roley (1988), Kaul and Seyhun (1990), and McCarthy, Najand, and Seifert (1990). For evidence that the negative relation holds in other countries, see Solnik (1984).

Inflation is, of course, only one possible influence on real stock prices. Changes in other important factors, such as alterations of the tax code, can make the relation between stock prices and inflation hard to see on a simple graph like the one above.

In fact, proponents of this view argue that the clearest evidence of an inverse link occurs both in the 1970s, when inflation trended higher and real stock prices plummeted, and in the 1980s, when the opposite occurred. (See *The Negative Link Between Inflation and Real Stock Prices*.) And those periods include major shifts in crude oil prices that could give rise to the spurious inflation/stock price link outlined above. For example, OPEC increased crude oil prices fourfold between mid-1973 and early 1974, and more than doubled them during 1979. Each rise in oil prices coincided with a weaker economy and with higher inflation. Meanwhile, OPEC's drastic oil price cuts of late 1985 and early 1986 coincided with a healthy economy and falling inflation.

If this challenge to contract theory has merit, then the apparent link between inflation and real stock prices should be eliminated by accounting for oil price shocks or, more generally, for changes in expected output and profits. Several studies have tested that proposition using both aggregate and individual firm data.[9] The evidence is mixed, and a good case that the inverse link is spurious has yet to be made. Indeed, a recent study by Steven Cochran and Robert DeFina finds that unexpected inflation has a consistently significant and negative impact on real stock prices. Moreover, inflation's estimated impact is robust to alternative estimation techniques, variable selections, and variable measures. The Cochran-DeFina study, which covers the period 1947-89, controls for oil price shocks and changes in expected output. Thus, the inflation/stock price link does not appear to be spurious.[10]

CONCLUSION

Does unexpected inflation depress the stock market? It probably does, by depressing real business profits. Nominal contracts, which disallow the immediate adjustment of revenues and cost to price changes, are likely the vehicle.

Strong evidence comes from simulation studies showing that unforeseen inflation can substantially reduce equity values. Those studies are especially convincing because they explicitly rely on standard economic theory and because they include what many regard as the most important nominal contracts. In that regard, certain elements of the tax code, such as the use of historic costs in figuring depreciation deductions, appear to play a prominent role. Recent statistical findings provide further support, including evidence that surprise inflation does not simply proxy for the effects of oil price shocks or, more generally, for changes in expected future output.

[9]Relevant studies include Fama (1981), Geske and Roll (1983), Hasbrouck (1984), Bernard (1986), Coate and Vanderhoff (1986), Kaul (1987), Pearce and Roley (1988), Ely and Robinson (1989), Kaul and Seyhun (1990), McCarthy, Najand, and Siefert (1990), and Cochran and DeFina (1991).

[10]The idea that the link is completely spurious is also questionable because early studies that uncovered the inverse relation analyzed data that excluded the experiences of the 1970s and 1980s. Examples are Bodie (1976) and Nelson (1976).

References

Arak, Marcelle. "Inflation and Stock Values: Is Our Tax Structure the Villain?" Federal Reserve Bank of New York *Quarterly Review* (Winter 1980-1981), pp. 3-13.

Bernard, Victor L. "Unanticipated Inflation and the Value of the Firm," *Journal of Financial Economics* (March 1986), pp. 285-322.

Bodie, Zvi. "Common Stocks as a Hedge Against Inflation," *Journal of Finance* (May 1976), pp. 459-70.

Coate, Douglas, and James Vanderhoff. "Stock Returns, Inflation, and Real Output," *Economic Inquiry* (October 1986), pp. 555-61.

Cochran, Steven J., and Robert H. DeFina. "Inflation's Negative Effects on Real Stock Prices: New Evidence and a Test of the Proxy-Effect Hypothesis," April 1991, mimeo.

Ely, David, and Kenneth J. Robinson. "Stock Returns and Inflation: Further Tests of the Proxy and Debt-Monetization Hypothesis," Federal Reserve Bank of Dallas Research Paper 8905 (March 1989).

Fama, Eugene. "Stock Returns, Real Activity, Inflation, and Money," *American Economic Review* (September 1981), pp. 545-65.

Feldstein, Martin. "Inflation and the Stock Market," *American Economic Review* (December 1980), pp. 839-47.

Feldstein, Martin, Jerry Green, and Eytan Sheshinski. "Inflation and Taxes in a Growing Economy with Debt and Equity Finance," *Journal of Political Economy* (April 1978, part 2), pp. S53-70.

Fortune, Peter. "Stock Market Efficiency: An Autopsy?" *New England Economic Review* (March/April 1991), pp. 17-40.

French, Kenneth, Richard Ruback, and G. William Schwert. "Effects of Nominal Contracting on Stock Returns," *Journal of Political Economy* (February 1983), pp. 70-96.

Geske, Robert, and Richard Roll. "The Fiscal and Monetary Linkage Between Stock Returns and Inflation," *Journal of Finance* (March 1983), pp. 1-33.

Hasbrouck, Joel. "Stock Returns, Inflation, and Economic Activity: The Survey Evidence," *Journal of Finance* (December 1984), pp. 1293-310.

Jaffe, Jeffery, and Gershon Mandelker. "The `Fisher Effect' for Risky Assets: An Empirical Investigation," *Journal of Finance* (May 1976), pp.447-58.

Kaul, Gautam. "Stock Returns and Inflation: The Role of the Monetary Sector," *Journal of Financial Economics* (June 1987), pp. 253-76.

Kaul, Gautam, and H. Nejat Seyhun. "Relative Price Variability, Real Shocks, and the Stock Market," *Journal of Finance* (June 1990), pp. 479-96.

Kopcke, Richard. "Are Stocks a Bargain?" *New England Economic Review* (May/June 1979), pp. 5-24.

McCarthy, Joseph, Mohammad Najand, and Bruce Seifert. "Empirical Tests of the Proxy Hypothesis," *Financial Review* (May 1990), pp. 251-64.

Modigliani, Franco, and Richard A. Cohn. "Inflation, Rational Valuation, and the Market," *Financial Analysts Journal* (March/April 1979), pp. 24-36.

Nelson, Charles R. "Inflation and Rates of Return on Common Stocks," *Journal of Finance* (May 1976), pp. 471-83.

Pearce, Douglas, and V. Vance Roley. "Firm Characteristics, Unanticipated Inflation, and Stock Returns," *Journal of Finance* (September 1988), pp. 965-82.

Solnik, Bruno. "Stock Prices and Monetary Variables: The International Evidence," *Financial Analysts Journal* (March/April 1984), pp. 69-73.

Shorter Recessions and Longer Expansions

*Francis X. Diebold & Glenn D. Rudebusch**

Have the patterns of U.S. business cycles changed since World War II? And if so, have they changed in ways consistent with the hypothesis that postwar business cycles have been more stable than prewar cycles? These questions are difficult to answer, and different researchers have arrived at sharply divergent conclusions.

*Francis X. Diebold is J.M. Cohen Assistant Professor of Economics at the University of Pennsylvania and a Visiting Scholar at the Federal Reserve Bank of Philadelphia. Glenn D. Rudebusch is an Economist in the Research and Statistics Division at the Board of Governors of the Federal Reserve System.

Earlier research, which failed to produce a consensus, focused almost exclusively on business-cycle *volatility*. Recent research, however, examines business cycles from the different (and complementary) perspective of *duration*, focusing in particular on the lengths of expansions, contractions, and whole cycles. The duration perspective—unlike its volatility counterpart—reveals striking changes in the nature of postwar business cycles.

THE STABILITY DEBATE: VOLATILITY PERSPECTIVE

Steady growth in the 1960s produced a generally accepted view that the U.S. economy had

become more stable in the period after World War II. This consensus was reinforced by formal studies that focused on business-cycle volatility and concluded that it had decreased in the postwar period.[1]

But the consensus on postwar volatility stabilization has been seriously challenged by Christina D. Romer, in a provocative and stimulating series of papers.[2] Romer argues that the higher volatility displayed by prewar aggregates—whether real GNP, industrial production, or the unemployment rate—reflects differences in methods of prewar and postwar data construction, and that the difference between prewar and postwar volatility is greatly lessened if similar methods are employed for both periods. In Romer's interpretation, the apparent moderation of the business cycle is largely an artifact of inconsistent data.

Romer's contention has not gone undisputed. Various authors have constructed alternative versions of prewar aggregates and have reached traditional conclusions about volatility stabilization.[3] Still others have argued that Romer's reconstructed aggregates—like the original series—depend significantly on unverifiable assumptions and therefore are not unambiguously superior to the original series.[4]

Currently, then, the debate focusing on volatility stabilization is deadlocked. The lesson emerging from the literature is that, given the limited availability of prewar data, it is difficult to measure quantitative prewar U.S. economic aggregates, even annually. Moreover, because the size of fluctuations in these macroeconomic aggregates will be crucial for resolving the volatility debate, inadequate measures of prewar aggregates make any comparison of pre- and postwar volatility rather uncertain.

THE STABILITY DEBATE: DURATION PERSPECTIVE

It is possible, however, to provide *new* evidence on the stability of the postwar economy by investigating a different aspect of stabilization and employing a different type of data.[5]

[1]The focus was typically on fluctuations in measures of aggregate economic activity, such as real GNP, industrial production, or the unemployment rate. The variability, or volatility, of such aggregates was defined as the variance of the detrended series—that is, the average squared deviation from trend. Two well-known and representative studies are Martin N. Baily, "Stabilization Policy and Private Economic Behavior," *Brookings Papers on Economic Activity* (1978:1), pp. 11-60; and J. Bradford Delong and Lawrence H. Summers, "The Changing Cyclical Variability of Economic Activity in the United States," in R.J. Gordon, ed., *The American Business Cycle: Continuity and Change* (University of Chicago Press for NBER, 1986). See also Robert J. Gordon, "Postwar Macroeconomics: The Evolution of Events and Ideas," in M. Feldstein, ed., *The American Economy in Transition* (University of Chicago Press for NBER, 1980).

[2]See her papers, "Spurious Volatility in Historical Unemployment Data," *Journal of Political Economy* 94 (1986), pp. 1-37; "Is the Stabilization of the Postwar Economy a Figment of the Data?" *American Economic Review* 76 (1986), pp. 314-34; and "The Prewar Business Cycle Reconsidered: New Estimates of Gross National Product, 1869-1908," *Journal of Political Economy* 97 (1989), pp. 1-37.

[3]David R. Weir, for example, considers historical unemployment series in "The Reliability of Historical Macroeconomic Data for Comparing Cyclical Stability," *Journal of Economic History* 46 (1986), pp. 353-65, while Nathan S. Balke and Robert J. Gordon consider GNP in "The Estimation of Prewar Gross National Product: Methodology and New Evidence," *Journal of Political Economy* 97 (1989), pp. 38-92.

[4]See, for example, Stanley Lebergott's discussion of Romer's paper in *Journal of Economic History* 46 (1986), pp. 367-71.

[5]This idea is developed more fully in "Have Postwar Economic Fluctuations Been Stabilized?" by Francis X. Diebold and Glenn D. Rudebusch, Economic Activity Working Paper 116, Board of Governors of the Federal Reserve System (1991). The present article is largely a nontechnical synopsis of that paper, which in turn builds upon our earlier work in "Scoring the Leading Indicators," *Journal of Business* 62 (1989), pp. 369-92, and "A Nonparametric Investigation of Duration Dependence in the American Business Cycle,"

The different aspect of stability concerns the relative *duration*, rather than the relative volatility, of pre- and postwar business cycles. In other words, the duration perspective considers explicitly the *lengths* of phases of the business cycle, whereas the volatility perspective focuses on amplitude.

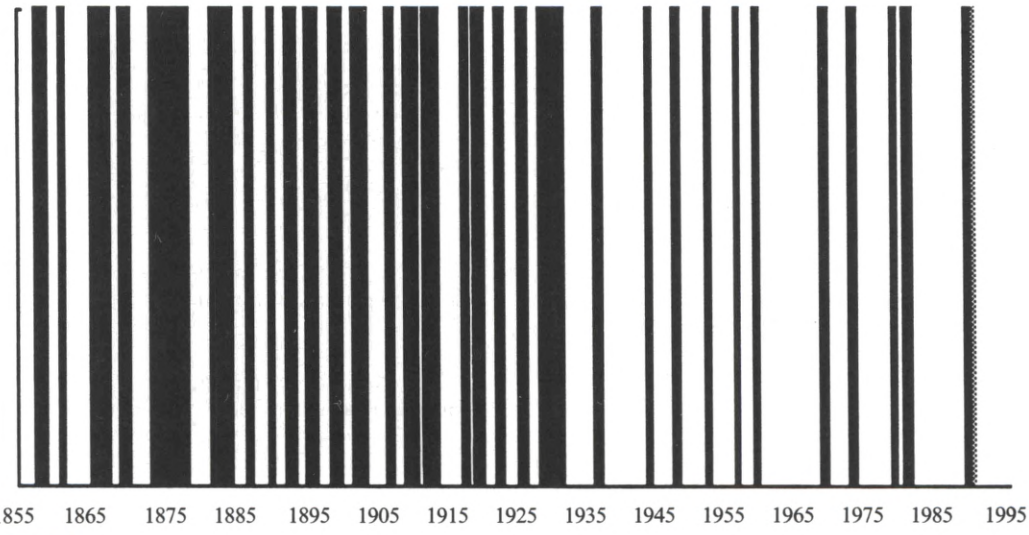
The different data are a chronology of business-cycle turning points. Compared to an aggregate measure of economic activity, a business-cycle chronology contains both less information, because the chronology is qualitative rather than quantitative, and more information, because the chronology can incorporate more sources of cyclical information. The former attribute is obvious: identification of turning points requires only a qualitative sense of the direction of general business activity. Thus, it is easier to determine, for example, that the second quarter of 1894 was a cyclical peak than it is to determine that real GNP rose x percent and fell y percent in the second and third quarters of that year.

At the same time, because only qualitative information is required, a business-cycle chronology can be constructed from a broader set of indicators of business activity than just the components of aggregate measures such as real GNP or industrial production. For example, the National Bureau of Economic Research (NBER) business-cycle chronology, which we use, incorporates a variety of sources of cyclical information, including the price movements of stocks and other assets as well as descriptive accounts of economic activity from historical

Journal of Political Economy 98 (1990), pp. 596-616. See also our paper with Daniel E. Sichel, "Further Evidence on Business Cycle Duration Dependence," forthcoming in J.H. Stock and M.W. Watson, eds., *New Research on Business Cycles, Indicators and Forecasting* (University of Chicago Press for NBER, 1991).

FIGURE 1

NBER Business-Cycle Chronology 1855-1991



Note: Recessionary episodes are shaded.

business annals. Such sources have necessarily been ignored in the volatility stabilization debate, which has focused only on aggregate measures; thus, the NBER business-cycle chronology implicitly brings new information to the debate about the changing nature of business fluctuations.

DOCUMENTING DURATION STABILIZATION

Duration stabilization is suggested by even a casual examination of the history of U.S. expansions and contractions, shown in Figure 1, in which recessions appear in black. The period before World War II contains a great deal more black; however, formal statistical analysis can assess the likelihood that the apparent postwar change in the business cycle is *real* rather than merely good luck.

Statistical analyses of data on lengths of expansions and contractions reveal that the apparent shifts in duration patterns following World War II are real. Statistically speaking, we can reject the hypothesis of no change in the behavior of expansion and contraction durations at the 0.1 percent level; that is, the probability that the rejection is incorrect is no larger than one-tenth of 1 percent. Furthermore, the nature of postwar change is clear: expansions have become longer, and contractions have become shorter.

It is unusual in empirical macroeconomics to obtain such high significance levels, particularly with such small samples as the number of expansions or contractions since World War II. But what of the more important question: are the postwar shifts significant from an economic, as opposed to statistical, perspective? Clearly, the answer is yes, as can be seen from three related perspectives.

First, consider average duration. The average duration of a prewar expansion is about 25 months, whereas that for postwar expansions is about 50 months; thus, the average duration of expansions has roughly *doubled*. Conversely, the average duration of prewar contractions is about 20 months, whereas that for postwar contractions is about 10 months; thus, the average duration of contractions has roughly been *halved*.

Second, consider the ratio of expansion duration relative to the duration of the preceding contraction. The prewar average of this ratio is 1.5, whereas the postwar average is a much larger 4.5.

Third, consider the amount of time spent in recession. More than 40 percent of the prewar period was spent in recession, compared to a much smaller 20 percent for the postwar period.

The striking changes in expansion and contraction duration patterns are readily seen by comparing the cumulative proportion of expansions and contractions lasting no longer than k months, for various values of k. We call the cumulative proportion F(k) in the prewar period and G(k) in the postwar period. Our interest centers on the overall shapes of F(k) and G(k) for expansions and contractions, and particularly on the relative speeds with which they rise from zero to 1. A fast rise corresponds to durations that are short on average, and conversely.

The pre- and postwar cumulative proportions F(k) and G(k) are graphed in Figures 2 (expansions) and 3 (contractions). The axes in each figure are scaled identically, so the two figures are comparable. Duration stabilization shows clearly in the rightward shift of the cumulative proportion for expansions, and by the leftward shift of the cumulative proportion for contractions. For example, Figure 2 shows that in the prewar period about 80 percent of expansions lasted less than 40 months, whereas in the postwar period only 50 percent lasted less than 40 months.

The behavior of whole-cycle duration patterns (whether measured peak-to-peak or trough-to-trough) is very different. Unlike the expansions and contractions of which they are

composed, whole cycles show no evidence of postwar change. In fact, the hypothesis of no change cannot be rejected even at the 20 percent level. Thus, a reasonable distillation of the results is that the lengthening of postwar expansions and shortening of postwar contractions approximately cancel one another, leaving the patterns of whole-cycle durations unchanged. The time per business cycle has remained approximately constant, but *within* each cycle much more time is now spent in expansion.

All of the conclusions discussed here are robust to 1) changes in the ending date for the prewar sample (June 1938, August 1929, December 1914) to exclude the influence of the Great Depression or the interwar period in general; 2) exclusion of the pre-1885 turning-point dates in order to avoid potentially unreliable dates in the very early period; 3) exclusion of the 1887 and 1899 recessions, to account for the possibility that these were merely growth recessions; and 4) exclusion of wartime expansions (and whole cycles that include wartime expansions) to avoid the possibility of spuriously long observations.

UNDERSTANDING DURATION STABILIZATION

One obvious potential source of duration stabilization, ironically enough, is volatility stabilization! That is, to the extent that postwar volatility actually *was* stabilized, one expects, *ceteris paribus*, concomitant duration stabilization because of the upward trend in aggregate economic activity.[6] Therefore, potential sources of postwar volatility stabilization are also po-

[6]To see this, note that if the volatility of fluctuations around an upward trend is decreased, expansions are lengthened and contractions are shortened. In the limit, when volatility is zero, the economy is in permanent expansion, growing at the trend rate.

FIGURE 2
Proportion of Expansions Lasting No Longer Than k Months

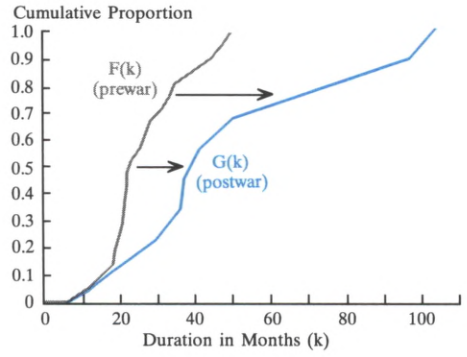
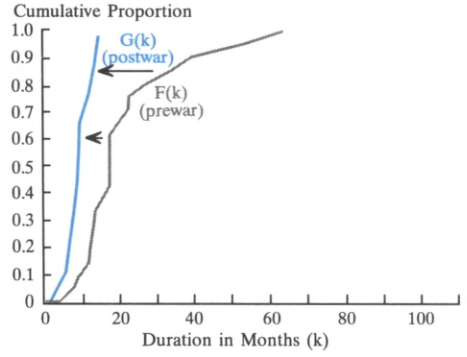


FIGURE 3
Proportion of Contractions Lasting No Longer Than k Months



tential sources, at least in part, for postwar duration stabilization.[7] It is unlikely, however, that *all* of the postwar duration stabilization is associated with volatility stabilization. To the extent that volatility actually was stabilized, previous research has found that the reduction was small and hard to detect. The postwar shift toward duration stabilization, however, is large and difficult to deny. It is therefore likely that at least some of the duration stabilization arose independently of volatility stabilization.

The remaining potential factors underlying postwar duration stabilization can be broadly classified into three categories: 1) postwar changes in the nature of macroeconomic shocks; 2) postwar improvements in discretionary government policy; and 3) structural changes in the postwar economy. It is conceivable that these factors may have produced concomitant volatility and duration stabilization, or duration stabilization alone.

The first possibility—a direct change in the nature of postwar shocks—is certainly a logical possibility, but no evidence, either econometric or anecdotal, has been given as support. In particular, we know of no evidence indicating that macroeconomic shocks have changed in a way that led either to duration stabilization independent of volatility stabilization (a change in pattern but not size), or to concomitant duration and volatility stabilization (a change in size and perhaps pattern).

As for the second possibility, the start of the postwar period saw both a significant strengthening of the powers of monetary and fiscal policy and of the public commitment to use them to stabilize the economy. There is some evidence that this commitment alleviated fears of macroeconomic catastrophes, by eliminating very long, deep recessions.[8] However, attempts to smooth the postwar period's moderate swings in business activity have been judged, even by those who normally might be somewhat sympathetic, as neutral at best, with successes offset by failures.[9] Overall, it would appear that if discretionary government policy in the postwar period produced duration stabilization, it did so independently of volatility stabilization. Such a scenario is not unreasonable, if policymakers perceived a link between the durations of expansions and contractions and welfare, perhaps along the lines discussed below, and took (successful) policy action accordingly.

"Potential sources of postwar volatility stabilization are also potential sources, at least in part, for postwar duration stabilization."

[7]Even the estimates least favorable to the volatility stabilization hypothesis—Romer's—indicate the possibility of some volatility stabilization in the postwar period.

[8]See J. Bradford Delong and Lawrence H. Summers, "How Does Macroeconomic Policy Affect Output?" *Brookings Papers on Economic Activity* 2 (1988), pp. 433-80.

[9]See Robert J. Gordon, "Postwar Macroeconomics: The Evolution of Events and Ideas," in Martin Feldstein, ed., *The American Economy in Transition* (University of Chicago Press for NBER, 1980); Alan S. Blinder, *Economic Policy and the Great Stagflation* (New York: Academic Press, 1981); and Arthur M. Okun, "Postwar Macroeconomic Performance," in M. Feldstein, ed., *The American Economy in Transition*.

The last set of factors—postwar structural changes in the economy—also includes likely sources of duration stabilization. Some of those changes have occurred independently of policy, such as the increased share of services (which have a very moderate cycle), increased availability of consumer credit (with a reduction in the number of liquidity-constrained households), and technical improvements leading to better inventory management. Others represent part of the postwar Keynesian institutional order, such as the introduction of "automatic stabilizers" (countercyclical entitlement programs, such as unemployment insurance, and an increasing marginal tax rate) and deposit insurance and regulation (which act indirectly through stabilization of the financial system).

Welfare Effects of Duration Stabilization. A natural question is whether duration stabilization improves welfare. A proper evaluation of this issue requires an economic model, and different models clearly produce different welfare rankings. Thus, an incontrovertible specification of the welfare gains and losses of duration stabilization will have to await a consensus theory.

From a Keynesian perspective, the lengthy periods of reduced output and low utilization of capital and labor inputs during recessions represent inefficient coordination failures; in particular, the additional unemployment and idleness incurred by workers during recessions is involuntary. The welfare cost of recessions in the Keynesian framework is clearly evident in the shortfall of actual output from potential output. In this framework, the duration stabilization of the postwar period is welfare-improving.

In contrast, a different welfare assessment may be obtained from a neoclassical perspective. Models in the neoclassical tradition treat economic fluctuations as efficient outcomes of free-market competition; for example, the additional unemployment incurred during recessions represents a voluntary—and optimal—response by workers to changing opportunities. Thus, for neoclassical economists, duration stabilization need not be associated with increased welfare.

Recent work has tended to focus on equilibrium interpretations of economic fluctuations. However, an important subset of this work has stressed the existence of multiple equilibria: the economy may end up at a low level of output with higher unemployment or at a high level of output with lower unemployment. These outcomes are rankable in terms of welfare, suggesting that duration stabilization improves welfare because less time is spent in the low-output equilibrium.[10]

One condition associated with multiple equilibria is the presence of a complementarity or spillover between aggregate conditions and the actions or opportunities of individual agents.[11] A natural technological spillover occurs when the level of aggregate activity in one period affects firms' production functions in the next. For example, knowledge accumulated in one production period may affect subsequent production possibilities.[12] Furthermore, the accumulation of knowledge can be linked to the level of activity.[13] Indeed, a large literature suggests that the costs of idleness on human capital are substantial, because a crucial factor in accumulating human capital is the opportu-

[10]See, for example, Steven N. Durlauf, "Nonergodic Economic Growth," NBER Working Paper 3719 (1991).

[11]See, for example, Russell Cooper and Andrew John, "Coordinating Coordination Failures in Keynesian Models," *Quarterly Journal of Economics* 103 (1988), pp. 441-63.

[12]Paul Romer, for example, focuses on spillovers associated with human capital accumulation in "Increasing Returns and Long-Run Growth," *Journal of Political Economy* 94 (1986), pp. 1002-37.

[13]See Kenneth J. Arrow, "The Economic Implications of Learning by Doing," *Review of Economic Studies* 29 (1962), pp. 155-73.

nity to maintain and update skills through employment. In contrast, unemployment results in an atrophy of skills, which reduces the effective supply of labor.[14] Thus, the shorter durations of postwar contractions may have curtailed the loss of human capital and raised the level of production during subsequent expansions.

CONCLUSION

Investigating the stabilization hypothesis from the perspective of duration (or length), as opposed to volatility (or amplitude), has proved fruitful. There is strong evidence of a postwar shift toward longer expansions and shorter contractions, which is consistent with a broad interpretation of the stabilization hypothesis. Moreover, there is no evidence of a postwar shift in the distribution of whole-cycle durations, which suggests a reallocation of business-cycle time away from contraction and toward expansion.

Much less is known, however, about the sources and welfare effects of duration stabilization. Although it is easy to list potential sources of duration stabilization and potential welfare effects, deciding among them is difficult. Additional research along those lines will likely prove useful.

[14]Extensive discussion of these effects can be found in Edward Phelps, *Inflation Policy and Unemployment Theory* (New York: Norton, 1972), and in Robert E. Hall, "The Phillips Curve and Macroeconomic Policy," *Carnegie-Rochester Conference Series on Economic Policy* 1 (1976), pp. 127-48.

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