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INTRODUCING

The Survey of Professional Forecasters by Dean Croushore
Economic Research Division

**How Costly Is Disinflation?
The Historical Evidence**
by Laurence Ball

- Sacrifice ratio
- Speed of disinflation
- Wage flexibility



Business Review

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INTRODUCING: THE SURVEY OF PROFESSIONAL FORECASTERS

Dean Croushore

Every three months the Federal Reserve Bank of Philadelphia takes a survey of forecasts of economic variables prepared by private sector economists. The Bank publishes the results in the Survey of Professional Forecasters. Who are these professional forecasters? Why do we need such surveys? How useful are the survey's results? Dean Croushore gives us some history on the Survey of Professional Forecasters and discusses its current form and applications.

HOW COSTLY IS DISINFLATION? THE HISTORICAL EVIDENCE

Laurence Ball

When it comes to disinflation, central banks face a dilemma: they'd like to reduce inflation, but they don't want the output losses that almost always accompany efforts to do so. Just what is the cost of disinflation? Economists measure the cost using the concept of the sacrifice ratio: the ratio of total output losses caused by disinflation to the decrease in inflation. Larry Ball looks at past episodes of disinflation in a variety of countries and uses these experiences to estimate the cost of disinflation. He finds that the speed of disinflation—quick vs. gradual—affects the sacrifice ratio and that the flexibility of wage-setting institutions is also a factor.

Introducing: The Survey of Professional Forecasters

*Dean Croushore**

Forecasts play a crucial role in the economy. Businesses won't hire workers as readily if they think the economy may go into a recession soon. Long-term interest rates will rise if people in the financial markets expect inflation to increase. And firms are less likely to borrow money for new investment spending today if they think interest rates will soon decline.

*Dean Croushore is Research Officer in charge of the Macroeconomics Section of the Philadelphia Fed's Research Department. He thanks Victor Zarnowitz for useful comments on an earlier draft of this article. He also thanks the National Bureau of Economic Research and Professor Zarnowitz for their help and cooperation when the Philadelphia Fed took over the survey in 1990.

Forecasts are important for many decisions, but not many people have the knowledge and experience to forecast economic variables well. It makes sense, therefore, for people to rely on the forecasts of experts. One easy way to get these forecasts is to subscribe to a survey of forecasts, such as the Survey of Professional Forecasters.

Every three months, the Federal Reserve Bank of Philadelphia takes a survey of forecasts of economic variables (including output, inflation, and interest rates) prepared by private sector economists—the Survey of Professional Forecasters. As the title suggests, the respondents are *professional* forecasters—those who produce regular forecasts of economic vari-

ables as part of their jobs in the business world or on Wall Street. This survey has proven to be valuable both for informing business firms and policymakers about the future direction of the economy and aiding economic researchers studying forecasting.

The American Statistical Association (ASA), together with the National Bureau of Economic Research (NBER), began conducting the survey (which came to be called the ASA/NBER Economic Outlook Survey) in the fourth quarter of 1968. In the early days, the survey attracted many forecasters, with over 50 participants each quarter in the first years of the survey's existence. As time went on, however, the number of participants declined, to fewer than 20 by 1988. After the first quarter of 1990, the ASA and NBER decided to discontinue the survey.

Later in 1990, the Federal Reserve Bank of Philadelphia revived the survey by inviting new forecasters into the survey, which boosted the number of participants into the 30s. We changed the dates at which the survey was mailed out and collected to make them consistent through time, and we modified the survey to ensure that everyone was forecasting the same set of variables. In addition, we added longer term forecasts of certain variables, including inflation. The survey's results are publicly released and are often reported in newspapers and on financial-market wire services.

WHY PEOPLE NEED FORECASTS

Policymakers, business planners, investors, and homeowners all have specific uses for educated forecasts of the economy. Policymakers need to know what the future holds so that current policies can be formed appropriately. For example, monetary policy affects economic activity with a lag of six months or more and affects inflation with an even longer lag, so to make the proper policy decision today, the Federal Reserve must anticipate the state of the economy some months in the

future. Similarly, to decide on issues such as how much to increase their labor force or whether the demand for a proposed new product is likely to be sufficient, business planners need to know how likely it is that different sectors of the economy will expand or contract over the next several years. Financial markets are extremely sensitive to forecasts of changes in interest rates, firms' profits, and the rate of inflation. Even in personal planning decisions, such as whether to refinance a mortgage loan, forecasts of interest rates and other economic variables are quite useful.

The Survey of Professional Forecasters can help meet many of these needs. It is produced quarterly and is available to the public at no charge. It is released at the end of the second month of each quarter (or early the next month); for 1993, new surveys were released March 1, June 1, August 30, and November 29. For the press, the survey is released via PR Newswire. The results of the survey are often reported in major newspapers, including the Wall Street Journal, and on financial newswires. (See *Highlights from the Latest Survey of Professional Forecasters*.)

WHAT ECONOMIC VARIABLES ARE FORECAST?

In the first survey, conducted in the fourth quarter of 1968, participants were asked to forecast 10 variables for the next five quarters. For example, survey respondents predicted the level of nominal gross national product (GNP) for the fourth quarter of 1968 and for all four quarters of 1969. The survey was restructured in 1981, adding some new variables, dropping some others, and adding annual forecasts. In 1992 the main aggregate output variable was changed from GNP to GDP (gross domestic product). Currently there are 27 different forecast variables included in the survey (Table).

In addition to the standard quarterly and annual forecasts, the forecasters are asked to predict two other types of variables: *probability*

August 30, 1993
THIRD QUARTER 1993

Forecasters See Weaker Growth, Improved Inflation Outlook over the Near Term

Current prospects for economic growth through 1993 and into 1994 are weaker now than they were just three months ago, according to 35 forecasters surveyed by the Federal Reserve Bank of Philadelphia. After lower than expected growth in the second quarter, the forecasters have reduced their projections for real GDP growth to 2.4 percent in 1993, down 0.6 percentage points from the second-quarter survey. In 1994, the economy is expected to expand at a 2.8 percent rate, down from 3.0 percent in the last survey. Despite the weaker GDP outlook, the forecasters continue to see the civilian unemployment rate decreasing gradually, averaging 6.9 percent in 1993 and 6.6 percent in 1994, virtually unchanged from three months ago.

Inflation, as measured by the CPI, is expected to average 3.1 percent in 1993 and 3.2 percent in 1994, both lower than the 3.4 percent forecast in the previous survey. Over the next five quarters, the forecasters see inflation reaching 3.3 percent in the fourth quarter of this year and leveling off at that rate through the third quarter of 1994.

Weaker growth and lower inflation over 1993 and 1994 will be accompanied by lower interest rates, particularly long-term rates, according to the forecasters. The median forecast currently calls for the 10-year Treasury-bond rate to average 6.0 percent in 1993 and to hold steady at that level in 1994, down from 6.2 percent and 6.3 percent, respectively, in the last survey.

The following table compares median forecasts for selected variables from the current survey with those from three months ago:

		Real GDP		CPI Inflation		10-yr. T-Bond Yield	
		Previous	New	Previous	New	Previous	New
Quarterly data:							
1993:	Q3	3.3	3.1	3.2	2.7	6.1	5.8
	Q4	3.3	3.2	3.3	3.3	6.2	5.8
1994:	Q1	3.1	2.7	3.5	3.3	6.3	6.0
	Q2	2.6	2.9	3.5	3.3	6.3	6.0
	Q3	N.A.	3.0	N.A.	3.3	N.A.	6.0
Annual average data:							
1993		3.0	2.4	3.4	3.1	6.2	6.0
1994		3.0	2.8	3.4	3.2	6.3	6.0

Forecasters Also See Lower Long-Term Inflation

The median forecast for the average inflation rate (based on the Consumer Price Index) for the next 10 years dropped to 3.45 percent, from 3.7 percent in the last survey. The middle half of the forecasts are in the range of 3.0 percent to 3.5 percent.

Slightly Higher Risk of a Negative Quarter

Forecasters continue to see only a slight chance of a decline in real GDP in the short term. However, those probabilities are a bit higher than in the previous forecast, as the following table shows:

Mean Probability of a Decline in Real GDP

		Second Quarter 1993 Survey	Third Quarter 1993 Survey
1993:	Q3	7.0	7.0
	Q4	9.0	10.0
1994:	Q1	12.0	14.0
	Q2	14.0	16.0
	Q3	N.A.	15.0

Impact of Midwest Flooding Expected to Be Small

The forecasters see Midwest weather conditions having only a limited effect on output and inflation over the next two years, with most of the impact concentrated in the remainder of 1993. Of those who expect an effect, most report adjusting their CPI inflation forecast upward by 0.1 to 0.2 percentage points for 1993, while adjusting downward their forecasts for real GDP growth in 1993 by about the same amount.

TABLE
Variables Included in the Survey of Professional Forecasters

	Data Availability		Data Availability
U.S. Business Indicators		Probability Variables	
Gross Domestic Product (GDP)	A	GDP Probability	D
GDP Implicit Price Deflator	A	Deflator Probability	D
Corporate Profits After Taxes	A	Recession Probability	D
Civilian Unemployment Rate	A		
Industrial Production Index	A	Long-Term (10-Year) Forecasts	
Housing Starts	A	Consumer Price Index	E
Consumer Price Index Inflation Rate	B	Real GDP	F
3-Month Treasury Bill Interest Rate	B	Productivity Growth	F
AAA Corporate Bond Yield	B	Stock Return (S&P 500)	F
10-Year Treasury Bond Interest Rate	C	10-Year Treasury Bond Return	F
		3-Month Treasury Bill Return	F
Real GDP and Its Components (all series adjusted for inflation)		Variables Deleted From the Survey	
Real Gross Domestic Product	B	Plant and Equipment Expenditures	G
Personal Consumption Expenditures	B	Change in Business Inventories (nominal)	G
Nonresidential Fixed Investment	B	Durable Goods Expenditures	G
Residential Fixed Investment	B	National Defense Purchases	G
Federal Government Purchases	B		
State and Local Government Purchases	B		
Change in Business Inventories	B		
Net Exports of Goods and Services	B		

Data Availability:

- A Quarterly forecasts begin fourth quarter 1968; annual forecasts begin third quarter 1981
- B Beginning third quarter 1981 for both quarterly and annual forecasts
- C Beginning first quarter 1992 for both quarterly and annual forecasts
- D Beginning fourth quarter 1968
- E Beginning fourth quarter 1991
- F Beginning first quarter 1992; collected only in the first quarter each year
- G Collected from the fourth quarter of 1968 to the second quarter of 1981; quarterly forecasts only

variables and (newly added) long-term forecasts. The "GDP Probability" and "Deflator Probability" variables reflect the degree of uncertainty in each respondent's forecast. These variables show the probability that real GDP and the GDP deflator will fall into particular categories of growth rates. For example, in recent sur-

veys, the forecasters were asked to indicate what probability they would attach to real GDP's rising 6 percent or more, 5.0 to 5.9 percent, 4.0 to 4.9 percent, 3.0 to 3.9 percent, 2.0 to 2.9 percent, 1.0 to 1.9 percent, 0.0 to 0.9 percent, -1.0 to -0.1 percent, -2.0 to -1.1 percent, and declining more than 2 percent. Someone

with a forecast of 3.5 percent real GDP growth might say that there is a 50 percent probability that real GDP will grow 3.0 to 3.9 percent, 20 percent probability of 4.0 to 4.9 percent growth, 5 percent probability of 5.0 to 5.9 percent growth, 20 percent probability of 2.0 to 2.9 percent growth, and 5 percent probability of 1.0 to 1.9 percent growth.

These probability categories provide important information to business people and policymakers, who often need not just a point forecast but also some idea of how much uncertainty there is about the forecast. Looking at how much the forecasts differ across forecasters gives some indication of uncertainty. But only the probability questions in the Survey of Professional Forecasters provide information on how uncertain each respondent is about her or his own forecast.¹

Forecasters are also asked how likely they think it is that real GDP will decline in the current quarter or in any of the next four quarters. We call this a "Recession Probability," though that is not completely accurate, since real GDP can decline in one quarter without the economy being in a recession. A rule of thumb suggests that a recession occurs when there is a decline in real GDP for two consecutive quarters.

Recently, the survey has begun asking participants for long-term forecasts of some variables. The survey asks respondents to forecast the average, over the next 10 years, of the CPI inflation rate, the real GDP growth rate, the rate of productivity growth, the rate of return on corporate stock, the yield on 10-year Treasury bonds, and the yield on three-month Treasury bills.²

In addition to these specific variables for which there is a quantitative response, we ask the participants for their general opinions about fiscal policy, monetary policy, international influences, and other factors that affect their forecasts. Occasionally, we ask a particular question about the state of the economy that isn't reflected in the other questions on the survey. For example, we have asked whether the participants thought the economy was in recession, then later asked whether they thought the recession was over.

The Economic Research Division of the Federal Reserve Bank of Philadelphia maintains a complete data base on all the survey results, including all the data from 1968 to 1990 when the ASA and NBER ran the survey. All the results are available by writing to the address in the box on page 8 (see *For Further Information*).

WHO ARE THE FORECASTERS?

The forecasters in the Survey of Professional Forecasters come largely from the business world and Wall Street. For example, out of 36 participants in a recent survey, 13 were from Wall Street financial firms, eight from banks, five from economic consulting firms, three from university research centers, and seven from other private firms, including chief economists at many Fortune 500 companies. This diverse group of forecasters shares one thing in common: they forecast as part of their current jobs. And they do so, according to Zarnowitz and Braun (1992), using statistical (econometric) models, other people's forecasts, leading indicators, and surveys such as the Consumer Confidence Index.

¹ Research by Zarnowitz and Lambros (1987) suggests that measuring forecast uncertainty by the variation in forecasts across forecasters understates uncertainty, compared with measuring it using the survey's probability variables.

² Because these variables are not expected to change much from quarter to quarter, we include all but one of these variables in the survey just once a year (in the first quarter). The exception is the long-term CPI inflation rate, which we ask about every time because of its importance and because inflation expectations seem to change rapidly.

For Further Information

To get your name on the mailing list to receive the survey, write to: Publications Desk, Research Division, Federal Reserve Bank of Philadelphia, Ten Independence Mall, Philadelphia, PA 19106.

To get data sets from the survey or to inquire about the possibility of becoming a panelist in the survey, write to Dean Croushore, Research Officer and Economist, Federal Reserve Bank of Philadelphia, Ten Independence Mall, Philadelphia, PA 19106. Two types of data sets are available: median data and individual data. The median data set provides the median values across forecasters for each variable in each survey over time. This data set is small enough to fit on one floppy disk and can be sent immediately upon request. The individual data set, containing every individual's response for each variable in each survey, is much larger; if you specify which variable(s) you are interested in, we will send that subset of the data.

One important feature of the Survey of Professional Forecasters is anonymity of the forecasters. We do not release the names of any participants in the survey.³ This anonymity is designed to encourage people to provide their best forecasts, without fearing the consequences of making forecast errors. In this way, an economist can feel comfortable in forecasting what she really believes will happen to interest rates, even if it contradicts her firm's official position. Also, the participants are more likely to take an extreme position that they believe in (for example, that real GDP will grow 5 percent in 1994), without feeling pressure to conform to the consensus forecast. The negative side of

³ Even though the names of the forecasters are not given as part of the data set, each forecaster is identified by a code number, so that a researcher can follow the forecasts of a particular forecaster over time.

providing anonymity, of course, is that the forecasters can't claim credit for particularly good forecast performance, nor can they be held accountable for particularly bad forecasts. Some economists feel that without accountability, forecasters may make less accurate predictions because there are fewer consequences to making poor forecasts.

HOW THE SURVEY OF PROFESSIONAL FORECASTERS COMPARES WITH OTHER SURVEYS

Other surveys useful to the public and readily available include the Livingston Survey, Blue Chip Economic Indicators, and the National Association of Business Economists (NABE) Outlook.⁴ The NABE Outlook is the closest to the Survey of Professional Forecasters in that it comes out quarterly, surveys professional forecasters, and maintains the anonymity of the individual forecasters. The Blue Chip survey provides a very useful forecast survey on a monthly basis, forecasting many important macroeconomic data series and including long-run forecasts twice a year. The semi-annual Livingston Survey has many variables in common with the Survey of Professional Forecasters.⁵

There are several key differences between the Survey of Professional Forecasters and these other surveys. The NABE Outlook forecasts

⁴ These are the most well-known forecast surveys for the U.S. economy. In addition, there are several international forecast surveys that include forecasts for the U.S., such as Economic Forecasts: A Worldwide Survey and Consensus Forecasts. Also, there are many private forecasting firms, such as DRI and WEF, that provide more detailed and more frequent forecasts than do the surveys. The higher price for such a service also buys you expert help in interpreting and understanding the forecasts; surveys do not provide such help.

⁵ For historical information on the Livingston Survey, see Taylor (1992). The Philadelphia Fed also produces the Livingston Survey.

only annual averages for most variables, while the Survey of Professional Forecasters forecasts quarterly detail. The Blue Chip survey does not preserve the anonymity of the forecasters, and for economic researchers studying inflation, the fact that the Blue Chip survey didn't begin until 1976 is a disadvantage, as it misses the first OPEC oil shock of 1973-74 and the runup of inflation in the late 1960s. The Livingston Survey provides forecasts over six-month periods, which may not be as useful as quarterly forecasts to some people (especially researchers). But the Livingston Survey began in 1946, so it offers a long historical record of forecasts for research use.⁶

HOW THE SURVEY IS USED IN PRACTICE

Labor Contracts. Employers and labor organizations use surveys of forecasts in setting wage contracts. Because wages are often determined for periods as long as three years ahead, people would like to have a reliable forecast of inflation so that they can set wages while allowing for expected changes in the cost of living. Because the Survey of Professional Forecasters has a good track record in forecasting (see *Measures of the Survey's Accuracy*), and because the survey's median forecast is generally more accurate than any one individual's forecast, the survey has been used by some firms and unions in negotiating wages.⁷

Business Planning. Before business firms undertake a major project, such as introducing a new product line or making a new capital

investment, they need to forecast not only the likely value of the product or capital item itself, but also how good the overall business climate is likely to be. A recession can easily overwhelm even the best-laid plans for a new investment. And starting up a new product line when the economy is about to turn down may reduce the product's chances of success. For that reason, using the forecasts of real GDP or recession probability in the Survey of Professional Forecasters may be beneficial.

Household Finance. Individuals may find the survey useful for their personal finances. If you are thinking about refinancing your mortgage, the survey gives you information about forecasters' beliefs about the likely direction of long-term and short-term interest rates. Or if you are thinking about how much to save for retirement, you can get some forecasts of rates of inflation and returns on stocks and bonds over the long run.

Tracking Inflation Expectations. Economic theory tells us that people's inflation expectations can affect the response of the economy to changes in monetary policy. One reason the Philadelphia Fed took over the Survey of Professional Forecasters from the ASA and NBER in 1990 was to continue the historical series on inflation expectations. The survey provides useful inflation forecasts in the short term (one-, two-, three-, and four-quarters ahead) and the long term (over the next 10 years).

Calculating Real Interest Rates. Economists have found that real interest rates (nominal interest rates less expected inflation) are important in determining such things as the amount of investment spending that businesses undertake and the amount of borrowing that consumers are willing to do. The gap between nominal interest rates and real interest rates is the inflation premium; it goes toward repaying the lender for the purchasing power that is lost to inflation over the life of the loan.

Since we can observe the level of nominal interest rates in the market, we can infer what

⁶ Carlson (1977) describes some problems in using and interpreting the Livingston Survey data. These problems were corrected in 1992.

⁷ Research on the quality of inflation forecasts in the survey is mixed. Some researchers find the forecasts to be quite good, while others find them to be biased at times. Of course, there are no guarantees that the Survey of Professional Forecasters or any other survey of forecasts will be as accurate and unbiased in the future as it has been in the past.

How accurate are the forecasts in the Survey of Professional Forecasters? We claim the survey is fairly accurate, but how do we measure this?

To begin, we must calculate the forecast error, which is defined as the actual value of a variable minus the forecasted value. For example, if I forecast in November 1991 that the CPI inflation rate for 1992 will be 4.0 percent, and in fact it turns out to be 2.9 percent, my forecast error is -1.1 percent (note that we don't know the forecast error until 1992 is over and the government releases the actual data on 1992 CPI inflation).

Forecast errors arise for many reasons; mostly, the future is just difficult to predict. In particular, inflation is difficult to predict because events like the OPEC oil-price hikes can cause sudden changes in inflation. Real GDP growth is difficult to predict because while economists understand many of the causes of recessions, predicting the exact date at which a recession will begin has proven to be very difficult. While continued study by economists gives us more information about how the economy works and thus better forecasts, there will always be events that cannot be predicted.

Accuracy in forecasting can be measured in a variety of ways, the two most common being mean absolute error and root mean square error. Mean absolute error (MAE) is found by calculating the average size (absolute value) of the forecast errors over time. Root mean square error (RMSE) is found by squaring the forecast errors, calculating their average value, then taking the square root. For both MAE and RMSE, the larger the number is, the worse the forecast accuracy is. The measures are similar, although using the RMSE to measure accuracy gives a bigger penalty to large errors than does the MAE.

The table at right reports data from Zarnowitz and Braun (1992), comparing the accuracy of the average of individual forecasts in the Survey of Professional Forecasters (SPF) to two other well-known forecasters, identified here only as A and B.

There are several interesting results from these forecast accuracy comparisons. First, notice that forecast accuracy varies a lot depending on the time period. The MAE and RMSE for real GDP from 1970 to 1990 for the Survey of Professional Forecasters are quite a bit higher than those from 1976 to 1990, because the early 1970s contained both an unexpected rise in inflation (from the first OPEC oil shock) and a recession (from November 1973 to March 1975), which was hard to predict. Second, notice that the Survey of Professional Forecasters was more accurate than forecaster A for real GDP and inflation, but less accurate for the

real interest rates are by using the Survey of Professional Forecasters to measure expected inflation. Real interest rates for each quarter from the first quarter of 1984 to the fourth quarter of 1992 are shown for government bonds with 10 years to maturity (Figure 1) and for bonds with one year to maturity (Figure 2). The figures show a clear downward trend in real interest rates over the past three years, which has begun to promote business investment and consumer borrowing.

HOW THE SURVEY IS USED IN ACADEMIC RESEARCH

The Survey of Professional Forecasters is increasingly used in research by academic economists who are investigating such questions as: Do forecasters correct their mistakes over time? Do their forecasts incorporate all available information? Are the forecasts biased in any way? What techniques of forecasting lead to the smallest errors? These questions are important because forecasts of economic vari-

unemployment rate. This is a result found quite frequently in studies of forecast accuracy—no one forecaster is superior at forecasting all variables.

It is important to realize that any comparison of forecast accuracy depends on the timing of when forecasts were made. Forecasts made with more information are usually more accurate, so in making comparisons of one forecast with another it is important to verify when the forecasts were made. For example, if forecaster A made a forecast on the 10th day of each month, while forecaster B made a forecast on the 24th day of the month, forecaster B would have a built-in advantage, because she would have more data on which to base her forecasts every month. Because forecasters make their forecasts at different times, comparing accuracy is difficult.

Finally, the choice of which data to use in examining forecast accuracy is also important. Many government-produced data series get revised over time because more complete data become available, because seasonal adjustment factors are changed, or because base years are changed. For example, real GDP growth for the fourth quarter of 1990 was released initially on January 25, 1991, revised on February 27 and on March 27, then revised (including a change in the base year from 1982 dollars to 1987 dollars) on December 4, again on July 30, 1992, and again on August 31, 1993. So to examine the accuracy of a forecast of real GDP growth requires a choice of which data to use in calculating the forecast error—and different choices may make a significant difference in measuring forecast accuracy.

Variable	Period	Name of Forecaster	MAE		RMSE	
			SPF	Forecaster	SPF	Forecaster
Real GDP	'70-'90	A	1.32	1.58	1.89	2.18
Inflation	'70-'90	A	1.12	1.40	1.56	1.98
Unemployment	'68-'90	A	0.61	0.58	0.85	0.78
Real GDP	'76-'90	B	1.12	1.53	1.57	1.90
Inflation	'76-'90	B	0.89	1.05	1.06	1.33

ables affect the response of the economy to changes in monetary and fiscal policy. Research results on these questions are also important to people who use the forecasts, as they attest to the reliability and accuracy of the forecasts.

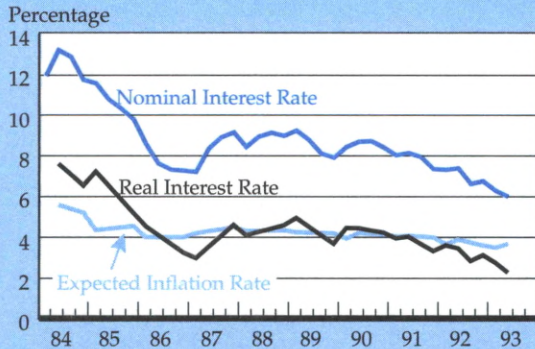
One economist who has used the Survey of Professional Forecasters extensively for examining these issues is Victor Zarnowitz of the University of Chicago and the NBER. He was involved in tabulating, analyzing, and evaluating the results of the survey from its inception

in 1968 through early 1990. During the quarter-century since 1968, Zarnowitz has published many research results based on the survey.⁸

The most comprehensive research study of the survey is that of Zarnowitz and Braun (1992). They provide a wealth of analysis about the survey, including the following results: (1)

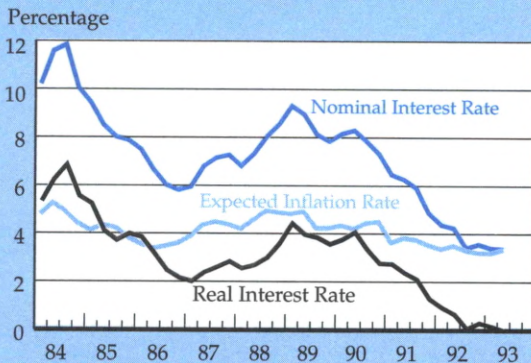
⁸ I will discuss some of these results briefly here. Other results can be found in Zarnowitz's research papers, many of which are summarized in Zarnowitz (1992).

FIGURE 1
Nominal and Real Interest Rates
on Ten-Year Government Bonds



Sources: Nominal interest rate: Federal Reserve 10-year constant maturity series; Expected inflation rate: 10-year consumer-price inflation forecast for 1984Q2-1991Q1 (except 1990Q2) from Blue Chip Economic Indicators, 1990Q2 and 1991Q2 from Livingston Survey, 1991Q4-on from Survey of Professional Forecasters; Real interest rate = Nominal interest rate minus expected inflation.

FIGURE 2
Nominal and Real Interest Rates
on One-Year Government Bonds



Sources: Nominal interest rate: Federal Reserve one-year constant maturity series; Expected inflation rate: one-year consumer-price inflation forecast from Survey of Professional Forecasters; Real interest rate = Nominal interest rate minus expected inflation.

Forecast errors generally increase as the number of periods in the forecast horizon increases (not surprisingly, it's harder to make accurate predictions further into the future); (2) Some macroeconomic variables (such as real GNP) are much easier to forecast than others (such as changes in business inventories); (3) Forecasters today don't seem any better than their predecessors (despite having more powerful computers and more modern economic theories); (4) Combining the forecasts of many individuals (by taking the mean or median) provides a consensus forecast with lower average errors than most individual forecasts (so it is important that the survey include many participants); (5) The survey compares favorably in forecast accuracy in comparison with a variety of econometric and time-series models (see *Measures of the Survey's Accuracy*).

Earlier, Zarnowitz (1985) published a study that tested the survey forecasts for bias, that is, whether the forecast error was zero on average, which we would expect if forecasts were formed rationally, i.e., if repeated mistakes are corrected over time. He found that 85 percent of the forecasts he looked at were unbiased. Of the forecasts that were biased, half were forecasts of inflation, which

Additional Research Using the Survey of Professional Forecasters

Research Study:

Main Results:

Hafer and Hein (1985)

The survey provides better forecasts for inflation than do interest-rate-based models or econometric time-series models.

Keane and Runkle (1990)

Forecasts of individual forecasters in the survey are consistent with rational expectations; that is, the forecasters do not leave useful information unexploited.

Lahiri and Teigland (1987)

Forecasts aren't normally distributed, but are skewed.

Lahiri, Teigland, and Zaporowski (1988)

Real interest rates decline when there is increased uncertainty about inflation.

McNees (1992)

Forecast errors are much larger during business-cycle turning points than during normal times.

Rudin (1992)

Simple time-series models are inconsistent with the survey's forecasts, and there is a great deal of diversity in forecasters' beliefs.

Su and Su (1975)

The survey forecasts are superior to forecasts from econometric time-series models and the survey is better at forecasting *changes* in the levels of the data than at forecasting the levels themselves.

was often underpredicted.⁹ Inflation seems to be a particularly difficult variable to forecast.

Besides Zarnowitz, other researchers have used the survey to examine forecasters' abili-

ties. (See *Additional Research Using the Survey of Professional Forecasters*.)

As time passes and the survey accumulates

⁹ Most forecast-bias studies whose data sets consist primarily of data from the 1970s find biased forecasts for inflation, largely because of the unexpected OPEC oil shocks,

which drove up the rate of inflation. But it is difficult to imagine that anyone could have foreseen these oil shocks, so the finding of biased forecasts may be due to the special events of the 1970s. In the 1980s, the forecasts show no bias.

more data, the long-range forecasts are likely to prove particularly useful to economic researchers. This is especially true of the inflation forecasts, which can be used in studies that examine how changes in monetary policy affect inflation expectations or studies that need calculations of real interest rates. A problem with short-range inflation forecasts (like the one-year forecasts of most surveys) is that government policy can have little impact on inflation over such a short span. For example, if the Federal Reserve indicates to the public that it is tightening monetary policy today to reduce inflation, little change is likely to occur in the one-year-ahead inflation forecast because a change in monetary policy takes a longer time to affect inflation. But if forecasters believe that the Fed will reduce inflation, this should affect

their long-range forecasts of inflation. So researchers studying the effects of monetary policy on the economy will find more value in long-range forecasts than in short-range forecasts.

CONCLUSION

The Survey of Professional Forecasters is a continuation of the ASA/NBER Economic Outlook Survey. The Philadelphia Fed, which took over the survey in 1990, has a complete data set on the forecasts of professional forecasters, starting with the fourth quarter of 1968. The survey is a useful tool for policymakers, business people, and private citizens to help them in making decisions. Researchers studying forecasting value it as well. The Federal Reserve Bank of Philadelphia plans to continue producing this survey.

REFERENCES

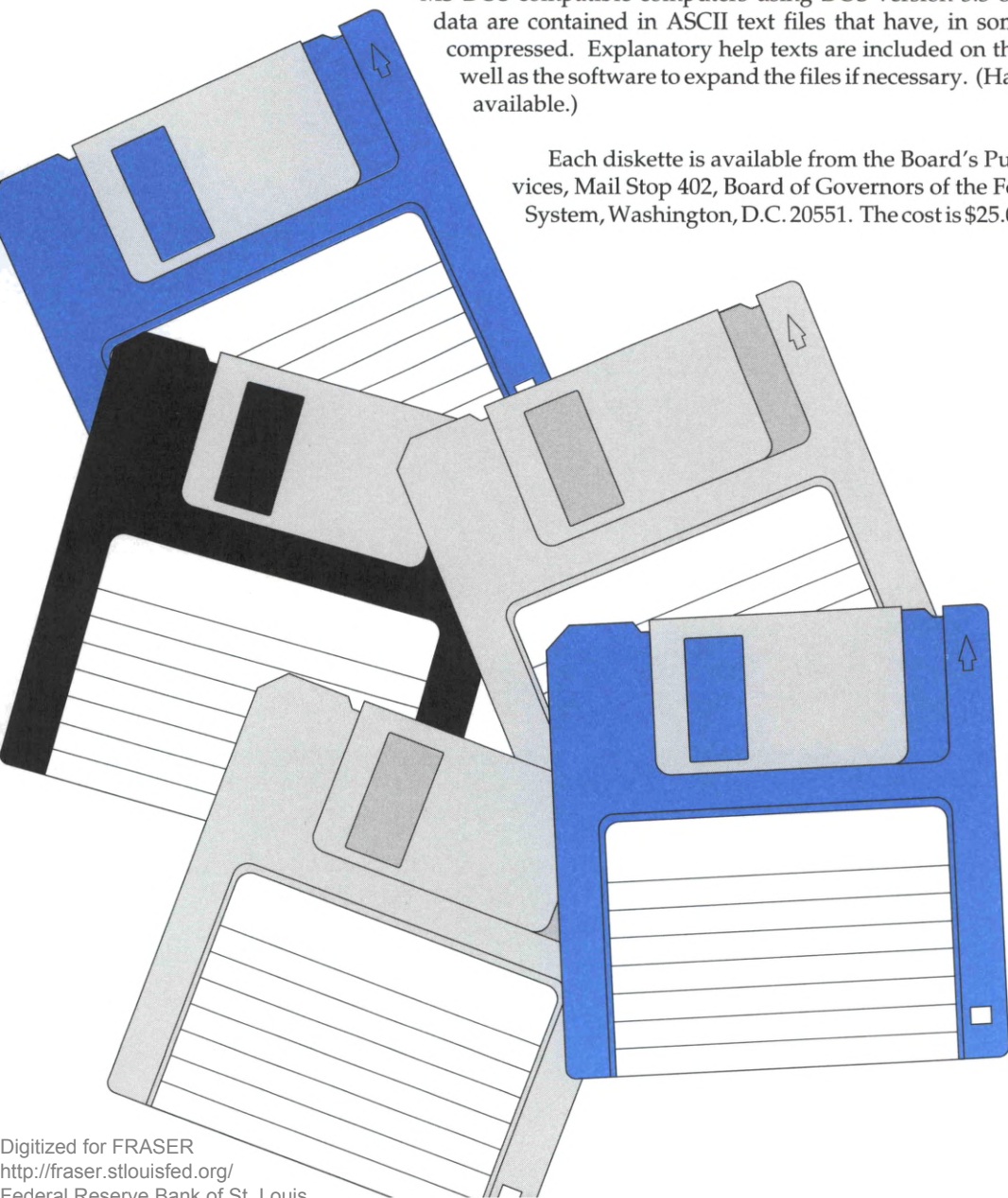
- Carlson, John A. "A Study of Price Forecasts," *Annals of Economic and Social Measurement* 6 (Winter 1977), pp. 27-56.
- Hafer, R. W., and Scott E. Hein. "On the Accuracy of Time Series, Interest Rate and Survey Forecasts of Inflation," *Journal of Business* 58 (October 1985), pp. 377-98.
- Keane, Michael P., and David E. Runkle. "Testing the Rationality of Price Forecasts: New Evidence from Panel Data," *American Economic Review* 80 (September 1990), pp. 714-35.
- Lahiri, Kajal, and Christie Teigland. "On the Normality of Probability Distributions of Inflation and GNP Forecasts," *International Journal of Forecasting* 3 (1987), pp. 269-79.
- Lahiri, Kajal, Christie Teigland, and Mark Zaporowski. "Interest Rates and the Subjective Probability Distribution of Inflation Forecasts," *Journal of Money, Credit and Banking* 20 (May 1988), pp. 233-48.
- McNees, Stephen K. "How Large Are Economic Forecast Errors?" Federal Reserve Bank of Boston *New England Economic Review* (July / August 1992), pp. 25-42.
- Rudin, Jeremy R. "What Do Private Agents Believe About the Time Series Properties of GNP?" *Canadian Journal of Economics* 25 (May 1992), pp. 369-91.
- Su, Vincent, and Josephine Su. "An Evaluation of ASA/NBER Business Outlook Survey Forecasts," *Explorations in Economic Research* 2 (1975), pp. 588-618.
- Taylor, Herb. "The Livingston Surveys: A History of Hopes and Fears," *this Business Review*, January / February 1992.
- Zarnowitz, Victor. "Rational Expectations and Economic Forecasts," *Journal of Business and Economic Statistics* 3 (October 1985), pp. 293-311.
- Zarnowitz, Victor. *Business Cycles: Theory, History, Indicators, and Forecasting*. Chicago: University of Chicago Press, 1992.
- Zarnowitz, Victor, and Phillip Braun. "Twenty-Two Years of the NBER-ASA Quarterly Economic Outlook Surveys: Aspects and Comparisons of Forecasting Performance," National Bureau of Economic Research Working Paper 3965, January 1992.
- Zarnowitz, Victor, and Louis A. Lambros. "Consensus and Uncertainty in Economic Prediction," *Journal of Political Economy* 95 (June 1987), pp. 591-621.

From the Board of Governors

The Federal Reserve Board has made available six major sets of statistics on computer diskettes. Data are provided in this format on flow of funds, industrial production and capacity utilization, monetary aggregates, reserves of depository institutions, bank credit, and selected interest rates.

The 3-1/2-inch high-density (1.4 megabyte) diskettes are formatted for MS-DOS-compatible computers using DOS version 3.3 or higher. The data are contained in ASCII text files that have, in some cases, been compressed. Explanatory help texts are included on the diskettes, as well as the software to expand the files if necessary. (Hard copy is also available.)

Each diskette is available from the Board's Publications Services, Mail Stop 402, Board of Governors of the Federal Reserve System, Washington, D.C. 20551. The cost is \$25.00 per diskette.



How Costly Is Disinflation? The Historical Evidence

*Laurence Ball**

A central goal of monetary authorities such as the Federal Reserve is to reduce inflation and ultimately to achieve stable prices in the belief that doing so will contribute to higher long-run growth. The Fed and central banks in other countries can reduce inflation by slowing the

rate of growth of the money supply. Why then do central banks not eliminate inflation once and for all? The answer is that doing so is usually costly: efforts to reduce inflation through significantly slower money growth push up interest rates and are followed by recessions. The United States, for example, undertook major efforts to reduce inflation in 1968, 1974, and 1979. While inflation fell appreciably in each case, a recession followed within two years. Many economists believe that anti-inflationary policy, while necessary to bring inflation down, contributed to the recessions (as did other fac-

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tors, such as the big jump in oil prices in 1974 and again in 1979).¹

Thus central banks face a dilemma: they would like to reduce inflation, but they do not want the pain of a recession. Is it worth paying the price to reduce inflation? To answer this question, we first need to know just how much pain is involved. How large are the costs of reducing inflation? Is there any way that wise policies or favorable circumstances can reduce these costs? Are there ever cases when inflation is reduced without any costs at all?

This article seeks to answer these questions by examining history. For 19 major countries, I examine the data since 1960 to find episodes of significant inflation declines resulting from tight monetary policy. This search yields 65 historical episodes. I then estimate the cost of each disinflation. The cost is measured using economists' traditional concept of the "sacrifice ratio." This variable is the ratio of the total output losses during disinflation, measured as a percent of a year's output, to the decrease in inflation. One can think of the ratio as giving the price of lowering inflation: the percentage points of lost output per percentage point of inflation reduction. After estimating the ratio for each episode, I ask how costly disinflation is on average and whether the ratio varies in ways that can be explained.²

There are several conclusions. First, the costs of disinflation are substantial. Averaging across all countries, each percentage point decline in trend inflation costs about 1.4 percentage points of a year's output. For disinflations

in the United States alone, the average loss is higher: 2.4 points of output per point of inflation reduction. It may be possible to reduce the cost of disinflating in the United States. If steps to do so are not taken, however, our average historical experience suggests that reducing U.S. inflation from 3 percent to zero would cost about 7 percentage points of lost output (which could be spread out over several years). Moreover, although the sacrifice ratio is lower in many countries than in the United States, it is almost always positive. Some disinflations are more costly than others, but completely costless disinflation is a historical rarity.

Second, the costliness of disinflation depends on how quick it is. In particular, a "cold-turkey" disinflation—one in which inflation is brought down rapidly—is accompanied by a smaller output loss than a gradual reduction in inflation. Policymakers often take a gradual approach because they fear that a deep recession will result from a sharp tightening of monetary policy. My results suggest that this strategy can raise the total output loss associated with disinflation.

Third, when looking across countries, the sacrifice ratio is lower where wage-setting institutions are more flexible. For example, the United States has many three-year labor contracts in the union sector, so that wages cannot adjust quickly to shifts in monetary policy. In addition, contract negotiations in different sectors are staggered across time, so that it is difficult to coordinate a general slowdown in wage hikes. In Japan, by contrast, contracts last only a year and are synchronized across sectors. The sacrifice ratio in flexible-wage Japan is considerably lower than in the rigid-wage United States.

SOME BACKGROUND

The effects of disinflations are highly controversial among economists. One traditional view, which is presented in many textbooks, is that reducing inflation necessarily causes a

¹An earlier article in this *Business Review* discusses these issues in more detail. See Ball (1993a). For a historical discussion of the Fed's major disinflation efforts, see Romer and Romer (1989).

²The original statistical results on which this article is based are contained in my more technical paper, "What Determines the Sacrifice Ratio?" (Ball, 1993b).

recession. Indeed, according to this view, the recession is the mechanism by which prices are forced down. The central bank slows the growth of the money supply, pushing up interest rates and thus reducing borrowing and spending. The resulting recession then induces firms to raise prices less quickly, in an attempt to maintain sales. Eventually inflation slows, and the economy returns to full-employment equilibrium.

In contrast to this traditional view, the new classical school of economics believes that the costs of disinflation can be small or nonexistent. According to Thomas Sargent (1983), disinflation is costless if it is anticipated. Suppose, for example, that the government announces its intention to reduce money growth to fight inflation and that price setters believe this announcement. Anticipating the fall in money growth, they can reduce their rate of price increases at the same time. In this case, money growth and inflation fall in tandem, so the real money supply is unchanged and there is no recession. Another version of the new classical argument stresses the idea that firms can adjust prices quickly if economic circumstances change. Even if the slowdown in money growth is unexpected, any effect on output is small and short-lived if firms can quickly adjust their rate of price increase.

Thus economists' conclusions about the effects of disinflation depend on their basic assumptions about whether shifts in monetary policy are anticipated by price setters—whether the central bank can clearly announce its policies and whether those announcements are believed—and about the speed with which prices adjust to economic shocks. Both issues are hotly contested. Apparently sincere promises from the central bank to reduce money growth are always suspect because the central bank may be tempted to choose fast money growth to stimulate the economy. New classical economists believe in quick price adjustment, while new Keynesians point to evidence

of sluggishness; neither side is likely to convince the other anytime soon.

When economists use theoretical models to estimate the costs of disinflation, their conclusions are greatly affected by their assumptions about these issues. In the May/June 1992 issue of this *Review*, Dean Croushore uses a number of formal macroeconomic models to calculate the loss in output from reducing inflation from 5 percent to zero. Robert Barro's new classical model, which assumes that shifts in monetary policy are known in advance, produces a sacrifice ratio of zero: given Barro's assumptions, disinflation has no costs. Benjamin Friedman's Keynesian model, which assumes that policies are not foreseen and prices are very sluggish, produces a sacrifice ratio of 40: eliminating inflation in the United States would cause a recession larger than any since the Great Depression. A variety of other assumptions produce a range of predictions in between.

Since economists cannot agree on their basic assumptions about expectations and price adjustment, and since these determine the cost of disinflation, is there any hope of resolving the question? In this article, I sidestep the thorny issue of choosing the right macroeconomic model and simply look to the evidence of history. I examine past episodes of disinflation in a variety of countries and use these experiences rather than macroeconomic models to estimate the costs of disinflation.

METHODOLOGY

Selecting Disinflation Episodes. My data cover 19 major industrial countries.³ I examine movements in inflation, as measured by the Consumer Price Index for each country, from

³ Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

1960 through 1991. To reduce the influence of unusual short-term movements in inflation, I examine not inflation itself, but “trend” inflation.⁴ Unusual shocks, such as cold weather that causes crop failures, can have big effects on inflation in one quarter, but these temporary fluctuations are smoothed out by looking at trend inflation.

The first step is to identify disinflations—episodes in which trend inflation fell substantially. In particular, I select episodes in which trend inflation falls at least 2 percentage points below its peak level. To illustrate this procedure, trend inflation from 1961-89 is shown for four countries: the United States, Germany, the United Kingdom, and Japan (Figure 1). For each country, the arrows indicate the beginnings and ends of disinflations—the peak level of inflation and the minimum level at the end. The United States experienced three disinflations according to my definition. Their dates are 1969-71, 1974-76, and 1980-83. Germany experienced three disinflations at roughly the same time, while the United Kingdom experienced five, and Japan six.

Are the decreases in trend inflation observed in the data caused by tight monetary policy—by intentional decisions by central banks? In principle, inflation could fall for other reasons, such as the sharp decrease in world oil prices in 1986. To investigate this issue, I examined the historical record for nine major countries out of my sample of 19 (mainly by reading the *Economic Outlooks* published by the Organization for Economic Cooperation and Development). Each country shows evidence of a significant

monetary tightening near the start of *every* disinflation episode. Decreases in inflation arising entirely from other sources are apparently too small to meet my criterion of a 2-percentage-point fall.⁵

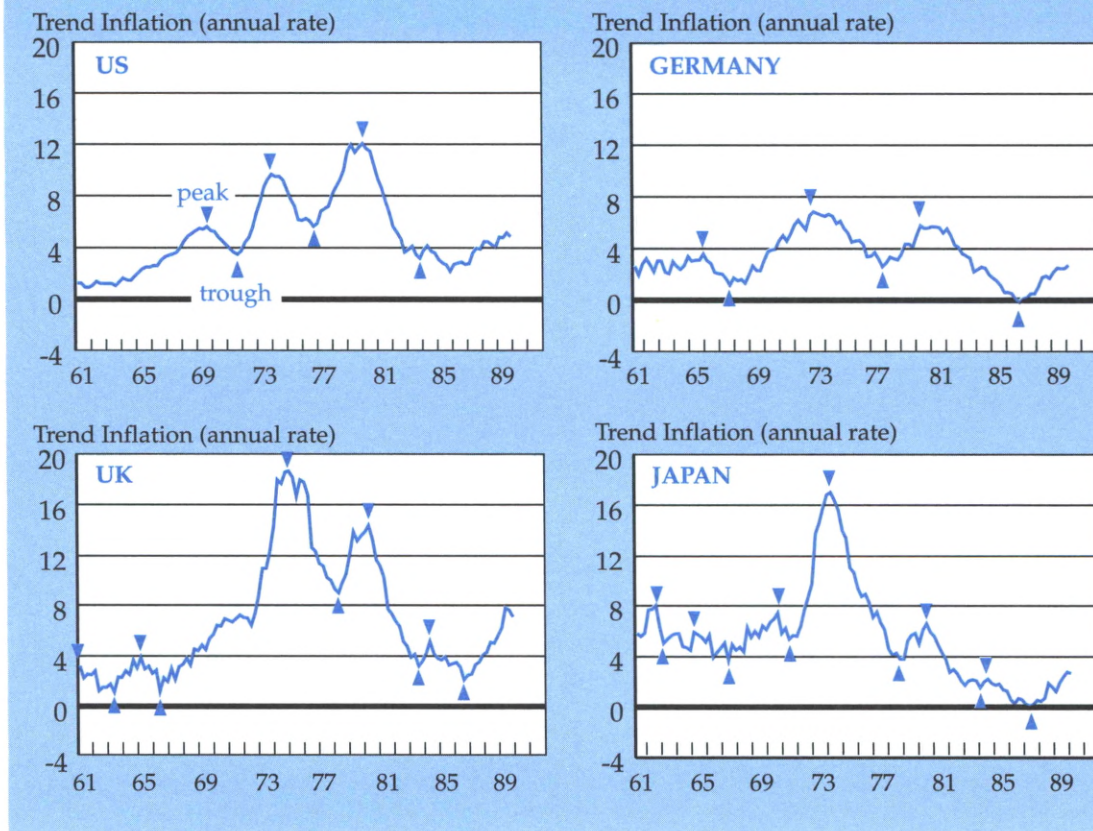
The Sacrifice Ratio. Once disinflation episodes are selected for each country, the next step is to calculate the cost of each disinflation, as measured by the sacrifice ratio. Again, this variable is the ratio of the output loss, as a percentage of potential output, to the decrease in the trend inflation rate. The denominator of this ratio—the change in trend inflation—can be calculated simply by taking the difference between trend inflation at the start and end of the episode. In the first U.S. disinflation, for example, this difference is 2.1 percentage points. (Trend inflation fell from 5.7 percent in the fourth quarter of 1969 to 3.6 percent in the fourth quarter of 1971.) The more difficult task is calculating the numerator of the sacrifice ratio: the lost output from disinflation.

The “output loss” from disinflation is the percentage difference between the actual level of output and what output would have been if there had been no disinflation, that is, if monetary policy had not tightened to fight inflation. The trick, therefore, is to estimate what would have happened under the alternative scenario.

⁵ I have also compared my lists of disinflation episodes to lists of tight-money episodes constructed for the United States by Romer and Romer (1989) and for Japan by Fernandez (1992). These comparisons confirm the close correspondence between tight money and disinflation. Romer and Romer report that policy tightened in 1968, 1974, 1978, and 1979. In all these cases, the Federal Reserve was responding to recent increases in inflation (arising from spending on the Vietnam War in the first case, and from oil price increases in the rest). If the last two tightenings are interpreted as a single two-year episode, there is a close correspondence to the disinflations that I identify, which start in 1969, 1974, and 1980. Similarly, there is a close relationship between the Japanese disinflations that I identify and Fernandez’s episodes.

⁴ Trend inflation in one quarter is defined as the average of inflation in that quarter, the previous four quarters, and the following four quarters. For example, trend inflation for the first quarter of 1992 is the average of inflation from the first quarter of 1991 through the first quarter of 1993. Trend inflation gives an accurate picture of the long-term rate of inflation.

FIGURE 1
Trend Inflation and Disinflation Episodes

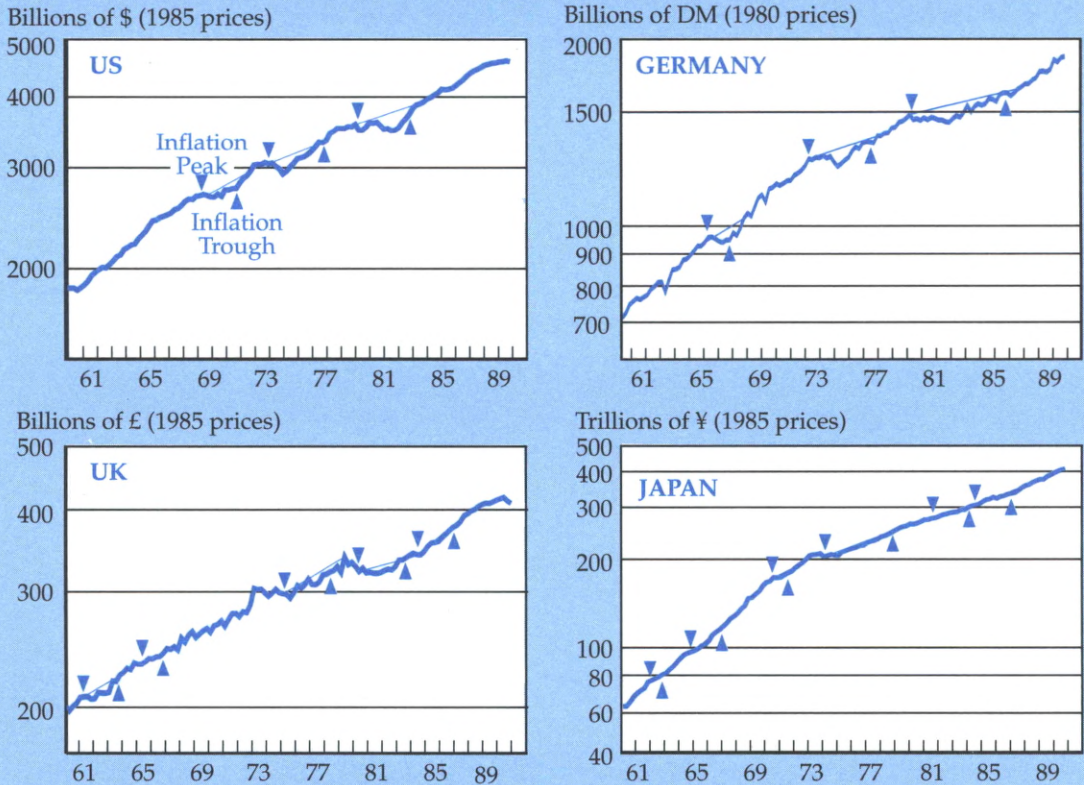


To do so, I make the key assumption that the effects of disinflation eventually wear off—that output eventually returns to the path it would have followed in the absence of disinflation. Specifically, I assume that output is back on this normal path one year after the end of disinflation—one year after inflation reaches its minimum level. This assumption is based on historical experience in the United States and other countries. Usually output falls during disinflation, then rises rapidly after the minimum inflation level is reached as the effects of tight money fade and the economy returns to normal. The rapid growth usually levels off

after about a year. In the United States, average output growth is 5.8 percent in the year after an inflation trough, considerably above average growth for 1960-91.

In addition to assuming that output is back to normal four quarters after the end of disinflation, I assume that in the absence of disinflation, output would have grown at a constant percentage rate between the start of disinflation and four quarters after the end. Figure 2 shows output for the same four countries shown in Figure 1. The arrows indicate the beginnings and ends of the disinflation episodes identified with the inflation data. For

FIGURE 2
Trend Output During Disinflation



each disinflation, the steady path that I assume output would have followed if there had been no disinflation is shown by the straight line from output at the start of disinflation to output four quarters after disinflation.

To understand this procedure, look at the graph for the United States. Outside of disinflation episodes, output grows fairly steadily, indicating fairly steady economic growth. When a disinflation begins, output dips down, then eventually rises rapidly. By connecting the two points on the output graph—the start of disinflation and the point one year after the end—I fill in the gaps created by these

temporary dips. These straight lines indicate a hypothetical output path that fits in with the smooth growth in other periods. Therefore, these lines are reasonable estimates of what would have happened to output if there were no disinflation. The results for Germany and the United Kingdom are similar to those for the United States: disinflations are accompanied by sizable output losses. In Japan, the constructed lines are close to actual output, implying that disinflation did not push output far from its normal level.

Once I have estimated the path that output would have followed if there had been no

disinflation, calculating the output loss from disinflation is easy: the output loss is the total area of the gap between my estimated output line and the actual path of output. This total output loss is divided by the fall in inflation to calculate the sacrifice ratio for each episode.

Is Disinflation Really the Cause of Temporarily Lower Output? In calculating sacrifice ratios, I assume that output losses during disinflations are *caused* by the disinflations—or more precisely by the tight monetary policy through which disinflation is achieved. As described earlier, this view is consistent with the traditional theory that inflation adjusts slowly to a reduction in money growth; under this assumption, tight monetary policy reduces the real money supply, raising interest rates and thereby reducing output. My assumption that tight policy caused the recessions is supported by the evidence that policy was indeed tight near the start of the disinflations in my sample. On the other hand, it is possible that other factors were also at work—that the output losses arise at least partly from other events that occurred around the same time as the disinflations.

Some disinflations occur shortly after OPEC shocks (as with the last two U.S. disinflations), for example, and so some of the output losses might be blamed on delayed effects of the oil shocks. However, there is little difference between the output losses in disinflations that are preceded by oil shocks and those that are not.⁶ This evidence suggests that tight monetary policy, which occurs in all disinflation episodes, is responsible for most of the output losses.

BASIC RESULTS

Here I will focus on the results for nine major countries: the United States, the United King-

dom, Germany, Japan, France, Italy, Switzerland, Canada, and Australia. There are 28 disinflation episodes in this sample.⁷ Table 1 lists the dates of the disinflations in the nine countries, the initial level of inflation, the change in inflation, and the sacrifice ratio. The results produce a clear conclusion about the central issue of this article: disinflations are indeed costly. Averaging over all 28 episodes yields an overall sacrifice ratio of 1.4: reducing trend inflation by 1 percentage point costs 1.4 percent of a year's output. On average, moderate reductions in inflation cause significant recessions: reducing trend inflation by 5 percentage points could be achieved at a cost of 7 percent of a year's output or 3.5 percent of output for two years.

The sacrifice ratio varies widely across different episodes, however. The lowest value of the ratio is 0.0 (UK 1965-66) and the highest is 3.6 (Germany 1980-86). Despite this variation, the ratio is positive in 27 of 28 episodes. Thus the view that disinflation can be costless gains little support from history: past disinflations are almost always costly.

The sacrifice ratio also appears to differ systematically across countries. For each of the nine countries I have looked at so far, Table 2 gives the average ratio for all episodes in the country. The United States is near the high end of the range, with an average ratio of 2.4. Thus a 5-percentage-point reduction in U.S. inflation costs 12 percentage points of output historically, compared with 7 percentage points for the average country. The sacrifice ratio in

⁷My data cover 19 countries in all (see footnote 3), with a total of 65 disinflations. The advantage of focusing on the nine major countries is that more precise data are available, leading to more accurate estimates of sacrifice ratios. (For the other countries there are no quarterly output data, and I must make inferences based on annual data.) In general, the main results for the smaller group of countries carry over to the larger group as well, although measurement error causes greater variation in individual sacrifice ratios.

⁶See Ball (1993b), pages 12-14.

TABLE 1
Disinflations
Quarterly Data

Episode	Length in Quarters	Initial Inflation (% per year)	Change in Inflation	Sacrifice Ratio
AUSTRALIA				
74:2-78:1	15	14.60	6.57	0.7234
82:1-84:1	8	10.50	4.98	1.2782
CANADA				
74:2-76:4	10	10.60	3.14	0.6273
81:2-85:2	16	11.60	7.83	2.3729
FRANCE				
74:2-76:4	10	11.90	2.98	0.9070
81:1-86:4	23	13.00	10.42	0.5997
GERMANY				
65:4-67:3	7	3.67	2.43	2.5590
73:1-77:3	18	6.92	4.23	2.6358
80:1-86:3	26	5.86	5.95	3.5565
ITALY				
63:3-67:4	17	6.79	5.74	2.6539
77:1-78:2	5	16.50	4.30	0.9776
80:1-87:2	29	19.10	14.56	1.5992
JAPAN				
62:3-63:1	2	8.11	3.00	0.5309
65:1-67:2	9	5.99	2.20	1.6577
70:3-71:2	3	7.53	2.09	1.2689
74:1-78:3	18	17.10	13.21	0.6068
80:2-83:4	14	6.68	5.07	0.0174
84:2-87:1	11	2.29	2.11	1.4801
SWITZERLAND				
73:4-77:4	16	9.42	8.28	1.8509
81:3-83:4	9	6.15	3.86	1.2871
UNITED KINGDOM				
61:2-63:3	9	4.24	2.10	1.9105
65:2-66:3	5	4.91	2.69	-0.0063
75:1-78:2	13	19.70	9.71	0.8679
80:2-83:3	13	15.40	11.12	0.2935
84:2-86:3	9	6.19	3.03	0.8680
UNITED STATES				
69:4-71:4	8	5.67	2.14	2.9364
74:1-76:4	11	9.70	4.00	2.3914
80:1-83:4	15	12.10	8.83	1.8320

Germany is even higher than the ratio in the United States; France and the UK have the lowest ratios (0.8).

Why does the United States have a relatively high sacrifice ratio? More generally, can we explain the variation in ratios across countries and the variation across different episodes in a given country? I turn to these questions next.

THE SPEED OF DISINFLATION AND ITS COST

Background. In explaining why the cost of disinflation can vary, many economists cite the speed of disinflation. In some cases, disinflation is quite slow; for example, it took Germany from 1980 through 1986 to reduce inflation by about 6 percentage points. In contrast, Australia reduced inflation almost as much (by 5 points) over just two years, from 1982 to 1984. Economic theory gives us many reasons to think that such differences in speed produce different output costs of disinflation.

Unfortunately, economic theorists do not agree on the effect of speed: some argue that

gradual disinflation is less costly, and others that quick disinflation is less costly. Gradualists argue that wages and prices possess considerable inertia and thus need time to adjust to a tightening of monetary policy. If the central bank slows money growth drastically before prices can adjust, a recession results. But if money growth falls slowly, prices can adjust in tandem, reducing the effect on the economy. Milton Friedman, one proponent of this view, in his 1980 book with Rose Friedman, writes:

The most important device for mitigating the side effects is to slow inflation gradually but steadily by a policy announced in advance and adhered to so it becomes credible. The reason for the gradualness and advance announcement is to give people time to readjust their arrangements—and to induce them to do so. Many people have entered into long-term contracts ... on the basis of anticipations about the likely rate of inflation. These long-term contracts make it difficult to reduce inflation rapidly and mean that trying to do so will impose heavy costs on many people. Given time these contracts will be completed or renewed or renegotiated, and can then be adjusted to the new situation. (p. 273)

Others disagree. In an influential paper, Thomas Sargent (1983) argues that *quick* disinflation is less costly because of the behavior of expectations. As discussed earlier, disinflation is less costly if it is anticipated in advance—or at least if expectations adjust quickly once disinflation begins. In Sargent's view, a quick disinflation can be accompanied by a dramatic announcement that policy is changing sharply, which produces a drop in expected inflation. Gradual disinflation is less likely to change expectations. Policymakers may announce that they are in the process of slowly reducing money growth, but price setters are unlikely to believe this until after they have seen a substantial amount of progress. As

TABLE 2
Average Sacrifice Ratios
by Country

Australia	1.00
Canada	1.50
France	0.75
Germany	2.92
Italy	1.74
Japan	0.93
Switzerland	1.57
United Kingdom	0.79
United States	2.39

Sargent puts it, "gradualism invites speculation about future reversals, or U-turns, in policy." In his view, firms may continue to raise prices quickly because they are not confident that the gradual disinflation will be completed.

Other arguments are possible as well. For example, recent research on price stickiness suggests that firms adjust their prices in response to large shocks but that it is not worth the effort to adjust to small shocks.⁸ This idea provides another reason to support quick disinflation. A sudden drop in money growth is a major shock, so prices will adjust and the real money supply and output will not change much. In contrast, a series of small drops in money growth—a gradual disinflation—may not trigger quick price adjustment because there is never a large shock. With inflation falling more slowly than money growth, there can be a major recession.

Considerable controversy exists over which of these views is correct. All seem reasonable

⁸ For example, see Ball and Mankiw (1993).

on theoretical grounds. Since theory cannot resolve the issue, I look once again at the costs of past disinflations.

Results. I adopt a specific definition of the “speed” of disinflation: the ratio of the change in trend inflation over the disinflation episode to the length of the episode in quarters. In other words, speed is the amount of disinflation per quarter during an episode.

After calculating the speed of the 28 disinflations in the group of nine major countries, I examine the relationship between speed and the sacrifice ratio: do episodes with faster speeds have higher or lower sacrifice ratios?⁹ The results support the view that quicker disinflations are less costly; that is, they support anti-gradualists like Sargent against gradualists like Friedman. According to my estimates, reducing the length of a given disinflation from 20 to 5 quarters (i.e., from five to one-and-one-quarter years) would cut the sacrifice ratio by almost two-thirds.

These results potentially help us explain differences in sacrifice ratios in different U.S. episodes. For example, the speed of disinflation was .27 in the disinflation beginning in 1969, but .59 in the disinflation beginning in 1980. (The greater speed in the second episode reflected a longer disinflation but a much larger overall fall in inflation: 8.8 percentage points compared with 2.1 percentage points.) The sacrifice ratio was 1.8 in the quicker disinflation, compared with 2.9 in the slower episode. Paul Volcker, the chairman of the Fed in 1980, was often criticized for disinflating quickly because a deep recession occurred in 1981-82. My

results suggest that the overall output costs would have been larger if disinflation had been more gradual.

LABOR CONTRACTS AND THE COST OF DISINFLATION

Background. As discussed above, one major factor determining the cost of disinflation is the speed with which wages and prices adjust to tighter monetary policy. In explaining wage and price rigidity, many economists have pointed to the existence of labor contracts that fix wages for substantial periods. In the United States, for example, union contracts usually set wages for three years in advance. Because renegotiating such contracts is difficult, firms and workers have little flexibility to adjust to changes in circumstances, such as tighter monetary policy. If the prices of firms’ products are closely tied to the wages they pay, these prices will also be quite rigid.

This reasoning has led many economists to suggest that differences in the costs of disinflation in different countries depend on differences in labor contracts. The degree of rigidity in contracts varies widely. The United States has three-year contracts and a staggered schedule of wage adjustments as well: contracts in different industries overlap rather than expiring at the same time. Macroeconomists such as John Taylor (1983) argue that this staggered adjustment makes it hard for wages to adjust to tighter monetary policy: no union wants to be the first to accept wage cuts, and a coordinated adjustment of all wages is impossible. In Japan, by contrast, labor contracts last only a year. In addition, contracts are synchronized: wages in all industries are adjusted together every spring. Many economists argue that Japanese wages are more flexible than U.S. wages, so that disinflation is less costly in Japan (Gordon, 1982).

A final difference in wage-setting institutions is the degree of indexation—of automatic “cost-of-living” adjustments for inflation. In

⁹ Specifically, I use the statistical technique of linear regression to estimate how much the sacrifice ratio changes for an increase in speed of a given magnitude. See Ball (1993b), Tables IV, V, and VI. Linear regression is the basic technique that economists use to measure the effect of one variable on another. A description of the technique can be found in most introductory textbooks on statistics.

theory, greater indexation should make wages adjust more quickly to disinflation, reducing the costs. Indexation also varies widely across countries; for example, indexation is more widespread in most European countries than in the United States. Again, economists often argue that these differences help explain differences in the costs of disinflation.

That wage-setting institutions should have an effect on the sacrifice ratio seems intuitive. On the other hand, some macroeconomic theories hold that these institutions have no role. For example, some theories emphasize rigidities that arise in product markets rather than labor markets; others deny that any kind of wage or price rigidity is important. I now ask whether the historical data show that wage-setting institutions help explain the variation in the sacrifice ratio.

Results. For this analysis, I draw on data for all 19 countries because doing so allows me to examine a wider range of wage-setting practices. As an overall measure of wage flexibility, I use a very convenient index of “nominal wage responsiveness” constructed by Michael Bruno and Jeffrey Sachs (1985). For each country, Bruno and Sachs rate the flexibility of wage-setting as zero, one, or two along three dimensions: contract length, indexation, and synchronization. For contract-length flexibility, countries with three-year contracts, such as the United States, are assigned a rating of zero. Countries with contracts between one and three years, such as the United Kingdom, are rated one; and countries with contracts of a year or less, such as Japan, receive the highest rating of two. There are similar classifications for the extent of synchronization and indexation. Bruno and Sachs’s overall measure of flexibility is the sum of the three individual rankings, and thus runs from zero to six. The only country with a total rating of zero—the country with the least flexible wages—is Switzerland. Denmark, Australia, and New Zealand have the maximum flexibility with a rating of six.

I compare the sacrifice ratios in various episodes with the wage responsiveness in the relevant country. The results support the theory that more flexible wages reduce the costs of disinflation. My estimates suggest that raising the responsiveness from zero to six—that is, moving from the sticky-wage institutions in Switzerland to the flexible-wage institutions in Denmark—would reduce the sacrifice ratio from 1.4 to only 0.5.

In addition to examining the effect of overall flexibility, I also examine the individual effects of the three components: contract length, indexation, and synchronization. These results suggest that contract length is the most important aspect of flexibility. My estimates indicate that reducing contract length from three years to one year would reduce the predicted sacrifice ratio by about half, even if the extent of synchronization and indexation is unchanged.

CONCLUSION

Do these results provide any lessons for policymakers? The central lesson is that disinflation is costly: reducing inflation is desirable, but it comes at a substantial cost in terms of lost output in the short run. Policymakers should disinflate only if they believe the long-term benefits of lower inflation are worth the price.

Another lesson is that gradual disinflation does not avoid the costs. My results suggest that pushing inflation down slowly eventually leads to a larger total output loss than does quick disinflation. But quick disinflation is likely to result in a deep recession. Some economists believe that deep recessions, even if short-lived, cause disproportionately large disruptions of economic activity. If so, there could be a case for gradual disinflation despite its higher total output losses. The overall lesson is an unhappy one: there is no costless way out of high inflation.

A more positive lesson is that the costs of disinflation can be reduced significantly if wage-

setting institutions are made more flexible. Japan's success at reducing inflation at low cost arises partly from its one-year, synchronized wage adjustments. Efforts to shorten and syn-

chronize U.S. labor contracts could mean less lost output if the United States again faces the need to disinflate.

REFERENCES

- Ball, Laurence. "What Causes Inflation?" this *Business Review*, March/April 1993a.
- Ball, Laurence. "What Determines the Sacrifice Ratio?" Federal Reserve Bank of Philadelphia, Working Paper 93-21, 1993b.
- Ball, Laurence, and N. Gregory Mankiw. "Relative Price Changes as Aggregate Supply Shocks," Federal Reserve Bank of Philadelphia, Working Paper 93-13, 1993.
- Bruno, Michael, and Jeffrey Sachs. *Economics of Worldwide Stagflation*. Cambridge, MA: Harvard University Press, 1985.
- Fernandez, David G. "Bank Lending and the Monetary Policy Transmission Mechanism: Evidence from Japan," Mimeo, Princeton University, 1992.
- Friedman, Milton, and Rose Friedman. *Free to Choose*. Avon Books, 1980.
- Gordon, Robert J. "Why Stopping Inflation May Be Costly: Evidence from Fourteen Historical Episodes," in Robert E. Hall, ed., *Inflation: Causes and Effects*. Chicago: The University of Chicago Press, 1982.
- Romer, Christina D., and David Romer. "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz," *NBER Macroeconomics Annual*, 1989, pp. 121-70.
- Sargent, Thomas. "Stopping Moderate Inflation: The Methods of Poincaré and Thatcher," in Dornbusch, R., and Simonsen, M.H., eds., *Inflation, Debt, and Indexation*. Cambridge, MA: MIT Press, 1983.
- Taylor, John B. "Union Wage Settlements During a Disinflation," *American Economic Review* 73 (December 1983), pp. 981-93.

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