Measuring Economic Uncertainty Using the Survey of Professional Forecasters*

BY KEITH SILL

Uncertainty about how the economy will evolve is a key concern for households and firms. People's views on how likely it is that the economy will be growing, stagnating, or in recession help shape the actions they take today. Consequently, how households and firms respond to uncertainty has implications for economic activity. In addition, uncertainty matters to policymakers: Monetary policymakers recognize that if uncertainty about future inflation is high, decision-making by households and firms becomes more complicated. In this article, Keith Sill describes how uncertainty can be measured using data from the Survey of Professional Forecasters and shows how these measures have changed over time for output growth and inflation. He also examines some links between the macroeconomy and measures of output and inflation uncertainty.

Uncertainty about how the economy will evolve is a key concern for households and firms. People's views on how likely it is that the economy will be growing, stagnating, or in recession help shape the actions they take today. For consumers, how much to spend, what to purchase, and how much to save depend in part on how uncertain they are about their future incomes. For firms, how many workers to hire or how much new capacity to invest in depends on expected future demand and how certain they are that forecasted demand will be realized. Consequently, how households and firms respond to uncertainty has implications for economic activity. In addition, uncertainty matters to policymakers: Monetary policymakers recognize that if uncertainty about future inflation is high, decision-making by households and firms becomes more complicated.

Keith Sill is a vice president in the Philadelphia Fed's Research Department and the director of the Real-Time Data Research Center. This article is available free of charge at www.philadelphiafed.org/research-and-data/publications/.

*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

The importance of gauging economic uncertainty points to the need for data on economic uncertainty. Forecast surveys are one such source of data, since they can often be used to construct measures of uncertainty about the future paths of key economic variables such as output growth, unemployment, and the inflation rate. The Philadelphia Fed's Survey of Professional Forecasters (SPF) is an important source of data on economic uncertainty, since it has a long history of directly asking its respondents to assess the uncertainty that surrounds their forecasts of key macroeconomic variables. The survey data enable us to evaluate how uncertainty about the future economy has changed over time and whether uncertainty is rising or falling as we look ahead.

In this article we will describe how uncertainty can be measured using the SPF data and show how these measures have changed over time for output growth and inflation. We will also examine some links between the macroeconomy and measures of output and inflation uncertainty.

UNCERTAINTY MATTERS

Uncertainty about the future can have consequences for the decisions we make today. It is not only what we expect will happen in the future that can matter but also how sure we are about the alternatives we face. A simple example can illustrate how uncer-

tainty about an outcome can influence choices. Take the hypothetical case of an employee who gets an annual salary bonus. In the first scenario, the employee is told he will receive a $1,000 bonus for certain at the end of the year. In the second scenario, the employee is told that there is a 40 percent chance that the bonus will be zero, a 40 percent chance that it will be $2,000, and a 20 percent chance that it will be $1,000. The average payoff in both scenarios is $1,000, but most people are probably not indifferent to the two alternatives: Most people prefer getting the $1,000 for certain rather than taking the gamble of the second scenario. For the most part, people try to avoid risk (all else equal) and would prefer low uncertainty surrounding their expected outcome compared with high uncertainty around the same expected outcome. The interaction of disliking risk and the amount of uncertainty about outcomes influences the choices people make.[1]

While the example above is a bit contrived, there is good reason to believe that households' decisions about how much to save and how much to spend are affected by their views about economic uncertainty. The consumption/saving decision depends on a host of factors, including current interest rates, time to retirement, and anticipated future income and expenses. The decision about how much to save would be easier if there were no uncertainty. If the household were sure of its future income, of its future expenses, of how long it would live, and of future asset prices and returns, it would face a fairly straightforward calculation to figure out how much to save and spend so that its wealth is spent down in the best possible way. However, if the future is uncertain, the nature of the calculation becomes more subtle. For example, if someone becomes very worried about his future employment prospects, even though he anticipates the most likely outcome is that he will keep his job, he may consume less today and try to build up a savings buffer to help maintain consumption during potential bad times.[2] If there were less uncertainty about the future, households would save less and average consumption would be higher.

It's not just households that are influenced by uncertainty; firms' views on uncertainty may affect their current decisions as well.

Indeed, this is a real concern for workers during the recovery. A recent *New York Times* report on a USA Today/Gallup poll showed that in 2011 the fraction of workers who reported being worried about being laid off was about 30 percent. This was substantially higher than the 20 percent or so who reported being worried over the period from 1998 to 2005. Given this uncertainty about their jobs, we might expect that households are being conservative about spending and are trying to build a savings buffer.[3]

It's not just households that are influenced by uncertainty; firms' views on uncertainty may affect their current decisions as well. A firm that expects demand for its products to increase in the future will need to consider expanding production capacity today. Suppose the investment in a new plant is irreversible in the sense that once the capacity is built, it cannot be used for anything other than its intended use. However, a decision to delay the investment until the future is reversible: The firm could go ahead and start the investment project next month if it decides not to start it today. When there is uncertainty about the expected future benefits and costs of the investment project, often the best choice for a firm is to undertake the investment only when the expected benefits exceed the expected costs by a large enough amount. If there were no uncertainty about expected future benefits and expected future costs of the investment, the firm should instead undertake the investment whenever the expected benefits just exceed the expected costs. This phenomenon is sometimes referred to as the option value of waiting. By waiting, the firm might find that its future path is clearer and the investment should then be undertaken.[4] This theory suggests that greater uncertainty about future conditions will lead to fewer investment projects being undertaken today.

Monetary policymakers consider economic uncertainty when designing policy as well. In a 2008 speech, then-Federal Reserve Governor Frederic Mishkin discussed inflation and inflation dynamics.[5] Mishkin noted that policymakers are concerned not just with forecasts of inflation but also with inflation uncertainty. In particular, "Policymakers need to be concerned about any widening of inflation uncer-

[1] See Pablo Guerron's *Business Review* article for a discussion of how uncertainty can affect the macroeconomy.

[2] See the papers by Christopher Carroll and Angus Deaton on the buffer stock model of consumption.

[3] See Shigeru Fujita's article on pages 1-7 for a discussion of how uncertainty can affect the labor market.

[4] See the paper by Robert McDonald and Daniel Siegel.

[5] See the speech by Mishkin.

tainty. Indeed, an increase in inflation uncertainty would likely complicate decision making by consumers and businesses concerning plans for spending, savings, and investment." Thus, monetary policymakers often strive to set policy in a way that leads to low and stable inflation (and maximum sustainable employment in the case of the U.S.). A history of stable inflation means that uncertainty about future inflation is likely to be lower, since people will perceive the central bank as being credible when it promises to deliver a good inflation outcome.

Since uncertainty seems to be an important component of decision making, are there data we can use to get a handle on uncertainty? Forecast surveys provide such data. In particular, the Philadelphia Fed's SPF was designed in part to give insight into the evolution of uncertainty.

THE SURVEY OF PROFESSIONAL FORECASTERS

The SPF asks professional forecasters to give their forecast for 32 key macroeconomic variables, including gross domestic product (GDP), short-term and long-term inflation, and unemployment. The survey was initiated as a joint product of the National Bureau of Economic Research (NBER) and the American Statistical Association (ASA) in 1968 and was originally known as the NBER-ASA Economic Outlook Survey. The Philadelphia Fed took over the survey in 1990. The SPF is conducted quarterly, and typically, the survey gets responses from 50 or so professional forecasters.[6] In the surveys conducted since the Philadelphia Fed took over, the forecasters provide quarterly forecasts for five quarters and annual forecasts for the current year and the following year. (See *Data on Forecast Uncertainty at the Federal Reserve Bank of Philadelphia* for links to various data from the Real-Time Data Research Center.)

To illustrate how the SPF can be used to gauge uncertainty, we will work with a survey that was published in 2011. The table shows the median forecast for real GDP growth, the unemployment rate, and payroll employment from the third quarter 2011 SPF released on August 12, 2011. The columns labeled "New" represent the latest forecast, and the columns labeled "Previous" represent the forecast provided in the second quarter of 2011. Looking across the columns, we see that forecasters were a bit more pessi-

[6] See the article by Dean Croushore for a description of the SPF. More information about the SPF, including the history of the survey, can be found on the Philadelphia Fed's website at: http://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters/.

TABLE

Survey of Professional Forecasters - Q3 2011

	Real GDP (percent)		Unemployment Rate (percent)		Payrolls (000s/month)	
	Previous	New	Previous	New	Previous	New
Quarterly data:						
2011:Q3	3.4	2.2	8.7	9.1	194.5	105.3
2011:Q4	3.5	2.6	8.5	9.0	173.9	148.7
2012:Q1	2.9	2.2	8.4	8.8	219.4	180.3
2012:Q2	2.5	2.9	8.2	8.7	182.0	138.0
2012:Q3	N.A.	3.2	N.A.	8.6	N.A.	187.0
Annual data (projections are based on annual average levels):						
2011	2.7	1.7	8.7	9.0	130.4	111.5
2012	3.0	2.6	8.1	8.6	194.8	150.1
2013	2.8	2.9	7.5	8.1	N.A.	N.A.
2014	3.3	3.1	7.0	7.6	N.A.	N.A.

Data on Forecast Uncertainty at the Federal Reserve Bank of Philadelphia

The Philadelphia Fed Research Department's Real-Time Data Research Center (RTDRC) makes available on its website data on the Survey of Professional Forecasters (SPF) and Livingston Survey, as well as measures of forecast dispersion for SPF variables.

The home page for the Real-Time Data Research Center is: http://www.philadelphiafed.org/research-and-data/real-time-center/.

The historical data from the SPF are available at: http://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters/.

Data sets on SPF variable forecast dispersion are available at: http://www.philadelphiafed.org/research-and-data/real-time-center/spf-forecast-dispersion.cfm.

The RTDRC also maintains the Livingston Survey http://www.philadelphiafed.org/research-and-data/real-time-center/livingston-survey/ and provides historical data on the forecasts of Federal Reserve Board of Governors' staff:

http://www.philadelphiafed.org/research-and-data/real-time-center/greenbook-data/.

mistic about their outlook for the U.S. economy compared with the second quarter 2011 survey. The median forecast called for real GDP growth of 1.7 percent in 2011, rising to 3.1 percent in 2014. The unemployment rate was expected to decline slowly to an average of 7.6 percent in 2014. The SPF asks respondents for a payroll employment forecast only for the current year and the next year. Those forecasts indicated a mean forecast of 111,500 jobs per month in 2011 and 150,100 jobs per month in 2012.

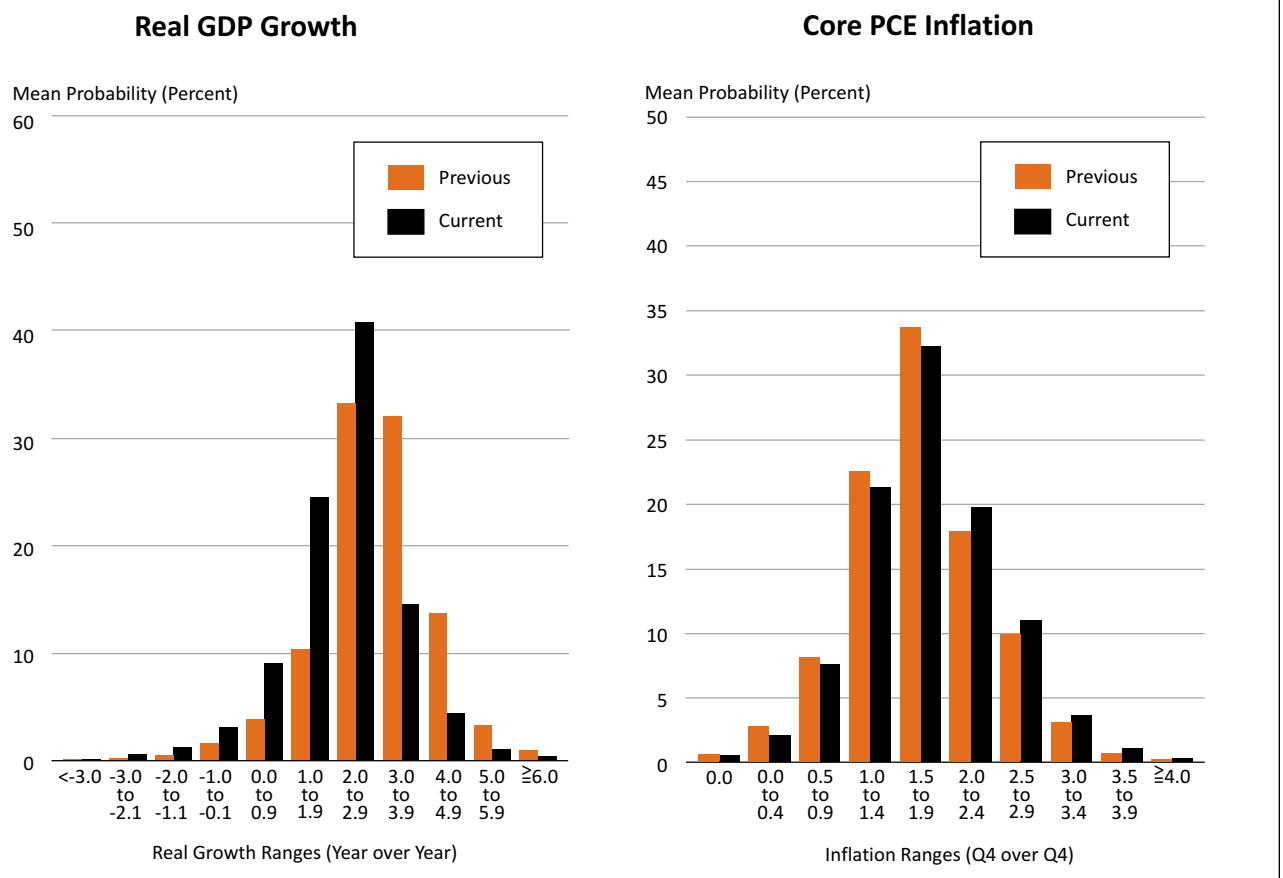
The numbers in the table are called point forecasts, since they show a single number for the forecasted variable rather than a range of likely outcomes. That is, each survey respondent gives a specific number representing his or her forecast (expected outcome) for output growth, unemployment, and inflation. The numbers in the table, then, represent the median response of the individual forecasts, but they give us no sense of how uncertain the forecasters are about their individual forecasts. Are they very certain about their forecasts, perhaps more so than usual? Or are they very uncertain about their forecasts? We cannot tell from the information in the table.

Fortunately, the SPF asks each forecaster directly about his or her forecast uncertainty. That is, the SPF respondents are asked to attach a probability to each of a number of pre-assigned intervals over which their forecast may fall. The Philadelphia Fed then takes the mean probabilities over the individual respondents and reports them in the SPF release in the form of a histogram. A histogram is a graphical representation of an estimate of a probability distribution for a variable. That is, a histogram shows the probability that a variable will lie in a certain range. For example, Figure 1 shows the mean probabilities for real GDP growth and core PCE inflation in 2012 as reported in the third quarter 2011 SPF.[7] The figure shows that respondents became somewhat more sure that real GDP growth in 2012 would fall in a range of 2 to 2.9 percent in the third quarter 2011 survey (black bars) compared with what they thought at the time of the previous survey in the second quarter of 2011

[7] Core PCE inflation removes the effects of changes in food and energy prices from the headline PCE measure.

FIGURE 1

Mean Probabilities in 2012



Source: Survey of Professional Forecasters, Third Quarter 2011

(orange bars). The forecasters attach some probability to real GDP growth being less than -1.1 percent, or greater than 5.9 percent, but the probabilities are small. It is clear from the figure that the forecasters see a bit above a 60 percent chance that real GDP growth for 2012 will fall in a range of 1 to 2.9 percent. In addition, the figure shows that forecasters see a greater chance of lower GDP growth compared with the previous forecast. We can see this from the fact that the height of the black bars toward the right side of the chart has shifted down and the height of the black bars toward the left side of the chart has shifted up. This means the forecasters are placing more probability on lower growth outcomes.

For core inflation, the figure suggests that forecasters shifted their views slightly toward the chance of higher inflation in the latest forecast. In particular, the height of the black bars to the right of the 1.5 to 1.9 bin has shifted up relative to the orange bars, and the height of the black bars toward the left end of the chart has shifted down.

What does Figure 1 tell us about forecast uncertainty? Note, first, that if all the SPF respondents were certain that real GDP growth would be in a range of 2 to 2.9 percent, there would be a single black bar at the 2.0 to 2.9 entry on the x axis, and the height of the bar would extend up to 100 percent. Alternatively, if the respondents thought that it was equally likely that real GDP growth would fall in any of the intervals labeled on the x axis, there would be a black bar of the same height (about 9 percent) at each entry on the x axis. In the former case, the respondents have very low (nil) uncertainty about real GDP growth in 2012. In the latter case, the respondents are very uncertain about real GDP growth in 2012. This indicates that a distribution of bars that is very tightly centered indicates low uncertainty compared with a distribution of bars that is very spread out.

One way to quantify the amount of uncertainty represented in Figure 1 is by using a measure of dispersion such as variance. To compute a variance, one calculates the average sum of squared differences of the observations from the mean. The units of measurement attached to variance are a bit awkward to work with, so researchers usually compute the standard deviation, which is the square root of variance. The standard deviation then has the same units of measurement as the data in question. All else equal, when dispersion around the mean is high, the standard deviation is high, and when dispersion around the mean is low, the standard deviation is low. For example, if all the observations of the variable in question were exactly equal to the mean, the standard deviation would be zero.

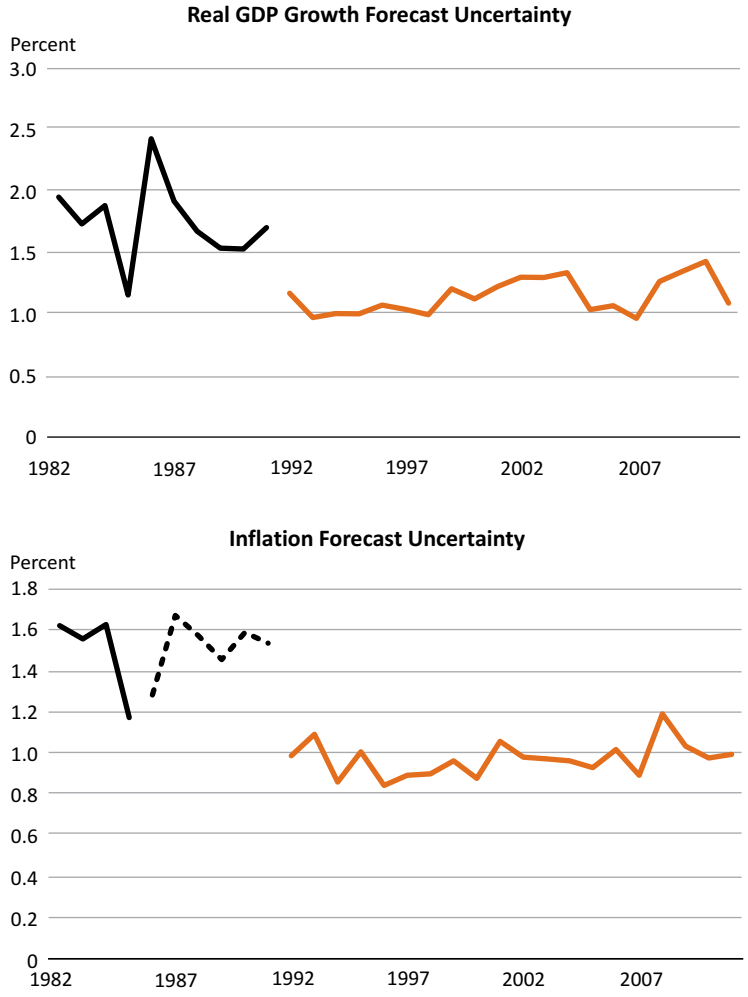
We can easily compute the standard deviation implied by the survey respondents' views on uncertainty that are embodied in Figure 1 using standard formulas. This gives us a single number for each histogram in the SPF that we can then use to make comparisons across time for uncertainty surrounding the forecasts. The time series of standard deviations from the uncertainty histograms for real GDP growth is shown in Figure 2. We plot the standard deviation for the year-ahead projections of real output growth as of the first quarter SPF for each year since 1981. Prior to 1981 the SPF asked respondents about nominal GNP uncertainty rather than real GDP, so we drop those observations. From 1981 to 1991 the survey asked forecasters to fill in six probability bins (or intervals on the x axis in Figure 1) for real GDP growth. Since 1992, the survey asks forecasters to fill in 10 probability bins. Because of this change in the survey question, we plot the pre-1992 data in black and the post-1992 data in orange. We construct a similar graph for inflation forecasts, where inflation is measured using the GDP deflator. We use this series because of its long history in the SPF (PCE inflation questions were only added to the SPF beginning in 2007). As in the case of GDP, the nature of the questions the forecasters are asked has changed over time. From the third quarter of 1981 to the first quarter of 1985, forecasters were asked to fill in probabilities for six bins (<4, 4 to 5.9, 6 to 7.9, 8 to 9.9, 10 to 11.9, and 12+). We plot the standard deviation from these histograms in black. From the second quarter of 1985 to the fourth quarter of 1991, the size of the bins changed (<2, 2 to 3.9, 4 to 5.9, 6 to 7.9, 8 to 9.9, 10+), and we plot standard deviations for these data in the dotted line. Since the first quarter of 1992, the forecasters have been asked for probabilities over the 10 bins shown in Figure 1, and we plot standard deviations for these data in orange in Figure 2.

The figure shows that there are large shifts in the uncertainty measures when the survey changed the

Especially in the case of inflation, there appears to be a link between the level of inflation and uncertainty as measured by the standard deviation. In particular, when the average forecast for inflation is high, forecast uncertainty tends to be high as well.

FIGURE 2

Output Growth and Inflation Standard Deviations Calculated from SPF Histograms



Top panel: black line shows pre-1992 data; orange line shows post-1992 data

Bottom panel: black line shows standard deviations Q3 1981 to Q1 1985; dotted line shows standard deviations Q2 1985 to Q4 1991; orange line shows Q1 1992 to 2011.

Source: Federal Reserve Bank of Philadelphia Survey of Professional Forecasters and author's calculations

number and/or size of the bins that it asked the forecasters to consider. This makes it difficult to compare SPF uncertainty over long spans of time. It is likely, for example, that inflation uncertainty was high in the 1980s, but how high compared to the 1990s and 2000s is difficult to say. Fortunately, researchers such as Robert Rich and Joseph Tracy and Paolo Giordani and Paul Soderlind have used statistical methods to refine the SPF measures of uncertainty and make them more comparable over time.[8] For the most part, their measures do indicate that inflation uncertainty was generally higher in the 1980s than it was in the 1990s. However, it remains a difficult task to assess the magnitude of changes in uncertainty when the survey changes over time.

If we focus on the uncertainty measures in the 1990s and 2000s that are consistently measured, we see that there are fairly sharp movements over the last two decades. Output growth uncertainty rose from the mid-1990s until about 2004 and then moved down sharply. Since the most recent recession, output uncertainty appears to have generally risen. For inflation, it appears that uncertainty has generally been rising since about 1996.

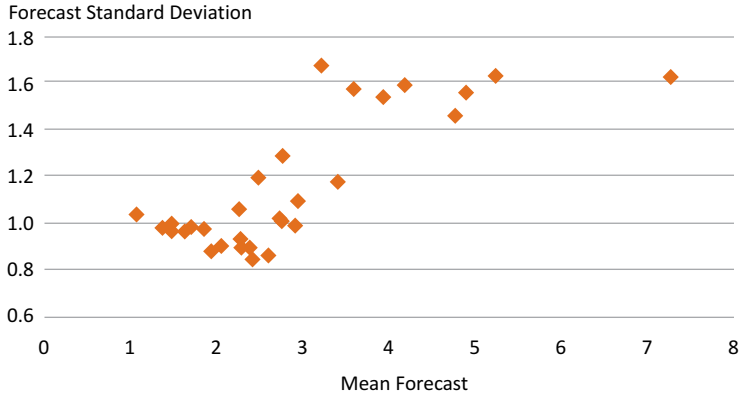
Especially in the case of inflation, there appears to be a link between the level of inflation and uncertainty as measured by the standard deviation. In particular, when the average forecast for inflation is high, forecast uncertainty tends to be high as well. We can see this by looking at a scatter plot of the mean one-year-ahead forecast for inflation and the standard deviation of the one-year-ahead inflation forecasts, both computed from the SPF histograms (Figure 3).[9] From the figure we see that there is a strong tendency for the standard deviation of forecasts for inflation to be high when the mean forecast for inflation is high (that is, the points tend to line up from southwest to northeast). Why might this be? It could be that when expected inflation is high, forecasters are especially unsure about the future course of monetary policy and so are more uncertain about what inflation will be in the future. Since forecasters use different models and beliefs to make their projections, their uncertainty about

[8] Giordani and Soderlind fit normal distribution approximations to the histogram data in the SPF. Rich and Tracy redefine the SPF bins to impose a common 2-percentage-point width throughout the sample period.

[9] A scatterplot is a diagram that displays values for two variables in a data set. The data are shown as a collection of points, each having the value of one of the variables shown on the horizontal axis and the value of the other variable shown on the vertical axis.

FIGURE 3

GDP Deflator Inflation Year-Ahead Mean Forecast vs. Forecast Uncertainty



Each point represents the degree of forecast uncertainty for a given mean forecast.

Source: Federal Reserve Bank of Philadelphia Survey of Professional Forecasters and author's calculations

future monetary policy is reflected in a wide range of inflation forecasts. This story is consistent with the episode in the early 1980s when inflation had been running at a high level and inflation expectations were unanchored. Paul Volcker, then-Chairman of the Federal Open Market Committee, engineered the disinflation that began to re-establish the credibility of monetary policymakers as guardians of price-level stability. During this time, forecasters may well have been very uncertain about how credible monetary policy would be and may have reflected this uncertainty in their inflation forecasts.

FORECAST DISAGREEMENT

An alternative measure that has often been used as a proxy for direct measures of uncertainty is called forecast disagreement.[10] Forecast disagreement measures how close the individual forecasters' projections in surveys like the SPF are to each other. The idea is that if all the forecasters are forecasting the same number, there is a sense in which forecast uncertainty may be lower. Similarly, if the forecasters are very far apart in their projections, there is a sense in which forecast uncertainty may be higher. The Philadelphia Fed Research Department's Real-Time Data Research Center (RTDRC) makes available on its website this proxy for uncertainty for selected variables in its SPF database.[11] The RTDRC provides forecast disagreement in the form of the 75th percentile of the point forecasts minus the 25th percentile. That is, we sort the point forecasts from high to low, chop off the top fourth and the bottom fourth, and take the difference of the remaining highest and lowest values. Since this measure removes the top and bottom of the distribution from the computation, it is less sensitive to extreme outliers.

The benefits of using a measure such as forecast disagreement are that such a measure is very easy to compute, it can be computed in a consistent way for the entire history of the survey, and it can be computed for every variable for which respondents provide forecasts. Figure 4 is a plot of inflation forecast disagreement constructed from the data provided on the RTDRC website.

It shows how disagreement about GDP deflator inflation forecasts has evolved over the past 20 years or so. We could examine an even longer history for this series, but we chose to limit it to 1983 for comparability with the measures of uncertainty we presented earlier. We see that there was more disagreement about inflation forecasts in the 1980s and that disagreement gradually declined until the late 1990s. Then, beginning in about 2007, there has been an upward movement in inflation forecast disagreement. Broadly speaking, this is in line with the uncertainty measure we calculated for GDP deflator inflation in Figure 2.

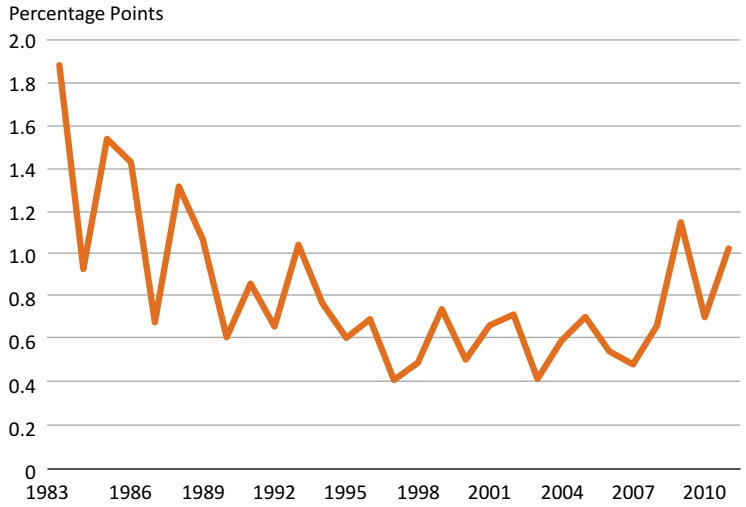
Disagreement measures account for how different the point forecasts of the individual forecasters are. But this is not the same thing as uncertainty about forecasts, and this measure of dispersion as a proxy for uncertainty is not without its problems. In particular, suppose only one forecaster responded to the SPF. In that case, there is no other forecaster with whom to compare her, and so we would conclude, using our forecast disagreement measure, that there was no disagreement; and if disagreement was our proxy for uncertainty, we would have to say that there was no uncertainty. But that lone forecaster who responded to the survey may have been very unsure of her forecast. In fact, she may have had high uncertainty about the future and about the forecast for variables such as output and inflation. We would clearly not be able to uncover information

[10] See, for example, the paper by William Bomberger, which investigates disagreement as a measure of uncertainty. See also the references in Giordani and Soderlind.

[11] See http://www.philadelphiafed.org/research-and-data/real-time-center/spf-forecast-dispersion.cfm.

FIGURE 4

GDP Deflator Inflation Forecast Disagreement



Source: Federal Reserve Bank of Philadelphia Survey of Professional Forecasters and author's calculations

about forecast uncertainty by looking at the disagreement measure. Similarly, it could be that forecast disagreement is not necessarily a good proxy for uncertainty even when we have many forecasters responding to the survey. However, we can compare forecast disagreement with the direct measures of uncertainty in the SPF to get an idea of whether disagreement might be an acceptable proxy for uncertainty.

EVALUATING MEASURES OF UNCERTAINTY

Is uncertainty measured from the SPF histograms the benchmark for measuring economic uncertainty? The SPF allows us to calculate a third measure of uncertainty that has the firmest grounding in terms of economics: We can calculate the standard deviation from each forecaster's histogram and then take the average across forecasters. We call this measure the average dispersion across forecasters.

Note that this measure differs from uncertainty calculated using Figure 1. In that case, we averaged the individual forecasters' views on uncertainty and then calculated a standard deviation, which we plotted in Figure 2. But what if, instead, we calculate the standard deviation for each individual forecaster and then take the average across forecasters? Why might these two measures differ? Because when we first take the average over the individual forecasters reported in the histograms and then compute dispersion, we are, in effect, incorporating information about how their point forecasts differ. That is, we don't account for individuals' mean forecasts when we compute the standard deviation; instead, we account for the mean across all forecasters when we compute the standard deviation. On the other hand, if we first compute the standard deviation for each forecaster, we are, in effect, taking out the mean, or point forecast, for each individual. The average of the individual standard deviations then does not contain information about differences in point forecasts across survey respondents.

This average dispersion measure across forecasters is probably what most people have in mind when they think about economic uncertainty. In effect, it calculates the average level of uncertainty across people. As a practical matter, though, this measure is somewhat difficult to work with. First, the same problem that we had with the survey questions changing over time is present with this measure, as it is with the aggregate measures shown in Figure 1; so a long time series is not readily available. Second, one now has to calculate a dispersion measure from many more histograms that might not have statistical properties as nice as those in the aggregate histograms reported in the SPF.

In part for these reasons, researchers have made use of the link between the uncertainty computed from the average histograms reported in the SPF (and shown in Figure 1) and forecast disagreement to back out average dispersion across forecasters, rather than compute it directly. It can be shown that the variance of the SPF average distribution equals the average variance over the individual forecasters plus forecast disagreement. So, if we want to calculate an uncertainty measure that does not incorporate forecast disagreement, we can simply subtract forecast disagreement from the variance of the aggregate distribution and take the square root to get the units right. This average dispersion across

Is uncertainty measured from the SPF histograms the benchmark for measuring economic uncertainty?

forecasters is probably what we mostly have in mind when we ask whether people are more or less uncertain about economic conditions. Note that if all of the forecasters agreed on their point forecasts, the standard deviation from the aggregate histograms in the SPF would coincide with the average uncertainty across respondents.

Several recent economic studies have examined whether forecast disagreement is a good proxy for average uncertainty, and the studies come to somewhat different conclusions. Giordani and Soderlind find that forecast disagreement is a pretty good proxy for average uncertainty in the case of inflation. Rich and Tracy use different statistical techniques and are more skeptical about how well disagreement proxies for average uncertainty for inflation; Gianna Boero, Jeremy Smith, and Kenneth Wallis are skeptical as well. While average uncertainty is a theoretically more appealing construct, forecast disagreement is easy to compute for any survey of forecasters and so provides a longer history covering more variables than average uncertainty. The European Central Bank is now collecting data on forecast uncertainty in its forecasting survey. In addition, the Bank of England's Survey of External Forecasters has been asking respondents to provide measures of uncertainty similar to those in the SPF. Over time, as the Bank of England's survey and the SPF build up larger data sets on forecaster uncertainty, researchers will have the opportunity to further investigate the extent to which forecast disagreement provides a good proxy for uncertainty.

UNCERTAINTY, DISAGREEMENT, AND AGGREGATE BEHAVIOR

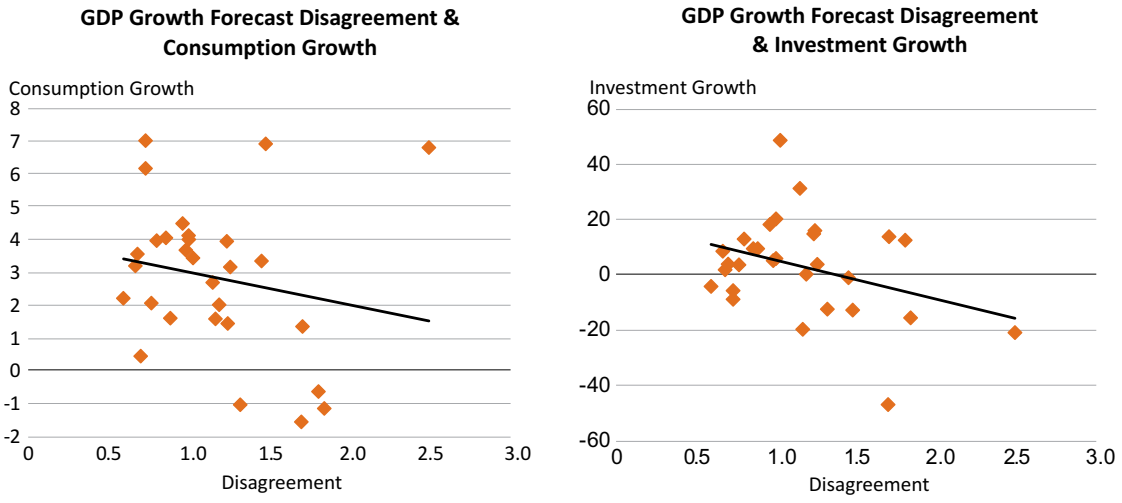
For practical purposes, we have two readily available measures that can potentially serve as proxies for uncertainty: uncertainty measured from the average histograms reported in the SPF (as shown, for example, in Figure 2) and forecast disagreement (as shown, for example, in Figure 4). Our earlier discussion on how uncertainty affects decision-making by households and firms suggested that when uncertainty is high, consumption growth and investment growth might be low. While we do not have a very long time series from the SPF, we can nonetheless examine whether there is a tendency in the data for consumption and investment to be low when uncertainty is high. We can look for this relationship in the data using simple correlations.[12]

However, any such relationships we uncover should not be taken as

[12] The paper by Bachmann, Elstner, and Sims uses survey data to explore the link between uncertainty and economic activity. They find that higher business uncertainty (measured using disagreement in business expectations from the Philadelphia Fed's Business Outlook Survey) leads to declines in economic activity.

FIGURE 5

Forecast Disagreement Versus Consumption and Investment Growth



Left panel: Each point measures disagreement computed from the first quarter survey of each year; vertical axis measures consumption growth in quarter in which that survey was taken.

Right panel: Each point measures disagreement for real GDP growth plotted against actual investment growth.

Source: Federal Reserve Bank of Philadelphia Survey of Professional Forecasters and author's calculations

proving or disproving an economic theory that posits a negative relationship between uncertainty and/or disagreement and consumption/income growth: We are instead exploring features of the data that would need to be accounted for by economic theory. Indeed, the causality between growth and uncertainty could go either way: Low consumption growth may indicate to forecasters that the economy is likely to enter a recession and so uncertainty about the future is high; or it may be that uncertainty is high, so consumers save more and consume less in anticipation of tough times ahead. We cannot distinguish between these alternative stories by looking at plots of uncertainty vs. consumption growth.

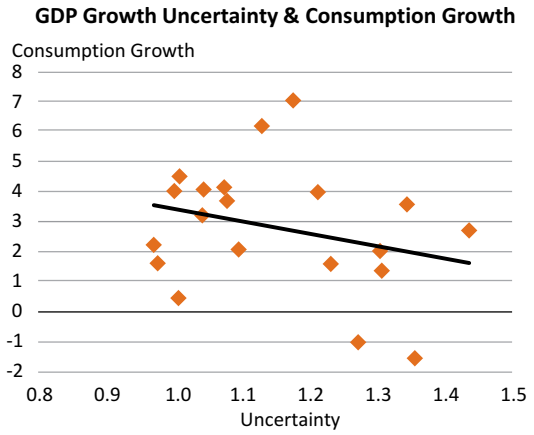
Figure 5 shows how forecaster disagreement is related to consumption growth and investment growth. The disagreement measure is taken from the RTDRC website and is the difference between the 75th percentile and 25th percentile for forecasts of one-quarter-ahead real GDP growth. We then compare that measure of disagreement to consumption growth and investment growth in the quarter in which the forecasts were made. We do this for the first quarter of each year since 1983 and present the data in the form of a scatter plot. For each point in the figure, the horizontal axis measures disagreement computed from the first quarter survey of each year, and the vertical axis measures consumption growth in the quarter in which that survey was taken. Similarly, the figure shows the scatter plot for disagreement for real GDP growth plotted against actual investment growth.

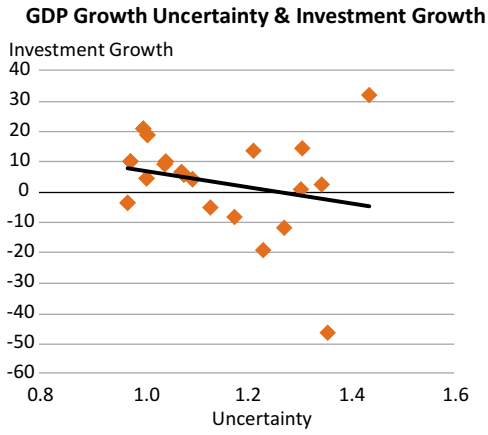
What we see in both panels is that the points have a tendency to line up down and to the right. This suggests that when disagreement is high, consumption growth and investment growth tend to be low. The regression trend line that is plotted in each figure (the solid black line) confirms this visual impression. This line is the best-fitting line through the points in the figure. The fact that the line in each figure trends down and to the right confirms that when disagreement is high, consumption and investment growth tend to be low.

We construct similar plots in Figure 6, which shows the relationship between uncertainty about real GDP growth and consumption and investment growth. We measure uncertainty using the standard deviation from the histograms reported in the SPF surveys for real GDP growth. Because of the data limitations discussed above, we use data only from 1991 onward for these figures. The uncertainty measure pertains to forecasted annual real GDP growth for the year in which the survey was taken (we again use the SPF from the first quarter of each year), and consumption and investment growth are measured in the quar-

FIGURE 6

Forecast Uncertainty Versus Consumption and Investment Growth





Left panel: Each point measures the relationship between consumption growth and uncertainty about real GDP growth.

Right panel: Each point measures the relationship between uncertainty and investment growth. Uncertainty is measured using the standard deviation from the histograms reported in the SPF for real GDP growth. The uncertainty measure pertains to forecasted annual real GDP growth for the year in which the survey was taken (using the SPF from the first quarter of each year), and consumption and investment growth are measured in the quarter in which the survey was taken.

Source: Federal Reserve Bank of Philadelphia Survey of Professional Forecasters and author's calculations

ter in which the survey was taken.

These figures look quite similar to those that investigated forecast disagreement and growth. In particular, there is a tendency for consumption and investment growth to be low when measured uncertainty is high. As is the case for Figure 5, the best-fitting trend line again slopes down and to the right, confirming a negative relationship between uncertainty and consumption and investment growth.

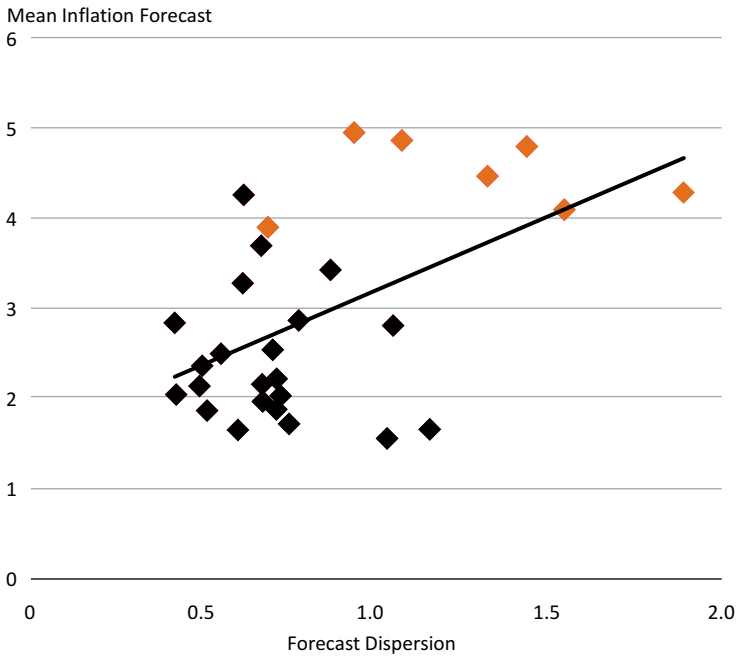
What about inflation uncertainty? Monetary policymakers care about inflation uncertainty, since it relates to their credibility as guardians of price stability. The Fed's dual mandate includes maintaining low and stable inflation. To the extent that policymakers can achieve this goal, price level changes will be fairly predictable over the medium and long terms for households and firms. This, in turn, should help to make their decision-making somewhat easier. Thus, policymakers care about what level of expected inflation households and firms have and how that expectation changes over time. Is there a relationship between expected inflation and uncertainty? The paper by Rich and Tracy investigates this question using SPF data. What they find is that average uncertainty across forecasters about inflation and expected inflation from the SPF does not appear to be strongly related. However, forecaster disagreement and expected inflation do appear to be related: Higher disagreement about inflation is associated with higher expected inflation.

We can see this relationship in Figure 7, which is a scatter plot of forecaster disagreement about GDP deflator inflation against their forecast of future inflation. The inflation forecast is for quarterly GDP deflator inflation four quarters ahead. The data are annual, measured in the first quarter SPF for each year from 1983 to 2011. The band of high-inflation points, marked in orange, is observations from the 1980s. We again plot the best-fitting trend line to the data, and it shows up as the solid, upward-sloping line in the figure.

The figure shows the tendency found by Rich and Tracy: Higher levels of disagreement about inflation are associated with higher expected inflation. As Rich and Tracy point out, the economic theory behind this apparent relationship is currently a bit thin, especially since their analysis indicates that other uncertainty measures for inflation are not very significantly correlated with expected inflation. It would seem to indicate that forecasters are using quite different models to forecast inflation and that, as inflation rises, those models are leading to quite different predictions about future inflation.

FIGURE 7

Mean Inflation Forecast and Forecast Dispersion



Plot of forecaster disagreement about GDP deflator inflation against forecast of future inflation. Inflation forecast is quarterly GDP deflator inflation four quarters ahead. Annual data, measured in the first quarter SPF for 1983 to 2011. High-inflation points, in orange, are observations from the 1980s.

Source: Federal Reserve Bank of Philadelphia Survey of Professional Forecasters and author's calculations

CONCLUSION

Economic uncertainty is an important facet of decision-making for households, firms, and policymakers. The data on economic uncertainty are not readily available and usually must be gleaned from forecast surveys. The SPF is somewhat unique in that, in addition to standard measures of forecast disagreement, it provides direct measures of uncertainty from its respondents. This has made the SPF a valuable tool for researchers investigating the link between economic uncertainty and economic outcomes.

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