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How Did the Economy Surprise Us in 1998?

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There is a one- to two-year delay between when the Federal Reserve changes monetary policy and the resulting effects on real output, unemployment, and inflation, so policymakers must be forward-looking and preemptive in order to effectively stabilize the economy and control inflation (Rudebusch 1995). Macroeconomic forecasts are thus a crucial element for the conduct of monetary policy, and good forecasts help ensure good policy. Accordingly, an important adjunct to the policy process should be an ongoing assessment of the quality of macroeconomic forecasts. This *Economic Letter* provides a forecast evaluation "case study" by examining the accuracy of the San Francisco Fed's (FRBSF) structural model forecast made in early September 1997 for economic growth and inflation during 1998. (For an overview of macroeconomic forecasting and evaluation, see Diebold and Rudebusch 1999.)

Constructing a forecast from an econometric model requires three assumptions. The first assumption is that the model is well specified and that it adequately captures the important interrelationships in the economy–for example, the parameters in the model are estimated at their correct values, and no important variables are missing from the model. The second assumption is that the future shocks to the model–that is, the residual errors made by the model's equations–are zero (or take on predetermined values). The third assumption is about the future paths for exogenous variables, that is, those not explained by the equations of the model; in the FRBSF model, some of the exogenous variables are foreign GDP growth, the price of imported oil, and the level of the stock market.

In general then, the difference between a model-based forecast and the actual behavior of the economy could be attributed to (one or more of) three possible sources: a misspecified economic model, unusual residual errors or shocks, and inaccurate projections of the exogenous variables. As shown below, it appears that a large portion of the FRBSF forecast error for real output growth in 1998 reflected the last of these; however, the forecast error for inflation reflects either a misspecified model or economic shocks.

Key assumptions for the FRBSF forecast

The structural model used by the FRBSF for producing macroeconomic forecasts is a substantially modified version of a model maintained at Yale University by Ray Fair (see Fair 1994). The FRBSF model has about 45 stochastic equations estimated from the data (and numerous identities) that specify the structure of the economy in fairly traditional Keynesian terms. For example, consumption depends on interest rates, disposable income, and household wealth, and investment spending responds to interest rates and sales. Wage inflation depends on the unemployment rate, trend productivity growth, and lags of price inflation (a "wage-price" Phillips curve), and price inflation is a "markup" over lagged wage inflation adjusted for trend productivity growth. Throughout the model, expectations of consumers and producers are formed in a fairly simple fashion on the basis of the past.

As noted above, the FRBSF forecast depends on a variety of assumptions about variables that are not explained by the model. For example, although the model can be simulated with a reaction function describing (or endogenizing) monetary policy actions (as in Judd and Rudebusch 1998), the typical assumption for a policy forecast is that the federal funds rate will be held exogenously at its current level (Rudebusch and Svensson 1999). At the time of the September 1997 forecast, the target for the federal funds rate was 5.5%, and the September forecast assumed that this rate would be maintained. In fact, this assumption was quite accurate, with the funds rate target remaining at 5.5% for almost all of 1998.

In contrast, events abroad held some dramatic surprises. In early September 1997, there was little inkling that the currency devaluations of a few small countries in Asia would escalate into a severe financial crisis that would stunt growth around the world. But as it turned out, foreign real GDP growth during 1998 was about 3 percentage points weaker than had been assumed for the FRBSF forecast. Also, a weakening of worldwide demand for energy in the wake of the Asian crisis (along with mild winter weather in the U.S.) led to an unexpected drop in oil prices, which is another exogenous variable in the model. During 1998, the price of imported oil averaged about $4 a barrel lower than we had anticipated in September 1997. Finally, the Asian crisis had more modest ramifications for the dollar, which appreciated as a safe haven during the first half of 1998 but gave up those gains in the second half. In the September 1997 FRBSF forecast, the value of the dollar was assumed to remain unchanged in the future (consistent with a random walk view), and this assumption was, on balance, fairly accurate.

U.S. financial markets also held some surprises last year. The corporate bond rate (the main long-term interest rate in the model) dipped significantly during the first half of 1998, partly in response to good inflation reports. On balance, corporate bond rates averaged a bit below the September 1997 FRBSF projection of essentially no change in rates. Finally, perhaps the greatest surprise last year was the jump in equity valuation. The September 1997 FRBSF forecast took a “random walk” view of the stock market and assumed that prices would change little from their levels in the late summer of 1997 (though allowing for a slight average upward drift). In the event, the S&P 500 soared over 20% by the end of 1998.

Analyzing the Forecast Errors

Table 1 provides the basis for our evaluation of the accuracy of forecasts for real economic activity and inflation. The first row provides the actual numbers on the growth in real GDP growth and inflation in the GDP chain-price index during the four quarters of 1998. The second and third rows give the September 1997 forecasts for these two series and the forecast errors. (Specifically, this is the error for average growth or inflation during the final four quarters of a 5-quarter-ahead forecast.) The next two rows give revised September 1997 forecasts using the actual values of the exogenous variables described above (e.g., on the stock market) and the corresponding forecast errors. The final row gives the average absolute errors of the model in forecasting these variables. (These are constructed from 500 stochastic simulations of the model, which take into account the estimated random shocks faced by the economy.)

The first column considers real GDP growth, which roared in 1998 at 4.2%. The September 1997 forecast underestimated future output growth by 2.2 percentage points. However, much of this error does not appear to be the result of large shocks to the model or model misspecification. Instead, incorporating the actual realizations for the exogenous factors described above into the forecast reduces the forecast error by about a third. In particular, if we had known in September 1997 that the stock market was going to continue to post robust gains, adding that information alone to the model would have added almost a percentage point to the GDP growth forecast. This large forecast revision reflects the fact that in the model, increases in financial wealth boost household spending. Even though the wealth coefficient is small, the recent increases in wealth are so large that the total effect is significant. The effects to the model GDP forecast from changes in the other exogenous factors are smaller and offsetting. If the weakness in demand abroad had been anticipated, the real GDP forecast would have been cut by ½ percentage point, but the lower interest rates and oil prices would have boosted growth by the same amount.

Table 1
1998 Forecast Accuracy

	Real GDP Growth	GDP Price Inflation
Actual	4.2	0.9
Sept. 1997 forecast	2.2	1.6
Forecast error	2.0	-0.7
Forecast with actual exogenous variables	2.9	1.7
Forecast error	1.3	-0.8
Mean model error	1.6	1.0

The second column tells a different story for inflation in two respects. First, the forecast in September 1997 overpredicted price inflation. (There was also an overprediction of wage or employee compensation inflation by a similar amount.) Second, incorporating the actual paths for the exogenous variables to the model does not reduce the prediction error. Incorporating the fall in oil prices holds down inflation, but this is more than offset by the inflationary pressure from the rise in the stock market and the corresponding faster U.S. economic growth.

Model misspecification or shocks?

Table 1 leaves open two possibilities: there may have been temporary shocks to the economy that show up as residuals in the model, or the structure of the model may be misspecified. There is not enough statistical evidence in the data to distinguish definitively between these two hypotheses. Any model misspecification is probably not idiosyncratic to the FRBSF model, as many other forecasters–for example, the September 1997 Blue Chip consensus forecast–made very similar output and inflation prediction errors. Indeed, the forecast errors in Table 1 are all smaller (in absolute value) than the average error that might be expected simply from the historically observed stochastic shocks to the economy (the "mean model error" in Table 1). Still, although last year's forecast errors were statistically small, 1998 was the second or third year in a line of small surprises that are all in the same direction: surprisingly strong output and low inflation. Such a run of one-sided forecast errors is unusual, so it is worth examining some of the anecdotal stories that might suggest a possible source for the forecast errors.

The obvious explanation for the forecast errors is a positive supply shock, that is, an exogenous increase to productivity that boosts output and damps inflation. Such a shock could reflect the influx of high technology into the economy and induce the model to underpredict growth and overpredict inflation. At this point, however, it is difficult to discern whether this is a transitory supply shock that may last only a couple of years or whether there may be a permanent element that requires a reevaluation of trend productivity and the structure of the model. Forecasters and policymakers often seem to face this decision of whether the recent past was an incidence of economic luck or the advent of a new era.

Two other widely noted transitory shocks that may have lowered inflation include the ongoing reorganization of health care management and the drop in prices in international markets for a wide variety of agricultural and industrial commodities (in addition to oil prices). The first of these has helped limit recent medical care cost increases and health insurance premiums, which have damped labor costs. The second has reduced the cost of raw materials for many producers and helped them to hold the line on product prices. These factors would be represented by residuals in the FRBSF structural model because it does not contain a separate accounting for health insurance benefit costs or (non-oil) commodity prices.

Some have suggested that the structure of the economy may have changed in more permanent ways. For example, in September 1997, the unemployment rate was almost 1 percentage point below the model's point estimate of the so-called natural rate of unemployment; thus, in the model, a labor market supply-demand imbalance provides the impetus for higher inflation. However, perhaps one of the impacts of high technology in the economy has been to enhance the flow of information and boost the matching of workers and jobs, which would reduce the natural rate of unemployment. Others have suggested that focusing simply on the unemployment rate as a gauge of slack in the economy is too narrow a view. For example, the factory utilization rate, another traditional measure of slack, suggests that the economy is in much better balance. Accordingly, it appears that last year's forecast error could have been smaller in a model that incorporated capacity utilization as well as labor market pressures in assessing the inflation outlook.

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