VECTOR AUTOREGRESSIONS AS A TOOL FOR FORECAST EVALUATION

Roy H. Webb

There are two important reasons for examining the historical accuracy of economic forecasts. For one, current users of economic forecasts need a guide to the probable accuracy of the projections they receive. Although the past record cannot perfectly predict future accuracy, it does provide valuable guidance. From another perspective, economists are interested in whether conventional model-building techniques provide a useful framework for economic research and policy analysis. One test of conventional large econometric models is whether or not they provide accurate forecasts. If not, one may then question other products of that framework as well.

Although one can compile a record of forecasts, compare them to actual results, and calculate descriptive statistics such as average errors, such summaries by themselves do not tell us whether a forecaster's record is especially good or bad. What is needed is a standard against which to judge a series of forecasts.

This article uses a relatively new statistical procedure, a vector autoregressive (VAR) model, as a standard of comparison for other forecasts. The article first explains how structural models are conventionally employed to generate forecasts. Conventional procedures for constructing and using large models are not endorsed by all economists, however, and a few objections are mentioned. Next, the article describes VAR models and explores their usefulness for generating forecasts. Also, it compares a particular VAR model's forecasts with a series of forecasts from a large structural model as well as with a composite forecast derived from a large number of individual forecasters. The final topic is the VAR model's estimate of the precision of its forecasts.

Forecasts from Large Structural Models[1]

Economic theory can be used to impose structure on data sets by specifying exactly how variables may interact. One purpose of such restrictions is to produce superior forecasts. For example, a widely-used theoretical representation has the demand for real money balances depending on real GNP and an interest rate. This could be written

$$(1) \quad \frac{M}{P} = L(X,R)$$

where M represents the nominal money supply, P is the price level, L is a specific liquidity preference (or money demand) function, X is real GNP, and R is an interest rate. In order to generate forecasts of the left-hand variable, it is conventional to approximate equation (1) by

$$(2) \quad \log\left(\frac{M}{P}\right) = c + b_1 \log(X) + b_2 \log(R) + e$$

where log indicates a logarithm; c, b_1, and b_2 are coefficients which can be statistically estimated from historic data; and e is an error term which is random noise if the theory embodied in equation (1) and its approximation, equation (2), are valid.

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1 Well-known large structural models include the Brookings Model, the Chase Econometrics Model, the Data Resources Model, the FMP Model, and the Wharton Model. Those models above are often referred to as Keynesian, due to their emphasis on the importance of aggregate demand and their analysis of demand by sectors (consumption, investment, etc.). The word Keynesian may be misleading, however, since Keynes himself [7] found fault with many statistical procedures used by today's model builders. Also, a large structural model could employ non-Keynesian theory and be vulnerable to all the objections mentioned in the text.

Once the coefficients in equation (2) are estimated, that expression can be used to predict real money balances, given values for real GNP and the interest rate. Such predictions of real money balances have not always been accurate,[2] and have typically led to modifications of equation (2).

One modification that is often made is to add the so-called lagged dependent variable term $b_3 \log (\frac{M}{P})_{-1}$ to the right-hand side of equation (2). Such a term is not rigorously derived from the theory underlying equation (1).[3] However, econometric investigators have found that including lagged values of the dependent variable often improves the statistical fit of an equation—that is, its average prediction errors are smaller within the time span over which the equation's coefficients are estimated. Another ad hoc technique might be to include additional lagged values of real GNP and the interest rate on the right side of equation (2).

As a result of those modifications, an equation for the demand for money might be (omitting the logs for notational convenience)

$$(3) \quad \frac{M}{P} = c + b_{11}X + b_{12}X_{-1} + b_{21}R + b_{22}R_{-1} + b_3(\frac{M}{P})_{-1} + e.$$

Although equation (1) can be derived from optimizing behavior of a representative individual, equation (3) specifies more complex behavior that is not derived from a dynamic model of an individual's optimizing decisions. Instead, it simply reflects statistical modifications that have been found to be consistent with the data.

Another objection to equation (3) is that real GNP and the interest rate are not truly exogenous—that is, they are not determined independently of real money balances. On the contrary, each variable influences the other as they are jointly determined. The main purpose of building large models is to take such interdependencies into account. In this example, there could be separate equations for the money supply, the price level, real GNP, and the interest rate. That approach, however, leaves two problems unresolved. First, although such simultaneous equation models require specialized econometric techniques, the complexity of many structural models may preclude the use of those techniques.[4] A second problem is that there are very few really exogenous variables (for example, a time trend, weather, and wars).

A final concern is the treatment of expectations. Since economic decisions of individuals are often based on what they expect to happen in the future, it might be more accurate to replace actual with expected real GNP in equation (1). In other words, an individual's demand for real balances would depend on his expected income rather than previously realized income.

Expectations raise a particular problem for model builders, however, since individuals' expectations are not observed directly. Rather than model the process of expectations formation, conventional practice is to substitute a series of lagged values for the expected future value of a variable. Such a practice is frequently observed in an equation such as

$$(4) \quad w = c + b_1U + \Sigma a_i p_{-i} + e$$

where w is the growth rate of wages, U is the unemployment rate, p_{-i} is the growth rate of prices i periods in the past, e is the error term, and the a_i's, b_1, and c are coefficients that can be estimated. In equation (4) (often referred to as a Phillips Curve) the lagged inflation terms are meant to represent an individual's expectation of future inflation. Economic theory, however, does not support that representation as an individual's best effort to predict future inflation.

Thus the following areas of conventional model-building practice have been challenged: (1) many key structural equations are not actually derived from the theory they purport to represent, (2) many variables are inappropriately labeled as exogenous, and (3) while expectations of future events determine many actual economic decisions, they are typically entered into a large model in a crude, theoretically unjustified manner. Although by no means an exhaustive critique of large structural models,[5] those

[2] See Judd and Scadding [6] for a thorough account.

[3] Investment in physical capital can be modeled as a "stock adjustment" process, which gives rise to a lagged dependent variable. Chow [1] used an analogy of money to consumer durables to justify the stock adjustment process. He did not, however, specify why adjustment of actual to desired money balances is so costly that it is not instantaneous. Since money can be easily exchanged for physical commodities or financial assets, the analogy of a stock of money to a stock of physical capital is unclear without a more complete model of transactions technologies.

[4] Los [10], for example, has criticized the use of ordinary least squares to estimate the FMP model, rather than using simultaneous equation methods.

[5] For a more complete critique, see Sims [12]; also, for a more thorough explanation of the construction of and philosophy behind large models, see Eckstein [3].

difficulties illustrate why many economists do not automatically accept the models' results. Yet if the models had a documented history of performing well, the force of those objections would be muted. Thus the relatively new statistical technique described below is of particular interest as a standard against which one product of the large structural models can be measured.

Other products of large models such as policy evaluation and hypothesis testing are at least as important as forecasting. Yet it is much harder to assess their performance in those areas than it is to measure predictive accuracy. Therefore, the forecasting performance of large models may be the only empirical evidence available to judge the success of modeling efforts.

VAR Models

In sharp contrast to the structural approach described above, a VAR model uses little economic theory. Therefore, VAR models make no attempt to satisfy the objections made concerning the theoretical specification of conventional models. In this and in other areas, both VAR and conventional models are thus suspect a priori. It is an empirical question as to which model actually produces better forecasts.

An extremely simple VAR model is illustrated by equations (5) and (6) below:

$$(5) \quad R = b_1M_{-1} + c_1R_{-1} + e_1$$

$$(6) \quad M = b_2M_{-1} + c_2R_{-1} + e_2$$

where M and R represent the money supply and an interest rate, the b's and c's are coefficients, and the e's are error terms. Note that the money supply and the interest rate are treated symmetrically. Each is determined only by its own lagged value and the lagged value of the other variable. As a practical matter, much longer lags are necessary in order to generate adequate predictions. Accordingly, in the model which is described below, six lagged values are included for each variable. Also, most VAR models use more than two different variables, and in the model below, five variables are included. The two equations above, however, illustrate the essence of the VAR approach.

The VAR model thus provides a conceptually straightforward method of producing forecasts that do not assume particular values of exogenous variables. At any point in the past, it is possible to estimate a VAR model's coefficients based on data through that point in time and then produce forecasts as far ahead as desired. Those forecasts, in turn, can be compared with actual results. Since the forecasts are mechanically generated and are based on data available at the time of the forecast, they provide a legitimate comparison for previously published forecasts from other sources.

VAR forecasts have a special appeal when used as a standard of comparison for forecasts from large structural models because the VAR models do not impose the controversial theoretical restrictions that those models contain. In particular, VAR models do not employ dubious exogeneity definitions. That is especially important for variables manipulated in the conduct of monetary policy. Although the large structural models often treat Federal Reserve actions as exogenous, some analysts believe that the Fed has usually responded in a predictable manner to the state of the economy, and therefore Federal Reserve actions are jointly determined with other macroeconomic variables.[6]

Thus on some points the VAR strategy avoids problems faced by conventional models. However, the VAR models' lack of theory and small number of variables lead many analysts to question their usefulness. It is therefore especially interesting to examine the actual performance of VAR and structural models. Although a model's performance has several dimensions, the easiest to measure is the accuracy of its forecasts. Accordingly, the following section contains some evidence on the forecasting ability of a particular VAR model.

A Comparison of Forecasts

This section compares recent forecasts from three sources: a major consulting service, a survey of professional forecasters, and a VAR model. Forecasts began in the first quarter of 1976 and were taken through the third quarter of 1983. Details of the VAR model's construction are provided in the Appendix. The survey covers as many as seventy professional forecasters. Average values from the survey have been found to be more accurate than most individual forecasters.[7] The consulting service bases its forecasts on a large structural model, but modifies the model forecast with the judgment of its staff before its forecasts are published. A calendar quarter's last monthly forecast (usually issued during the last week of the quarter) was used.

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[6] For a more detailed account of Federal Reserve response to economic conditions, see Hetzel [5].

[7] See Zarnowitz [13] for a description of the survey, and Zarnowitz [14] for an analysis of errors from forecasts derived from the survey.

As noted in the Appendix, in some respects the comparison favors the VAR model due to the procedures used to construct the model. Also, the VAR forecasts had access to the latest revisions of published data. Offsetting those advantages, however, are two important factors. While the VAR model only employs five variables, the structural model contains several hundred. That additional information should help improve the accuracy of its forecasts. In addition, unusual events such as the Carter credit controls of 1980 could have been incorporated into the published forecasts via judgmental adjustments. Therefore, after considering these factors, it is the author's judgment that the consulting service should have been able to provide forecasts with substantially greater accuracy than the VAR model if their model's theoretical restrictions were valid.

Charts 1-3 illustrate four-quarter-ahead forecasts and actual outcomes, with summary statistics given in table I for one-, four-, and eight-quarter forecasts. Some observers have questioned the accuracy of VAR predictions. Lawrence Klein, for example, is reported to have expressed the view that "VAR models are all right for predictions one quarter ahead,

Table I

FORECAST ERRORS

(Percent)

	Forecast Horizon		
	1 Quarter	4 Quarters	8 Quarters
Real GNP Growth			
VAR	4.49	2.36	1.56
Forecasting Service	4.66	2.65	1.89
ASA-NBER	4.23	2.36	
Inflation Rate			
VAR	2.62	1.85	2.46
Forecasting Service	1.65	1.87	2.21
ASA-NBER	1.80	1.70	
Commercial Paper Rate			
VAR	1.78	3.10	5.00
Forecasting Service	1.82	3.58	5.09

NOTE: Entries represent the root mean squared difference between actual and predicted values. Real GNP and inflation are percent changes expressed as annual rates. The commercial paper rate is the quarterly average value. Actual values range from 1976 Q2 to 1983 Q3 for one-quarter forceasts, from 1977 Q1 to 1983 Q3 for four-quarter forecasts, and 1978 Q1 to 1983 Q3 for eight-quarter forecasts. The ASA-NBER survey did not include an interest rate for the entire period, and also did not include eight-quarter forecasts.

Chart 1

REAL GNP GROWTH OVER 4 QUARTERS

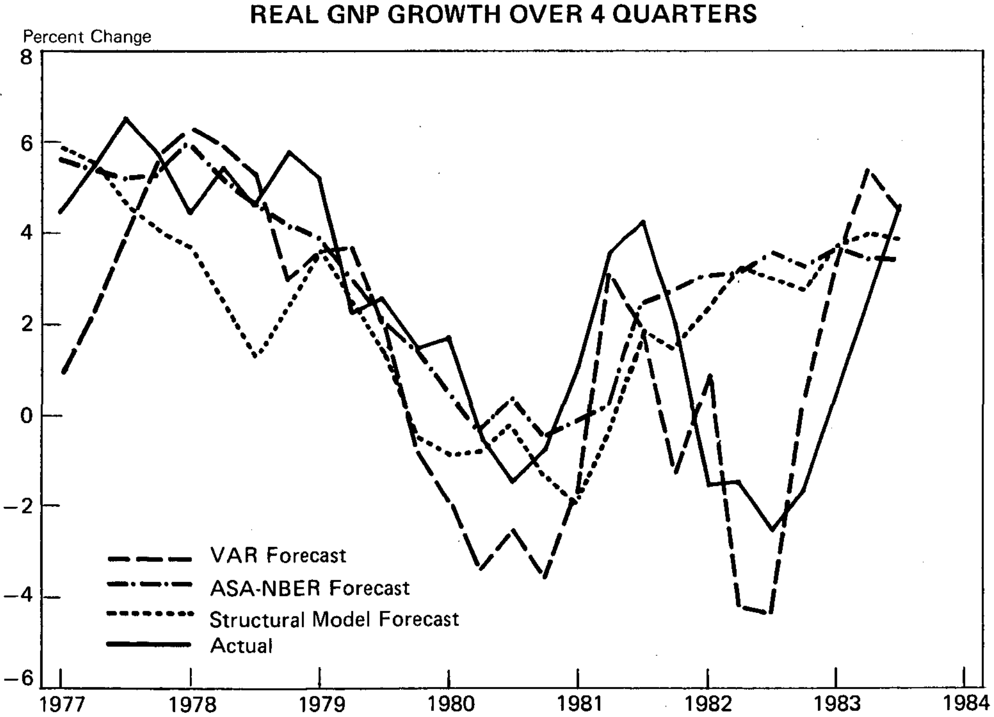


Chart 2

PRICE LEVEL CHANGE OVER 4 QUARTERS

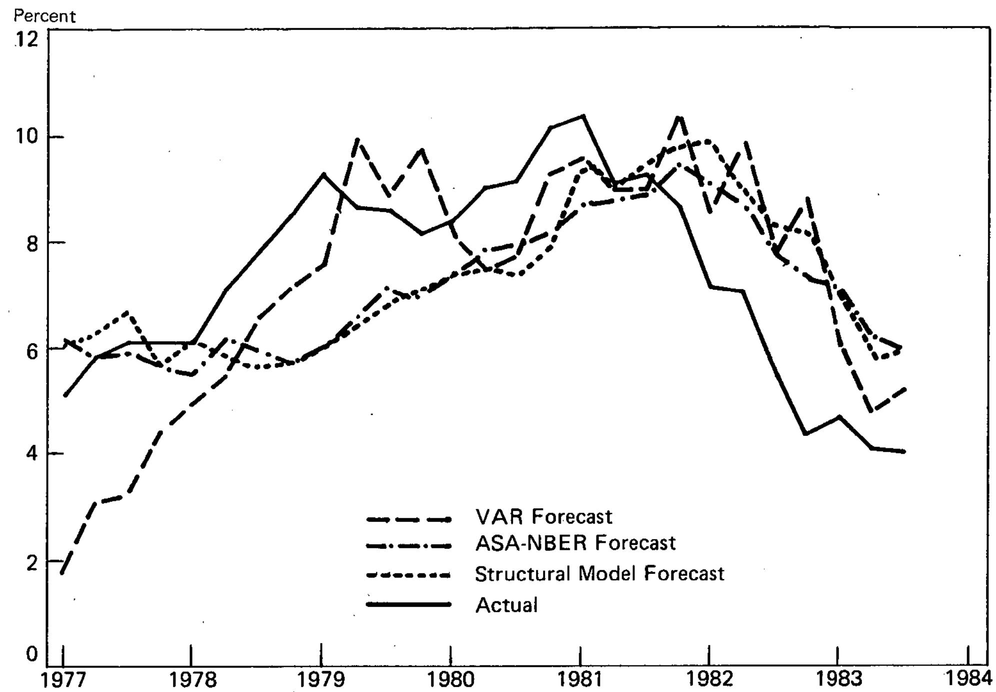
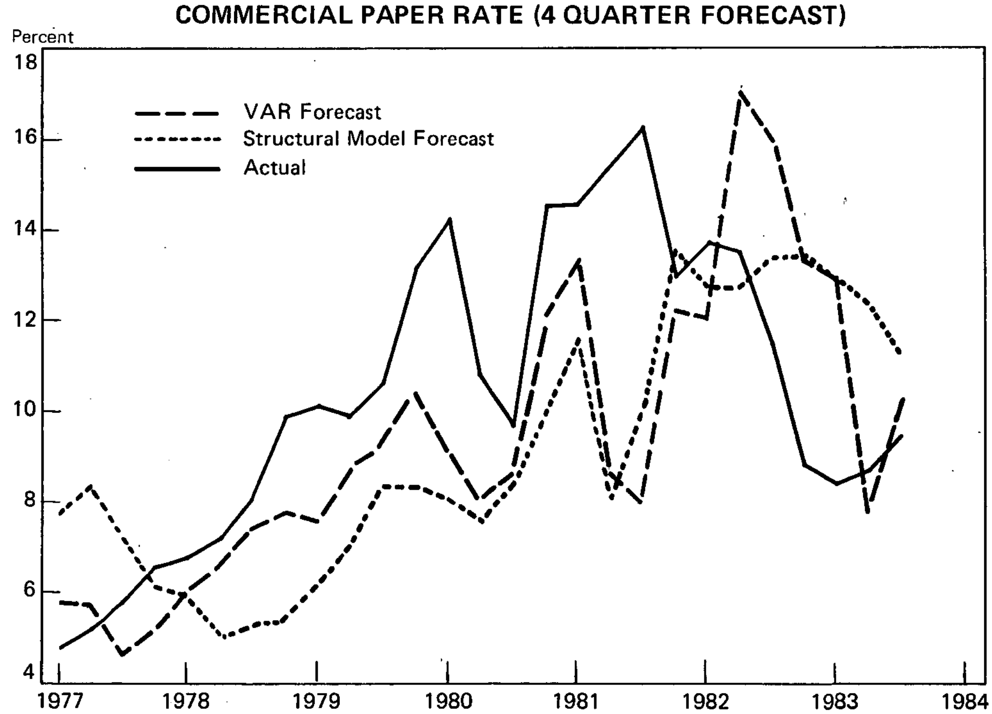


Chart 3

COMMERCIAL PAPER RATE (4 QUARTER FORECAST)



but VAR predictions quickly deteriorate so that conventional models offer superior predictions further in the future." [2] The results shown here clearly contradict Klein's view. At a four-quarter horizon, the VAR model's predictions are more accurate than both published forecasts for real GNP, and more accurate than the forecasting service for inflation and the interest rate. And at an eight-quarter horizon, the VAR model's forecasts are more accurate than the forecasting service for real GNP and the interest rate. It is especially noteworthy in chart 1 that only the VAR model predicts the 1982 recession.

There is additional evidence from other models. Stephen McNees [11] has found that for real GNP and the unemployment rate, published forecasts from a VAR model constructed by Robert Litterman were more accurate than three large structural models at four- and eight-quarter horizons. (McNees, however, had only four observations at the longest horizon, making his comparisons tentative at this stage. Also, his results were less favorable for the Litterman model for several other variables.) Litterman [8] also compared a VAR model's performance with that of seven major forecasters from 1970-75, and found better performance from the VAR in many cases, especially at longer horizons.

Uncertainty of Forecasts

Another use of VAR models is to estimate the uncertainty attached to a particular forecast. Since the VAR forecasts are not judgmentally adjusted, they yield objective estimates of uncertainty. In contrast, it is difficult to imagine an objective measure of the accuracy of judgmental adjustments that will be made to forecasts from large structural models.[8]

Forecast errors can be traced to several sources. One source is the error term included in statistical models. Taking equation (2) as an approximation to equation (1), for example, gives rise to such an error term. That modeled error can be expected to cause forecasts from both VAR and structural models to differ from actual outcomes. The variance of future errors from that source can be estimated using errors within the sample period. A second source of prediction errors for both types of models is that the coefficients are not known with perfect accuracy, but instead are statistically estimated and thus are to some extent erroneous. Another problem for structural models is the error in predicting future values of exogenous variables. Finally, the extent to which a model is incorrectly specified will add to forecast error. Some potential misspecifications are noted above for structural models. A misspecification that is particularly applicable to small VAR models is that relevant explanatory variables are omitted, thereby causing the in-sample error term to understate the true imprecision of forecasts.

Analyzing probable forecast errors due to in-sample errors, errors in estimating coefficients, and errors in predicting exogenous variables is a conceptually straightforward task. Estimating probable forecast errors due to model misspecification, however, is much more difficult. Fair [3] has attempted this latter task for several models, and has found the probable error due to misspecification to be sizeable for both a VAR and a structural model.

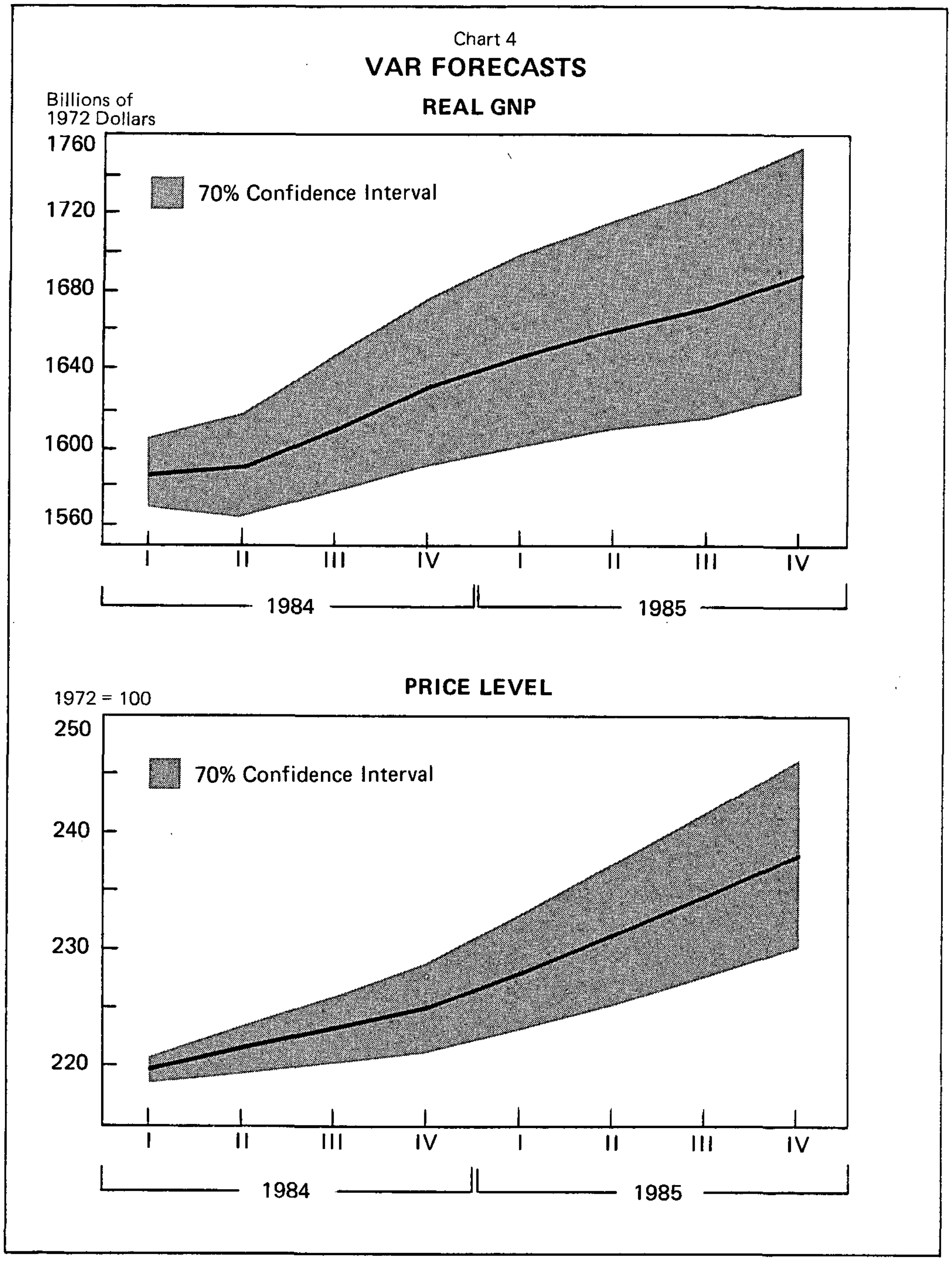
The VAR model's probable forecast errors presented below account only for the first type of error, and thus are best interpreted as an upper bound on the probable accuracy of current forecasts. Even so, the illustrated imprecision is considerable. To illustrate, chart 4 contains the VAR forecast for real GNP and price level in 1984-85 and confidence intervals for that forecast. Taking account of the error mentioned above, the shaded areas indicate that there is a 70 percent likelihood that the actual value will fall within that range. The charts thus indicate a large degree of imprecision in forecasts which prospective users should take into account.

Conclusion

There is a limited amount of information in our time series of economic data, and economists do not agree on the best strategy for extracting that information. Innumerable hours of labor have been devoted to building ever-larger models with continual ad hoc adjustments. Another strategy is to use relatively simple VAR techniques. This paper poses the question: which strategy actually produces more useful information?

In this article, the amount of useful information is measured by the accuracy of forecasts. If small, atheoretical VAR models can consistently match the

[8] The author is aware of only one large structural model that does not routinely modify the model forecasts.



forecasting accuracy of large structural models, that could lead one to question the usefulness of the large models' theoretical restrictions for other purposes, such as policy evaluation and formally testing hypotheses concerning the structure of the economy. The results here are not conclusive. (Comparing a long series of published VAR forecasts with large models singled out for having the best forecasting records would permit a more conclusive judgment to be made.) Nonetheless, the fact that in many comparisons, post-sample predictions from a simple VAR model did well vis-à-vis the published forecasts of a major consulting service as well as the median forecast from a survey of forecasters over a seven year period should encourage further research with this relatively new method.

APPENDIX

This section describes the construction of a VAR model in sufficient detail so that the reader may (1) judge the extent to which experimentation in model construction qualifies the conclusions in the text, and (2) replicate the model and the results cited in the text.

Five variables are employed: the six-month commercial paper rate, the monetary base, the capacity utilization rate, the GNP implicit price deflator, and real GNP. The commercial paper and capacity utilization rates are levels (quarterly averages), and the other variables are percent changes from the previous quarter at annual rates. The data were taken from Citibank's on-line data base, updated through November 1983. All data were available starting in 1947, except for capacity utilization, which began in 1948. The model was estimated with six lagged values for each variable for every equation, in addition to five constant terms, yielding 155 estimated parameters.

One change that improved the inflation forecasts was substituting the monetary base for M1. Forecast statistics from the M1 specification are also shown in table II. Thus the form of the model shown in table III was based on some experimentation, namely: (1) the substitution of the monetary base for M1; and (2) the author's prior knowledge that these five variables moved together over recent years. Such experimentation, of course, was not available to the producers of the forecasts to which the VAR forecasts are compared in the text.

Extensions and Improvements

The model as described above is unusually simple. Complications were deliberately avoided in order to make its workings easy to follow. There are several obvious changes which could improve the accuracy of its forecasts, however.

Although the variables were treated symmetrically in each equation, other approaches are possible. For example, restricting the lag lengths when the longest lags contribute little information could allow more accurate estimation of the remaining coefficients and thus more accurate forecasts. This could be accomplished by an ad hoc process, such as removing the last lagged value when the final t-statistic is near zero. Robert Litterman [8, 9] has used a more complicated procedure that allows a forecaster to

Table II

FORECAST ERRORS FROM VAR SIMULATIONS

(Percent)

Variables	Real GNP	GNP Deflator	Commercial Paper Rate
R B C P X	2.32	1.86	3.19
R M C P X	2.47	2.82	3.02

NOTE: Each entry is the root mean squared difference between actual and predicted values. Forecasts are average growth rates over four quarters for real GNP and the deflator, and the level four quarters ahead of the interest rate. Actual values ranged from 1977 Q1 to 1983 Q4.

Table III

A VECTOR AUTOREGRESSIVE MODEL

Each of five equations has the form

$$V_i = k_i + \sum_{l=1}^{6} r_{il}R_{-l} + \sum_{l=1}^{6} m_{il}M_{-l} + \sum_{l=1}^{6} c_{il}C_{-l} + \sum_{l=1}^{6} p_{il}P_{-l} + \sum_{l=1}^{6} x_{il}X_{-l}$$

where

- i is the equation number (1, 2, 3, 4, 5)
- l is the lag number
- k_i, r_{il}, m_{il}, c_{il}, and x_{il} are estimated coefficients
- V_i is the dependent variable
- R is the six-month commercial paper rate
- M is the monetary base (St. Louis), percent change
- C is the capacity utilization rate (Federal Reserve Board)
- P is the GNP implicit price deflator, percent change
- X is real GNP, percent change

introduce prior beliefs concerning the distribution of the coefficients on the lagged terms. He found that such restrictions did improve forecast accuracy in several VAR models.

The model was estimated over the entire period for which quarterly data were readily available. It is likely, however, that the structure of the economy has changed between 1947 and 1983. Thus it is possible that a later starting date would provide more accurate forecasts. An alternative strategy would be to allow the estimated parameters to vary over time, thereby capturing any changes in the economic structure. Litterman [9] has reported positive results from such a procedure.

Therefore, the VAR model discussed above does not attempt to employ many statistical techniques that might improve its predictive accuracy. That it nonetheless forecasts relatively well indicates the robustness of the VAR approach to economic forecasting.

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CORRIGENDUM

The note corrects two errors in the article, "Why Economic Data Should Be Handled with Care: The Case of the Suspiciously Slow Growth Statistic," published in the July/August 1983 issue of this *Review*. In the fourth paragraph, the penultimate sentence should read, "In order to estimate real GNP, the Department's analysts adjust the current dollar figure for inflation by dividing each detailed component of nominal GNP by a specific price deflator." (Also, the word "indices" should replace the word "index" in the next sentence.)

In addition, the fifth sentence in the sixth paragraph should read "Had that index been used to convert nominal GNP into an alternative estimate of real economic activity (an implicit quantity index rather than real GNP) then real growth in the first quarter would have been placed at 5.7 percent rather than 3.1 percent."

The author is indebted to Robert P. Parker of the Bureau of Economic Analysis for pointing out the errors in the original text. Views and opinions expressed in the text are solely those of the author and should not be attributed to any other person or institution.

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THE ECONOMIC OUTLOOK FOR FIFTH DISTRICT STATES IN 1984: FORECASTS FROM VECTOR AUTOREGRESSION MODELS

Anatoli Kuprianov and William Lupoletti

I.

INTRODUCTION

According to the National Bureau of Economic Research, the 1981-1982 economic recession ended in November of 1982. Since then, the United States economy has experienced a rapid recovery, evidenced by reports of strong economic growth and a dramatic decline in the unemployment rate. The strength of the current economic expansion initially surprised most analysts, although there now seems to be a rapidly developing consensus that this expansion will continue through 1984. However, the renewed economic growth apparent in the national economy has not affected all regions of the country equally. This article examines the implications of recent improvements in national economic conditions for the states in the Fifth Federal Reserve District.[1] The results of this analysis suggest that the economic growth experienced by most Fifth District states in 1983 will be sustained through the year ahead.

An outline of this article is as follows. First, the cyclical variation in economic activity experienced by Fifth District states over the past five business cycles is compared with that experienced by the national economy over the same period. This is followed by an examination of forecasts of real personal income and total employment through the end of 1984 for each of the Fifth District states and for the U. S. economy. These forecasts are produced using a purely statistical technique known as vector autoregression. The concluding section of the paper summarizes the results.

[1] The Fifth Federal Reserve District includes the District of Columbia, Maryland, North Carolina, South Carolina, Virginia, and most of West Virginia.

II.

THE RECENT PERFORMANCE OF FIFTH DISTRICT ECONOMIES

Data

In order to examine the past behavior of the economies of the states in the Fifth Federal Reserve District and to forecast future trends, this study focuses on two measures of economic activity: real personal income and total employment.

On the national level, the indicator that is most often used to measure the overall performance of the economy is the gross national product. Gross state product is not commonly measured; the closest available substitute for GNP on the state level is personal income. In order to separate the effects of inflation from those of true economic growth, personal income is divided by a measure of the national price level, the implicit price deflator on personal consumption expenditures, to yield real (inflation-adjusted) personal income.

Another closely watched economic indicator is the unemployment rate. However, consistent quarterly data on unemployment rates for all states in the District are only available starting in 1965. Measures of total employment, on the other hand, begin in 1958. This study concentrates on total employment in order to capitalize on the availability of a larger data set.[2]

[2] Employment data for this study comes from the Bureau of Labor Statistics' survey of business establishments, which does not include farms. Farm employment is not ordinarily very sensitive to changes in business cycle conditions. Therefore, movements in total nonagricultural employment should be similar to those in total employment including farms, and using nonfarm employment as a proxy measure of total employment should not cause much distortion.

In an analysis of regional economies, it is important to know whether the data series being employed are measured by place of work or by place of residence. This distinction is especially crucial for the District of Columbia, where a large portion of the labor force lives outside the city limits. The relevant questions to ask about the performance of the District of Columbia economy are: (1) Is the income of its residents increasing or decreasing, and (2) Is employment within its boundaries increasing or decreasing? Statewide total employment measured by place of work is the only data series available, but personal income is measured both ways. This study employs personal income measured by place of residence.

Data on both personal income and total employment for the states are available in seasonally adjusted form beginning in 1958 on the Chase Econometrics Regional Macro data base. The National Bureau of Economic Research has determined that five complete business cycles, measured trough-to-trough, occurred between the second quarter of 1958 and the fourth quarter of 1982.[3] Although peak-to-peak measures are more common in the analysis of business cycles, adopting a trough-to-trough convention allows a more complete use of the available data in this instance (since only four complete peak-to-peak cycles have occurred since 1958) and leads to the same general conclusions about the performance of the state economies.

Table I summarizes the recent history of economic growth, as measured by personal income and total employment, of Fifth District states over the last quarter century. The table shows that the economic growth experienced by the states of the Fifth District was greater than that of the national economy over this period. Four of the six states in the District had higher rates of growth of income and employment than did the nation. North Carolina, South Carolina, and Virginia grew at least as much as the U. S. over each of the five business cycles. Virginia was the most consistent of all: it outperformed the national economy in every business cycle of the last 25 years. On the other hand, the District of Columbia grew more slowly than the nation in every cycle except the first. The Fifth District's rate of economic growth slowed somewhat during the past decade, though. Since 1975, the District as a whole appears to have lagged slightly behind the nation's rate of expansion.

[3] Business cycle troughs, marking the end of a recession and the beginning of an expansion, occurred in the second quarter of 1958, the first quarter of 1961, the fourth quarter of 1970, the first quarter of 1975, the third quarter of 1980, and the fourth quarter of 1982. Dates of cyclical peaks are 1960Q2, 1969Q4, 1973Q4, 1980Q1, and 1981Q3.

Table I

PERFORMANCE OF FIFTH DISTRICT ECONOMIES OVER THE LAST FIVE BUSINESS CYCLES

			Business Cycles				
		Full Period (58:2-82:4)	1 (58:2-61:1)	2 (61:1-70:4)	3 (70:4-75:1)	4 (75:1-80:3)	5 (80:3-82:4)
US	P.I.	3.7	3.2	4.6	2.7	3.4	2.1
	Emp.	2.2	1.2	2.7	2.0	2.5	−0.7
DC	P.I.	2.0	2.9	2.5	1.3	0.8	1.8
	Emp.	0.9	1.8	1.1	0.6	1.1	−1.4
MD	P.I.	4.3	4.3	6.1	2.9	2.5	2.4
	Emp.	2.7	1.5	4.2	2.1	2.3	−0.9
NC	P.I.	4.4	3.8	5.7	3.4	3.3	2.3
	Emp.	3.1	2.7	4.1	2.0	2.9	−0.9
SC	P.I.	4.8	3.8	6.1	4.5	3.5	2.2
	Emp.	3.1	2.1	3.8	3.1	2.8	−1.1
VA	P.I.	4.7	3.6	6.0	4.4	3.6	3.2
	Emp.	3.2	1.7	4.2	3.4	3.1	−0.5
WV	P.I.	2.8	−0.6	3.9	4.8	3.5	−0.8
	Emp.	0.8	−2.7	1.5	2.3	1.8	−3.5

Note: Data are annualized compound growth rates, expressed as percentages.

Effects of Business Cycles on State Economies

Cyclical recessions and expansions typically do not affect all regions of the nation equally. Examination of table II indicates that the states comprising the Fifth District tend to have diversified economies which depend relatively little on highly cyclical heavy industries. Additionally, the federal government is an important (and relatively stable) employer of residents of the District of Columbia, Maryland, and Virginia. These observations lead to the conjecture that the state economies in the Fifth District should exhibit less cyclically-related variation in growth than the nation as a whole.

This conjecture is tested by examining the degree of cyclical movement exhibited by the personal income and total employment variables for each state. The degree of cyclical movement in a variable is measured by calculating the difference between its growth rate during the cyclical expansion or recession and its growth rate over the whole business cycle. If the absolute value of this difference is greater for a state than for the nation, it can be said that the state variable shows a large degree of cyclical movement relative to the national variable. In other words, the state variable's peak was relatively higher than that of the national variable and its trough was lower.

Table III presents these measures of the relative degree of cyclical movement for Fifth District states over the last five business cycles. The table indicates that in the aggregate the District tends to have lower peaks and higher troughs than the United States. The growth paths of Fifth District states have been especially smooth over the two most recent business cycles. In looking at state patterns of cyclical movement, it appears that North and South Carolina share patterns. Both were smoother in the second cycle, more cyclical in the third cycle, and about the same as the nation in the others.[4] Significantly, table II shows that the economies of the Carolinas have a certain similarity: both have relatively small services sectors and a relatively large number of people employed in light manufacturing. The textile industry is important in both states; in October of 1983 it accounted for 13.3 percent of all nonagricultural employment in North Carolina and 13.4 percent of nonagricultural employment in South Carolina.

[4] The similarity in the patterns of cyclical growth shown by North and South Carolina is less evident when business cycles are measured on a peak-to-peak basis, however.

Table II

DISTRIBUTION OF NONAGRICULTURAL EMPLOYMENT IN SELECTED INDUSTRIES

		Manufacturing				
		Durables	Nondurables	Total	Services	Federal Government
US	Oct. 83	12.3	8.6	20.9	21.8	3.0
	Jan. 80	14.0	9.1	23.1	19.3	3.1
DC	Oct. 83	N.A.	N.A.	2.3	32.2	35.8
	Jan. 80	N.A.	N.A.	2.5	28.8	37.3
MD	Oct. 83	6.6	5.7	12.3	23.8	7.7
	Jan. 80	8.2	6.3	14.5	20.3	7.9
NC	Oct. 83	12.6	20.7	33.3	15.5	2.1
	Jan. 80	13.1	21.9	35.0	14.0	2.0
SC	Oct. 83	9.4	21.1	30.5	15.0	3.2
	Jan. 80	10.5	23.4	33.9	12.8	3.1
VA	Oct. 83	8.7	10.2	18.9	20.0	7.4
	Jan. 80	9.1	10.6	19.7	18.3	7.3
WV	Oct. 83	8.4	7.2	15.6	17.4	2.6
	Jan. 80	11.4	7.6	19.0	14.8	2.5

Notes:

Data are percentages of total nonagricultural workers employed in each sector.

Data come from the Bureau of Labor Statistics' establishment survey.

Table III

RELATIVE DEGREE OF CYCLICAL MOVEMENT IN FIFTH DISTRICT STATES

	Business Cycles				
	1 (58:2-61:1)	2 (61:1-70:4)	3 (70:4-75:1)	4 (75:1-80:3)	5 (80:3-82:4)
DC	L	L	L	L	L
MD	L	M	L	L	L
NC	A	L	M	A	A
SC	A	L	M	A	A
VA	L	M	A	L	L
WV	M	Z	L	M	Z

Notes:

Degree of cyclical movement is measured as the rate of growth of the variable during the business cycle expansion minus its rate of growth during the whole business cycle, and as the rate of growth over the whole cycle minus the rate of growth during the cyclical recession.

Relative degree of cyclical movement is the comparison between the degree of cyclical movement of the state variable and that of the U. S. variable.

M means the state showed more cyclical movement than did the U. S.; in other words, the state variable had a higher peak and a lower trough than did the U. S. variable.

L means the state showed less cyclical movement than did the U. S.; in other words, the state variable moved along a smoother path than did the U. S. variable.

A means the state and national experiences were similar.

Z means the data are ambiguous and cannot be clearly interpreted.

Real personal income and total employment are the variables used.

The District of Columbia's pattern is remarkably consistent: in every business cycle its economy has moved on a significantly smoother path than has the economy of the United States. To put it another way, the District of Columbia has grown at a rate very close to its trend during all phases of the last five business cycles. This is hardly surprising, since the federal government employs more than one out of every three workers in the nation's capital, making it the city's largest employer. Over the postwar period, the federal government has grown at a steady rate regardless of the phase of the business cycle. Evidently the steady growth of government has swamped any cyclical behavior in the District of Columbia, making the growth path of its economy a remarkably smooth one. The paths of Maryland and Virginia, the two other Fifth District states in which the federal government is a major employer, have also been less cyclical than the nation as a whole. Both Maryland and Virginia are also characterized by relatively large service industries and relatively small amounts of heavy industry.

West Virginia's economy has exhibited patterns of growth which are quite different from those of the other states in the District. The economy of West Virginia is strongly influenced by the coal-mining industry: at the business cycle peak in January of 1980, 10.4 percent of all workers in West Virginia were employed in the mining industry. As a result, factors affecting this industry can overwhelm the effects of changes in national economic conditions. For example, United Mine Workers' strikes are apparently responsible for the severe oscillations evident in the West Virginia personal income and total employment series pictured in chart 1.[5]

The 1973-1975 recession also illustrates the importance of the coal industry to West Virginia's economy. The onset of the recession coincided with the so-called "energy crisis," when the price of oil in the United States increased dramatically. Increases in the price of oil drove up the demand for coal; as a result, while the U. S. economy experienced a severe recession, West Virginia prospered. During the 1973-1975 national recession, West Virginia personal income grew at a 4.4 percent annual rate, similar to the growth rates in each of the two expansions surrounding the recession (4.8 and 4.2 percent, respectively).

More recently, economic conditions in West Virginia appear to have deteriorated greatly. Economic growth was brought to a halt in the 1980 recession, and the state's economy seems not to have fully recovered since that time. The mining industry has been especially hard hit in the eighties: the number of people employed in West Virginia's mining industry fell 23 percent from January 1980 to October 1983, from 66,400 to 50,900. It would appear once again that conditions in the coal industry are a crucial factor affecting economic growth in West Virginia.

Timing of Peaks and Troughs

The preceding analysis has assumed that turning points of the state personal income and employment series coincide with national business cycle turning

[5] When the UMW struck in the second quarter of 1981, West Virginia's personal income fell 21.8 percent and total employment dropped 23.7 percent; when the union returned to work in the following quarter, income rose 36.4 percent and employment gained 30.3 percent. Similar movements in the income and employment series occurred at the times of the UMW strikes of 1978Q1 and 1971Q4.

points. This assumption is consistent with the U. S. Commerce Department's classification of national personal income and nonagricultural employment as coincident indicators of the business cycle. Nevertheless, it is possible that movements in measures of a particular state's economic activity could precede or lag movements in the corresponding national variable.

The timing relationships between state and national variables were examined using a statistical technique known as a Granger-causality test.[6] In a Granger-causality test, one observes whether the past history of a variable X can help to predict the current outcome of another variable Y, given the past history of Y. If past X helps to predict current Y, X is said to Granger-cause Y. Care must be taken in interpreting the results of such tests; the term "causality test" used in this context is somewhat misleading, although it is standard nomenclature. Finding that a variable X Granger-causes Y is neither necessary nor sufficient evidence to support the conclusion that observed changes in Y are a direct result of changes in past X. For example, it may be that both X and Y have a common cause, but the effects of changes in this underlying cause become apparent in movements in the variable X before changes in Y are observed.

It is also possible that changes in the currently observed value of X help to predict the current realization of the variable Y, given Y's past history. In this case, X is said to Granger-cause Y instantaneously. Once again, it may be the case that currently observed changes in both X and Y, while being highly correlated, are the result of a third variable driving both of the others. In the context of the present analysis, it is not unreasonable to suppose that observed changes in state personal income and employment occurring over a business cycle are a result of many of the same factors which also affect the corresponding national macroeconomic variables. Nevertheless, changes in overall economic conditions may become apparent in certain regions either before or after changes in national economic conditions become noticeable. In the present analysis, Granger-causality tests were employed in an effort to uncover evidence on the timing of cyclical peaks and troughs for Fifth District states.

None of the states in this group was found to systematically lead or lag the nation in both measures of economic activity considered here, namely personal income and nonagricultural employment. The tests suggest that changes in North Carolina and South Carolina personal income tend to lag changes in U. S. personal income over the 25-year period. Maryland nonagricultural employment appears to lag changes in national nonagricultural employment, while changes in Virginia employment appear to lead national changes. The remaining tests found evidence of strong contemporaneous relationships between state variables and their national counterparts. Overall, the results are not inconsistent with the hypothesis that the economies of the Fifth District states reach cyclical peaks and troughs roughly coincidental with those of the national business cycle.

III.

FORECASTS OF FIFTH DISTRICT ECONOMIC CONDITIONS

Regional Forecasting Models

The forecasts presented in table IV were prepared using vector autoregression (VAR) models. Application of VAR models to economic forecasting problems is a relatively recent development.[7] Unlike the more familiar structural econometric models employed by commercial forecasters and government agencies (which are purportedly based on economic theory), VAR models represent a purely statistical approach to forecasting applications.

Structural models attempt to reproduce the workings of an economic system with a set of simultaneous equations. Each of these equations attempts to incorporate some theoretically predicted aspect of economic behavior. In contrast, restrictions on the relationships among different economic variables that are suggested by various theories are typically ignored in the VAR models. A forecast of a given variable obtained using a VAR model is based solely on the observed history of that variable and the history of a number of other related variables.

As a practical matter, movements exhibited by economic time series tend to be highly correlated. Since VAR forecasts rely solely on the correlations existing among different variables, this approach seems well-suited for economic forecasting applications. Moreover, because VAR models ignore the complicated interrelationships among all the variables of an economic system predicted by theory, they require much less time, effort, and attendant cost to

[6] The statistical theory underlying this technique is described in Granger (1969, 1980).

[7] Application of the VAR model for forecasting economic time series was largely popularized by Sims (1980). Anderson (1979) applied the VAR model to regional forecasting problems.

implement and are especially useful when the forecasting problem at hand is concerned with a very small number of variables. Structural models, if well-specified, are more efficient for large-scale forecasting applications. The cost of implementing such models, however, may be quite high.[8]

VAR models have one noteworthy limitation. Because they embody no economic theory, such models are not appropriate for the analysis of the effects of changes in economic policy. Lucas (1976) and Sargent (1981) have argued forcefully that a careful analysis of the effects of changes in economic policy (e.g., a significant change in tax rates or a choice of a new operating target for monetary policy) must take into account the effects of this policy change on the behavior of individuals. They argue that changes in economic policy may be expected to alter the observed behavior of individuals in the market because different policies change the economic environment, or set of incentives, faced by these decision makers. Failure to account for such effects can result in erroneous policy conclusions. McCallum (1982), among others, has criticized the use of VAR models for policy evaluation precisely on the grounds that such models are subject to Lucas' criticism. As a consequence, the forecasting performance of VAR models may be expected to deteriorate in periods when significant policy changes occur.

However, existing structural econometric models have similar limitations. While such models attempt to capture important aspects of economic behavior, it has been argued they have not been entirely successful in attaining this goal; Lucas' policy evaluation critique was initially directed at the methodology underlying structural models existing at that time. Despite the subsequent widespread acceptance of Lucas' arguments, the methodology employed by most forecasters has not really changed. As Sims (1980) has noted, much of the "theory" underlying existing large-scale econometric models is largely ad hoc; that is, restrictions imposed on the models are likely to reflect analytically convenient assumptions or empirical regularities apparent in existing data samples rather than being a result of predictions based on a coherent theory of economic behavior. As a consequence, the forecasting performance of such models is likely to be subject to many of the same limitations stated above in connection with VAR models. Forecasts obtained using VAR models would therefore appear to offer a viable low-cost alternative technique for regional forecasting problems.

A separate five-variable VAR model was constructed for each of the states in the Fifth District. Each VAR model uses two statewide and three national variables.[9] The state variables are total nonagricultural employment and real personal income. The three national variables common to all the models are the six-month commercial paper rate, the index of industrial production, and the M1 measure of the money supply. All variables except the commercial paper rate were expressed in the form of percentage changes from the previous quarter. The models were estimated using data for the time period 1958Q1 through 1983Q2, which was the longest sample period available at the time of this writing. To facilitate the evaluation of the state forecasts, national real personal income and nonagricultural employment forecasts obtained from a national five-variable VAR model were also included.

Following the example of Anderson (1979), the state variables were excluded from the equations used to forecast each of the three national variables. This restriction reflects the prior belief that the state variables would not be useful in forecasting the national variables, given that lags of each of the latter were present in each of the forecasting equations. The VAR model used to forecast national personal income and employment incorporated no such restrictions, however.

Survey of the Forecasts

Table IV and chart 1 summarize the forecasts produced using the VAR models described above. Since the regional data were available only through the end of the second quarter of 1983 at the time the forecasts were prepared, forecasts for the last two quarters of 1983 were included. (Data on all national variables were available through the third quarter of 1983). These forecasts were obtained as a by-product of producing the 1984 forecasts.

The VAR forecast for U. S. real personal income growth for all of 1983 is 4.2 percent. Total U. S. nonagricultural employment was forecast to grow at a 2.8 percent annual rate for all of 1983. For 1984 the forecasts suggest that a slightly different pattern of growth will evolve—growth in real personal income is forecast to fall somewhat from its 1983 rate, to 3.2 percent (still a healthy increase); growth in total

[8] See Anderson (1979) for a comparison of the relative costs of these two forecasting methods.

[9] The West Virginia model included dummy variables to capture the effects of strikes by the United Mine Workers.

Chart 1

ACTUAL AND PREDICTED ECONOMIC GROWTH FOR FIFTH DISTRICT STATES

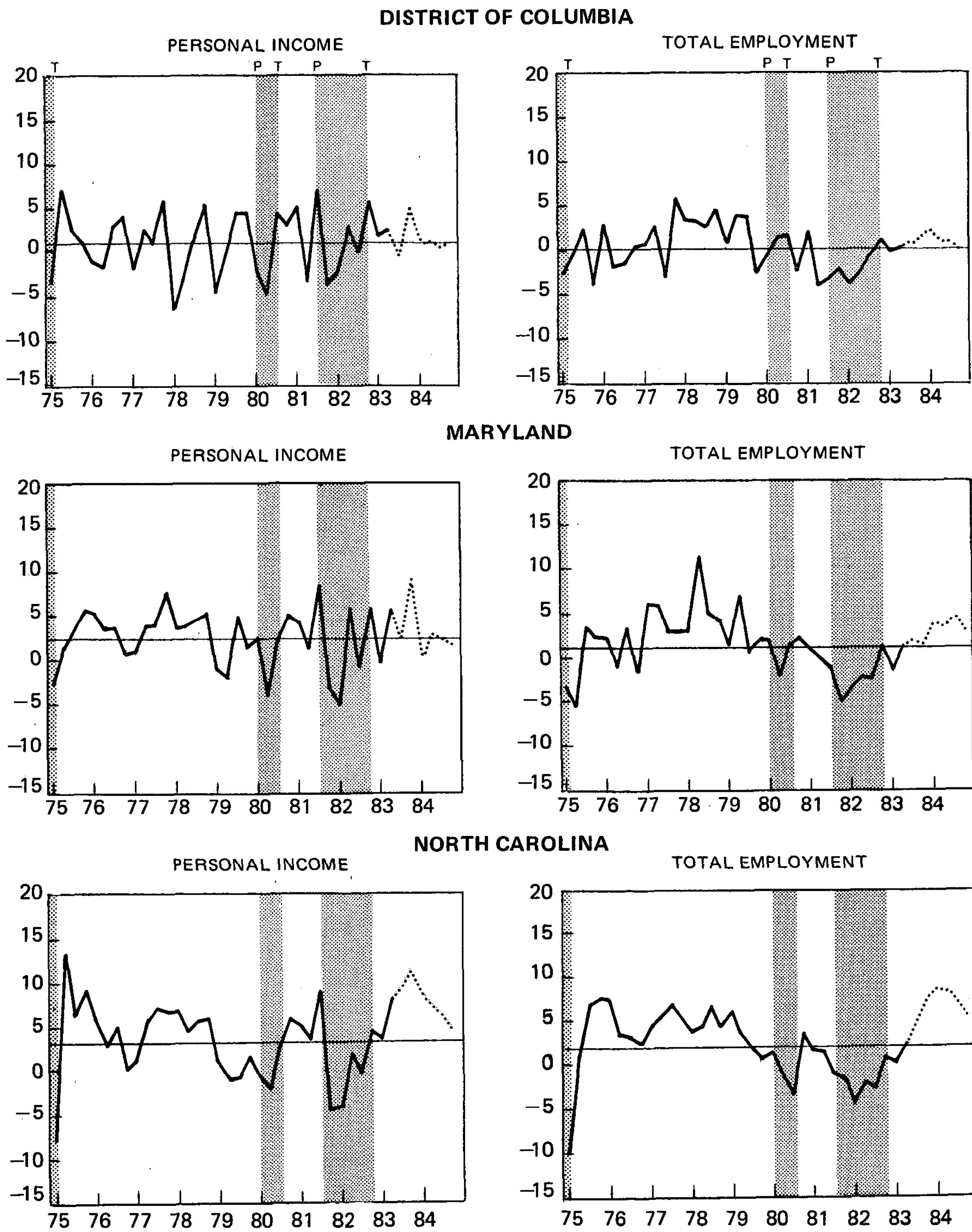
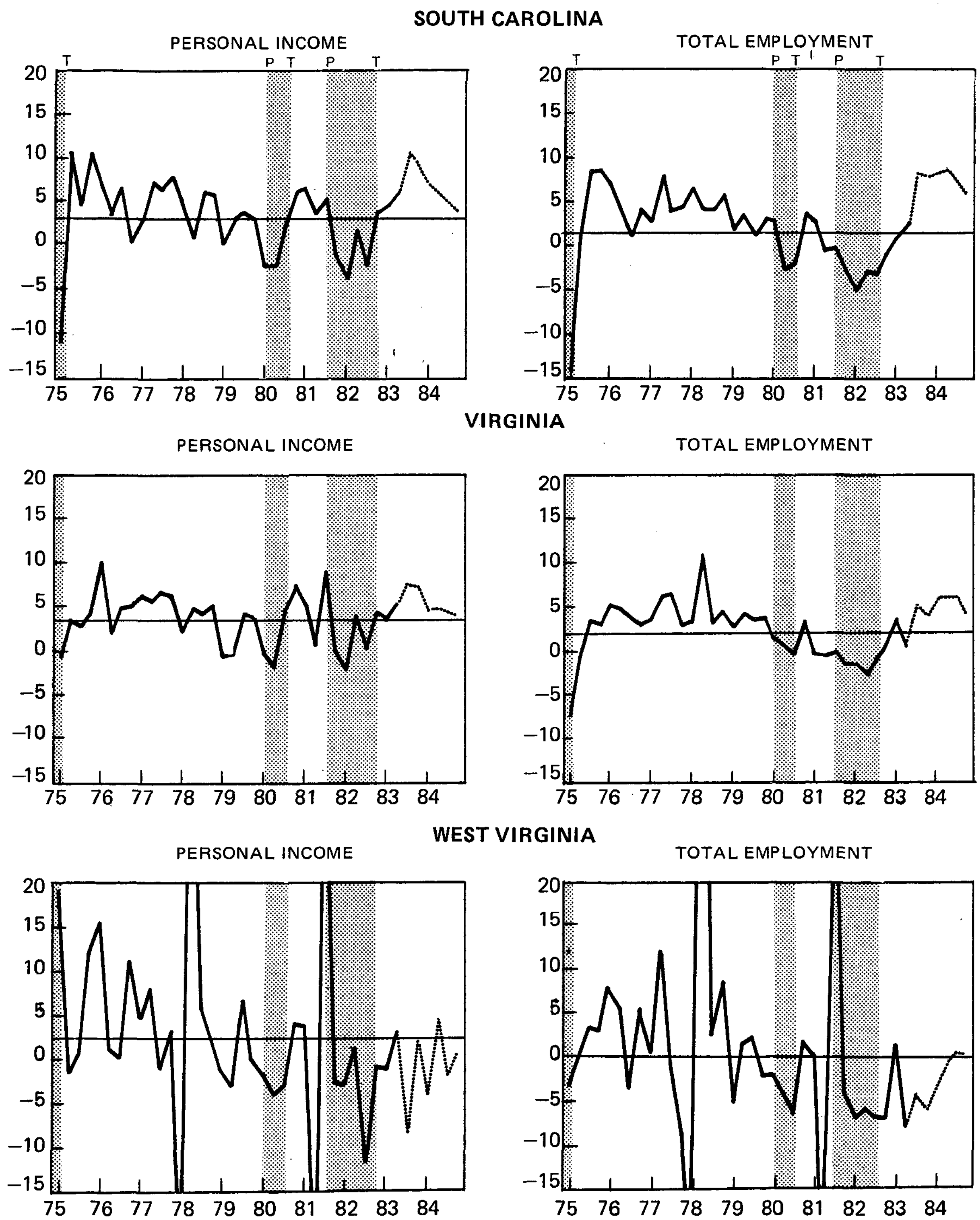


Chart 1 (con't.)



Notes: Data are quarter-to-quarter annualized compound growth rates, expressed as percentages. Solid lines represent actual values from 1975 Q1 to 1983 Q2. Dotted lines represent forecast values from 1983 Q3 to 1984 Q4. Horizontal lines show the trend rate of growth from 1975 Q1 to 1983 Q2. Shadings mark peaks and troughs of national business cycle. Tic marks correspond to first quarter of each year.

Table IV

FIFTH DISTRICT PERSONAL INCOME AND TOTAL EMPLOYMENT FORECASTS FROM VAR MODELS

		1982 Total (actual)	1983 Total (forecast)	1984 Total (forecast)
US	P.I.	−0.3	4.2	3.2
	Emp.	−2.5	2.8	4.2
DC	P.I.	1.6	2.3	0.9
	Emp.	−1.5	0.6	1.0
MD	P.I.	1.4	4.3	1.6
	Emp.	−1.8	0.8	3.8
NC	P.I.	0.4	8.0	6.2
	Emp.	−2.2	3.5	7.2
SC	P.I.	−0.1	7.4	5.3
	Emp.	−2.9	5.0	7.6
VA	P.I.	1.6	6.1	4.4
	Emp.	−1.3	3.2	5.4
WV	P.I.	−3.9	−1.4	−0.5
	Emp.	−6.4	−4.0	−0.7

Notes:

Data are annualized compound growth rates, expressed as percentages.

1983 total is based on forecasts for the last two quarters of the year.

1983 total for US is based on a forecast for the last quarter only.

nonagricultural employment, on the other hand, is expected to rise to 4.2 percent. An increase in nonagricultural employment of this magnitude would be consistent with an unemployment rate of under 7 percent by the end of 1984.[10] This is well below the consensus of other publicized forecasts, and would probably be regarded by most analysts as an overly optimistic prediction. It is probably reasonable to expect a slightly lower growth rate of employment to be realized in the year ahead.

According to the VAR forecasts, four of the six states in the Fifth District will experience growth in real personal income which is roughly equal to (Maryland) or is greater than (North Carolina, South Carolina, and Virginia) the rate of growth forecast for the United States as a whole. The latter three states are also forecast to experience a higher rate of growth in total employment than will the national economy; however, Maryland total employment growth will be less than that of the United States. Both the District of Columbia and West Virginia are forecast to continue to grow more slowly than the national economy in 1983.

For 1984 the forecasts indicate that each of the states in the Fifth District, with the exception of West Virginia, will experience a lower growth rate of personal income and higher growth in total employment than in 1983. Notice that this is similar to the pattern of growth predicted for the United States as a whole over the 1983-1984 period. The VAR forecasts suggest that three of the states in the District (North Carolina, South Carolina, and Virginia) will again experience faster growth than the national economy in the coming year. The forecasts for the District of Columbia and Maryland predict continuing positive growth for 1984, but at a rate lower than that expected for the U. S. economy. Finally, the forecasts suggest the economy of West Virginia will continue to lag in the current economic recovery. The growth rate of West Virginia real personal income will average —0.5 percent in 1984; it also appears that total employment will decline further in the coming year (note, however, that the attached charts show a predicted gradual improvement throughout the year).

In summary, the VAR forecasts predict continuing economic improvement for the United States and for Fifth District states. The performance of the District of Columbia, Maryland, and West Virginia economies will be modest but greatly improved over 1982. Unusually strong growth is predicted for North Carolina, South Carolina, and Virginia through 1984. However, the forecasts for employment growth, both for the nation as a whole and for the individual states, may prove to be overly optimistic.

Evaluation of Model Performance

One criterion commonly used to evaluate the performance of forecasting models is the analysis of out-of-sample forecast errors. Out-of-sample forecasts for the period 1980Q1 through 1983Q2 were produced for all seven VAR models. The resulting values of the average root mean square errors (RMSE) for each VAR model are listed in table V. Forecast

[10] The total employment forecast can be combined with guesses about the growth of the labor force to produce estimates of the unemployment rate in 1984. If the labor force grows by 0.9 percent, as it did in 1983 (measured November over November), the resulting unemployment rate in November of 1984 would be 5.4 percent. If the labor force grows 2.5 percent, a rate that would make its 1983-1984 growth equal to the average growth rate experienced in the first two years of the last five recoveries, then the unemployment rate would be 6.8 percent. These two estimates can be considered the upper and lower bounds of unemployment rates consistent with 4.2 percent growth in total employment over 1984.

errors for forecasting horizons of two through six periods ahead were calculated as the difference between the average realized growth rate over the forecast horizon and the average growth rate forecast for the same period. The general pattern noticeable in the results contained in table V is that the average RMSE becomes smaller as the forecast horizon ranges between one to four, five, or six quarters. It would appear that the quarterly forecast errors largely offset each other for forecast horizons in the neighborhood of one year ahead. This pattern would presumably not continue for arbitrarily large forecast horizons—past some horizon (which appears to be in the range of five to six quarters for these VAR models), one would expect to observe successively larger average forecast errors.

Average forecast errors for these models are rather large for the 1980-1983 period. For example, the average RMSE for the two-period ahead forecast for District of Columbia personal income is about 5.6 percentage points. This compares with an average growth rate of 2.0 percent for this variable over the 1958-1982 sample period. The first impression one gets from looking at these results is that the forecasts are not very precise. However, this particular time period was a turbulent one for the U. S. economy. For instance, the United States experienced two separate recessions during this brief time. In addition the period was characterized by important changes in tax laws, the imposition of credit controls in 1980, unusually large fluctuations in money growth, and rapid regulatory decontrol of the banking system.

The earlier discussion of the limitations of VAR models noted that these models may be expected to produce poor forecasts in periods when major changes in economic policy occur. Most of the major policy changes that occurred during this time were enacted in 1980 and 1981. Since that time money growth has become slightly more predictable and no other major policy initiatives have been introduced (although two scheduled tax cuts have gone into effect). Moreover, it appears that no significant new policy initiatives will be forthcoming in 1984. Hence, there is reason to believe that an analysis of average forecast errors over the more recent 1982-1983 period might be more relevant for drawing inferences about the expected errors associated with the 1984 forecasts.

Table V

ERRORS FROM VAR FORECASTS MADE IN THE 1980s

		Forecast Horizon (Number of Quarters Ahead)					
		1	2	3	4	5	6
US	P.I.	5.3	4.5	3.6	3.0	2.6	2.6
	Emp.	2.5	2.4	2.1	1.9	1.6	1.5
DC	P.I.	10.3	5.6	2.9	2.0	1.5	2.1
	Emp.	4.2	2.9	2.9	3.1	3.3	3.1
MD	P.I.	6.7	4.5	3.5	3.1	3.1	2.8
	Emp.	3.6	2.7	2.1	1.6	1.4	1.0
NC	P.I.	7.1	5.4	4.1	3.2	3.0	3.0
	Emp.	2.3	1.8	1.7	1.6	1.6	1.7
SC	P.I.	7.1	4.9	3.9	3.1	2.4	2.1
	Emp.	4.2	3.5	3.1	2.7	2.3	2.2
VA	P.I.	4.5	2.9	2.2	2.0	1.5	1.4
	Emp.	4.0	2.0	1.2	1.4	1.6	1.8
WV	P.I.	9.8	7.0	5.7	4.9	4.6	4.5
	Emp.	6.6	2.7	2.7	2.7	2.7	3.5

Notes:

Sample includes forecasts made with data ending in 1979:4 through forecasts made with data ending in 1983:2.

Errors are root mean square errors, expressed as percentage points.

Table VI shows that the VAR models produce much more accurate out-of-sample forecasts on average over the post-1981 period. This improvement is especially noticeable for the shorter term forecasts and for forecasts of the personal income variable at all horizons. It should be kept in mind that the post-1981 period, while less volatile than the previous two years, was a period in which the U. S. economy experienced a cyclical trough, and business cycle turning points are typically difficult to forecast. The performance of these forecasting models over this period is encouraging. In view of the average errors reported in table VI, the VAR forecasts should prove to be reasonably accurate and therefore useful in assessing regional business conditions for the year ahead.

IV.
SUMMARY AND CONCLUSIONS

This paper has presented a brief statistical history of the patterns of economic growth experienced by Fifth District states over the past 25 years, and vector autoregression forecasts of real personal income and total nonagricultural employment for both the United States economy and Fifth District states for 1984. Comparing the forecasts with evidence available from the last five business cycle expansions, it appears that the U. S. economy will continue to experience a normal recovery from recession in the year ahead. Growth in U. S. real personal income is projected to average 3.7 percent per year over 1983 and 1984; this is slightly below the average rate of growth for this variable in the last five cyclical expansions. Total U. S. nonagricultural employment is forecast to grow at a 3.5 percent annual rate over the 1983-1984 period; this is a full percentage point above the average growth rate over the last five expansions for this variable. An examination of unemployment rates consistent with the VAR forecast for total employment growth in 1984 suggests that this forecast might be expected to err on the high side.

The VAR forecasts point to a strong improvement in total employment throughout the Fifth District. Five of the six states in the District are predicted to experience employment growth over the 1983-1984 period at rates that are at least equal to their average growth rates over the last five business cycle recoveries. The outlook is especially favorable for North Carolina, South Carolina, and Virginia. These three states are forecast to experience growth rates of both personal income and total employment that are

Table VI

ERRORS FROM THE LAST SIX VAR FORECASTS

		Forecast Horizon (Number of Quarters Ahead)					
		1	2	3	4	5	6
US	P.I.	2.7	3.1	2.1	1.7	1.6	1.8
	Emp.	1.4	1.9	1.6	1.6	1.0	0.8
DC	P.I.	5.8	3.9	2.0	1.1	1.4	2.0
	Emp.	2.9	2.8	3.0	3.4	3.5	3.2
MD	P.I.	3.3	2.3	1.7	1.5	2.5	2.4
	Emp.	2.3	2.7	2.4	1.8	1.4	1.0
NC	P.I.	3.3	2.1	1.7	1.6	1.9	2.0
	Emp.	2.6	1.7	1.2	1.3	0.9	1.7
SC	P.I.	2.6	3.0	1.7	1.3	1.9	1.5
	Emp.	3.3	4.4	3.4	3.3	2.7	2.6
VA	P.I.	2.2	1.2	1.2	1.3	1.5	1.3
	Emp.	3.4	1.6	1.1	1.4	1.7	2.0
WV	P.I.	7.0	6.6	6.1	4.9	3.8	2.9
	Emp.	7.4	2.7	2.8	2.8	2.2	3.3

Notes:

Sample includes all forecasts made of 1982:1, 1982:2, 1982:3, 1982:4, 1983:1, and 1983:2.

Errors are root mean square errors, expressed as percentage points.

greater than the growth rates expected for the nation as a whole. The predicted rates of cyclical expansion for these states are well above their historical averages. In fact, if the forecasts prove to be correct, the expansion in North Carolina will be the strongest in the last 25 years and both South Carolina and Virginia will turn in their best economic performances in over a decade.

Both the District of Columbia and Maryland should experience continued economic growth, although neither is forecast to do as well as the nation as a whole. The predicted growth rates of personal income for these states are slightly lower than those observed in past recoveries, while employment growth is expected to be about average. The rate of growth of total employment in Maryland should show substantial improvement during the year ahead: 1983 total employment growth will only be 0.8 percent, but the VAR forecast calls for a healthy 3.8 percent rate of growth in 1984. As has been the case in the past, the economy of the District of Columbia should continue to experience slow and steady growth in the year ahead.

Real personal income in West Virginia is predicted to decline at an average annual rate of 0.5 percent in 1984, and total employment is expected to decline an average 0.7 percent over the year. If these forecasts are correct, they will represent a great improvement for the West Virginia economy over the recent past; additionally, the quarter-by-quarter forecasts pictured in chart 1 point to a gradual improvement over the course of the year.

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FORECASTS 1984

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The views and opinions in this article are those of the various forecasters, and should not be attributed to this Bank or to the Federal Reserve System.

Above-average real growth and moderate inflation are predicted for 1984 by economic forecasters, according to a survey of forecasts collected for this Bank's *Business Forecasts 1984*. Summaries of the forecasts are presented in tables I and II.

The forecasts this year show a remarkable degree of optimism and unanimity. Real gross national product (GNP) is expected to grow by 4.3 percent in 1984, as shown in table I. That rate of growth would be above the postwar trend rate, 3.4 percent,

Table I

MEDIAN QUARTERLY CHANGES FORECAST FOR 1984

Percentage Changes at Annual Rates Unless Otherwise Noted

	4Q 82-4Q 83	Forecast 1984* I	II	III	IV	4Q 83-4Q 84
Gross national product	10.4	9.5	9.2	9.7	9.6	9.5
Personal consumption expenditures	9.1	8.4	8.1	8.6	8.1	8.3
Durables	17.1	11.3	9.2	10.8	9.7	10.3
Nondurables	6.8	7.4	7.3	7.6	7.4	7.4
Services	8.8	8.3	8.6	8.5	8.6	8.5
Gross private domestic investment	40.4	9.2	12.3	16.4	15.7	13.4
Fixed investment:						
Nonresidential	10.2	11.7	11.0	12.0	11.8	11.6
Residential	45.5	5.8	8.0	14.0	10.7	9.6
Change in business inventories[a]	17.7[c]	19.8	21.6	28.0	33.6	
Net exports[a]	−32.6[c]	−24.8	−25.0	−25.5	−25.0	
Government purchases	3.2	12.0	9.4	9.3	11.1	10.4
Federal	−1.3	18.7	12.0	10.7	14.1	13.8
State and local	6.4	7.8	7.7	8.2	8.2	8.0
Gross national product (1972 dollars)	6.1	4.5	4.1	4.4	4.0	4.3
Corporate profits after taxes		12.9	13.8	14.8	16.6	14.5
Private housing starts	34.1	4.9	8.5	11.6	−4.0	5.1
Domestic automobile sales	20.9	11.3	16.4	5.3	6.8	9.9
Rate of unemployment[b]	8.4[c]	8.3	8.1	7.9	7.8	
Industrial production index	15.3	7.0	5.2	5.3	5.1	5.7
Consumer price index	3.3	4.8	4.9	5.4	5.5	5.2
Producer price index	1.9	5.2	5.4	5.0	5.5	5.3
GNP implicit price deflator	4.1	4.7	4.7	4.8	5.5	4.9

* Median quarterly percentage change forecast for each quarter for each category, incorporating 27 forecasts.

[a] Quarterly levels, billions of dollars at annual rates.

[b] Quarterly levels, percent.

[c] Level, 4Q 1983.

and would indicate generally rising incomes, production, and employment. The projected growth in expenditure shown in table I is not confined to any one sector: consumer spending is projected to rise by 8.3 percent, business fixed investment by 11.6 percent, residential investment by 9.6 percent, and government spending by 10.4 percent.

Only moderate increases in inflation are expected in 1984. Consumer prices are expected to rise by 5.2 percent, and producer prices by 5.3 percent. These rates, although significantly higher than in 1983, would nevertheless remain well below the high rates experienced in the late seventies.

In short, while the economy is not expected to repeat precisely its extraordinary performance of 1983, a better than average year is expected. Before placing too much confidence in that exact scenario, however, it is useful to examine the record of forecast accuracy. As table III indicates, economic activity in recent years has not been predicted very well.

For example, consider the projection for real economic conditions during 1983. Although most forecasters expected a moderate recovery from the recession that began in mid-1981, economic activity in fact advanced at an extremely rapid pace. Industrial production rose 15.3 percent, more than twice the 7.2 percent forecast. The rate of unemployment averaged 8.4 percent in the fourth quarter, well below the predicted value of 9.7 percent. And real GNP growth was 6.1 percent, as opposed to 3.9 percent forecast.

Forecasters also erred the previous year by predicting moderate real growth for 1982 (that is, a 2.8 percent increase in real GNP). Actually, real GNP

Table II

MEDIAN ANNUAL AVERAGES FORECAST FOR 1984

	Base Unit or	Preliminary 1983*	Forecast 1984**	Percentage Change: Preliminary 1983/1982	Percentage Change: Forecast 1984/1983
Gross national product	$ billions	3,309.5	3,644.1	7.7	10.1
Personal consumption expenditures	$ billions	2,158.6	2,352.3	8.4	9.0
Durables	$ billions	178.6	315.1	13.9	13.1
Nondurables	$ billions	804.3	869.0	5.7	8.0
Services	$ billions	1,075.7	1,168.2	9.1	8.6
Gross private domestic investment	$ billions	471.3	562.7	13.7	19.4
Fixed investment:					
Nonresidential	$ billions	347.7	388.7	−0.2	11.8
Residential	$ billions	130.5	150.1	43.9	15.0
Change in business inventories	$ billions	−6.9	24.1	—	—
Net Exports	$ billions	−10.6	−25.4	—	—
Government purchases	$ billions	690.2	754.5	6.3	9.3
Federal	$ billions	275.2	304.6	6.4	10.7
State and local	$ billions	415.0	449.9	6.3	8.4
Gross national product (1972 dollars)	$ billions	1,534.8	1,614.6	3.3	5.2
Private housing starts	thousands	1,703.0	1,723.0	60.4	1.2
Domestic automobile sales	millions	6.8	7.7	17.2	13.2
Rate of unemployment	percent	9.6	8.1	—	—
Industrial production index	1967=100	147.7	161.7	6.6	9.5
Consumer price index	1967=100	298.4	313.0	3.2	4.9
Producer price index	1967=100	285.2	298.0	1.6	4.5
GNP implicit price deflator	1972=100	215.6	225.7	4.2	4.7

* Data available as of January 1984.

** These data are constructed using preliminary 1983 data and the median annual percentage change forecast for each category, incorporating 42 forecasts.

fell by 1.7 percent. Also, forecasters missed the dramatic fall in inflation in 1982. Whereas producer prices only rose 1.5 percent and consumer prices rose 4.5 percent, predicted values were 7.7 percent and 7.4 percent, respectively.

Thus while it may be encouraging to note that most forecasters expect economic expansion in 1984 without a dramatic increase in inflation, it would not be surprising if actual outcomes were to differ from their predictions. Forecasts are based on historical economic data that contain only a limited amount of information about future economic conditions. Even that limited information can be rendered irrelevant by political shifts and other factors that are difficult to predict. Therefore, rather than placing complete confidence in an economic forecast, readers should treat it as useful but imperfect information. Like french fries, popcorn, or Margaritas, economic forecasts are best when taken with several grains of salt.

Table III

THE RECORD OF MEDIAN FORECASTS

	Real GNP (Percent Change)			Inflation Rate (GNP Deflator)			Treasury Bill Rate		
	Actual	Predicted	Error	Actual	Predicted	Error	Actual	Predicted	Error
1971	4.7	3.8	0.9	4.7	3.6	1.1			
1972	7.0	5.6	1.4	4.3	3.2	1.1			
1973	4.3	6.0	1.7	7.0	3.3	3.7			
1974	−2.7	1.2	3.9	10.1	5.5	4.6	7.3	6.0	1.3
1975	2.2	−0.6	2.8	7.7	7.1	0.6	5.7	7.1	1.4
1976	4.4	6.0	1.6	4.7	5.4	0.7	4.7	7.1	2.4
1977	5.8	5.0	0.8	6.1	5.7	0.4	6.1	5.8	0.3
1978	5.3	4.2	1.1	8.5	5.9	2.6	8.7	6.5	2.2
1979	1.7	1.5	0.2	8.1	7.1	1.0	11.8	8.1	3.7
1980	−0.3	−0.8	0.5	9.8	8.2	1.6	13.7	8.6	5.1
1981	0.9	2.4	1.5	8.9	9.1	0.2	11.8	10.8	1.0
1982	−1.7	2.8	4.5	4.4	7.1	2.7	8.0	11.2	3.2
1983 (preliminary)	6.1	3.9	2.2	4.1	5.4	1.3	8.8	8.1	0.7
Average error			1.8			1.7			2.1

Note: Predictions are from **Business Forecasts**, published annually by the Federal Reserve Bank of Richmond. The error is the absolute value of the difference between predicted and actual values. Real growth and inflation are from the fourth quarter of the previous year to the fourth quarter of the stated year. *The Treasury bill rate is the average value of three-month bills in the fourth quarter.*