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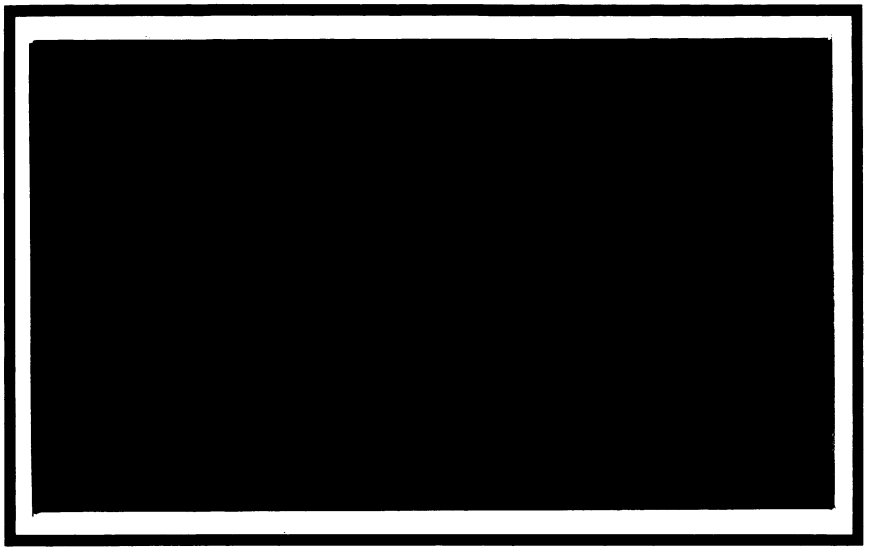

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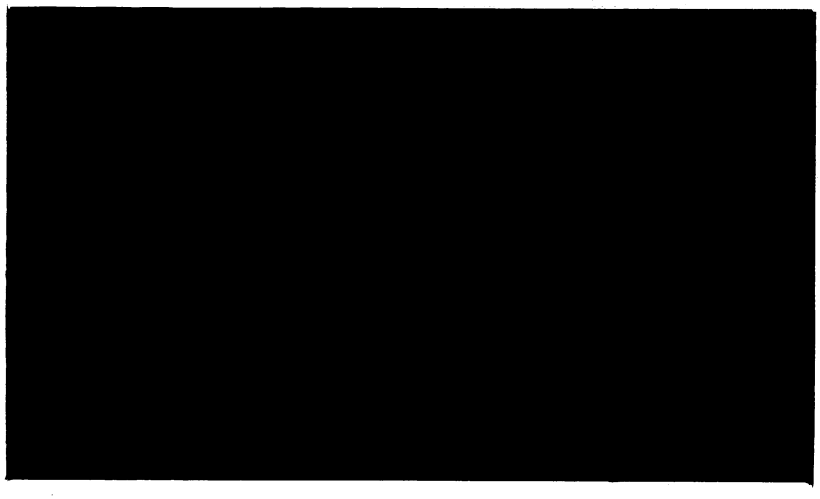

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PERSPECTIVES ON THE ACCURACY OF MACRO-ECONOMETRIC FORECASTING MODELS

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I. Introduction

Times of economic crisis have always (since Joseph in Egypt) generated considerable - though often transient - interest in the potential value of business cycle theories (metaphysical and otherwise) as guides to the short-run evolution of the economy. The modern (20th Century) evolution of economic forecasting has, in fact, a symbiotic relationship both to the development of theories designed to explain fluctuations in macroeconomic activity and to the generation of an ever-broader spectrum of high-quality data on economic activity. It is, therefore, useful to consider forecasts from structural macroeconometric models , as part of a longer term and continuing effort to perceive the future course of the economy. Other techniques preceded them, coexist with them, interact with them, and will perhaps survive them. On the eve of the systematic application of modern statistical analysis to macroeconomic forecasting, Marshall seems to have anticipated both the "romance" and frustration of macroeconomic forecasting.

> It is conceivable that a body of able disinterested men, with a wide range of business knowledge, may ultimately be able to issue predictions of trade storm and trade weather generally, that might have an appreciable effect in rendering the employment of industry more steady and continuous.[1]

The potential value of "accurate" macroeconomic forecasts in helping to stabilize macroeconomic activity has continued to win many disciples for macroeconomic forecasting, while its failure to adequately realize this potential has always permitted the survival of skeptics. Marshall himself seems to have remained rather skeptical. One half century later, the following comments by Moore (1969) reflect the continuing skepticism and hope on these matters.

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1. Marshall, A. (1923), p. 262.

> Economic statisticians do not enjoy an untarnished reputation for accurate forecasting - (yet) we have also had our share of successes - (we must) try to arrive at a balanced appraisal.

The intervening period, however, witnessed an unusual amount of effort devoted explicitly to improving our capacity to anticipate various characteristics of the short-run evolution of the economy. There have been substantial investments in the generation of economic data, in the development of economic theory and the formulation of appropriate statistical procedures. As a result, it is widely perceived that we now understand a great deal more about our economic environment. As economists, we believe that our capacity to understand (rationalize?) developments in the economy is vastly improved, but we remain much more skeptical about our ability to anticipate future developments - even in the short-run. This skepticism is, moreover, supported by a well-documented contemporary record of faulty predictions that may have led, at times, to the selection of ill-advised policies in both the public and private sectors. Two of the more "celebrated" errors were, the prediction of a post World War II recession, and the failure to anticipate the more recent concurrence of accelerating inflation with slowing real growth rates.[2] In the interim, less dramatic errors and some major successes mark the economic forecaster's record. Interest in economic forecasting, however, has remained intense as the capacity to anticipate economic developments is critical to our ability to improve economic decision making. Further, in a market economy, widespread interest in regular business forecasting is a natural development, as implicit in many market transactions are forecasts of future possibilities - possibilities which do not seem dominated by one or two indivi-

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2. For an analysis of the forecast errors in the immediate post World War II period see Sapir (1949).

duals or institutions. Indeed, as long as public and private agents must make decisions that require judgement as to the future of economic events, forecasts will not only continue to be made, but acted upon.

Considered as a branch of econometrics, the broad purpose of macroeconometric models is to improve our decision making in the context of the uncertain environment in which we must make our way. All forecasts generated by these models are wrong in the simple sense that they are not as accurate as they could be. There is always either some error or some relevant aspect of reality they do not address, or both. It should be understood that econometric models, even structural econometric models, are simplified images of the "true" economy that highlight certain aggregate relationships for the purpose of generating useful insights into the possible evolution of the economy. In constructing such macroeconometric models, we are always choosing among alternative approximations. The exact nature of these approximations will depend principally on the overall structure of the economy, the intended use of the model, the availability of data and the stability of particular relationships. Further, it is important to remember that the size of the available data sample is small relative to the variety of events that can be expected to have an important impact on the economy. It will remain true, therefore, that these models will normally be in a stage of transition as they are adapted to changing circumstances and interests. Their value hinges on whether the "core of stability" that characterizes macroeconometric models is sufficient to continue to provide useful information through the ever-changing circumstances that characterize our economy. That is, can econometric models continue to embody over time an adequate understanding of relevant economic behavior.

Quite aside from these general considerations, existing structural

macroeconometric models have certain well-documented shortcomings. The failure of existing models, for example, to properly articulate the role of wealth or the impact of the government's budget constraint has been widely noted and obviously places limits on the uses of these models and the quality of their output. Similarly, the continuing difficulty of explaining, within the context of these models, changes in the labor force participation rate leaves considerable margin for improvement in the specification of their structures and, the quality of their forecasts.

It is, therefore, quite clear that in their current form, the output from these models is inadequate for certain highly important economic policy decisions. It is equally clear, however, that their increasingly widespread acceptance and use in certain important contexts may be considered prima facie evidence of their current value.[3] The critical question is whether these models, as forecasting tools, have played a significant or increasingly significant role in improving our decision making on relevant matters of economic policy. That is, we would like to know not only whether they have had an impact (i.e. affected decisions) but whether higher quality decisions resulted from this interaction. These questions are difficult to answer, since the available evidence consists of a series of forecasts, decisions, and associated outcomes that are connected in a complex and often uncertain fashion and are themselves the result of a wide spectrum of important factors which are difficult to properly disentangle. Furthermore, the basic framework within which forecasts have been generated has changed significantly over time (e.g., improved data) making inter-temporal comparisons somewhat hazardous. Despite these difficulties, this paper will

3. The proportion of forecasts in the ASA/NBER survey that rely primarily on econometric models has risen from one-eighth to one-third in the last decade and almost two-thirds of this group now rely on such models in important respects.

attempt to provide some perspectives on this question.

It should also be borne in mind throughout that the appropriate criteria for measuring the "success" of a macroeconometric model and/or the forecasts that it helps generate will depend on the particular use that is anticipated for the output. Simply put, evaluation is a problem-dependent process. Further, the impact of a particular model or procedure may not be related solely to its accuracy but, for example, to its accessability and comprehensability to decision makers. Undoubtedly, however, accuracy remains the key measure.

Given current forecasting technologies in the area of economic policy, we must still accept the probability of being seriously wrong a good deal (20 percent?) of the time. Thus accuracy (as opposed to perfect accuracy) in this context has no obvious or unique meaning. In order to establish a useful standard of accuracy, the impact of a forecast error must be clearly articulated. The implication of a $10 billion error in forecasting GNP may be quite different for the decision makers in an individual firm vis a vis those charged with formulating aggregate economic policy. The idea of accuracy, is given meaning only by placing it in the context of some decision. For those that must take action, forecasts are a means of decreasing uncertainty and this is their real value. For economists, forecasts also help us choose between alternative theories and statistical procedures, but this is a distinctly different benefit. Evaluation of forecasts may take quite a different tack for decision makers vis a vis those interested in "hypothesis testing" (searching?). A good example of this possibility is the discussion of the comparative forecasting performance of macroeconometric models in their ex ante and ex post modes. Ex post forecasting is of little direct interest to the decision maker, but is a critical component of model evalua-

tion for economists and econometric model builders.

Although it is clear that the use of structural macroeconometric models and the forecasts they generate has steadily increased in the last three decades, they remain only one of the important techniques used by forecasters in industry and government. Informal GNP models, Input/Output models, leading indicators, autoregressive models, and anticipation surveys, remain important alternative procedures in generating actual ex ante forecasts. It is, difficult to assess to what extent the relative importance of structural macroeconometric models has changed in the last decade since most forecasters either directly or indirectly now use a number of different techniques in combination. The existing evidence seems to indicate that each of these techniques does yield some additional independent information. Given the nature of the available record, the failures and successes in anticipating the future evolution of the economy cannot always be easily attributed to one particular technique.[4]

In assessing the contribution of structural econometric models, the search for a standard of measurement normally focuses on alternative, possibly less costly, techniques. We should recognize at the outset, however, that adequate time series data on well-defined consistent ex ante forecasts simply do not yet exist. The evidence available consists of small samples characterized by rather complex correlation structures which limit the useful application of available formal statistical inference procedures. Appraisals, therefore, rely on descriptive measures and, while judgements from this evidence may be instructive, they are limited. In particular, as we shall demonstrate below, the evaluation of contemporary ex ante macroecono-

4. Provocative support on the desirability of combining different types of forecast techniques is provided by Granger and Newbold (1974, 1975).

metric forecasts relative to other alternatives is quite sensitive to the nature of the forecast period (initial conditions). Given these problems, the existing record is not sufficient to support strong conclusions. Nevertheless some key issues can certainly be clarified and this is the aim of our paper.

In order to provide an appropriate perspective for evaluating the "successes" of these models, we begin with some observations on the "successes" of alternative techniques. Our attention focuses on efforts in the United States and on ex ante forecasts of the indicators of national economic activity.[5,6] In concentrating on ex ante forecasts we must, given the procedures

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5. We have not located any systematic record with respect to the accuracy of economic forecasts in foreign countries in the post World War II era. Theil (1961, 1966) reported on the ex ante forecasting performance of an annual econometric model of the Dutch economy and compared this to the ex ante forecasts being generated in other Scandinavian countries using a variety of forecasting procedures. Sims (1967) has also reported on the ex ante forecasting performance of the Dutch Central Planning Bureau model in the period 1953-1963. The period covered was the decade of the 1950's and the early 1960's in the Dutch case, but only the early 1950's for the other countries. The forecast errors were considerably larger (in percentage terms) than those achieved by U.S. forecasters (to be discussed below), even in the case of the Netherlands which had the best record. The forecasts however, did out-perform simple extrapolation techniques by a considerable margin. In the case of turning point predictions, somewhat over 25 percent of economic reversals were missed and about 40 percent of forecasted reversals were false signals. These latter results are not quite as good as the U.S. record compiled by Zarnowitz (1967), but are based on a much smaller sample. In Britain the debate over the accuracy of econometric forecasts has been more acrimonious than informative. (See Kennedy (1969), Worswick (1975), Polyani (1973), Ash and Smythe (1973) and Ash (1975)).

6. Although it is difficult to address the issue of forecast accuracy without simultaneously dealing with the size of models, the role of economic theory and the role of statistical inference, we leave all these matters to other conference papers and participants. We merely note here that the number of estimated parameters relative to the number of observations is often high enough to eliminate the use of some statistical procedures and that the connection between parameters and behavior remains unresolved. (See Koopmans (1950), Liu (1960) and Fisher (1965)).

employed by "practitioners", often deal with the output of "models" that are not completely and objectively specified.[7] Even in the ex ante forecasts generated from structural econometric models judgement and intuition normally play a critical role. These elements, however, are not often as carefully and completely specified as other inputs. Despite these reservations it is the ex ante forecasts that are critical for decision making and these forecasts do yield insights into how effectively particular procedures are using available information.

In the post World War II era, the continuing work of Victor Zarnowitz and his colleagues at the NBER have provided us with a continuing summary record of the ex ante forecasting "success" of a wide variety of techniques.[8] This work serves to provide a convenient metric to any assessment of the forecasting performance of structural macroeconometric models. There are, however, some even earlier less well-known efforts at systematic economic forecasting that deserve consideration in the current context. We turn briefly to this record.

II. The Early Record

In addition to his pioneering work in the development of economic theory, W.S. Jevons had a strong interest in the collection and analysis of economic data. Moreover, he seems to have had an active interest in marketing information about the state of the economy. The last page of his 1863 pamphlet on the value of gold advertises The Merchants' Atlas and Handbook of Commercial Fluctuations, which he said was in progress. Ap-

7. Klein et al (1978)

8. Other important studies have been those of Christ (1956, 1975), Stekler (1970), Theil (1961, 1966), Fromm and Klein (1976), McNees (1976).

parently, Jevon's proposed handbook did not receive an overwhelming response as it never got off the ground.

A contemporary of Jevon's, an Ohio farmer by the name of Samuel Benner, may have been the first of the regular forecasters in the U.S. From 1876 to 1907, he published sixteen editions of Benner's Prophicies of Future Ups and Downs in Prices which was revealingly subtitled, "What years to make money on pig-iron, hogs, corn and provisions". Benner plotted the mentioned series and noticed regularities in their fluctuations. The generation of these regular fluctuations he thought to be due to some regular, but unexplained, meterological cycles. From his analysis, Benner formulated the "Cast Iron Rule" that "one extreme invariably follows another". His predictions were based on a simple univariate analysis of the past regularities in a particular economic time series.

The twenty years following Benner's last edition was a boom period for forecasting. In 1907, there was only one commercial agency doing business forecasting but it was just beginning and not well known. By 1927, there were more than a half dozen forecasters with a national clientel and a large number of businesses had established internal groups to assess the business outlook. It can be noted that in 1927, five of the large commercial forecasting services had combined subscription lists of around 35,000. Many others during this period received forecasts through various business journals or as an offshoot of various stock market forecasting services. Moreover, scholarly associations were not immune to the forecasting fever of the 20's. Both the American Statistical Association and the American Economic Association held annual sessions on the economic outlook and on improving the collection and analysis of economic data.

The first of these early forecasting services, the Babson Statistical Organization, was begun by Roger Babson in 1904 and began forecasting in

1907. Babson began by analyzing Benner's series in order to develop an index of economic activity. When one of his former professors at M.I.T. drew a normal line through the index and suggested to him that Newton's Law of Action and Reaction might apply to economics, Babson adopted and marketed the idea. A more general index was formed by scaling and weighting twelve series[9] and a line of "normal" business activity superimposed. The summary plot of this was called the Babsonchart, and served both as an index of economic conditions and as a forecasting device. Forecasts were based on the notion that over the cycle, the areas above and below the normal line must be equal. The length and intensity of a depression was said to be equal to the length and intensity of the preceding "over-expansion."

The next of these forecasting services, the Brookmire Economic Chart Company, began in 1911. Brookmire believed that early indication of changes in business activity could be gained from certain business and financial series. By looking at correlations over various time lags of a number of series, he formed three indicators that tended to move in a particular sequence: 1) an index of bank credit, 2) a speculative index (equity prices), 3) an index of general business activity. The expected relationship was that the index of bank credit led the speculative index by several months and that a turn in the speculative index correctly anticipated changes in the direction of the general business activity index. These three indexes were marketed as the U.S. Barometer Chart and were used to make forecasts of general business conditions. To our knowledge, Brookmire was the first forecaster to study correlations across economic time series in order to isolate systematic lead/lag relationships between various aspects of economic

9. Immigration, value of building permits, liabilities of business failures, FRB check transactions, a WPI, dollar value of exports and imports, foreign money rates, 4-6 month prime commercial paper rate value of crops, rail earnings, and an index of stock prices.

activity. Although there was some initial work done using spectral methods of analysis for business cycle forecasting (Moore (1914)), no regular forecasts were developed from these studies.

Another notable forecasting service, the Harvard Economic Service, began after the Harvard University Committee on Economic Research commissioned Professor Warren M. Persons to do research on forecasting. In 1918 and 1919, Professor Persons investigated the possibility that there was a regular sequence of economic events that could be used as the basis for short-term forecasting. The resulting Harvard ABC index, in most essential respects, was the same as the first Brookmire index. Forecasts of general business conditions were based on "leading" movements in certain indicies of banking and stock market activity, although forecasts were modified in light of special factors or a close resemblance of the current to a particular historical situation. To disseminate the forecasts, as well as other statistics and current research, the Review of Economic Statistics and the Weekly Letter were begun. Although changes were constantly being made and the forecasts were considered an expression of the research, Harvard's poor performance in late 1929 and the early 1930's caused it to be one of the first of the large services to cease forecasting.

These groups were the early leaders in developing more systematic methods for generating economic forecasts. Their initial methods were adopted and, in time, supplemented and expanded upon by other forecasting services such as Moody's Investor Services, Standard Statistics Company and the National City Bank of New York, as well as important research groups - especially the National Bureau for Economic Research (NBER).

Another famous forecaster of this period was Irving Fisher. From 1911-1920, he published an annual forecast in the American Economic Review based on his equation of exchange. In these articles, he analyzed the course

of M and V, charted their paths, and gave his views of the implied outlook for business. Fisher, however, was "surprised" by the great depression. He failed to forecast the downturn or recognize the severity of the depression after the downturn had occurred. He then ceased to publish any further forecasts. During the 1930 ASA meetings, Fisher went to some length to explain that his forecasts were, of course, conditional on the assumption of no drastic changes in M and/or V! Perhaps we could consider the Fisher model to be the first econometric forecasting model. Although no estimated parameters were involved the issue of "stability" of relationships has continued as a dominant theme in assessing the forecasting potential of macroeconometric models.

The year 1929 represented a cyclical peak in the activity and influence of these forecasters. Their failure to anticipate the Depression drove many out of the forecasting business - among them both Fisher and the Harvard Economic Service. As might be expected, the survival rate was highest among those services who did not depend solely on revenue from forecasting. Thus, while the Harvard Economic Service folded quickly because of its poor 1929-30 record, National City Bank could continue in spite of an equally poor performance. In fact, during the decade of the Great Depression, banks were the leading source of business forecasts and their efforts provide the longest uninterrupted forecast records. Moody's and Standard (eventually continuing as Standard and Poors) also provided services other than forecasting and were able to shift emphasis away from it. Babson provided other services, but was also able to claim, unlike the others, that their service had warned of the fall. Babson's penchant for predicting a downturn as soon as business seemed to have recovered from the last drop caused him to become pessimistic well ahead of this downturn - and others, both realized and not realized.

Efforts to evaluate the forecasting performance of these early fore-

casters are limited by the qualitative nature of many of their forecasts. Consequently, utilization of many of the current "standard" evaluation techniques is not always possible. Proceeding with evaluation at all requires that, to some extent, subjective judgments be made. The first major evaluation of these forecasts was conducted by Garfield Cox (1930). Cox selected six forecasters that made predictions on a regular basis for most of the period from November, 1918, until December, 1929. Representative excerpts were taken from the forecasts of each service for each month. Two methods of evaluation were used; the first, to test for the general adequacy of the forecast and the second, to test the adequacy of turning point forecasts.

For the first test, each month's forecast from each forecaster was scored for "definiteness" on a 1/4, 1/2, 3/4, 1 scale and for "correctness" on a -1, -3/4, ... , 3/4, 1 scale. Forecast adequacy was taken to be the product of these two scores. Monthly adequacy scores were averaged both across and within services so that comparisons could be made for particular periods of time or by forecasting service. The main results are summarized in Tables 1 and 2.

Table 1

Forecast Accuracy Scores by Forecast Service
(Maximum Score = 1.0)

Forecast Service	Adequacy Score
Standard	.52
Babson	.45
Brookmire	.31
Harvard	.31
National City Bank	.23
Moody	.21
Average (1918-1929)	.34

Table 2

Forecast Accuracy Scores by Year of Forecast
(Average of Six Services, Maximum Score = 1.0)

Year	Score
1919	.27
1920	.37
1921	.48
1922	.53
1923	.10
1924	.30
1925	.55
1926	.29
1927	.18
1928	.43
1929	.11

In order to provide both a benchmark and metric with which to interpret these results, we constructed a number of naive models (based on the Federal Reserve index of industrial production) that generated forecasts over a six month forecast horizon. These forecasts were then scored in a manner similar to that described above. The results strongly suggest that a great deal of the implied forecasting ability was due to their ability to extrapolate recent trends and even then in a rather naive way. More than two-thirds of the "adequacy" scores achieved above are due to the continuation of very simple recent trends. Further, given that business cycle peaks occurred in early 1920, 1923, 1927, and 1929, it is immediately clear that these services seemed to have done poorest at the upper turning points.

Another evaluation of the forecasts of this period was done by Andrew and Flinn (1930) at the invitation of the JASA editors for the 1930 meeting.

and Moore applied their turning point analysis to one year ahead annual forecasts. Generally they were forecasts made in the fouth quarter for the year ahead. Exact comparison of the Cox group is not possible because the early forecasters used no set time horizon. As an approximation, two assumptions were tried. First, the forecast of each January was assumed to apply to the next twelve months and scored for turning points. Second, the forecasts of each January and July were assumed to apply to the next six months and scored for turning points. Further, the index of economic activity being predicted differed from the Industrial Production index and GNP figures that occupied Zarnowitz and Moore's attention. Nevertheless, the comparison is interesting.

	Early Forecasters (1918-1929)		Zarnowitz-Moore Groups (1947-1965)	
	6 mo. horizon	12 mo. horizon	12 mo. horizon	
	Index of "Business" Activity		GNP[12]	IP
Percent of Observed Turning Points Missed	55.6	55.3	25.0	17.6
Percent of Predicted Turns that were False	39.4	10.5	7.0	33.3

On the basis of these statistics, the Zarnowitz/Moore group certainly demonstrates some considerable improvement over earlier efforts. However, considering the lack of information of comparable quality, the framework now provided by various macro theories and the level of statistical analysis,

12. In evaluating the forecasts of the Dutch Central Planning Bureau over the period 1953-1962, Theil (1966) reports that with respect to the volume of private production that 25 percent of the turning points were missed and 40 percent of the predicted turning points were false signals.

They took yearly forecasts by eleven forecasters, made during November and December of 1924 to 1929. Brief quotations representing the forecast of the level and movement of wholesale prices, short-term money rates, auto production, stock prices, and building construction were scored on a 1, 1/2, 0, -1/2, -1 scale. Results were similar to those of Cox with an average score over all forecasters of +.39. They found that the most successful forecast series were: money rates, commodity prices and auto production. The poorest results were for equity prices!

Cox (1930) also specifically tested the capacity of these forecasting techniques to predict turning points. The major turning points were selected for the 1918-1929 period and the forecasting services were scored from the point in time when the first of the services correctly anticipated the turn until just after the turn.[10] Each month each service was scored for timing and amplitude and recognition. Scores were averaged and compared between services over turns. Cox interpreted his results as showing some modest ability to generate forecasts better than those from "no change" or "naive extrapolation" methods. Similarly, Andrew and Flinn's (1930) ratings for specific turning points revealed a very modest amount of forecasting success at these crucial moments.

To develop a more useful perspective on the capacity of these forecasters to recognize turning points, the Cox scores can be translated into the type of turning point table used by Zarnowitz (1967) and Moore (1969) in analyzing forecasts generated in the 1950's and through the mid-1960's.[11] Zarnowitz

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10. Peaks: March 1920, May 1923, March 1927, July 1929. Troughs: March 1919, March 1921, July 1924, December 1927.

11. Forecasts made by government, business and academic economists, with or without a macroeconometric model.

the performance of the "Early Forecasters" is better than might be expected. The greatest problem for both groups of forecasters was predicting downturns, but the average decline in industrial production from the peak to the trough was 19% in the early period and only 9% in the latter. Thus, the "target" was much smaller in the later years. In addition, the relative frequency of turning points also declined somewhat in the later period. Finally, quite different secular movements in prices in the earlier period may make current dollar GNP a rather poor target to test against.

The year 1929 was the global peak in the influence of the then existing methods of business forecasting. During the 30's, skepticism about the old methods was prevalent and by the 1940's new types of alternatives appeared - among them the structural econometric model. With the post World War II economic expansion, interest in economic forecasting quickly revived, but the structural econometric model, and other procedures that could take fuller advantage of the rapid new developments in statistical analysis, the availability of better economic data and new more advanced computational facilities, were now effective competitors for the attention of decision makers. Throughout the 1930's and 1940's, the United States Department of Agriculture continued to issue forecasts for selected macroeconomic aggregates. These were largely judgmental forecasts appropriately constrained by the National Income Account identities, to be used as an aid in farm planning. The forecast horizon was generally one year or less. Baker and Paarlberg (1952A, 1952B) and Cavin (1952), have provided an evaluation of these efforts with respect to their forecast accuracy. These forecasts did marginally better than single trend line extrapolations, but displayed no capacity to anticipate turning points in industrial production or total demand. Interestingly the weakest forecasts were in the area of farm prices.

III. The Contemporary Record

As more and more high-quality information on the economy became available, and as the structure of macroeconometric theory took greater root, researchers began to take a greater interest in structural models. An initial model was formulated by Frisch (1933), followed by the famous efforts of Tinbergen (1937, 1939) and Klein (1950). Regular forecasts from these structural models began with forecasts for the Netherlands from Tinbergen's model in the 1940's with regular U.S. forecasts not appearing until the early 1950's. Controversy over the use of macroeconometric forecasts, however, began sooner. In the U.S., it began with one of the first forecasts issued, the so-called Hagen-Kirkpatrick forecast for the immediate post-World War II period.

For the post-World War II era, there has been a continuous series of studies considering the record of economic forecasters. Interest has centered not only on the overall performance of economic forecasters, but on the relative performance of various techniques. The record of macroeconometric model forecasts has been given special attention as these represented a new entry in the "field". As noted above, the controversy started immediately. The issue that motivated the exchange between Klein (1946) and Woytinsky (1947) in the immediate post World War II years in some sense has yet to be resolved. That exchange centered on the stability of the consumption function and the implication of this issue for the potential of econometric model forecasts. While the focus on consumption has certainly shifted somewhat, the issue of stability remains at the heart of the discussions. Despite the interest in the relative performance of various techniques, we should acknowledge again that there is a limiting difficulty in assessing this issue. The reason as already noted above is that most forecasters now

use, directly or indirectly, a combination of techniques. The "judgmental" forecasters may use the output of econometric forecasts as input to their own considerations, and vise versa. This means that any improvement in the performance of economic forecasters must be attributed to the whole spectrum of improved forecasting and data generation techniques that have characterized the last three decades.

Perhaps the earliest evaluation of the forecasting capacity of an econometric model was Christ's (1951) study of predictions generated by the Klein model for the year 1948. Christ (1956) also produced a similar evaluation of the forecasts generated by the Klein-Goldberger model for the years 1951 and 1952. These initial studies ought to have been quite discouraging to model builders as they showed that very simple naive models outperformed these two early econometric models in most cases. A series of more contemporary studies (e.g., Cooper (1972), Cooper and Nelson (1975)) also seemed to find that simple ARIMA models outperformed structural econometric models for most variables. These studies, however, were based on very small samples and often focussed on a single period (one-quarter) forecast horizon. More recent studies, (e.g., Hirsch et al (1974)) covering a longer period of time reach opposite conclusions and indicate that the superiority of structural econometric model forecasts increases with the length of the forecast horizon. Indeed, the most recent study by Christ (1975) also finds that the ex post forecasts of the well-known U.S. econometric forecasting models clearly outperform ARIMA models in the period studied (1956-1970). Although we believe the weight of the evidence now supports this latter conclusion, the time series available for testing such comparisons is, once again, not rich enough to reach final judgments. All these studies do reveal that most structural econometric models do not yet capture all the relevant time-series information on many of the endogenous variables. The structural econometric

models, of course, would seem to have an advantage in dealing with non-linearities.

The most comprehensive record and evaluation of ex ante economic forecasts in the post World War II period has been created by Zarnowitz (1967, 1972, 1978). His work covers both econometric and non-econometric forecasts and provides a very useful starting point for our considerations. With respect to annual one-year ahead forecasts of current dollar GNP he finds that:

a) forecast errors are now less than one percent of GNP and declining slowly (in percentage terms) over time

b) forecast errors are considerably smaller than those generated by simple naive models

c) there is little systematic difference between the forecasting performance of econometric models and other operational procedures

d) The record demonstrates very limited capacity of any of the techniques to detect reversals in the economy well in advance. There is, however, a capacity to quickly recognize turns once they have begun. The forecasts are generally late in recognizing periods of unusually rapid growth and even later in recognizing slowdowns.[13]

With respect to constant dollar GNP, a more modest record exists, in two respects. First, there were few ex ante forecasts issued prior to the mid-1960's. Second, as a percent of the target, the forecast errors are somewhat larger. In fact, the forecasts of current dollar GNP have often "benefitted" from the strong negative correlation observed between forecast errors in predicting prices and constant dollar GNP. Again, the major errors occur at turning points, and there seems to be little systematic difference

13. Fels and Hinshaw (1968) found similar evidence in their study of the forecasts of eight "analysis" and the Federal Reserve Open Market Committee.

in the performance of the various operational techniques in this respect.

The record that Zarnowitz studies with respect to quarterly forecasts reveals very similar qualitative judgments. Remarkably, the record available is derived almost exclusively from the output of econometric models. Forecasts of current dollar GNP are superior to those for real GNP, but in both cases, the forecast errors rise steadily as the forecast horizon increases. The correlation between predicted and actual changes is higher in the case of real GNP, but relative to the size of actual changes, the real GNP errors are larger than the current-dollar GNP errors. Over the first four quarters, the forecast errors are, on the average, about the same as for the annual forecasts noted above. Again, these forecasts, outperform simple naive models. In general, the worst forecasts are those generated by ARIMA models and naive models - especially when the forecast horizon is more than one quarter.[14] Interestingly, while the relative superiority of the econometric forecasts decreased beyond a one-year time horizon during the 1960's, the reverse is true through most of the 1970's. The forecast record with respect to price inflation, however, is not reassuring. In fact, the ex ante forecasts tend to be little better than a projection of the most recently observed rate of inflation.

In summary, the "Zarnowitz record" seems to indicate that although steady progress is being made in our capacity to predict both current and constant dollar GNP, our current ability to predict reversals in economic activity and to adequately anticipate new movements in the rate of inflation remains limited.[15]

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14. Howrey, et al (1974) have demonstrated, in part, why ARIMA forecasts do relatively better with only a one-quarter forecast horizon.

15. Zarnowitz also finds that a significant percent (1/3) of the forecast errors are what he terms "base errors", or errors due to inadequate preliminary data. Cole (1969) has provided a more detailed analysis of this phenomenon. An interesting article by Howrey (1978) outlines a general approach to the more efficient use of preliminary data in econometric forecasting that should decrease variance of forecast errors.

For the period of the 1970's, the most careful record of the ex ante forecasting performance of quarterly econometric models has been presented by McNees (1976). Further, he also compares their performance with the "forecast" produced by the ASA/NBER group. McNees finds, as did Zarnowitz and Moore, that the timing of the forecast release is quite important, with the later forecasts (later in the quarter and/or year) being somewhat more accurate. Also consistent with the Zarnowitz results are the findings that forecast accuracy declines with the lengthening horizon (although not always dramatically, especially with respect to forecast changes), and that, in general, forecasts of current dollar GNP are relatively more accurate (as a percent of the target) than real GNP. Again, this latter result is explained by the observed negative covariance in the forecast errors for constant dollar GNP on the one hand and inflation rates on the other. In the earlier post-war period, forecasters tended to over-predict rates of inflation and underpredict growth rates. In the 1970's the record is marked by the reverse tendency. In addition, the available record does not enable one to choose a "best" econometric model. Assessment of the relative performance of the models depends on the variables of interest, length of horizon, etc., and no model dominates the others in all respects. Finally, McNees finds that the forecast of the ASA/NBER group is generally at the median of the econometric model forecasts. This latter result is similar to Christ's (1975) finding in assessing the ex post forecasts of these two groups.

The key question is what standards to use in understanding the actual results achieved and displayed by McNees (1976). Klein (1973) and Fromm and Klein (1976) and more recently Fair (1978) have offered some suggestions in this respect which provide a useful starting point. At the Twentieth Anniversary Conference on the Economic Outlook at the University of

Michigan, Klein suggested the following as standards of accuracy:

a) for GNP, less than one percent error in the level, and 5 to 10 percent in the change.

b) for unemployment rates, less than one-half percentage point

c) for aggregate price indices, less than one index point

d) for short-term treasury bill rates, less than 100 basis points.

Somewhat later an "ultimate" standard was suggested by Fromm and Klein (1976) for contemporary econometric forecasts. In summarizing the error statistics generated by ex post within sample simulations of a set of the best known U.S. econometric models they note:

> The error statistics for this group of simulations are about as low as we could expect to realize with "noisy" economic data.[16]

These standards for a forecast horizon of one year, involve errors of only 50 basis points in short-term interest rates, one-half an index point on aggregate price deflators, and somewhat less than one-half a percentage point on unemployment rates. The standards for GNP, however, remain at about one percent of the level. At the current time, the evidence strongly suggests that these more stringent standards remain aspirations only. Ex post simulations of the same models outside the sample period yield errors two to three times those particular standards and as the authors note are "... just on the borderline of being usable for policy application."[17] In fact on the basis of the errors generated in the "out-of-sample" simulations, all the models fail the earlier unemployment rate standard. Over half fail the lower interest rate standard, and most fail Klein's initial proposed standard for inflation rates. With respect to GNP, virtually all models

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16. Fromm and Klein (1976)

17. Fromm and Klein (1976)

fail the one-percent benchmark beyond the first quarter.

In a more recent study Fair (1978) has proposed a method both for deriving estimates of the overall uncertainty attached to an econometric model forecast and for decomposing the expected error into its basic sources.[18] Using successive re-estimation and stochastic simulation of the model and a number of important assumptions, Fair derives estimated standard errors of forecasts for his model (see Fair (1976)), for the period 1978 to 1981. The standard errors of forecast for the key macroeconomic indicators 4 and 8 quarters out can be summarized as follows:

	Forecast Horizon (1978.1)	
	4 Quarters	8 Quarters[19]
Real GNP (percent of forecast mean	1.96	2.27
GNP Deflator (percent of forecast mean)	1.87	3.45
Unemployment Rate (percentage points)	.82	.71
Bill Rate (percentage points)	1.17	1.72

Although these estimates are derived from a particular model at a given point in time, they do provide some useful overall perspective. Of the three sets of standards noted here, these are the most forgiving (realistic?)

As has been documented elsewhere (e.g., Evans, Haitovsky and Treyz (1972), Haitovsky, Treyz and Su (1974)), the ex post forecasts of econometric models are inferior to the models (and the model proprietors) ex ante forecasts. It is useful, therefore, to compare the McNees record with either of the

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18. The error terms in the model, the error from using estimated coefficients, the error in projecting exogenous variables, and the error for using a mis-specified model.

19. Analogous results for a simple autoregressive model are 4.74 for real GNP, 6.20 for the GNP deflator, 2.19 for the unemployment rate, and 1.83 for the Bill rate.

above standards. In summary, such a comparison leads to the following conclusions:

1) With respect to prices, unemployment rates and short-term interest rates, the ex ante forecast errors fail all of the proposed standards at forecast horizons of three and six quarters.

2) With respect to the level of current and constant dollar GNP, the standards are met at a time horizon of three quarters, but not at the six-quarter mark.[20]

3) As with the Zarnowitz record, current dollar GNP forecasts do better than their constant dollar counterparts.

4) If the forecasts are evaluated in terms of predicted changes, the GNP forecasts, the unemployment forecasts and the interest rate forecasts all satisfy the first (more lenient) set of "level" standards proposed by Klein (1973), and, therefore, the "Fair" standards, but the forecast errors for both current and constant dollar GNP fail - beyond the first quarter - to be between five and ten percent of the actual changes.

5) Generally speaking, errors in predicting the growth rates in GNP rise quite slowly over a six-quarter forecast horizon. This is especially true with respect to current dollar GNP which once again benefits from the negative correlations between the forecast errors in real growth rates and inflation rates.

6) Forecasts of the federal budget deficit are a politically sensitive issue and may easily have an effect on government policy. Unfortunately, the data presented by McNees (1976) indicates that the

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20. The capacity to meet these standards, at the 3 quarter mark reflects the relatively good performance of ex ante forecasts between 1970.3 and 1973.1, a steady period of expansion.

ex ante forecast errors in this "balancing item" were too large ($25 billion six quarters out) to be very useful.

Although the ex ante forecasts of the structural econometric models do not yet meet the standards suggested by Klein, recent studies (e.g., Hirsch, et al (1974), Prothero and Wallis (1976), Christ (1975), Howrey et al (1974), Zarnowitz (1978)), indicate that these models, even in their ex post mode do out-perform ARIMA models at times by quite substantial margins. This is especially noticeable when the forecast horizon extends beyond one quarter. One quarter out there is little difference between these alternative techniques. The ability of econometric model forecasts to out-perform "naive" alternatives represents a change from the early post World War II days and must be attributed to a combination of improved model-building techniques, improved data, and improved understanding of the economic system itself. In this latter respect econometric models have played a significant role especially regarding our understanding of the dynamics of the system. On the other hand, it is important to note that forecasters who do not use econometric models - at least directly - achieve ex ante forecasting records very similar to those generated by the models. These forecasters, however, generally provide much less useful information on the nature of the anticipated evolution of the economy with respect to the components of GNP and National Income and with respect to their detailed quarterly movements.[21] With the bias of model builders, we would also state that these forecasts are in most cases conditional on the readily available output of the econometric models. There is, of course, also some feedback

21. Among the components of GNP, the econometric models generate their largest percentage errors with respect to relatively small magnitudes such as fixed investment and inventory investment. On the income side, the error in predicting profits is as large as that generated in predicting the much larger wage component. (See McNees (1976), Fromm and Klein (1975), and Zarnowitz (1978)).

in the other direction.

The finding that the ex ante forecasts of econometric models out-perform their ex post forecasts remains a concern to both model builders and their "clients" (i.e. decision makers). The possible explanations are many and no satisfactory resolution of this issue has yet been achieved. It is quite clear the confidence of decision makers in the output of econometric models is a function of both their ex ante and ex post forecasting performance. In either the ex ante or ex post modes, the evaluation of the relative performance of these models over the last two or three decades is limited by the small sample of outcomes. It is clear from the evidence that such an evaluation is dependent, in part, on the cyclical status of the economy. The available evidence, therefore, permits only partial judgments at this stage. A similar observation holds regarding the demonstrated advisability of combining various forecasting techniques. The optimal combination undoubtedly shifts over time and seems to be, at least in part, a function of initial conditions.

Finally, we should consider Leading Indicators and their capacity to assist forecasters (see Moore and Shiskin (1967), Hymans (1973), Vaccara and Zarnowitz (1978), Moore (1969, 1974), and Alexander and Stekler (1959)). This, after all, was the "first" technique, tracing back to the early years of the current century. How does it compare to the forecasts generated by econometric models? Despite continued work in this area, leading indicators, even after careful filtering (to eliminate their chronic tendency to yield many false signals) have an effective forecast horizon that is very short. Although they do outperform simple autoregressive schemes in predicting real GNP one quarter ahead, and can provide, at times, useful additional information to the econometric model forecasts, on the whole the evidence supports the superiority of the econometric model forecasts.

The "acceptance" of the output of econometric models by decision makers is heavily influenced by their demonstrated performance at certain crucial sensitive times. Standard error statistics do little to reveal this type of information. For example, the perceived quality of the advice generated from these models at times of changes in Presidential administrations may have long-ranging impacts not only on economic policy, but the willingness of decisions makers to rely on these models in the future. Consider an imaginary meeting in December 1974, in Plains, Georgia, at which a group of econometric model builders have been asked the following question:

> "What would be the effect on the national unemployment rate if the path of Federal expenditures (or purchases) over the next three years is $10 billion below that currently anticipated?"

The uniform answer would have been - unemployment rates will rise. The actual evidence, however, is quite different, and in formulating policy over the next few years, the current administration may choose to ignore our advice.

The record of successes and failures of forecasts from structural econometric models has been widely noted and is largely understood. Only provisional judgments are possible, not only with respect to the forecasting record but with respect to such issues as size, aggregation and identification. Why then does there appear to be so much controversy? This, we believe, can be traced to intemperate statements and resulting disappointed expectancies. Despite the successes, therefore, humility once again suits us all and will serve us well.

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